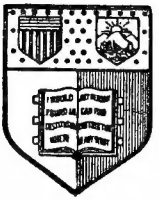

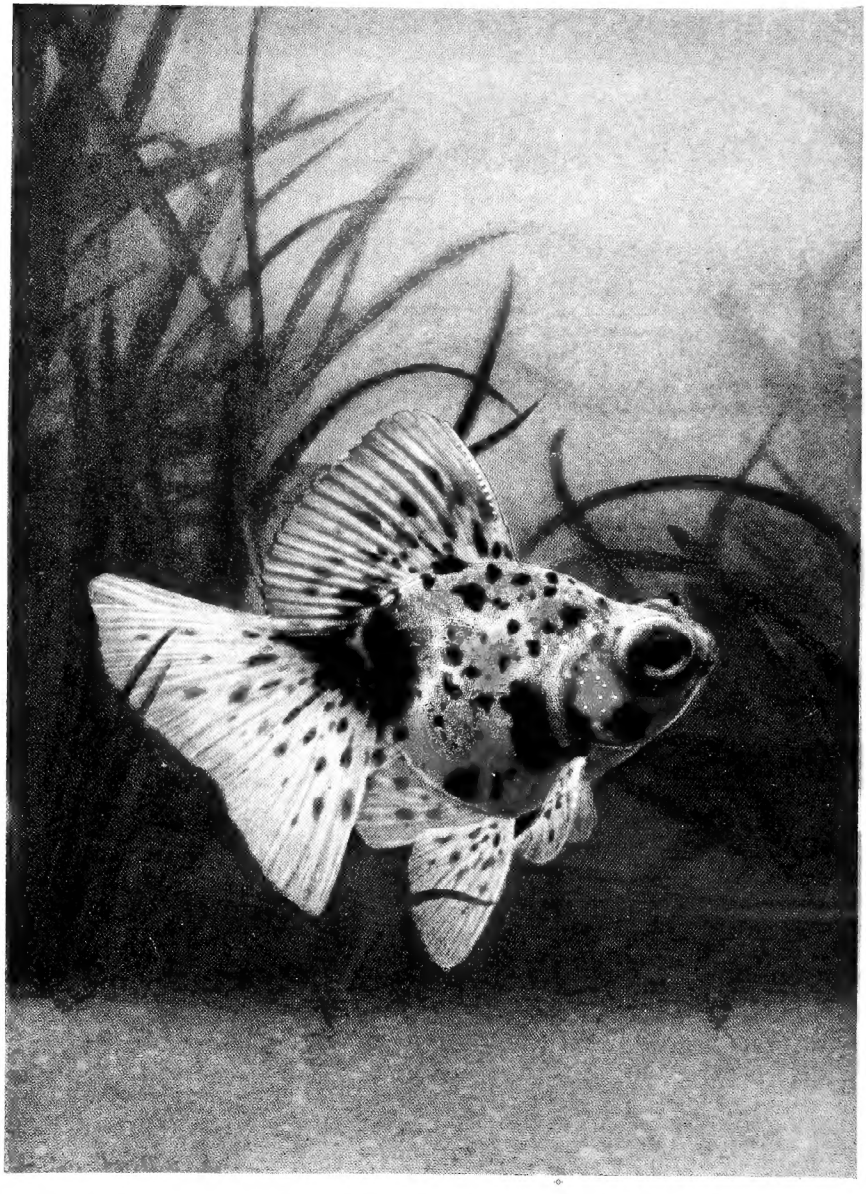

A Champion Young Calico Telescope Goldfish
*(From Life)*

# Goldfish Varieties and Tropical Aquarium Fishes

*A Complete Guide to Aquaria and Related Subjects*

BY

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## AUTHOR'S PREFACE

There is perhaps no other means of bringing so complete a bit of Nature into our very homes as that afforded by the aquarium. Here we have opportunity for the student, the artist, the scientist, the photographer and for those who simply love pets. Modern research, by the discovery of a few simple principles, has enabled us to reproduce the conditions of aquatic Nature, so that now we may have, at first hand, an intimate knowledge of much of that mysterious life of the water-world. Through the glass of the aquarium we have a window where that which we see is only limited by our own capacity for observation.

Although interest in aquaria has undergone a great awakening in the past few years, the public in general is still ignorant of the correct principles of aquarium management, and of the wonderful accomplishments of the breeders of fancy fishes. In addition to the extraordinary goldfish forms there are now available for our purposes over three hundred kinds of aquarium fishes. These, with other aquatic animals and a wide range of plants, give us a great wealth of material from which to choose.

It is the aim of the author and the publishers to present in simple yet comprehensive form a practical digest of all available information on the aquarium and allied subjects. This, it is hoped, will be of real value to the intelligent aquarist and at the same time give the general public a clearer idea of possibilities under proper management, so that an aquarium will no longer be merely a container which must be perpetually re-stocked with fishes, but an endless source of pleasant and profitable observation.

The illustrations used are, in nearly all cases, either drawn or photographed from life, thus establishing records which should be of value for present or future reference.

In the preparation of this volume the author has received valued assistance from leading specialists, breeders and general experts, including the distinguished head of the United States Bureau of Fisheries, Dr. Hugh M. Smith. Special acknowledgment for generous co-operation is tendered Dr. E. Bade, Mr. Franklin Barrett, Dr. David Starr Jordan, Mr. Wm. H. De Nyse, Mr. Richard Dorn, Mr. Henry W. Fowler, Mr. Frank J. Myers, Mr. Wm. L. Paullin, Mr. W. A. Poyser and Dr. C. H. Townsend.

FIG. 1. A PERFECT VEILTAIL MOOR *(Reduced one-third)*

Considered one of the finest black goldfishes ever bred. The short, deep body, the proud dorsal fin, the broad, luxuriant tails, the very prominent eyes, the velvety blue-black color, combined with splendid carriage, make this remarkable fish a pattern which we may hope to equal, but hardly to surpass.

FIG. 2. PRIZEWINNING CONCRETE AQUARIUM

Length, 50 inches. Capacity, 60 gallons

*See page 217*

*Chapter One*

# Aquarium Management

The principles involved in successful aquarium management are really simple, and if applied success is bound to follow. Although many interesting kinds of fishes are now used as aquarium pets, the goldfish still holds the popular fancy, so for the present our remarks apply chiefly to this member of the aquarium family.

The common goldfish is a very hardy pet, and with proper handling should live from ten to twenty years. Yet we hear of numerous failures, and there are many who would like to keep an aquarium, but refrain from doing so because of two erroneous ideas: first, that goldfish are delicate; second, that an aquarium requires frequent cleaning. On the contrary, the goldfish will survive under conditions that would kill most other fishes, and aquaria seldom need to be cleaned if properly set up in the first place. The main causes for failure, in the order of their importance, are:

Overcrowding
Overfeeding
Sudden temperature changes
Lack of proper plant life
Insufficient lighting.

**Overcrowding.** Some unscrupulous and short-sighted dealers, in order to increase sales, recommend the use of more fishes than should properly be put into an aquarium of given size. The beginner also wishes to have as many as he possibly can, so that this is one of the greatest difficulties to overcome. The proper rule is this: ONE INCH OF FISH TO ONE GALLON OF WATER. That is, in a ten-gallon aquarium of the usual oblong shape, well planted and in a good light, one could successfully keep ten one-inch fishes or five two-inch or two five-inch fishes. Successful aquarists adhere to this rule, and for some of the fancy and more delicate varieties, even more water per fish is allowed. The beginner will do well to do likewise and disregard all advice to

the contrary. If already over-stocked, some of the specimens should be disposed of or a larger aquarium secured. Should the fishes get into poor condition from overcrowding it will be difficult to save any of them.

When the fishes persist in coming to the top and gasping air, it is usually a sign that they are overcrowded or that the water has become bad from some kind of decomposition. The trouble should be quickly found and remedied before the pets become seriously affected or perhaps suffocate. A partial change of water or the removal of some of the fishes will usually improve matters. Sometimes the condition is produced by a dead snail or mussel, or again from the decomposition of uneaten food.

**Overfeeding.** Many people kill their fish by kindness. Whenever they seem hungry they are fed. This is a very great mistake. In Nature the food is scarce and difficult to get. Therefore the fishes have to exert themselves in procuring it. In the small confines and artificial conditions of the household aquarium, less food can be properly digested, for fishes, like men, suffer from indigestion, but with quicker and more fatal results. Fish should never, on any account, be fed more than will be consumed at once. (This does not apply in raising young stock.) If any food is left after five minutes, they have been overfed and the surplus should be removed with a dip-tube. (See Chapter on Aquarium Appliances.) In summer or at any time when the water is at 60 degrees or higher, it is allowable to feed daily. Should the water range from 55 degrees to 60 degrees, every other day is sufficient, and when it is from 40 degrees to 55 degrees, feedings separated by about three to six days, will keep them in good condition. An exact scale is difficult to establish, partly because fish, under one year of age, can assimilate more food than old ones, and partly because the temperature in an aquarium varies at different hours in the day. The foregoing scale will give a very good working basis, to be followed with a certain amount of personal judgment. Let it be said there is practically no danger of starving a fish, the errors being almost altogether on the other side. A correspondent once wrote the author that she kept a fish for seventeen years, and in that time had fed it on rice wafers once a week only. The matter of feeding fish is a difficult point to correctly impress on the mind of the general public. When they swim coaxingly to the near side of the aquarium it is truly a great temptation to feed them, whether it is their meal time or not, but those who love their pets will do them a far greater kindness by depriving them until the usual feeding hour.

**Temperature Changes.** If for any reason it becomes necessary to change the water, there is one very important thing to keep in mind—*do not subject the fishes to any sudden change of temperature, either higher or lower.* This is one of the most frequent causes of sickness and eventual death.

**Changing the Water.** With the correct conditions carefully observed and carried out there should be no need to change water except at rare intervals. Experienced aquarists completely replant and change water about once a year, otherwise only adding water to make up for evaporation.

The fish are stimulated and probably benefited by changing a small part of the water every few days. From one-fifth to one-tenth of the total volume should be sufficient. If the aquarium is in proper condition and not overcrowded, even this slight changing of water is not necessary.

In cases of overcrowding, a partial change of water should be made daily, the amount depending on the degree of over-population. It is better to reduce the overcrowding than to try to find a way of overcoming its evil results. A case where "an ounce of prevention" is very much the better.

Occasions do arise when the water must be completely changed. At these times there are two points of importance to observe; first, have the temperature of new and old waters nearly the same; second, ripen the new supply by letting it stand at least an hour or two before using. A full day is better. Don't use galvanized iron nor new wood receptacles for this purpose. If necessary to use raw water from the spigot, it can be improved by the addition of a small amount of salt—say a teaspoonful to the gallon. Raw water in summer and early autumn is not so injurious.

A sprinkling pot is excellent for adding new or freshening old water in the aquarium. The small streams oxygenate well and do not disturb the contents of the aquarium.

If running water is used, a very tiny stream will be sufficient. Fish used to this condition when placed in still water should first be given ample room.

Running water is not generally to be recommended except in overcrowding. In these cases a mere drip will usually do.

**Water.** We sometimes hear that certain water is too pure for fishes to live in. This is "pure" nonsense. Extremely small, newly-hatched fishes eat some of the microscopic life commonly in water, but as they grow larger they are unable to strain out such fine matter.

Distilled water, on account of its lack of desirable mineral content, is not beneficial to fishes, and, on the other hand, some natural waters are so heavily charged with minerals (sulphur and lime mainly) that they cannot be successfully used for aquarium purposes. Ordinarily the city water is satisfactory unless an extra heavy charge of germicide has been placed in it. If one has aquarium troubles and the water is suspected, it is a good plan to refill the aquarium from a stream known to contain fishes.

Water exposed to the air absorbs free oxygen. The gills of a fish mechanically extract this. The fish is in reality breathing air in a finely divided state. The cooler the water the more oxygen it can hold. Therefore, cool water can maintain more fishes than can warm. Heat drives the oxygen out of water. If boiled in a bottle, quickly stoppered and cooled without contact to air, it will be incapable of supporting fish life. Suffocation in such water would soon take place.

**Chemical Depletion of Water.** Constant absorption of minerals from the water by plants and fishes makes a condition which should be provided for. This can be done by the occasional addition of salts. Make a mixture of three parts of evaporated sea salt (Turk's Island Salt), and one part Epsom salts. About once a month a level teaspoonful to 20 gallons of water will prove beneficial. Usually the fishes will greedily swallow these salts as they sink to the bottom, which act as a mild cathartic with them.

As previously stated, it is also well to add a small quantity of salt to entirely new water, particularly if fishes must be placed in it at once, for shipping or other purposes. This lessens the liability to disease arising from bruises received in transit.

The decomposition of plants, etc., sets up an acid condition in the aquarium, which is not good for the fish and which causes most of the crumbling noticed on the shells of snails. Ten drops of lime water to the gallon of aquarium water will neutralize any ordinary acid condition, but a better method is to keep a small piece of Plaster-of-Paris in the aquarium. In dissolving, it neutralizes the acid, but as it only dissolves under acid conditions, there is no danger of getting the water too alkaline by this method. If the Plaster-of-Paris dissolves quickly it is a sign of pronounced acid condition. We would call two weeks a short time in which to dissolve a piece half the size of a shellbark in a 20-gallon aquarium. Pieces of gypsum will perform the same function, but more slowly. Plaster-of-Paris can be made into convenient pieces by mixing the powder with water into a mushy consistency. It is then spread on a piece of clean glass to a depth of

about a quarter inch, where it will "set" in a few minutes. Score into small squares as soon as firm enough to take a crease, which is about three minutes. When dry it is easily removed and broken on the scored lines.

**Plant Life and the Balanced Aquarium.** Fishes, as we have stated, live by absorbing oxygen, and they give off carbon dioxide as the waste product of their chemical lives. Plants, under the influence of daylight, do the exact opposite, so that what is poison to one is life to the other. Therefore if an aquarium has its full quota of fishes it is very desirable to have plants to increase the supply of oxygen, because at times the absorption at the surface is insufficient. If, however, there be a great abundance of water surface, plants become more ornamental than necessary. As this is seldom the case, it may be stated as a general fact that growing plants perform a valuable service in the aquarium and will often turn the scale from failure to success. While the mutually beneficial interchange between plants and fishes is not maintained with uniform exactness, the term "balanced aquarium" expresses the condition rather happily. In this connection it is an interesting fact that plants thrive much better in an aquarium where there are fishes than where there are none.

**Light.** Plants require daylight in order to do their work. Without it they are worse than useless. Select for the aquarium a place close to a window with a good, strong light, preferably one where it will get about two hours of direct sun a day. In hot weather one should be careful not to overheat a small aquarium in the sun.

Some enthusiasts, in order to provide against the short, dark day and the low barometer, equip their aquaria with compressed air pipes, so as to liberate small bubbles at the bottom and thus be assured of a plentiful supply of oxygen at all times. This keeps the sediment stirred up and is a refinement of doubtful value. The scheme was quite a fad at one time, but has largely died out. Air pumps, operated either by water power or electricity, may be had. The latter are rather expensive.

**Aquarium Plants.** Different plants have varying powers of producing oxygen. It is therefore well to bear this in mind when making a selection for planting. Purely ornamental plants are desirable only after a fully sufficient quantity of the oxygen-producers have been provided. In the order of their oxygenating powers we would name, Anacharis, Vallisneria, Sagittaria, Nitella, Herpestis, Fontinalis, Potamogeton, Ludwigia and others which will be more fully described later.

**Temperature.** The larger the water surface, the higher temperature the fishes can stand. A practical general standard for goldfishes would be from 65 to 75 degrees in summer and from 50 to 65 degrees in winter. Newly-hatched goldfish fry under six weeks of age do well in temperatures between 75 and 85 degrees. Floating thermometers with red or blue spirits are easily read and are of value in aquarium work.

**Green Water** is caused by the presence of microscopic forms of vegetable life suspended or swimming in the water. Their growth is usually promoted by a combination of too much direct sunlight and a large number of fishes in the aquarium. There are several ways of clearing the water. First change it, add a few fresh-water mussels, cut down the light by use of tissue paper, ground glass, frosted varnish on the glass, or other means, and reduce the number of fishes. To clear the water chemically, add one grain by weight of permanganate of potash (dissolved) to each gallon of aquarium water. This will turn the water first a lavender, and then a brownish color for a few days, after which it will clear up. Unless the original conditions are changed, however, the water will soon again become green. Before using this chemical remove all snails and mussels. Goldfish can withstand the strength of the solution recommended, and probably be benefited if suffering from any form of fungus. (See Chapter on Diseases.) Other fishes do not stand this chemical so well. Green water, while unsightly, is not unwholesome. On the contrary, a sick fish is often cured by being transferred to a tank of green water. Live daphnia (page 134) will clear water in a few days.

**How to Know When the Fishes are Sick.** The first signal of distress in most fishes is the drooping of the dorsal (back) fin. This fin should be carried stiff and upright. When the fish is sick its movements are sluggish and it often seeks a quiet corner in which to hide. In some of the fancy varieties the dorsal fin is so over-developed that the fish even in health has not sufficient strength to hold it erect. When such fishes are ill their fins become more or less stiff, losing flexibility. Fins should be clear and clean-cut. When they become thick-looking, opaque, lined with red veins, overcast with red, bloodshot at base, or ragged and split, the fish is in need of attention. (See Chapter on Diseases.) Another sign of poor condition is thinness of the body. The excrement of fishes in health is usually of a dark color. When it is pale, dotted with gas bubbles, and of slimy appearance, the fish is apt to be out of condition.

**Sick Fishes.** It is always safer to remove an affected fish from its fellows. If the trouble is a contagious one, the aquarium or tank should be thoroughly disinfected, not overlooking the plants in this matter. For all practical purposes they can be sterilized by placing for one hour in a permanganate of potassium solution, 3 grains by weight to the gallon of water. Satisfactory results will also be given by dipping plants for a few moments in concentrated lime water, or in household ammonia, reduced to one-twentieth strength. Either of these methods should be applied to all new plants introduced into the aquarium, especially those collected from the wild, or from aquaria of doubtful condition. In case of an aquarium becoming contaminated, it can be disinfected by dissolving in it permanganate of potash to the strength already indicated, allowing it to stand from two to three hours, first removing all mussels, snails and fishes. In changing to clear water again it will do no harm if a little permanganate remains.

Unless newly acquired fishes come from a source beyond suspicion it is a grave risk to introduce them at once into an established aquarium of healthy fish. They should first be quarantined and carefully observed for about two weeks, this being particularly true of imported goldfishes. They may already be inoculated with diseases only in process of incubation, but which will nevertheless develop.

**Scavengers.** Nature has supplied us with means of getting rid of most of the harmful offal and decomposition in the aquarium. These consist largely of those species of snails that do not attack the plants. Among the best known, most satisfactory and easily obtained are the large Japanese Snails *(Viviparus malleatus)*, the so-called African Paper-shelled Snail *(Lymnaea auricularia)*, the Ramshorn Snail *(Planorbis)*, and the Pond Snail *(Physa)*. These are all active in eat-

FIG. 3. *Pond*

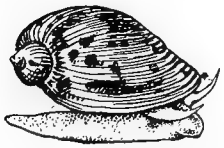


FIG. 4. *African*

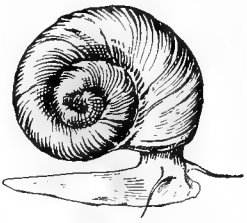


FIG. 5. *Red Ramshorn*

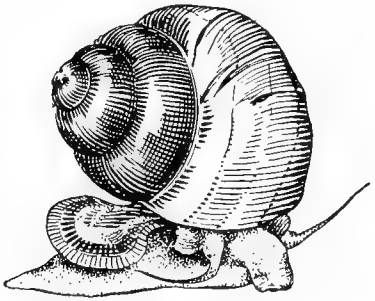


FIG. 6. *Japanese*

THE BEST FRESHWATER AQUARIUM SNAILS *(Life size)*

ing vegetable growth from the glass or particles of food which the fish have not taken, and in no case will they injure any of the aquarium plants. Most snails consume decomposing animal matter, such as dead tadpoles, fishes, etc.

JAPANESE SNAILS are very interesting in that they bring forth fully developed young about the size of a pea, able to take care of themselves among goldfishes. These snails are male and female, but a female once impregnated seems, like a queen bee, to remain fertile for the remainder of her life. The right horn of the male is somewhat the longer, this serving a sexual purpose. These snails are quite long-lived and grow to the size of a large walnut. Another snail resembling the Japanese species is the Potomac Snail. This has two brown stripes on a horn-colored background running with the spiral. It is quite attractive and is frequently sold as the Japanese Snail, but it is sluggish and should not be crossed with the Japanese. The latter can be identified by the slightly raised keels showing on the last spiral.

THE AFRICAN OR PAPER-SHELLED SNAIL is very prettily marked with brown spots on a horn-colored background, and is an extremely rapid breeder, but is of short life.

RAMSHORN SNAILS in both the European and native varieties are excellent aquarium scavengers.

The European Red Ramshorn or Coral Snail *(Planorbis corneus, var. rubra)* is a comparatively recent introduction and is unique on account of the bright red coral color of the body. When seen in the sunlight this snail is quite an added attraction to the appearance of an artistic aquarium and is an active worker.

THE POND SNAIL is extremely common in the Eastern and Middle States. Small snails and spawn often adhere to purchased aquatic plants, later appearing in numbers in the aquarium. It may be identified by the left-hand turn of the dark-colored shell. This little friend has been unfairly treated by some writers, including the author, who accuse it of being a plant eater. Further observation and the experience of others fails to sustain this charge. On the other hand, it is both the most active and the hardiest of all snails in the aquarium, and is an intrepid scavenger. It breeds at an early age and the young have sufficiently hard shells that goldfishes do not molest them.

FOUR-HORNED SNAILS *(Ampularia gigas)*. These interesting snails are ravenous plant-eaters and are only mentioned here on account of their curious breeding habits. They lay a mass of large, beautiful coral-colored eggs on the side of the aquarium *above the water*. The egg mass is about three-quarters by two inches. As the eggs hatch

the young fall into the water. Young and old must be fed on lettuce leaves. They will quickly ruin aquatic plants. These snails have a general resemblance to the Japanese variety as to size and style, but have a richer, deep brown color and longer, more graceful horns. Altogether it is a very handsome snail.

They are equipped with an extremely long air-breathing tube, with which they can reach fully two inches to the surface.

The frog tadpole has been used by many as an aquarium scavenger, but its value is of considerable doubt. They dash about the aquarium in an aimless manner, keeping the water stirred up and the natural sediment agitated. Furthermore, they soon learn to eat fish food, and, after that step in education, they refuse to consume the less desirable particles found in an aquarium occupied by fish.

Another scavenger is the freshwater mussel. The chief value of the mussel is to keep down the vegetable growth which causes aquarium water to turn green. Mussels are equipped with a sort of siphon arrangement, by which they suck in water in one opening and

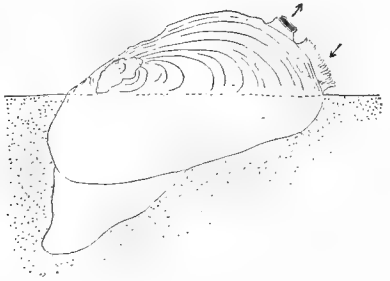


FIG. 7. FRESHWATER MUSSEL, SHOWING WATER INTAKE AND OUTLET; ALSO "FOOT" WITH WHICH IT BURROWS AND TRAVELS

eject it from another. In the few moments which they hold the water they extract from it the floating vegetable organisms. Two or three mussels should keep a ten-gallon aquarium free of green water. Care should be taken to occasionally see whether the mussels are living, as they decompose very rapidly and spoil the aquarium water. This can be done by tapping lightly on the shell and seeing whether they respond by closing.

A curious and useful scavenger is an eel-like fish called the Weatherfish. Varieties are native to Europe and Asia. They are freely imported and inexpensive. When not scouring the aquarium bottom for bits of decomposing matter, they sometimes burrow into the sand, leaving only the head exposed, producing a quaint appear-

ance. In their special occupation as scavengers they employ a method which is both effectual and interesting. The dirt and top sand are taken in the mouth and rapidly shot out through the gills. Any par-

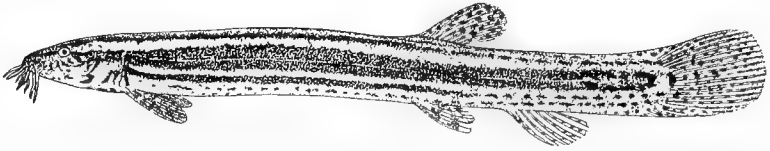


FIG. 8. THE WEATHERFISH *(Cobitis fossilis)*

ticle of food considered edible is automatically separated from the bulk of the dirt and swallowed.

Another scavenger fish is the Saccobranchus fossilis. This fish has a head like a catfish and an elongated body like an eel. Both of these scavengers are harmless to other fish, but should not be used when over five inches long, as they stir up the water too much.

Goldfish keep the sand loose and in good condition by picking it up in their mouths, but most other aquarium fishes do not touch it, which allows it to cake and become permanently dirty. The Weatherfish is most excellent to introduce with such fishes, even a single small one keeping the sand in a large aquarium loose on the top.

**Breeding Snails.** Perhaps here would be a good place to state that no kind of snails can be kept in the company of carnivorous fishes, such for instance as Sunfish (except Chætodons) and most of the tropicals—Paradise Fish, Chanchitos and the like.

The breeding of snails is extremely simple, yet there are certain conditions that are necessary to success. Among the ordinary and really useful aquarium snails there are only two kinds whose breeding requires any attention. These are the African and the Ramshorn, especially the coral variety. Both these snails deposit eggs on plants or glass in small, gelatinous masses. The young of the Japanese and Pond Snails are able to take care of themselves among the gentler fishes.

The most important point is that the young hatch and spend the first several weeks of their lives where there are no large fishes. Naturally this will be done either by removing the plant leaves with attached eggs to a special tank, or by removing the fishes from where the eggs are laid. Snail spawn is often placed with newly-hatched fishes, and they grow together.

The second point has to do with feeding. If the tank is an old one with green-covered sides and some decaying vegetation, no spe-

cial feeding is called for. Otherwise they will need some attention in order to thrive. Dried powdered lettuce leaves, or rice flour, or finely powdered fish food sprinkled on the surface of the water, are satisfactory foods for the young snails. The thick paste from boiled oatmeal is good, both for young and adults.

It is just as well to remove parent snails from the young, so that the latter will get all the food, especially if artificial feeding is not resorted to.

After snails have passed the early stage of development they relish lettuce leaves. These snails, especially the breeders, thrive finely on raw meat. They should receive about a two days' supply in a place where it can be watched for decomposition. This is a safe food only in a large tank, where the water runs little chance of fouling.

Cypris, a small crustacean figured on page 134, is injurious to snails and should be excluded if possible.

There are commercial possibilities in the breeding of Japanese and Coral Snails.

If one does not care to rear these snails to keep up a stock, the young of the African and Ramshorn at least form a valuable diet for fishes, so much so that their extensive culture has been proposed as a diet for the young of our food fishes.

**Aquarium Covers.** It is a popular idea that a free access of air to the aquarium is essential to the welfare of the fishes, but this is not so, particularly if there is a liberal plant growth. A glass cover, raised about a quarter inch, promotes a more luxuriant growth of plants, keeps the surface of the water free of dust or bubbles, prevents objects from accidentally falling into the aquarium, keeps the fishes from leaping out and our friend the cat from fishing in. Wire gauze, properly secured, will serve the latter purposes.

With most tropical fishes the glass cover should rest directly on the aquarium or jar, with no intervening space. This keeps the water a few degrees warmer. Furthermore, there are a number of tropical fishes which can leap through a very small opening. This they are most apt to do when newly placed in an aquarium or otherwise disturbed. Our wild native fishes have an increased tendency to leap as the breeding season approaches, this characteristic being shared by the single-tail goldfishes.

**Testing Aquaria.** Before putting plants or sand in the aquarium it is well to test its tightness. More often than not the larger sizes leak after moving or standing dry. These leaks can usually be cor-

rected in a few days by filling with very muddy water, stirring it occasionally.

**Fish Globes.** Ignorance is responsible for most barbarity, and one of the commonest forms of both is the keeping of fishes in globes. The globe is in every way opposed to the correct principles of aquarium-keeping. When it is filled, the air surface of the water is extremely small in proportion to the bulk. A really proper plant growth in a small globe is almost impossible. The evils are multiplied by the apparently universal overcrowding in these little prisons, and by the frequent pollutions of the water by overfeeding. As these globes are the cheapest form of aquarium, it seems as though they are destined to remain with us, but the public could be educated in the rudiments of handling them—not to overcrowd nor overfeed, nor fill over two-thirds, nor stand in summer sun; and to establish growing plants. If this point can be reached it is a step towards the abandonment of the "globe" for a real aquarium, where the chances of success are so much greater. If a globe *must* must be used, select one of the larger sizes.

**Removing Dust and Scum.** When the aquarium has no cover glass or when there is a considerable decomposition of old plants there is sometimes a scum formed on top of the water. To remove this, tear a piece of newspaper to the width of the aquarium. Float the paper at one end of tank, lifting by one edge, and draw quickly over the length of the water. Repeat once or twice with fresh paper.

**Foul Sand.** Sometimes sand or pebbles will turn black and become quite ill-smelling. The cause for this is not always easy to determine. It is more apt to occur where the light is feeble and the plant growth poor, also where sand is too deep. If taken out and dried in a thin layer it will clear up. If the conditions seem right and there are sufficient plants, do not be hasty about taking out dark sand. The condition often corrects itself if given a chance, and besides, it may be just a little natural dirt which does no harm.

**Algæ and Confervæ.** Should the plants become completely covered with algæ or "moss," try introducing a considerable number of small snails. The large Japanese variety is not always suitable for this, as it is unable to crawl on the smaller leaves. If this fails, remove and destroy the plants, thoroughly disinfect the aquarium in every particular and replant. Do not allow quite so much light in the future.

There is a very long, hard conferva about the thickness of horsehair which grows into matted masses. This is quite a pest when once established, as it soon fills the aquarium and enmeshes young fish,

which usually die before being rescued. The only way to get rid of this is to take up all plants, go over each carefully and see that no single thread of the conferva is left. If the smallest bit remains the growth will soon be as bad as ever.

**Cleaning the Glass.** When the aquarium glass has become green or dirty, it may be quickly cleaned by scraping with a safety razor blade. A thorough cleaning of the empty aquarium is accomplished by rubbing with either whiting or table salt on a moist cloth. Sand should not be used. It causes minute scratches, which are unsightly and may lead to the breaking of the glass.

**Coal Gas.** Water absorbs most gases and fumes readily. This includes coal gas, which is so injurious to all life, plant and animal. Many homes are cursed with the presence of this gas at night, to the detriment of every inhabitant in the house, especially the fish. A way should be found to correct the condition, but if this is not at once practicable, cover the aquarium tightly with glass during the hours of exposure to the poisonous influence. The same precaution should be taken when the air is heavily laden with tobacco smoke.

**Hints to Beginners.** The author would draw special attention to what follows under this heading. It is founded on wide observation, and if followed will prevent much loss and disappointment for those going in for fancy goldfishes.

In starting with fancy breeds go to a reliable dealer or breeder, preferably in September or October, purchasing fish of the spring hatching. The style of fish to select is a matter of personal taste, but do not pick undersized fishes by any inducement of price or word, especially on explanation of their being "a late hatch." The bodies, exclusive of tails, should at this time be at least 1½ inches long. Two inches or more is better. Be willing to pay the price for robust fishes. The runts are dear at any price.

If it is not convenient to purchase in autumn, make it a rule not to get fishes over one year old. Buying spawn in the spring is an interesting way to start.

Unless desirous of making a flashy show in an aquarium at once, it is very bad policy to purchase fully developed fishes with long fins. These have usually reached their zenith and are ready to "go back." The change of aquarium is enough to start them on the down grade. Good young stock will develop the fins later and will be more likely to "stay with you." None except advanced fanciers who know what they are about should purchase the older stock and *they* seldom *do*.

*Chapter Two*

# The Goldfish

There are two root-stocks from which the goldfishes of today have originated. Both are members of the carp family. The European goldfish, *Carassius carassius*, has never been developed into any of the fancy forms except by crossing with cultivated types of the Asiatic stock, *Carassius auratus*. The Orientals, principally those of Korea, China and Japan, must be given credit for first establishing, by selective breeding, the goldfish as an ornamental pet, as well as for the incredible lengths to which they have gone in fixing fancy breeds.

Although a common American goldfish has been described by at least one writer, no such division properly exists. Those sometimes found in American waters are invariably from escaped or liberated stock from one of the two varieties mentioned, or from their hybrids.

The normal color of fishes of both root-stocks is of a silver-gray or olivate hue, but with a strong natural tendency towards albinism, which produces occasional specimens of a yellow or golden color. By selective breeding these colors have become fairly well fixed, although in the scaled varieties the color is still at first carp-like, turning to gold, white or black, as a rule, in from three to eight months. Instances are quite common where they live to an old age without ever turning, so strong is the tendency among goldfishes to revert to the ancestral strain.

**Colors in Goldfishes.** There are two great divisions among goldfishes as to color—the scaled and the so-called "scaleless" classes. The scaled specimens are those having a metallic lustre, usually of red, white, olive-gray or black. The great majority of commercially bred stock belongs to the scaled division. The more prized colors in common goldfishes are deep red (called "gold"), white (called "pearl") and a combination of the two.

The smoke-colored fishes are known as silverfishes, their color and metallic lustre somewhat resembling tarnished silver. It is the ancestral carp color, and every "scaled" goldfish first passes through

this color period. Breeders call them "uncolored," because they have not yet turned to one of the more desirable colors. Goldfishes of the metallic or "scaled" type are liable to change color at any time, the least liable to turn being the white or pearl fishes. After the first change from "silver," the rule is to progress towards a lighter color, that is, from black to red or from red to white. Exceptions are very rare. It will also be found that the lighter colors are the more persistent in breeding, and as these are considered the least desirable, it is well to avoid light-colored fishes when it comes time to select breeding stock. Even when darker-colored breeders are used, the fancier is frequently disappointed by having a large proportion of the young develop light colors.

Black is a color which for some unknown reason is confined almost exclusively to the telescope goldfish. In breeding telescopes it not infrequently happens that the abnormal eye development never takes place. These fishes may develop any or all of the color peculiarities of their parent-stock except that of being black. In the breeding of fancy goldfishes any freak combination of characteristics seems liable to occur, but the writer has never seen a good black fish without telescope eyes.

We have referred to "scaled" goldfishes. The other division not known to the general public, but which plays a highly important part in the goldfish fancy, is the "scaleless" variety. These fishes are really not without scales, but the scales are of such transparent character that they are scarcely perceptible to the eye. However, they usually show with moderate distinctness in a clear photograph. "Scaleless" fishes do not have the metallic sheen of the ordinary goldfish. The colors are more refined and present a far greater range of variety. The most important difference is the presence of blue and lavender tints. Among the scaled fishes these are not found. A further account of these colors will be found in the description of the Calico Telescope on page 34 and in the chapter on judging Goldfish Competitions, page 42. Our frontispiece shows an unusually fine specimen of a young scaleless goldfish of the Calico type.

Another important peculiarity of this type is that they never go through the period of being silverfish, but at the age of about six weeks commence to develop their permanent colors. The first color is white, sprinkled with small black specks. A good idea of the final color may be had in ten weeks, although as elsewhere remarked, the very finest of the calico colors are not fully apparent under two or three years. "Scaleless" fishes have a charm of refinement distinctly their own and make most interesting inmates of the aquarium. So transparently

scaled are some specimens that at the breeding season it is often possible to tell females by seeing the eggs through the translucent walls of the belly. The main objection to the transparently scaled fish is that the ribs or rays of the fins are rather weak. Soon after the fins have attained a high degree of development the fish is no longer able to hold them in a position where they will show to advantage. In the majority of instances the dorsal and caudal fins (the latter hereafter popularly referred to as "tails") commence to droop and sag in from two to three years, while the scaled fish often maintains an admirable stiffness of fins for years.

**Length of Life.** Although millions of common goldfishes die annually at an early age under the outrageous conditions of a miniature fish globe, they are endowed by Nature for a long life. Under fair conditions and proper management, they should live from ten to twenty years in an aquarium. In ponds where not subjected to severe winter conditions they will live at least thirty years, if not caught by enemies. The Fish Commission at Washington has at this writing a number of specimens over thirty years of age. Questions are frequently asked regarding the length of life of fancy goldfishes, but these are always difficult to answer satisfactorily. A large proportion die under the age of 6 weeks. Of the remainder there are quite a few which do not develop rapidly, always remaining "runts." A few of these drop off from time to time during the winter, but in the early spring months they, and all other weak fishes, go rapidly, so that very few of the undersized fishes are left by the first of May. Those passing this period are generally good for a few months more, when the death toll is rather heavy again. To answer the question in a general way, it might be said young fancy goldfishes with a body length of not over 1 inch in October (no matter when hatched) are quite unlikely to live a year. Those from 2 to 2½ inches will average about 4 years under good conditions. Anywhere from six to twelve years can be considered a long life for a fancy goldfish, although well authenticated instances exceeding this are known.

**Development of Fancy Breeds.** In breeding single-tail fishes together in which there is no known double-tail stock, one will sometimes find a fish with the lower lobe of the tail double, making it a reasonable supposition that this was the first "break" in form away from the common stock. This is called a "tripod tail." The next higher development is the "web-tail," in which both tails are fully formed but joined at the top edge instead of being completely divided. From these early "breaks" have been developed the fully divided tails, double anal fins, *et cetera*.

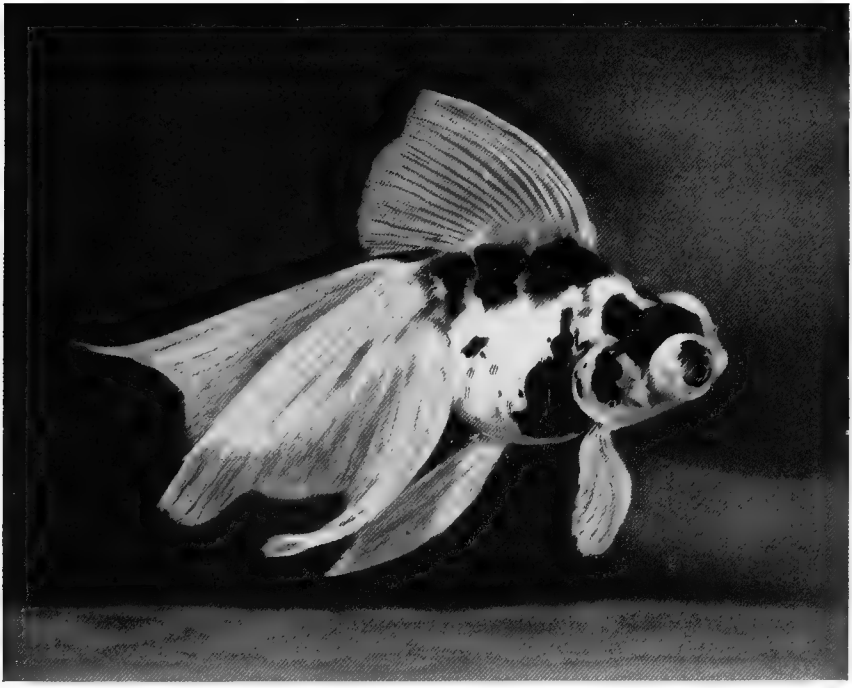


FIG. 12. PRIZEWINNING SCALELESS TELESCOPE

FIG. 13. PRIZEWINNING CELESTIAL TELESCOPE *(Top view)*

One of the rarest, strangest and most difficult varieties to breed and keep alive.

FIG. 14. TELESCOPIC-EYED SHINER *(Top view)*

A remarkable case of telescopic eyes found in Nature, proving that they do occur spontaneously, and making it practically certain that the strain of telescopic-eyed goldfishes is descended from wild Oriental goldfish stock showing this tendency in some degree, the characteristic being later firmly set by selective breeding. Normal specimen of this fish shown in Fig. 98.

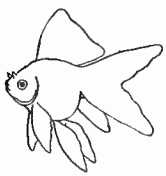


FIG. 9
SINGLE TAIL

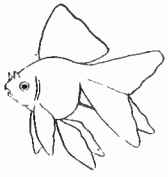


FIG. 9A
TRIPOD TAIL

FIG. 10
WEB TAIL

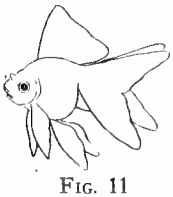


FIG. 11
DOUBLE TAIL

EVOLUTION OF DOUBLE TAIL OR FANTAIL GOLDFISH

The origin of those weird telescopic-eyed goldfishes has been the subject of a number of fanciful theories, but there can be little doubt that the strain was produced by selective breeding from the individuals which showed more or less bulging eyes. This would be the correct scientific theory, and a recent discovery helps confirm it. The goldfish belongs in the same family as the minnows *(Cyprinoids)*, and a minnow has been found in Nature with enormous and perfectly developed telescopic eyes, proving that the break is a natural one that might be expected to occur occasionally, and from which a strain of the same kind could be established, especially in a subject so readily bred as the goldfish. The specimen referred to is not a case of the disease called "pop-eyes," common to the sunfish and others. The eyes are purely telescopic and have been so determined by Henry W. Fowler, an ichthyologist of world repute who has specialized on the *Cyprinoids*. The accompanying photographic reproduction of the fish is convincing, but the preserved specimen can be seen at the Academy of Natural Sciences of Philadelphia. In life the fish was shown in a number of local aquarium society exhibitions.

By careful selective breeding, types have become fairly well fixed, but the goldfish has a strong tendency to revert far back to ancestral types, in form as well as color, often to the annoyance of the breeder. One of the most interesting things about a spawning of goldfishes is the tremendous variety in the color. In a lot of a thousand young scaleless fishes there may not be two alike, and none may resemble either parent. That this is not *always* so is a self-evident fact, else selective breeding would be without results.

The accomplishments of Oriental breeders seem only to be limited by the scope of the imagination. Through the most patient efforts, not only of a lifetime, but of several generations of a family, such changes have been wrought in form and color that some of the breeds do not seem to even distantly resemble the common goldfish. That this is so is often evidenced by the fact that strangers to the fancy on first seeing a collection of highly developed fishes *want to know what*

*they are.* An amusing incident illustrating this point occurred in the preparation of the present volume. An engraver who made a plate of a goldfish billed the publishers with "One Cut of Butterfly"! Those outside the fancy sometimes seriously refer to the fins of fancy specimens as "wings." Among fanciers a high dorsal fin is often referred to as the "sail."

When it is borne in mind what a considerable period of time must have been necessary to bring about these strange breeds, it is not surprising that racial ideas and characteristics should, to a certain degree, be expressed in them. The Telescope Goldfish was originated in China and undoubtedly bears a resemblance to Chinese art. It has a sort of beautiful ugliness, a deliberate grotesqueness, intended first to shock and then excite curiosity. The wonderful range of colors, too, suggests the art of the Chinese—that race which continues today to lead the world in the clever use of color. The Japanese Fringetail Goldfish is another expression of national art. It is the very embodiment of that æsthetic elegance and grace so well understood by the Japanese people. America has not been without its logical contribution. Here in this vast melting pot it is our desire to bring forth combinations of the best from the old worlds, to which is added a touch of our own individuality. Although we have made several other combinations in crosses, the most important is the beautiful Scaleless Fringetail. European aquarists have not as a rule developed fancy goldfish breeding to the point it has been carried in America. Their interests, particularly among the Germans, are centered in tropical fishes, in which specialty they easily lead the world, although their leadership has been greatly impaired by the immediate and subsequent effects of the great war. In the Veiltail Telescope, the most important breed in this country, American breeders have virtually created a new class, although none of the separate points are of our own development. We have combined the short body and long fins of the Japanese Fringetail with the Chinese eyes, and colors. The broad, square tails seem to come from the Chinese side, but so far as we know they did not especially breed for this point nor for length in connection with it.

It is believed that the first cultivated goldfishes came from Korea, that country from which even ancient China borrowed ideas, education and arts, but so little is known of this that we have to take our facts as we now find them. That there have been and are breeds of goldfishes in both China and Japan which have never been exported is well attested by travelers and by a book published in Paris in 1780, by de Sauvigny. This remarkably illustrated work shows many of the varieties in color. The only known copy in the United States is

in the Academy of Natural Sciences, Philadelphia, where it will be shown those interested.

## THE COMMON GOLDFISH

The common Goldfish, being closely related to the original stock, has most of its characteristics. It is very hardy, can withstand extremes of temperatures if brought about gradually, can remain out of water for several hours when kept moist, will eat almost any food, is easily tamed and is a prolific breeder. The body is rather long and

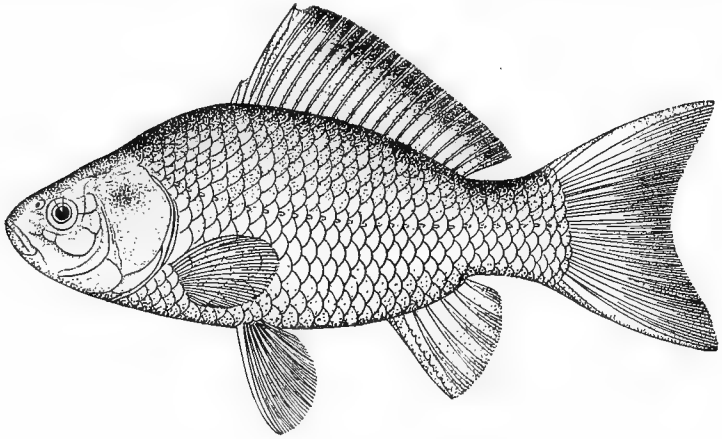


FIG. 15. THE COMMON GOLDFISH *(Carassius auratus)*

flattened on the sides. The head is short, wide, and without scales. Names of the different fins should here be carefully noted, as they are frequently referred to in other parts of this work. The Dorsal Fin (on back), the Caudal Fin (the tail) and the Anal Fin (small fin nearest tail) are all single in the Common Goldfish. The Pectoral Fins (nearest head) and Ventral Fins (nearer lower centre of body) are paired.

One of the easiest characteristics to fix in a breed is the lengthening of the body and fins. This brings us to a description of the first of the fancy goldfish varieties or breeds.

## THE COMET GOLDFISH

The Comet has been referred to as the Japanese Comet because it is probably a "sport" from Japanese stock. Japanese experts have assured us the breed is not recognized in their country and certainly no considerable numbers of them have ever been imported from there.

The first of the long single-tail breed appears to have been originated in the ponds of the Fish Commission in Washington in the early eighties. Mr. Hugo Mullertt either secured some of this stock or later originated a strain of his own. At any rate, he was the first to place them on the market in quantity. The Comet is long of body and fins, the tail in particular being very free-flowing. In movement this fish is the most graceful of all the fancy goldfishes and it can swim with great rapidity when necessary. This activity has made it easy for the fish to revert to its ancestral tendency to leap out of the water. Aquaria containing Comets should be covered by a screen, particularly in

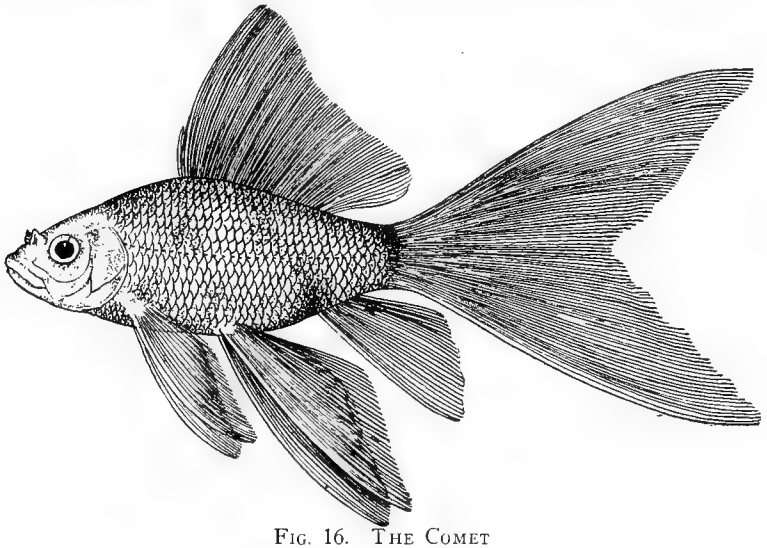


FIG. 16. THE COMET

spring. The Comet makes the most beautiful and generally satisfactory pond goldfish where a decorative effect is desired. They are perfectly hardy over winter in a deep pool or where they may burrow in leaves or soft mud. The type breeds quite true to form and many thousands of them are raised annually for the trade. A few years ago there was a wonderful strain of Scaleless Comets of deep oxblood red color. Unfortunately this was lost and present-day breeders with scaleless stock that could be so crossed as to produce Scaleless Comets find it more profitable to utilize their spare time and energy in propagating other breeds.

## THE SHUBUNKIN

One of the more recent introductions is the Shubunkin. This is simply a transparently scaled, highly mottled, common goldfish. All

breeders of fancy stock occasionally get fish which are known as "sports" which have reverted back in form, but not in color, to the original type. The Japanese have now fixed them as a breed, and export a fair number of them. They are of the most striking variation

FIG. 17. THE SHUBUNKIN

in color, and make a hardy, attractive aquarium or pond fish. The colors most sought after are blue backgrounds, sprinkled and mottled with dark red, brown, yellow and black.

## THE FANTAIL GOLDFISH

This is no doubt the early type of double-tailed goldfishes and is the kind most frequently met with in pet shops. Enormous quantities

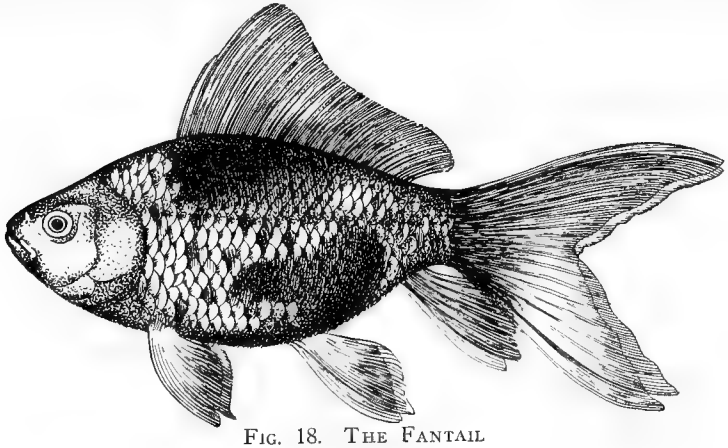


FIG. 18. THE FANTAIL

of them are annually raised in Japan, China, United States and Germany. Being long of body, with fins not highly developed, they make good breeders and agile swimmers. Since the price of Fantails is in advance of that for commons, it would seem a better commercial venture to invest a little more money at the start for Fantail breeding stock. However, none should go into the raising of fish of any kind as a commercial enterprise without first obtaining actual experience in a smaller way.

The anal fins, as well as the tails, should be double and clearly divided.

## THE JAPANESE FRINGETAIL GOLDFISH

In point of pure elegance there is no breed of goldfish equal to the Japanese Fringetail. Our illustration is taken from a sketch of the

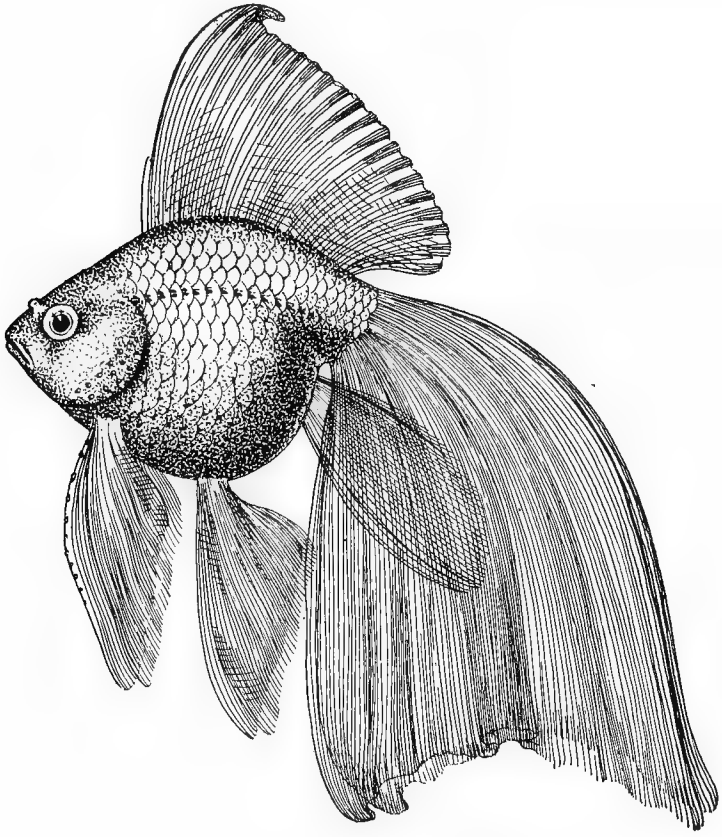


FIG. 19. THE JAPANESE FRINGETAIL *(Veiltail or Broadtail Type)*

fish, made by its owner. A few words regarding this, probably the best-known individual fish that has ever been owned in this country, might be of interest. The Japanese Imperial Government sent a collection of its best goldfishes to the World's Fair at Chicago in 1893. Only a few of them survived the journey and still fewer lived through the Exposition. These had fallen into a diseased condition and were given to Mr. William P. Seal. He cured them and later sold this one, now known as "The World's Fair Fish," to Mr. Barrett, for a comparatively small consideration. At that time the fish had not developed the wonderful qualities which have made it famous. It was one of those cases where "blood will tell."

Regarding this fish as a type of perfection that could not be improved upon, the Aquarium Society of Philadelphia had a drawing of it made from a sketch and used as a society emblem. The society later had the fish struck on its medal. It lived to an age of about fifteen years, and was the father of many fine specimens.

The characteristic points of the Japanese Fringetail are brought out in the illustration. The body is short, rounded and chunky, with short head and flat eyes. The lower fins are long, pendant and delicately lace-like, and are all paired. The dorsal fin is as high as the body is deep. It should be carried erect, producing the effect of a sail as the fish moves through the water. As in most other varieties, the deeper colors, both in scaled and scaleless specimens, are the more highly prized. Scaleless Fringetails, an American production obtained by crossing Japanese Fringetails with Chinese Scaleless Telescopes, are exceedingly refined in appearance.

The illustration shows the tubercles on the gill plate and pectoral fins, indicative of the male sex.

## THE JAPANESE BARNACLED GOLDFISH

Barnacled goldfishes are so rare that the majority of leading fanciers have never seen them. They were first imported from Japan in 1897, soon disappearing from view. Although no new stock is known to have been imported, the peculiar characteristic has recently made its appearance again. Whether these fishes are inheriting from the original imported stock, or whether they represent an independent "break," such as the Japanese breeders utilized in starting the breed, it is impossible even to surmise. The scales are raised sharply in the center, presenting regular lines of dots along the sides of the fish. These should not be confounded with fishes suffering from dropsy. In the latter case the scales stand from the body at the outer edge. Otherwise the fish has the characteristics of the Telescope fish.

## THE JAPANESE NYMPH GOLDFISH

The Nymph is virtually a single-tail Fringetail. The anal fin and tail are single. The latter, instead of drooping, should be carried out straight, and well spread. This fish is usually a "sport" from Fringetail stock. Although seldom deliberately bred, fine specimens are very

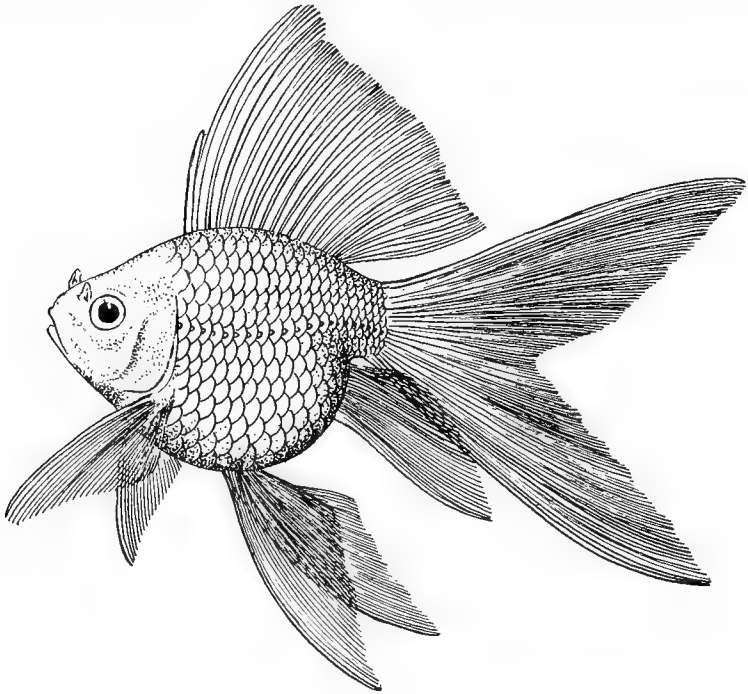


FIG. 20. THE NYMPH

attractive in an aquarium and are often retained by fanciers. In their active movements, as well as in points of conformation, they make a pleasing contrast with the double-tailed varieties. One of the principal features is the dorsal fin, which should be large and carried quite erect, as described for the Fringetail. The body requirements are also the same.

## CHINESE TELESCOPE GOLDFISHES

This most curious fish is either of Chinese or Korean origin, but was undoubtedly brought to its highest stage of development in China. The name correctly implies its chief peculiarity—projecting eyes suggestive of a telescope barrel. These make a very weird appearance, and almost without exception produce a shocking impression on being

seen for the first time. Telescope eyes vary quite considerably in shape and in direction. The majority of them are spherical or conical. Tubular eyes are rare and highly prized, but any form is considered good so long as they are large and stand out far from the head. Most telescope eyes point in the same direction as normal eyes, but some point forward. This is unusual. The Celestial Telescope has still more peculiar eye formation. This is described under its own heading.

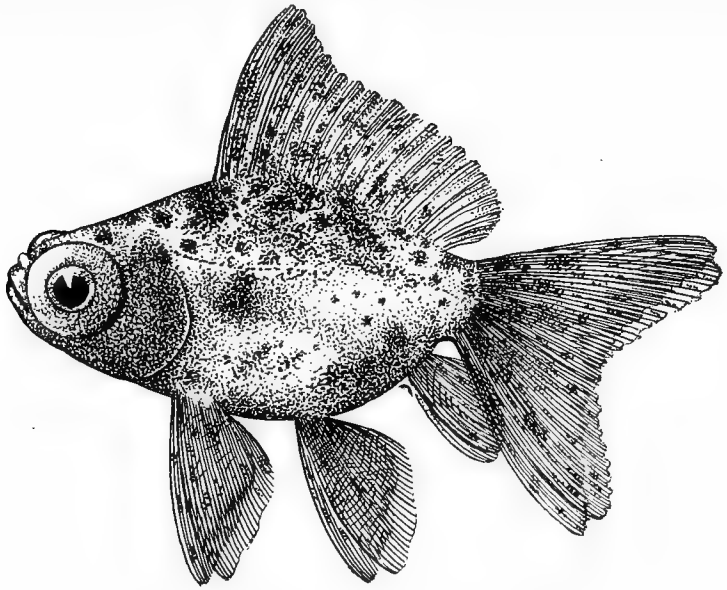


FIG. 21. EARLY TYPE CHINESE TELESCOPE

One point in common between all Telescope goldfishes is that in the early weeks of life the eyes appear entirely normal. Until they actually start to "develop eyes" at anywhere from two months to even two years, it is impossible to tell whether or not they will become Telescopes. The usual development period, however, is from three to five months. Should they pass ten months without turning, they may be safely called Japanese Fringetails. Many such fishes that have come from Telescope stock are used to breed to Telescopes to produce Telescopic young. This is usually successful in the first generation, but it has a tendency to spoil the breed by gradually reducing the size of the eyes. Telescope fishes of the present time are, for the most part, considerably inferior in point of eyes compared with the stock of fifteen years ago, due mainly to breeding too exclusively for short bodies and long fins. Type characteristics in any kind of breeding can, like liberty, only be maintained at the price of eternal vigilance.

## THE CHINESE SCALELESS TELESCOPE GOLDFISH

As before stated, "scaleless" is somewhat of a misnomer, the fish being transparently scaled, making the scales difficult to detect. We use the word "scaleless" in its accepted popular sense.

Fishes of this general division are divided into two color classes —Plain Scaleless and Calico. The Plain Scaleless is red, white or a combination of the two. Red in scaleless fishes is quite different from that in scaled varieties, being more of an oxblood color, producing a highly refined appearance. In scaleless fishes the bodies do not have a metallic lustre. The colors seem as though they had been laid on

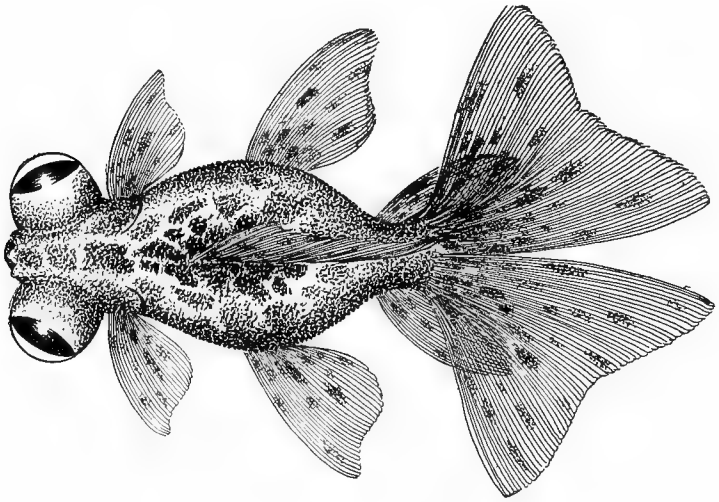


FIG. 22. CHINESE SCALELESS TELESCOPE *(Dorsal view)*

by the delicate hand of a water-color artist. These fishes have white fins, sometimes dotted with black. During the first few months the roots of the tails are usually dark, but this gradually disappears.

The Calico Telescope is the consideration of first importance, not only in this group, but among all fancy goldfishes in America. Its name is suggestive of its coloring, but the colors are by no means in geometrical arrangement, as they are in the fabric. Red, yellow, brown, gray, black, blue and lavender are laid in fantastic blotches and spots over the body, usually on a lighter background. Many small dots of black are sprinkled over the body and fins. In extra fine specimens red dots will also appear in the fins. The color chiefly sought is blue, and the more blue the more valued the fish. Probably every

American breeder of Scaleless Telescopes has an ambition to breed a solid blue fish with high-class body and fins. A few solid blues have been produced, but the other required points were lacking. Calico Telescopes of the higher order seldom find their way into the pet shop, the price effectively keeping them out. This is true of most of the finer fishes. Public taste in these matters is not sufficiently educated to warrant dealers in taking the risk of carrying the more highly developed, and therefore more delicate, specimens in stock. It must be noted, however, that the past few years have witnessed a gratifying development of general interest in the better aquaria and fancy fishes of all kinds.

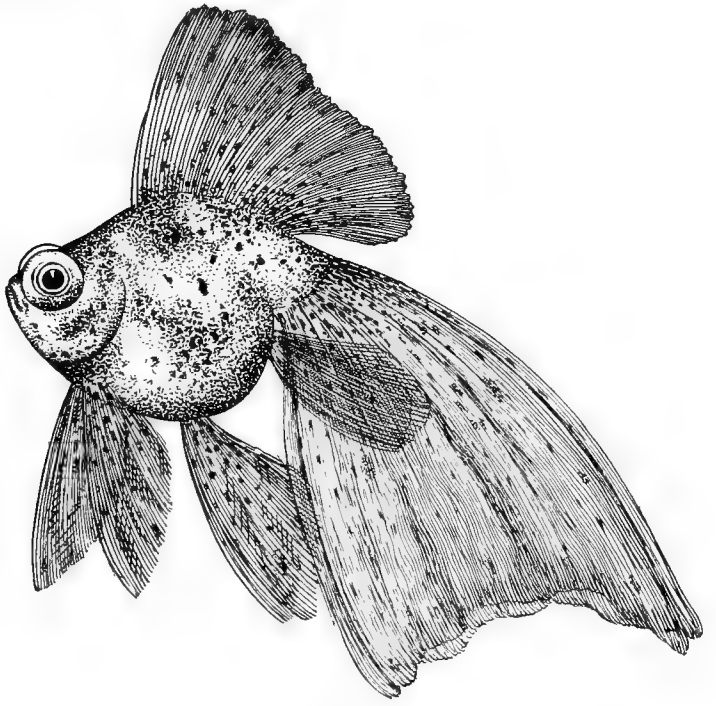


FIG. 23. IDEAL VEILTAIL CALICO TELESCOPE

## THE SCALELESS VEILTAIL TELESCOPE

While it is true that some of the early Chinese scaleless importations had broad tails and medium length bodies, it is highly probable that none of them equaled in short bodies and long fins the present American standard type. We crossed Japanese Fringetails with Scaleless Chinese Telescopes, thereby producing two new varieties

which have become permanent—Scaleless Japanese Fringetails and Scaleless Veiltail Telescopes. Both have been bred for broad-tail qualities (veiltail), and may be considered an American variation. The characteristic points of the Scaleless Veiltail Telescopes are the same as those for the body and fin formation of the Japanese Fringetail and the eyes and coloring of the Chinese Telescope. The coloring almost always tried for is calico, but if a fish fails in this and still retains the other characteristics of the breed, it is considered a good fish. A perfect Calico Veiltail Telescope is the acme of perfection which most American breeders have in mind as their highest goal. If the fish turns out black, it comes under the following classification.

## THE CHINESE MOOR TELESCOPE GOLDFISH

The Moor is a most striking breed of the goldfish, its intense, velvety black color forming a rich contrast for the more gaily colored

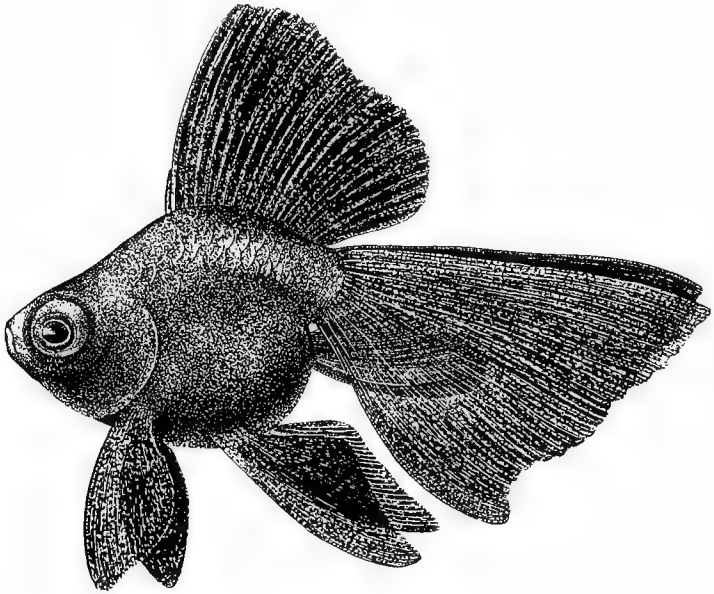


Fig. 24. The Chinese Moor

specimens in the aquarium. The intense blackness extends to every part of the fish except the under side of the belly. This shades off to a blue-gray or a slight golden tint. In the latter case the fish is likely to eventually turn gold. This is not certain, nor is the blue-gray a guarantee against turning, although it is less likely to do so. Breeders have not found that the greatest percentage of blacks is produced by

using two blacks, but by crossing a deep red scaled fish with a black. A good Moor, with the body and fin development of the Fringetail, is a very choice fish, and is always in demand. The accompanying illustration, made from a very fine yearling fish, does not give a full idea of the intense black color of the original. Some of this had to be sacrificed in order that the drawing might show all details of the fish. Our photographic illustration of a Veiltail Moor, on page 5, will give a better idea of the color.

If the foregoing references to Fringetails and Veiltails are found confusing to the reader, a more detailed explanation will be found under the following chapter, "Judging Goldfish Competitions."

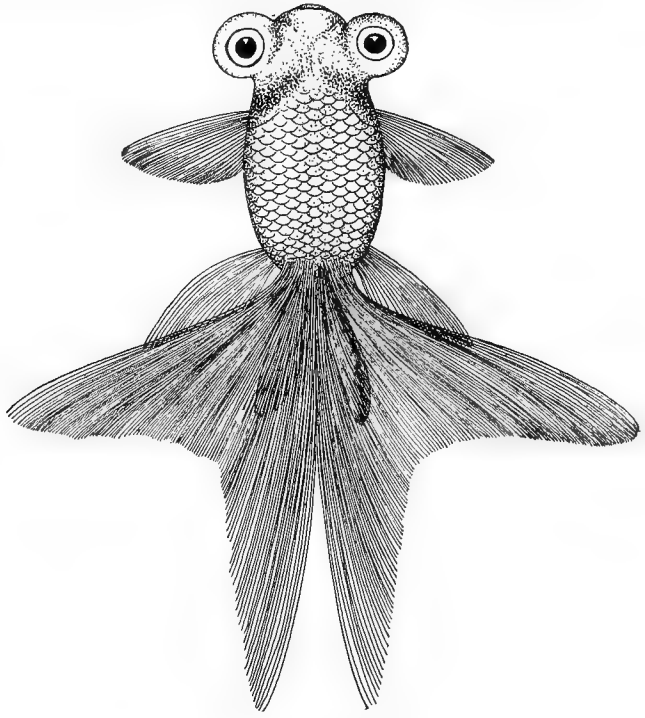


FIG. 25. THE CELESTIAL
(*Top View*)

## THE CHINESE CELESTIAL TELESCOPE GOLDFISH

For a long time an erroneous belief existed that the peculiar eyes of the Celestial Goldfish are produced by placing the young in jars which were lighted only from a small slit in the top. Although this variety is difficult to breed, it has been done several times in the United

States. No peculiar contrivances of any kind were used. At the usual period of about twelve weeks they developed ordinary telescope eyes in the regular way. Later they gradually turned towards the top of the head, as shown in Figs. 13 and 25. It lacks the dorsal fin.

If any such peculiarity had been produced by mechanical means, it would not be reproduced in the offspring. By some Orientals the Celestial Goldfish is considered sacred on account of its constant heavenward gaze, and is accorded a place in their temples.

The Celestial Telescope is the most difficult of the imported goldfishes to rear or to keep alive in the aquarium.

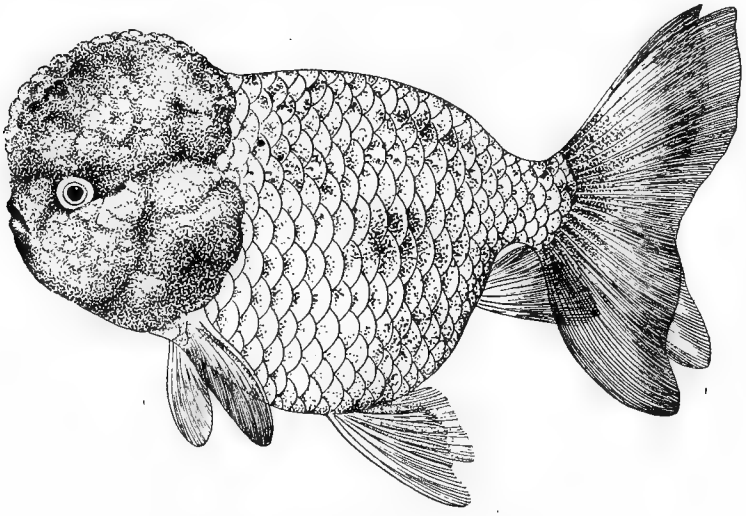


FIG. 26. THE LIONHEAD, OR BUFFALOHEAD

## THE LION-HEADED GOLDFISH

In point of grotesqueness and the amazing accomplishments of breeding fancy goldfish, probably nothing surpasses the so-called Lionhead. It is often remarked that the name is not particularly appropriate, but seems to have become established. "Buffalo-head" would be a much more descriptive and appropriate name. There are three strong characteristics to this fish. The first is a thick growth over the gill plates and head somewhat resembling a large raspberry. The second is the entire absence of dorsal fin, and the third is the extremely thick, short body. The growth on the head seldom commences before the age of six months and sometimes never appears. It is frequently well developed in four years and increases in size as long as the fish lives. After the head growth has become quite thick it is

advisable to keep the fish in running or other well oxygenated water. The mechanical difficulty of breathing is considerable and unless there is plenty of oxygen the fish is liable to suddenly expire when in apparently good condition. The tails and anals should be double, but defects in these points are not considered serious if head and body are good. The colors are the usual pearl and red of the common goldfish. A few transparently scaled specimens have been produced by crossing with transparently scaled fish of other breeds. One or two Lionheads in a mixed aquarium add considerably to the variety. It was believed by some that the absence of dorsal fin was the result of its being extracted by Japanese breeders while the fish was young. This has been proven a gross error for the same reasons stated in paragraph on Celestial Telescopes.

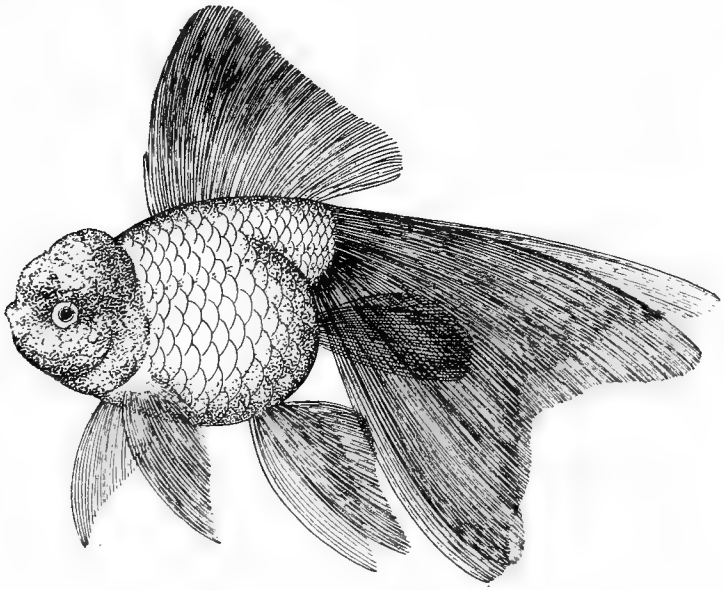


FIG. 27. THE ORANDA

## THE ORANDA

In the opinion of the writer an Oranda was originally a Lionhead with a dorsal fin—in other words, a Lionhead which did not come true to form. However, it is recognized as a variety and is accorded a place in goldfish exhibitions. The fins and body are usually longer than in the Lionhead. There is a bluntness about the head of Oranda stock, noticeable even when they are young, before the peculiar development has started.

## CHINESE LETTERED GOLDFISHES

It has been claimed that in some instances the Orientals have succeeded in breeding fishes marked with Chinese letter characters on the sides. In strongly mottled stock such a design might accidentally appear, but from our knowledge of goldfish breeding traits we do not believe any definite color pattern could be deliberately produced. It is much more probable that the fishes have been cleverly stained by the use of a solution of oxalate of iron or dilute hydrochloric acid.

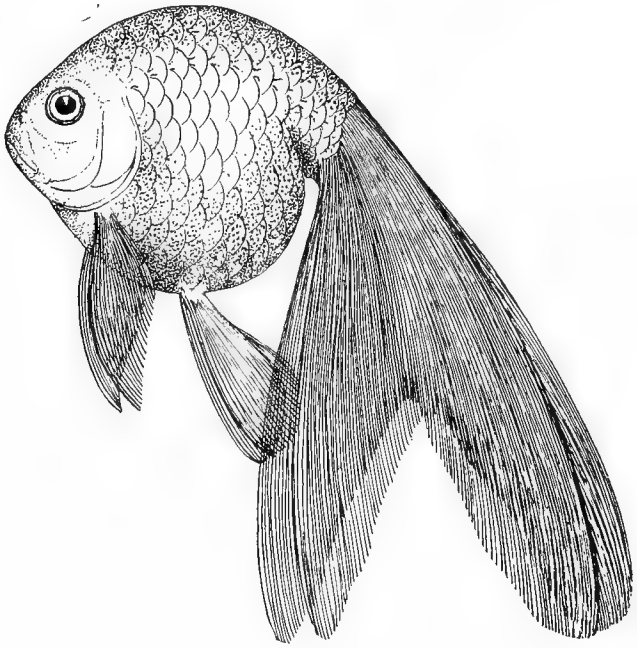


FIG. 28. THE EGGFISH

## THE CHINESE EGGFISH

A few of these fishes were imported some years ago, but have never become generally known. So far as America is concerned the breed is temporarily lost. This fish, as its name correctly implies, has a rounded white body resembling an egg. The absence of dorsal and anal fins enhances this effect very much. The tails are bifurcated and decidedly drooping. This fish would form an almost dazzling contrast with a Veiltail Moor Telescope. The breed is recognized in Europe.

*Chapter Three*

# Judging Goldfish Competitions

Among aquarium societies there is a certain demand for competitive exhibitions of goldfish varieties. The difficulties of making satisfactory awards are considerable, due in part to varying ideas as to what constitutes standards of perfection. To reduce this difficulty to a minimum the Aquarium Society of Philadelphia instituted a series of conferences of leading fanciers in order to establish a satisfactory and uniform scale of standards. The diagrams shown herewith represent a composite of the best ideas obtainable. The majority of leading societies have adopted them as a whole.

The "point system" of judging, as it is called, is too slow and laborious for use on an entire large exhibition. The two or three best fish, selected on general appearances, should be set aside from the others and judged independently by three judges, on points. The totals are then averaged and awards made.

In those classes requiring double anal fins the fish is penalized three points for having only one.

In the Fringetail classes the tails must be fully divided to receive consideration.

The Longtail or Fringetail group is divided into two classes, the Veiltail and the Ribbontail. These are also called "broad-tail" and "swallow-tail" or "cut-out-tail." In the Veiltail the centre of each tail is indented or forked less than one-third of its total length. The swallow-tail is cut in to one-third or more. The diagram on page 45 will plainly show this.

The making of these classes has caused some confusion. The author believes that fishes of these two types and those on the difficult dividing line should all take their chances together. The division was undoubtedly made as an expediency in order to make more awards and thereby please as many people as possible. So far as can be determined, no such divisions of fin shape have ever been recognized in China or Japan, and the same was true here until the period of 1910-12,

when it became a conspicuous fact that nearly all winners of competitions were of the broad-tail type. Those not possessing stock of this style became dissatisfied, and in order to appease them, a class of the old-style fish was established. While the Veiltail is the more difficult to handle and to breed, it is accepted as the standard to be striven for. The word "veiltail" was adapted by the author from the German Schleierschwanz, and is more truly descriptive than "fringetail," a word more apt to describe the split and ragged ends of the fins of a fish out of condition.

In competitions goldfish are divided into the scaled and "scaleless" classes, the latter being transparently scaled. The scaled fishes are colored gold (metallic red), silver (metallic drab or smoke), pearl (metallic white), and moors (blacks). The first should be of a deep shade of red. The second is a transitory color and varies but little. As a color value it ranks low. The pearl is a grade higher, but light colors in general are not favored. Moors should be of a deep blue-black, free from the appearance of a white scum. These blacks are never completely black under the belly. It is at this point that they usually begin to turn red, which is liable to happen to a Moor at any age.

"Scaleless" fishes are divided into red, white, mottled and calico. The preferred shade of red is of the deep oxblood color. White ranks lowest. Mottled is a combination of red and white, while the highest prized is the calico, a combination of all the colors in finely divided spots. In this class the all-important color is blue or lavender, the deeper the better, and also the more the better. The ideal Calico has a body background of blue, red and white, over which is a sprinkling of fine black dots. The black dots and some red ones are also freely distributed over all the fins, which are otherwise white in these and all "scaleless" fishes. The highest development of this color seldom occurs under the age of from two to three years.

There are special competitions for fishes under one year old. A recent ruling in this connection is that a fish to be judged must have a body as large as a half dollar. Also that the body of an adult must be as large as a dollar. This is because many "runt" fishes, if judged strictly on points, would carry off the awards, their development having gone all to fins.

In the opinion of the writer, societies should avoid too frequent competitive exhibitions. They promote discord and tend to develop professionalism. Those truly interested in the development of the fancy will be willing to bring out their fish without thought of reward other than giving pleasure to their friends and the public.

FIG. 29. AQUARIUM EXHIBITION, PHILADELPHIA

Horticultural Hall, one of the two permanent buildings from the Centennial Exhibition, forms, with its magnificent setting of tropical vegetation, an ideal background for the National Exhibition of Aquarium Fishes held annually in October. Upwards of 15,000 interested visitors attend in three days, including many enthusiasts from distant points. Public exhibitions in other large cities are also remarkably successful.


FIG. 30. MEDAL OF THE AQUARIUM SOCIETY OF PHILADELPHIA
(Exact size)

The first medal offered by an American Aquarium Society. It is awarded originally for the best fish owned and the best fish bred by a member; also for distinguished achievement or services in the advancement of aquarium study.

## Charts Showing Ideal Figures of the Principal Goldfish Varieties, Together with Valuation Points

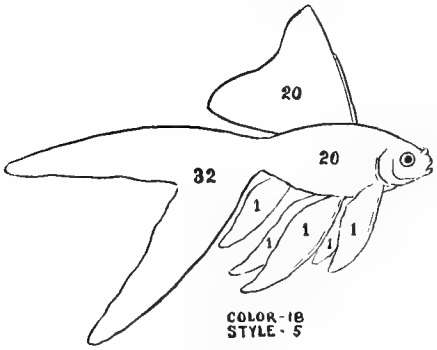



FIG. 31. COMET (RIBBONTAIL)

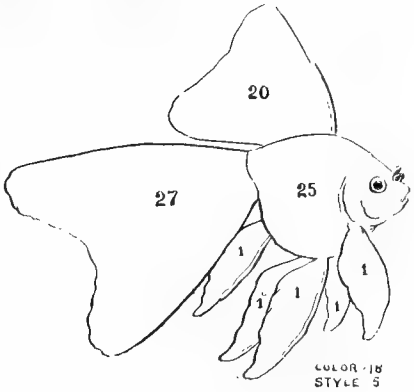



FIG. 32. NYMPH (VEILTAIL)

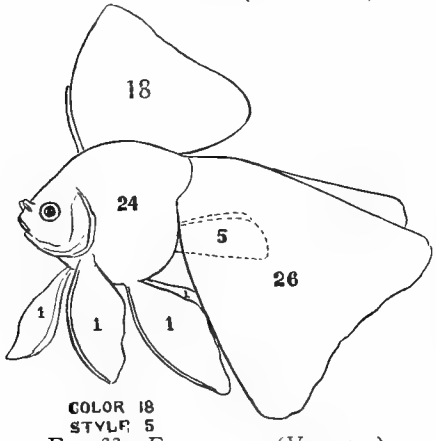



FIG. 33. FRINGETAIL (VEILTAIL)

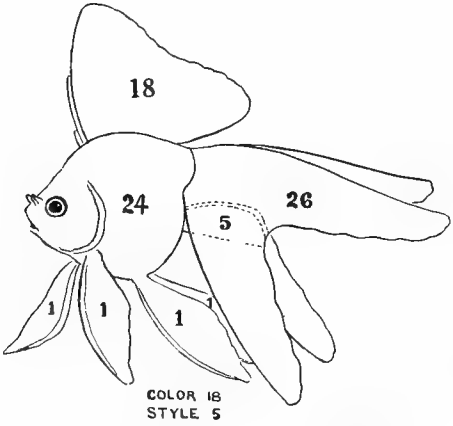



FIG. 34. FRINGETAIL (RIBBONTAIL)

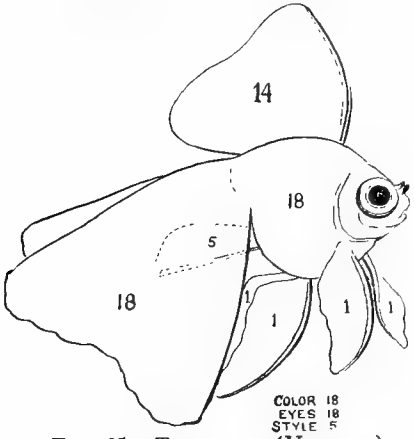



FIG. 35. TELESCOPE (VEILTAIL)

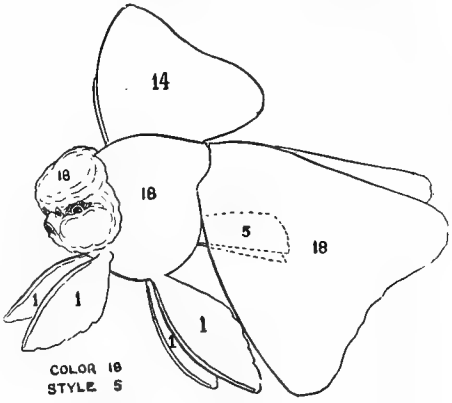



FIG. 36. ORANDA (VEILTAIL)

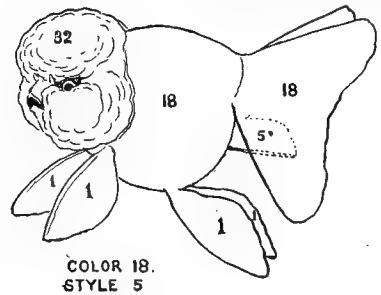



FIG. 37. LIONHEAD

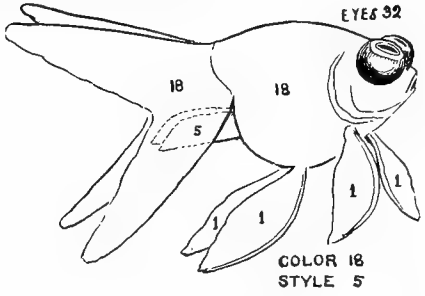



FIG. 38. CELESTIAL

| | Body | Tail | Dorsal | Fins | Color | Double Anals | Style | Eyes | |
|---|---|---|---|---|---|---|---|---|---|
| Telescopes | 18 | 18 | 14 | 4 | 18 | 5 | 5 | 18 | 100 |
| Japs | 24 | 26 | 18 | 4 | 18 | 5 | 5 | | 100 |
| Nymphs | 25 | 27 | 20 | 5 | 18 | | 5 | | 100 |
| Comets | 20 | 32 | 20 | 5 | 18 | | 5 | | 100 |
| Telescope Nymphs | 19 | 19 | 16 | 5 | 18 | | 5 | 18 | 100 |
| Celestials | 18 | 18 | | 4 | 18 | 5 | 5 | 32 | 100 |
| Shubunkins | 10 | 10 | 10 | 5 | 60 | | 5 | | 100 |
| | | | | | | | | Head | |
| Lion Heads | 18 | 18 | | 4 | 18 | 5 | 5 | 32 | 100 |
| Orandas | 18 | 18 | 14 | 4 | 18 | 5 | 5 | 18 | 100 |

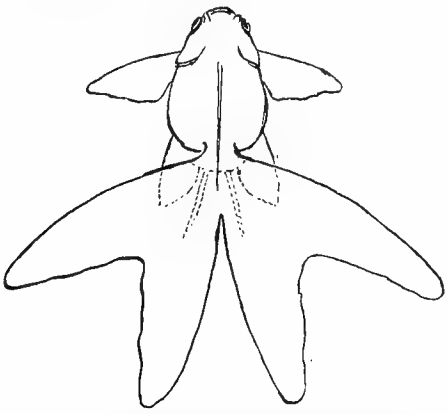


FIG. 39

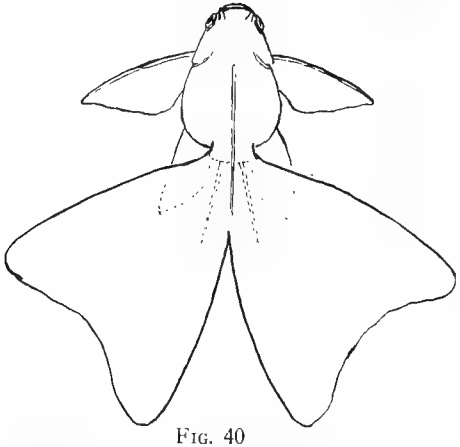


FIG. 40

The above two illustrations show the two types of tails. At the left the "Swallowtail," "Ribbontail" or "Cutouttail;" the right the "Veiltail" or "Broadtail." Both types are embraced under the old general classification of "Fringetails." All varieties of the fancy goldfish may be subdivided into these two classes for purposes of competition, but it is a step of doubtful wisdom, for in many cases it is impossible for the judges to decide even to their own satisfaction in which class a fish belongs, much less to the satisfaction of the contestants.

*Chapter Four*

# Breeding Goldfishes

The breeding of fancy goldfishes is one of the most fascinating of diversions. There are many difficulties to be encountered and even the oldest fanciers sometimes have new troubles to face. It should be said that, on the whole, the breeding of the goldfish is not difficult, and may be undertaken by beginners with reasonable prospects of success. It is the production and maintenance of the finer and more exacting requirements of the fancy varieties which present the real difficulties. Goldfish, possibly more than any other creatures, draw their characteristics from far-removed ancestors. Or again they may become a counterpart of either parent. This makes a considerable element of uncertainty, since the characteristics of their preceding stock have for the most part contained a great deal of variety, due, no doubt, to experimental crosses. This produces a most interesting and sometimes annoying variation in a lot of young goldfish. As the fish gets beyond the small fry stage the breeder becomes intensely absorbed in daily observation of points of form, color and size as they appear.

The percentage of fancy fish coming true to type is usually small. Ten per cent. of fish to pass the critical inspection of the fanciers' eye is not considered bad. Besides these, about fifty per cent. of the hatch will come true, but will be qualified by slight defects. The balance may be anything at all, single-tail and web-tail fish from double-tail parents being the principal disappointment. These percentages are averaged from general breeding, but are liable to wide variation. Sometimes there is no fish in a hatching to approach the quality of either parent; sometimes a large percentage is better than both parents. If a strain is carefully watched for several generations and no fish varying from the desired type is allowed to breed, the percentage of young coming true can be kept very high.

Considering the other great variations of points in fancy goldfishes, it is remarkable how well fixed we find the telescopic eyes. From well-developed telescopic stock there will probably be not over two per cent. of young which do not sooner or later show this peculiarity.

The beginner should get his first experience in breeding the more hardy varieties—the comet, for instance—but this stage passed he should select none but the best breeding fish out of known good stock. As previously stated, the best time to purchase new stock is in September and October, preference being given to the larger fish about seven months old. At this period the dealer-fancier is usually willing to sell off some of his larger old breeders. These are more showy than the young, but should not be selected.

## SEX IN GOLDFISHES

The chief indications of a male fish ("buck") in the breeding season—about January till August—are the small tubercles appearing on the gill plates, and sometimes on the first ray of the pectoral fins. These are a little smaller than pin-heads and the fish must be viewed at a certain angle in order to see them. (See illustration on page 30 and lower photograph on page 55), as well as colored frontispiece.

The female fish ("roe") is usually shorter and fuller of body, particularly when carrying spawn. The spawn as a rule is more on one side of the fish than the other, so that in looking directly down on the fish's back it may be found to be curved to one side. After spawning is over this deformity often remains. In a female which has spawned the vent is always a little protuberant. The eggs can often be seen through the translucent skin of females of the scaleless type.

Early in the year the young males will begin swimming after the females, following close to the vent. Without observing any of the foregoing rules the sex may often be told in this way. If this is observed before March, the sexes should be separated, as early spawns are not to be desired, unless one has very special facilities for securing a supply of live food. If the spawning can be delayed until May, results will be more satisfactory. The reasons for this are that the harmful long cold spells are less likely to occur and that living food can be obtained with more certainty. Spawning may be somewhat delayed by separating the sexes and by keeping the fish in cool water. With this object in view the females should be placed where they cannot rub against plants, as it induces an excitement at this time liable to promote spawning, even without males being present.

## BREEDING METHODS

As spawning time approaches the fish should be well fed on nourishing food. Finely chopped earthworms are excellent. Live daphnia are as good. Scrambled egg, alternating every other day with regular fish-food, is a fair substitute for live food at this time. When the breeders have been selected they should be placed together by themselves. If possible there should be three males to one female. This insures a higher percentage of fertilized eggs than if only one male is used. If the definite results of a certain cross are wanted, then use only one male. A second female not spawning should never be present, as she will devour the spawn.

Papier maché tubs are very nice for spawning in, but seasoned wood tubs or tanks will do. The aquarium may be used, or the spawning net shown on page 232.

Should there be no spawn after the fish have been together several days, remove about a quarter of the water daily and replace by fresh, slightly cooler water. This is very stimulating. Some intimation of an approaching spawning may be had by the fact that the males occasionally "drive" the ripe female for several days before the spawning takes place. This usually increases in intensity the evening before, and when spawning is in full swing it develops into a wild chase punctuated by short periods of rest. So vigorous is the swimming at this time that fishes with large fin development generally have their fins torn and frayed. Males with shorter caudal fins (tails) are the more rapid swimmers and their fins become less torn. As these are usually also the young, vigorous males, they are to be preferred for breeding purposes. Spawning usually starts at daybreak and lasts till mid-afternoon. It may be repeated every few weeks until the first of August, but the first spawn of the season is the largest.

Goldfishes deposit their eggs preferably on floating aquatic plants, and these should be freely provided (first making sure they contain no snails or other enemies to fish eggs). The best are water hyacinths (with as large roots as possible) and bunches of myriophyllum. The female will swim over the plants and drop the eggs. As they fall the male passes over and fertilizes them by the ejection of spermatic fluid. They are of a mucilaginous character and adhere where they touch. This egg adhesiveness is one of Nature's interesting little secrets. Man has never succeeded in making a substance that will "take hold" under water and yet not dissolve.

The eggs are about 1-16 of an inch in diameter and are at first of a pale amber hue, becoming still paler and more difficult to see

on the second and third days. The infertile eggs turn white on the second day and soon become the centre of a ball of fungus. Their comparative prominence soon convinces the beginner that most of the eggs are bad. He is pleasantly surprised, as a rule, to see what a large number hatch after all. The fish drops from ten to twenty eggs at a time, and after short intermissions repeats the operation. A complete spawning of a medium-sized female runs from five hundred to one thousand eggs. Large fish not infrequently spawn over three thousand. This refers to the first breeding of the season. As previously remarked, subsequent spawnings are considerably smaller. As the plants become covered with eggs they should be removed from time to time, allowing a few minutes for the last deposit to become fertilized. The eggs when dropped are slightly flattened. They have a tiny pore, and as the egg rounds itself like a rubber ball that has been squeezed, it sucks in water charged with the spermatic fluid, thus helping impregnate itself. The egg-covered plants should be removed to large enamel receptacles, containing clean water of the same temperature as breeding tank. Enamel is not absolutely necessary, but is desirable in the early stages, as it facilitates observation. If more convenient, the fish may be removed after spawning and allow the eggs to hatch where they have fallen. One of our leading breeders makes an egg-trap composed of a number of bunches of myriophyllum, secured together in a radiating circle, like the spokes of a wheel. About 10 bunches are used. The tinfoil is removed from each and tied again with thread. The same thread is carried half an inch to the next bunch, and so on until they are all arranged on a string, which is then knotted together in the form of a circle. The fishes spawn in this with their heads to the centre, and as the eggs are discharged in the direction of the rays of plants, the chances of the eggs finding a lodging place in them are very good. Such a circle need not be removed until well filled with eggs. Some females eat their own spawn, so removal of eggs is safer if hyacinths or small bunches of myriophyllum are used. No snails should be present, as they eat the eggs. However, after the eggs have hatched, the snails should be used to eat the infertile ones.

The development of the embryo under the microscope is plainly observable and is extremely interesting. The hatching time is from four to fourteen days, according to temperature. At a temperature ranging from 70 to 75 degrees Fahrenheit they should take from five to seven days. This is considered to produce stronger fish than a slow hatching. The hatching trays and young fish should be kept in a

light place, and, if possible, where they may be protected from temperatures below 60 or over 80 degrees. If stood in hot sun for several hours in a shallow tray, the eggs are liable to be "cooked," and therefore spoiled.

When the alevin or newly-hatched embryo bursts from the egg it is a very weak creature. It appears a mere thread with a pair of eyes at one end and small lump in the centre. This lump is the yolk sac and serves as subsistence for the first few days. At first the alevin can only swim by a few jerky motions, and has the power of sticking wherever it touches. At the age of one day they are to be found hanging on the plants and the sides of whatever receptacle they are in. In from two to three days they are swimming freely. When the yolk sac has been absorbed, which is in about three days, the babies will need some food which has been previously prepared. The first natural food is a large variety of microscopic animals known under the general heading of infusoria. These are present in all exposed water which has stood a few days, but in order to have sufficient for fish food it is necessary to have conditions favorable to their culture. This consists mainly of vegetable decay. Dried and powdered lettuce or duckweed leaves or pea flour, sprinkled thickly on the water, produce good results in a few days, kept in a warm place and a subdued light. Also a quantity of hay over which boiling water is poured will soon produce the creatures. A low-power microscope or cheap magnifying glass should be employed in this work. (See page 236.) After the culture is apparent and the fish are swimming freely, occasional dips of culture water should be put in with the young fry. Sometimes the infusorians can be found freely in standing pools, particularly where the water is not very clean, and where there are no cyclops or other carnivorous crustaceans. One species, *Brachionus rubens*, sometimes occurs so thickly that the surface of the water appears to be covered by a thin, rusty scum. When such a scum is observed in a stagnant pool some of it should be placed in a small bottle and observed with a low-power magnifying glass. If there is the appearance of dust-like particles moving continuously about, it is very likely they are rotifers. A thimbleful of this yellowish skimming contains more rotifers than several gallons of ordinary stagnant water, and the breeder who can locate this kind of live food when his fish are from one to three weeks old is in good luck. Very small live food tends to keep the young fishes more nearly a uniform size. If daphnia are fed at first, it is only the more robust individuals that can eat them, and the result is a rapidly increasing disproportion in size that soon ends in cannibalism unless the young giants are promptly placed by themselves. Small

pools about a cattle yard are particularly favorable to infusoria and rotifera, but, of course, if the water is very dark it should be used sparingly. This sort of food should be used for about ten days to two weeks. Illustrations Nos. 93 to 96 show types of this living food, but one does not need to be very particular as to the exact form. In general, anything alive that is too small to be well seen by the naked eye, but which is visible under an ordinary magnifying glass, will answer the purpose. Collection can be made with nets of fine bolting cloth. If green water can be had, some of it should be put in with the young fish. It contains vegetable matter of value to very small fry. After the fry have noticeably increased in size they should be fed young daphnia which have been screened through a fine wire tea strainer. As size increases, feed full-size daphnia. (See page 134.)

In instances where it is not possible to secure living food for raising young fish they may be started on rice flour, yellow of egg forced through bolting cloth or fishfood reduced to a powder and sifted through cheese-cloth. As they increase in size an excellent diet is the paste from boiled oatmeal after straining through muslin or cheese-cloth. Powdered shrimp or codfish as described on page 129 can be added to the oatmeal to advantage. This oatmeal diet had best be fed in a miniature fish globe, bowl or deep saucer submerged in the tank. Scrambled egg with a little Cream of Wheat or Cream of Barley cooked in it makes one of the best substitutes for live food, to be used after the babies are six weeks old.

Whether fed on living or prepared food, young goldfish should be fed very liberally. They will eat more than their own bulk in a day. This is essential to securing large, strong fish of good constitution. They eat almost constantly. It is better to feed several times daily than to put in a whole day's supply at one time. With prepared food it is liable to foul the water with long standing and too many daphnia introduced at one time exhaust the oxygen in the water. This lack of oxygen retards growth and may produce suffocation.

**Forcing Growth.** Contrary to previous theories, numbers of our leading breeders now use a drip of water in the tanks with young fish over one month old. In many cases this plan seems to produce remarkable growth. The use of an ordinary overflow in this connection is inadvisable, particularly if outdoors, as a heavy downpour of rain is liable to carry off the small fish. If the tank used has an overflow pipe, a large wire guard covered with cheesecloth will answer the purpose, but the cloth should be renewed occasionally, as the water rots the fabric. If fish are in a tub, a good drain can be made by placing a two-inch strip of stiff felt around the top. Secure the felt

in position by securely wrapping a cord around it as close to top of tub as possible, allowing the felt to stand about one inch above sides of tub. This will not only secure the young fish, but will prevent the loss of any daphnia by overflow.

Best results are had in raising fish outdoors, but one invites catastrophe by placing them out in the first warm spell of spring unless it is possible to again bring them indoors promptly on the arrival of the cold spells sure to occur in most climates.

No matter how fishes are fed, there will be a tremendous difference in their growth, and it will be desirable to sort them into sizes several times in a season. The really practical thing to do is to pick out the "growers" which have good points (there will be few enough with this combination), and a few of the most promising of the second size. Dispose of all the rest by sale or gift. They will make someone happy. If possible, plant them in a protected pond. They may do wonders if not caught by bird, frog, rat, snake or boy.

This wholesale culling should not be done later than midsummer, so that the choice specimens will have the full benefit of the extra space and food. Even many expert fanciers fail to get the best results on account of trying to raise too many young in a given space. At the age of six weeks they should have at least one gallon per fish, three gallons at nine weeks and six gallons at twelve weeks and over. This rule is for fishes which are growing.

Small fry should be dipped out with a spoon and never poured. Rough handling kills them almost instantly.

Goldfish at any age should be at least partially protected from the direct glare of the sun, so that they may at will go into the sun or shade. This is particularly true of young blue Calicos, whose delicate tints are apt to bleach in excessive direct sunlight. A few sticks to form a rough lattice over the tray or tub will do very well. In case of rain the sticks, unless already weather-beaten, should be removed, as water from new wood is injurious. If the fish are in a position where they get only about two hours of morning sun, no protection from light need be considered. Goldfish do not prosper in excessive heat, and temperatures above 85 degrees, even temporarily, are to be avoided if possible. Fish under eight weeks old can stand more heat than when older.

**In-breeding.** A certain amount of in-breeding is necessary in order to preserve the best points of a strain of stock—say a cross as close as first cousins. Closer than this weakens the vitality of the stock. When we have two breeders of good ancestry, but of no blood relationship, we are likely to get strong fish, but with poor points.

NOTE: On the following eight pages the principal points in the story of Goldfish Breeding are re-told in picture.

FIG. 41. A RIPE FEMALE

The body does not appear so full as this in all cases. One must be somewhat familiar with the natural shape of the fish in question in order to judge its condition. If the scales stand out it is a case of dropsy.

FIG. 42. A RIPE MALE

Indicated by the small dots on the gill plate

FIG. 43. TELESCOPE GOLDFISHES SPAWNING

This unusual photograph shows two females spawning on a ring of Myriophyllum. The smaller fishes are the males, in vigorous pursuit. Males do not average of smaller size than the females, but the younger ones are the more active and fertilize a higher percentage of eggs than when older.

FIG. 44. GOLDFISH EGGS *(Slightly magnified)*

Being of a pale amber color, goldfish eggs are very difficult to photograph as they actually appear. The one beneath the arrow gives a more correct idea than any of the others, but the general distribution of the eggs on hyacinth roots is shown in a characteristic manner.

FIG. 45. GOLDFISH EGGS, THREE DAYS OLD *(Magnified two diameters)*

Three infertile ones have been attacked by fungus. The nineteen good ones are really more difficult to see at this stage than the illustration would indicate. The fungus does no harm to the fertile eggs.

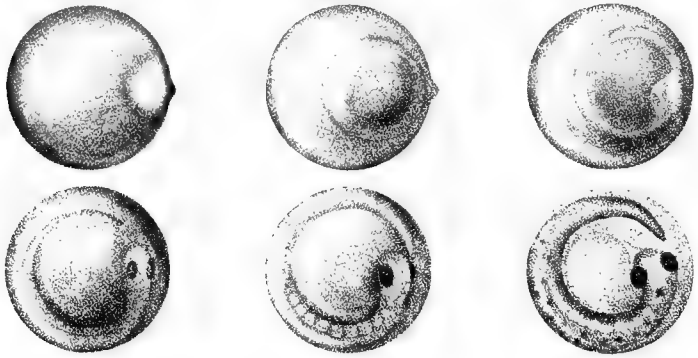


FIG. 46. DEVELOPMENT OF GOLDFISH EGGS

Greatly enlarged drawings made at intervals of thirty-six hours, in an average temperature of sixty-five degrees. First figure made at age of one day.

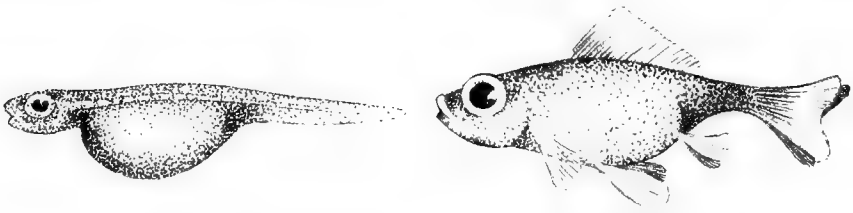


FIG. 47. NEWLY HATCHED GOLDFISH FRY
*(Same as shown in Fig. 48)*

THREE DAYS OLD, WITH FINS FORMED
*(Same Enlargement as Eggs)*

FIG. 48. NEWLY HATCHED GOLDFISHES
*(Life size)*

They are clinging in characteristic fashion to the side of the aquarium. They move about frequently and swim with effort, the air bladder not having yet filled.

FIG. 49. GOLDFISH AT EIGHTEEN DAYS
*(Reduced one-third)*

The abdominal yolk-sacks have been absorbed, but the stomachs protrude in a way to show that plenty of small living food has been provided.

FIG. 50. GOLDFISH AT SIX WEEKS
*(Reduced one-third)*

At this period they have come to look like fishes. From this point until late fall they eat at least their own bulk daily, and the bodies in fancy stock will continue to deepen.

FIG. 51. TELESCOPE GOLDFISH AT TWELVE WEEKS
*(Reduced one-third)*

They have now attained their body form and started to develop telescope eyes. In the scaleless varieties the colors have largely appeared, but among scaled stock the young at this period remain "uncolored." By this time the breeder has usually selected the best specimens to hold for the following year. These should be placed by themselves in ample room. When the supply of live food is limited, they are the ones which are favored.

*Chapter Five*

# Wholesale Breeding

With the rapidly growing demand for aquarium fishes there is no reason why, with the proper facilities, one should not make a comfortable living from the breeding of goldfishes and other fancy kinds. Good water, plenty of room, moderate taxes, ample shipping facilities and thorough experience in fish culture are all prime requisites. Climatic conditions must be carefully considered. The weather should be settled by May 15 and continue moderately warm until early October. Localities where the nights are cold or the days excessively hot are not suitable. States in the same temperature belt as Maryland and Virginia are particularly advantageous, although it is by no means to be said that success cannot be had elsewhere. Farmers in many localities are turning otherwise unprofitable land both into goldfish and foodfish ponds. In the latter branch several of the State Fish Hatcheries are giving encouragement and practical help.

It is not necessary to have an expensive establishment in order to succeed, but certain natural advantages, besides those already mentioned, are of importance. If one has a good spring, clay-bottom soil and ground that lends itself readily to a series of pools that will drain from one to another, a start can be made with reasonable chances of success. Figure number 52 will give a good general idea of an inexpensive layout. The water runs from springhouse to a tempering pond, where the water becomes more heated by the air and sun. It also absorbs oxygen, for in this element spring water is apt to be lacking. Where no tempering pool is used it is advisable to arrange small waterfalls if there is sufficient drop. Even two or three inches is better than none. From the tempering pond the water is run through a series of sluices into the rearing ponds. As the fishes develop, some will grow much more rapidly than others. In order to prevent these from devouring their smaller fellows, they must constantly be sorted out, particularly in the first several weeks. These larger ones can be placed to advantage in the two long pools shown in illustration, using

one side for choice grades with good fin development, color, etc., and the other for single-tails or fish with blemishes.

As a final use for the water it can be placed to advantage as shown in a large pond for the propagation of daphnia or other live food. The fish pools should be drained in the winter in order to expose the bottoms to the action of frost, thereby killing lurking insect enemies. We have shown an outlet on the daphnia pond, but ordinarily this is not to be emptied. By draining it the stock of live food would not be entirely lost, but many daphnia eggs would be carried away, and con-

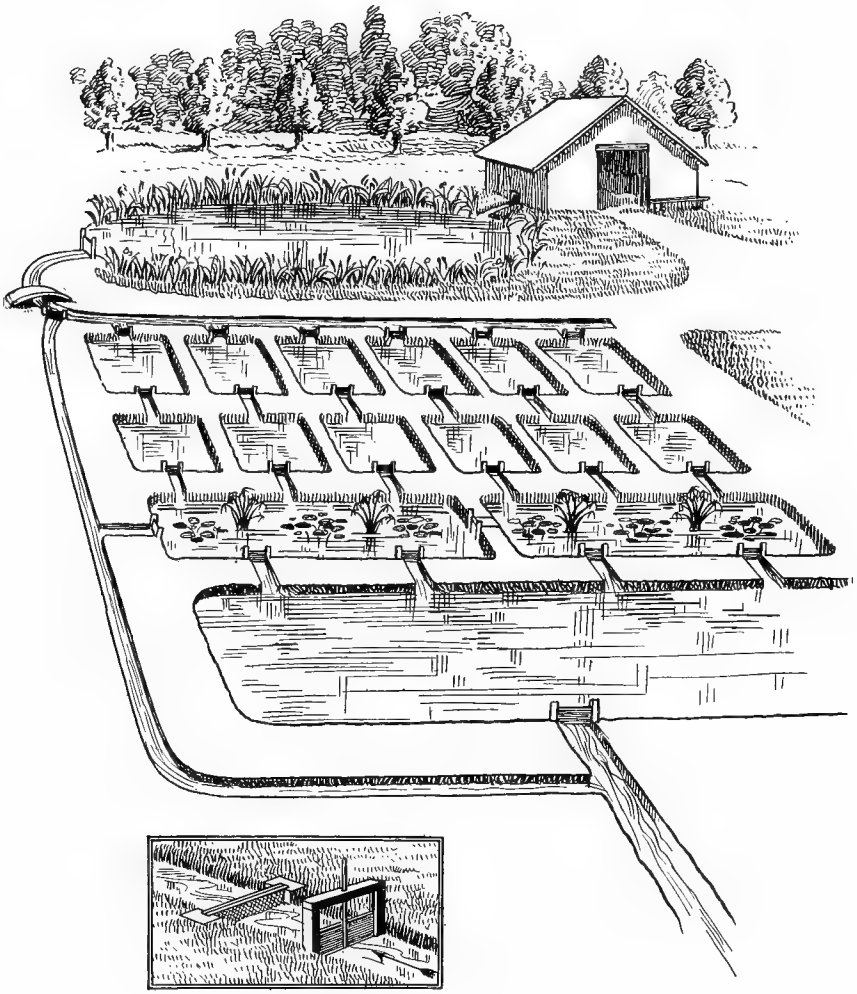


FIG. 52. FARM BREEDING PONDS, SHOWING DETAIL OF SLUICE AND GUARD

sequently it would take longer in the spring to develop a stock large enough for practical use. If possible, it is a good plan to have two or more daphnia ponds, so that one may be replenished while the other is being drawn from. The bottom of daphnia pools should be prepared with a substantial layer of dead leaves and manure of any kind. Later in the season, when this has all disintegrated, a new supply should be occasionally added. Any decomposing vegetal or animal substances will do. If a prowling cat has met accidental death by shooting, its carcass placed in the daphnia pond will give quite an impetus to the production of live fish food. For æsthetic reasons it would be well to weight the carcass down with stones.

The plan of this system of pools does not call for running water, but only to admit it as needed. It will be seen that an overflow is provided to carry off the surplus from the tempering pond, this finally discharging into the natural brook from the spring, or into any other place capable of carrying it off.

By this plan of having one pool drain into another, instead of discharging into a general overflow, we have an added chance of saving fishes in case of an overflow or accident to the sluices.

Unless a spring is known to be thoroughly dependable at all times, the possibility of securing water from other sources should be considered in the beginning, particularly as most establishments of the kind now being described are constructed only on clay bottoms, where a certain amount of water is sure to be lost through seepage.

If the soil has no natural clay bottom, the hole should be dug 6 inches lower than the intended depth of pool, say 20 inches in all. Now mix pure clay with water in a mixing box and plaster on bottom and sides to a depth of 6 inches. To secure the sides in this manner they will have to slope gradually. It is better to make the sides of cypress boards and puddle the clay in back of them. These had best be sloped at a slight angle, about 2 inches to a 14-inch board. Even when soil is mostly of clay, there is often serious loss of water near the top on account of the more porous earth. A layer of sand on top of the clay will keep the mud from rising.

One very important consideration in all outdoor ponds or pools is the possibility of serious loss through freshets. Not only does the pool itself have a tendency to overflow in a protracted downpour, but drainage from higher portions of ground is liable to sweep over low ponds. The latter danger can be overcome by having ample trenches dug on the sides exposed to such risk, and seeing that they in turn drain off where the water will do no harm. In regard to direct overflow, it is a good plan to have screened emergency outlets in each pool

at a point a little higher than the regular outlet, which is, of course, also screened according to the sizes of fishes contained. Another point is to have a safety factor by not filling to within 3 inches of the top. That is to say the regular drain should be placed at that level. The importance of the danger of flood in a system of this kind cannot be emphasized too strongly, and unless the point is carefully provided for in the beginning, trouble is bound to ensue, and *serious* trouble.

An advantage of the tempering pool is that fishes can be kept in it over winter. Fishes bring better prices in the latter part of the winter, and one of the serious problems of the wholesaler is how he shall carry a large stock where it will be kept in good condition and will be available. If the spring has a good flow, the tempering pool can be kept comparatively free of ice and fish can be caught as wanted all winter.

With the use of ground-level ponds the snake, frog, rat and hawk have good chances of enjoying the luxury of feeding upon goldfishes, unless the vigilant breeder adopts effective means of keeping these pests under control.

As stated in the former chapter, it is advisable to provide shade for the fishes. Aquatic plants, particularly water-lilies, are to be recommended. Plant life in a clay-bottom pool should be strictly limited to a few species, as some plants once obtaining a foothold can only be eradicated with the greatest difficulty. The plants to be used are Giant Anacharis, Myriophyllum, Cabomba, Ludwigia and Water Cress. All of these are desirable and furthermore find ready sale. Cyperus, such as shown in illustration, may be kept in pots.

**Specially Equipped Breeding Establishment.** A more elaborate and considerably more expensive establishment is shown in figure 53, consisting of greenhouse, indoor and outdoor concrete pools and all accessories going to make up a modern commercial fish-breeding plant. The tanks are 26 inches deep on the outside surface and are not sunk into the ground. This avoids the expense of so much excavating and makes a height which ordinarily cannot be scaled by rats, snakes or frogs. Tanks had best be covered by frames of screening, but these will sometimes be warped or placed on carelessly, thereby giving these particular enemies an opportunity. Let us repeat that galvanized screening should be scrubbed with a stiff brush and water before placing over any kind of fish container. The acid-flux used in making galvanized wire is extremely fatal to fishes, and unless precaution is taken, the first rain on new screening will wash the free acid among the fishes and cause wholesale deaths. Uniform size of compartments

has several advantages, among which is interchangeability of screens or covers. Allowing 6 inches for the thickness of bottom will leave an inside depth of 20 inches, but under ordinary circumstances they should not be filled beyond 14 to 15 inches. With the outside tanks this gives a safety margin of several inches before a heavy downpour of rain causes the level to rise to the screened safety overflows one inch from the top. It also catches practically all of the rainwater of the season, which is excellent for the fishes. If the water becomes

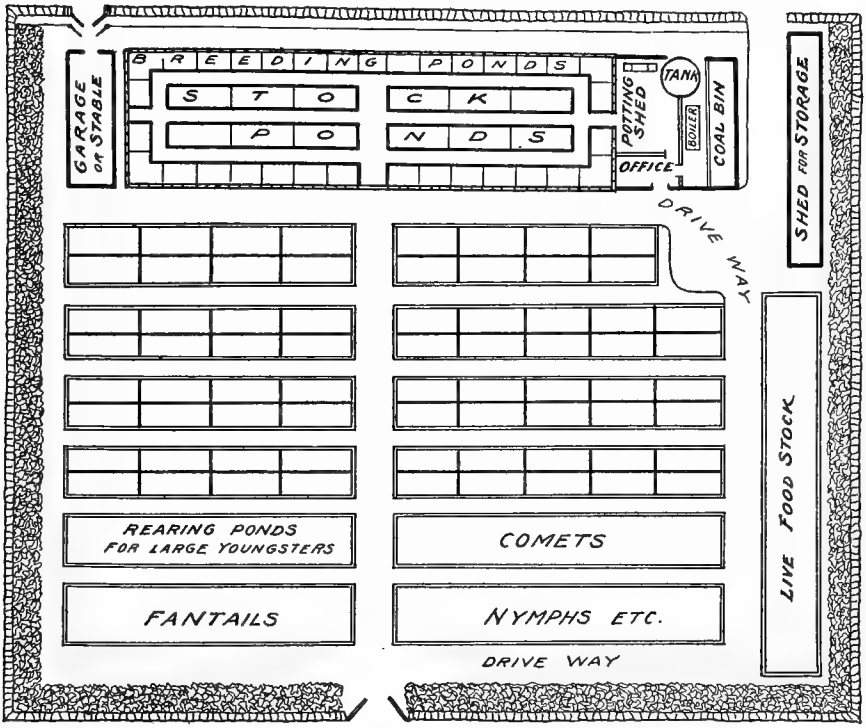



FIG. 53. WHOLESALE BREEDING ESTABLISHMENT, SHOWING GREENHOUSE AND OUTDOOR CONCRETE TANKS

nigh, it can be siphoned off from the bottom until original level is reached. The advantage of being able to fill up, if necessary, to 19 or 20 inches in an inside tank is that at certain seasons the greenhouse capacity for fishes is taxed to the fullest. At such times the extra volume of water for the storage of fish stock will be keenly appreciated. An economy of space can be effected by building wooden tanks to stand over the section marked "Breeding Ponds" in figure 53, thus making two rows here instead of one. The wooden tanks should be somewhat narrower than the lower concrete pools.

Goldfishes are hatched in the greenhouse from February until May. The young, as stated in the previous chapter, should not be placed out until the weather is settled, but there is a magic about outdoors which puts growth and vitality into the fish which the cunningest devices of temperature, plants. food, aeration, etc., cannot successfully imitate in the greenhouse. There has been much speculation as to why fishes do not do as well as might be expected in greenhouses. The author suggests that the water is too dead, owing to lack of evaporation, the atmosphere being already charged with dampness. Evaporation produces cold. The cold, oxygenated water drops to the bottom, thereby setting up a beneficial circulation of re-vitalized water. Also there is more microscopic life falls on the water outside than indoors. A partial renewal of water in indoor tanks is undoubtedly beneficial and is one means of at least partially securing that freshness of water which we have outdoors. Those handling fishes in wholesale quantities in greenhouse or other large indoor pools usually maintain a small spray of running water. This should in no sense be of sufficient quantity to be regarded as running water, but merely enough to add a trifle of freshness and oxygen. Stock accustomed to actual running water is liable to suffocate when placed in an ordinary aquarium. Retail dealers are not always conscientious in this matter. In order to carry a large stock in a small space they have to resort to a liberal use of running water. They dip fishes directly out of such tanks to sell for use in household aquaria, knowing full well that the chances of survival are poor. It is by no means impossible, or even difficult, to accustom such stock to still water, but the change should be brought about slowly. Frequent partial changes of water at first, gradually increasing the length of time between them, will accomplish the result.

Some years ago Mr. Wm. P. Seal devised a fish-breeding house of a somewhat different character from the ordinary greenhouse, and the idea has been generally accepted as correct in principle. The structure is long and narrow, with solid roof. The lighting is from window sashes in the sides, these being swung or pivoted so as to admit the air in summer. The objections to the ordinary type of greenhouses are, first, too much light for fishes and plants, producing an excessive growth of algæ (including green water); second, high cost of heating in cold weather and too much heat in the warm season; third, attendant risks due to glass breaking from various accidents, including, in some sections, large summer hailstones. Where an all-glass greenhouse is used, the light is cut down in summer by painting

glass with a mixture of white lead and gasoline. The principal one is to coat glass on the outside with a mixture of white lead and gasoline.

The chief objection to the long-narrow type house with opaque roof is that it is not compact and multiplies walking steps. A successful modification in nearly square form has been worked out, in which enough light is secured in the centre of the building by a series of skylights in the roof, comprising about one-quarter of the roof area.

When the windows or sashes are open they should be fitted with inside screens of ¼-inch mesh to keep out insect enemies, but admit gnats and other forms of insects, which, together with their larvæ, form an important item of fishfood.

The most satisfactory form of heating is with the hot-water system, this being much more flexible than steam, and cheaper to operate. Modern invention has produced automatic heat-control devices which can be installed at moderate cost. These are extremely valuable in guarding against the dangers of sudden cold spells at night, particularly where tropical fishes are kept or when young goldfishes have been hatched in the late winter or early spring months. Oil stoves are not to be recommended and should only be used in emergencies. The carbonic product of combustion while small in quantity is, nevertheless, injurious. Water absorbs most gases very freely.

The cement floors of fish houses should be provided with gutters next to the tanks, these all draining to a single point so that the floors can easily be flushed.

A description of methods of building concrete ponds and tanks will be found on page 219.

## WINTERING GOLDFISHES

As the thermometer drops towards 50 it is time planning to bring the fishes indoors. By leaving them out till really cold weather sets in they are at first stimulated by the indoor heat and then become droopy. A little freshening of the water from time to time is advisable until they become used to indoor life.

If one has insufficient aquarium or indoor pool space to keep the stock of fine fishes over winter, tubs will be found good, especially those of papier maché, or of old wood.

Fishes do well over winter in tubs in cellars at a temperature between 50 and 60 degrees. The dim light from a window is sufficient. Allow plenty of air surface per fish and use no plants. The water may be quite shallow—about 4 to 6 inches. Occasional partial changes of water will prove beneficial, particularly in concrete tanks.

Winter is the natural resting period of goldfishes and at this time they do not require much warmth nor food. Their food at this time, however, should receive careful attention. They need a certain amount of fresh animal food, and as the usual form (daphnia and earthworms) cannot generally be had in winter, substitutes are of value. This is taken up in chapter on Fishfoods, page 130.

Transparently-scaled white or nearly white fishes need more warmth than the others, as cold causes swimming bladder trouble in these more sensitive fishes, and once they sink to the bottom they are a misery to themselves and their owner.

In outdoor ponds which do not freeze to the bottom, where there are plenty of dead leaves and soft dirt, the hardier varieties of goldfishes will survive the winter. The ice should be broken to admit air. This air space also tends to prevent deeper freezing. If a few warm spells occur it will do no harm to feed the fishes very lightly when the ice entirely melts. This should not be done oftener than once a week.

## COMMERCIAL BREEDING OF TROPICALS

We would draw attention to the detailed descriptions of breeding habits described on pages 244 to 261 which will give a practical working basis for anyone wishing to enter this attractive field commercially. There are, however, a few generalizations which ought to be of value here. In Nature the fishes manage to reproduce themselves without the help of man. The three principal reasons are because they have water of the proper temperature, food of the right character and plenty of opportunity for the young to hide. All of the conditions can be produced artificially. The European breeders use tubs, introduce a thick growth of plants, place in one or more pairs of breeders as occasion demands, feed plenty of daphnia, mosquito larvæ, etc., and disturb the fishes as little as possible. In the absence of greenhouses the tubs are sunk in the ground, covered with wire netting in warm weather and with glass on cool nights or days. Quite large tanks are sometimes used, placing different species with the same breeding habits together, not attempting to sort out the various young until fall. In the livebearing groups there is no likelihood of hybridization if males and females of the same species are both present. Some fishes do not like plants and will tear them out (cichlide group, for instance), but as a rule the young very early appreciate their value and quickly hide among them. They also hunt sloping, shallow edges where the large fishes cannot follow, particularly if Salvinia or other small floating plants are along the edge.

A continuous warm temperature is imperative for some species and for these it is not worth while attempting to breed outdoors in a temperate climate.

In selecting a stock to breed from for commercial purposes it is inadvisable to choose the species which have already become common, even though they are easy to breed. It is much better to pay more for something out of the ordinary if there seems to be a reasonable chance of breeding it. The "fashions" change so rapidly in tropical fishes that we could not attempt here to advise what to breed, as our book would be likely to look old by the time it is off press.

**Sex in Tropical Fishes.** With live-bearing or viviparous fishes the sexes are easily told by the anal fin of the male having developed into a sexual organ. Even before this development has taken place it will be found that the anal fin at an early age is slightly more pointed in the young males. In the adult females there is a dark spot in the body, just above the vent, caused by the presence of young not yet delivered.

The means of identifying the sexes in the egg-dropping tropicals are not so obvious and must be confined to generalities. The comparative fullness of the female prior to spawning, the pursuit of the females by the males, the brighter coloring of the males are all points which we look for. With many fishes the fins of the males are a little longer and more pointed than in the female.

There are many wild fishes from both tropical and temperate climates whose sex is impossible to determine from external observation. Even in studying the matter by dissection the microscope must sometimes be brought into play when the fishes are out of breeding season.

*Chapter Six*

# Tropical Aquaria

**General Conditions.** Where one has limited space and wishes for a variety of fishes, it will be found that many of the tropical varieties now available will do admirably. Most of them stand close quarters, thriving in aquaria which are nothing more than quart jars. Some of the fishes are of such belligerent disposition that they must be kept alone, and in these cases it is well that they will stand cramped quarters. Larger aquaria with divisions for separating the different species are a convenience, especially if artificial heating has to be resorted to.

The question of space, however, is not the chief point in favor of tropical fishes. It is the endless variety of habit, structure and coloring, opening, as it continually does, new avenues for personal study and observation. Some idea of the variation in breeding habits alone is contained on pages 253 to 260.

**Water.** Many tropical fishes are very sensitive to the bad effects of new water, even though it be of the proper temperature. It is well to keep some of the old water to mix with the new when the aquarium must be cleaned.

**Feeding.** The majority of tropical fishes are not heavy feeders like goldfishes and there is not great danger of overeating. Care should, of course, be taken to leave no unconsumed food in the water. When they are warm and comfortable they may be fed twice daily, although this is not essential.

**Heating.** The majority of tropical species thrive in temperatures ranging from 65° to 80° F. Nearly all will do well at 70°. For short periods they will stand temperatures below that at which they will thrive, and it is very probable that after a few generations in our climate they become accustomed to cooler water. When fishes are new and rare it is emphatically a mistake to experiment on seeing how low a temperature they will stand. That should be left for a later period after breeding has been accomplished and a stock secured. *Tight-fitting glass covers should be provided for all tropical aquaria.* This helps keep the temperature up

and prevents the fish from leaping out, at which many of them are extremely expert. Failure to replace covers has caused the loss of many prized fishes. They will not suffocate if glass is down close.

If one is not blessed with a heated greenhouse or a room of warm, even temperature, artificial heating becomes necessary. There are several devices which accomplish this purpose, but only a few are satisfactory.

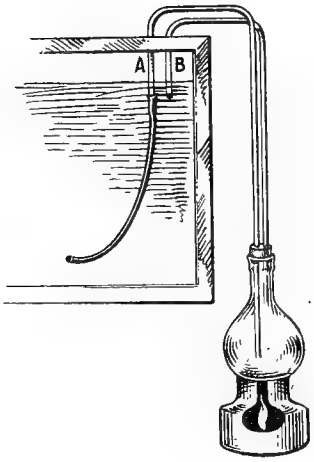



FIG. 54

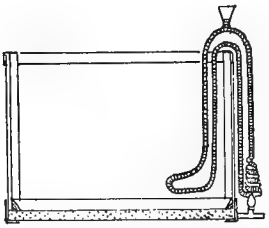


FIG. 55

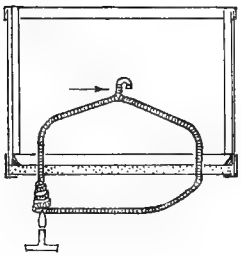


FIG. 56

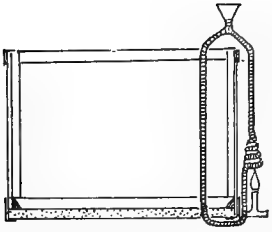


FIG. 57

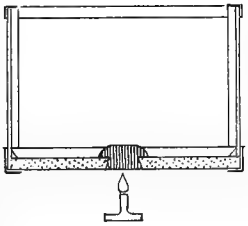


FIG. 58

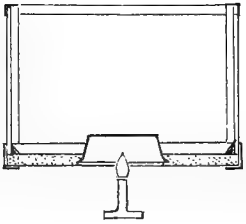


FIG. 59

TYPES OF HEATING METHODS

In general those are to be avoided which concentrate the heat on a small portion of the aquarium water. This action drives out oxygen and other life-giving qualities and also produces uneven temperature for the fish to

pass through. Such an arrangement is shown in Fig 54. Aquarium water is directly heated in the small outside reservoir and circulated back again. With this device the water intake may easily become clogged, which soon causes the water to boil. This heating method is frequently used, but it is bad in theory and in practice. A better arrangement is shown in Figs. 55 and 57, which is a complete hot water system not using the aquarium water. The tubing is of copper, ¼-inch inside diameter, and of thin walls. Before bending any such work to shape it should be packed quite hard with dry sand and the ends corked up. This prevents buckling at the sharp curves. At the very top of the loop rising from the heating coil should be bored a ¼-inch hole and a small funnel soldered around this. All hot water systems create some vapor. If this were allowed to collect in the pipe there could be no circulation and boiling would soon take place. The two open ends need not be soldered together. They can be satisfactorily joined by rubber tubing, but this should be arranged to occur in the rising side of pipe in the water. In Fig. 55 the arrangement can be hooked over the edge of any aquarium and has the advantage that the aquarium does not have to be elevated to heat from underneath. The first filling of the system is not always easy. Water is poured in the funnel until it will take no more. Then the hand is placed over the funnel and the pipe turned upside down. Turn upright again and put in more water. Hold at different angles. When it will take no more water, try heat under the coil. If the water in funnel moves up and down there is still air in the tube. Sometimes it can be removed by actively filling and discharging a fountain pen filler in the opening. When the water remains still in funnel when heated, it is all right to use. The funnel must always contain water, or boiling will soon occur. If a filled bottle with small neck is inverted, stood in funnel and secured in some manner, it will last a long time without refilling. The copper tubing should be heavily nickeled after bending into shape, as copper is fatal in the aquarium.

Fig. 56 shows a modification of the same idea with the pipe carried through aquarium base. The little hollow hook at top of the hot water system was devised by the writer to avoid the necessity of filling the funnel, and to have the heater more concealed. The tubes within the water are of glass, connected by rubber, the end hook also being a separate piece. By removing hook the system is easily filled. When it is on, the vapor collects in top of curve, and when enough has collected to force a bubble out, a drop of water is automatically sucked back to take its place. The air space in hook also prevents any circulation between hot water

system and aquarium water proper. This system also gives a higher percentage of heating efficiency than the outside form.

For the highest efficiency and greatest all-round satisfaction, note should be taken of Fig. No. 59. This is a 4-inch agate pan set in the cement base described on page 216. When making the aquarium it is little extra labor to set this in. For aquaria already constructed it is somewhat of an undertaking to cut a sufficiently large hole, but it can be done and the pan cemented on top. Fig. 58 shows a simple and fairly effective expedient. After hole is cut in slate, pour in lead or tin. When the metal is poured, use a form made of putty so that the surface of metal will come as high as the sand. The object in using the inverted pan is to have the heating surface come just above the sand. Then the heat is the most efficient as well as fairly diffused and does not interfere with the roots of plants. The objections to this type are that the aquarium has to be raised and that there is an occasional drip of condensed water caused by combustion. The best flame to use is a small gas Bunsen burner. They may be had of some scientific apparatus concerns or dealers in German aquarium supplies. These dealers also handle a rather good all-glass aquarium for heating by lamp, and which does not need to be raised. There is, however, the eternal liability of cracking. All-glass aquaria at best are liable to crack, and particularly when unevenly heated. In the German catalogs and aquarium publications will be found numberless heating devices, but after trying many of them and conducting numerous experiments himself, the author finds those described here the most practical. Smells are caused by chilling the flame before combustion is complete. No more than the tip of flame should be allowed to touch the heating surface. Even this is not necessary in system shown in Fig. 59.

**Heat Control.** In a room where there are wide changes of temperature, particularly when these dip to the cold side, it is desirable to have some means of heat control. To start in the simplest way first, an aquarium may be kept noticeably warmer over night by covering with a thick blanket, quilt or any warm fabric. If near a window the curtain should be pulled completely down. Another help for any aquarium near a window is to have a sheet of glass standing nearly vertical on the base and leaning against the top of the aquarium. This sheds much of the cold air which constantly falls from a window in cold weather.

Tropical aquaria, if not too small, may be kept at a satisfactory temperature standing on a board on the radiator of a hot-water system, the heating result not being so extreme as might be expected.

The most satisfactory means of controlling temperature is to heat by gas and use a thermostat to control gas flow. See Fig. 60. This is placed either in the water or tightly against the outside of the aquarium

and insulated from the influence of surrounding air by plenty of wool or cotton batting. It contains a large body of mercury over which the gas passes through a small space. As the water rises in temperature, the mercury expands and so reduces this passageway, and *vice versa*. It is a very ingenious and effective device and may be obtained from makers of scientific glassware at small cost. Those selling them are glad to give complete instructions regarding regulation, etc. With this equipment in operation one never need worry about aquarium temperature as long as the wind cannot blow out the small pilot light. The thermostat is not in itself a heater, but merely controls the source of heat so as to keep a nearly uniform temperature.

Electric light bulbs in the water are good heating units. Submarine sockets are made for immersing the whole light, or the ordinary socket may be used by immersing only about two-thirds of the bulb.

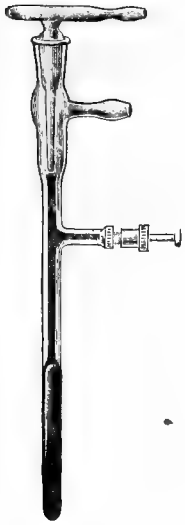


FIG. 60.
GAS THERMOSTAT

**Shipping Tropical Fishes.** It is bad policy taking the risk of shipping tropical fishes when the weather is not settled and warm. They may keep warm during the train travel, only to receive a fatal chilling in delivery. To guard against this some shippers have designed special boxes equipped with an extra outside shell, the intervening space being filled with an insulating substance, ground cork being excellent for this purpose. A simple expedient consists of a tin can (with a tight lid) or glass jar set in a wooden box, then completely covered with ground cork, excelsior, papers or other substance, and the lid nailed down. The top of the box should be boldly marked, stating contents. A handle on the top will help keep the top side up.

The best method of transporting tropicals, where it does not interfere with interstate laws, is to get in touch with a Pullman porter and have him carry them through, packed in a grip. Ventilation is unnecessary.

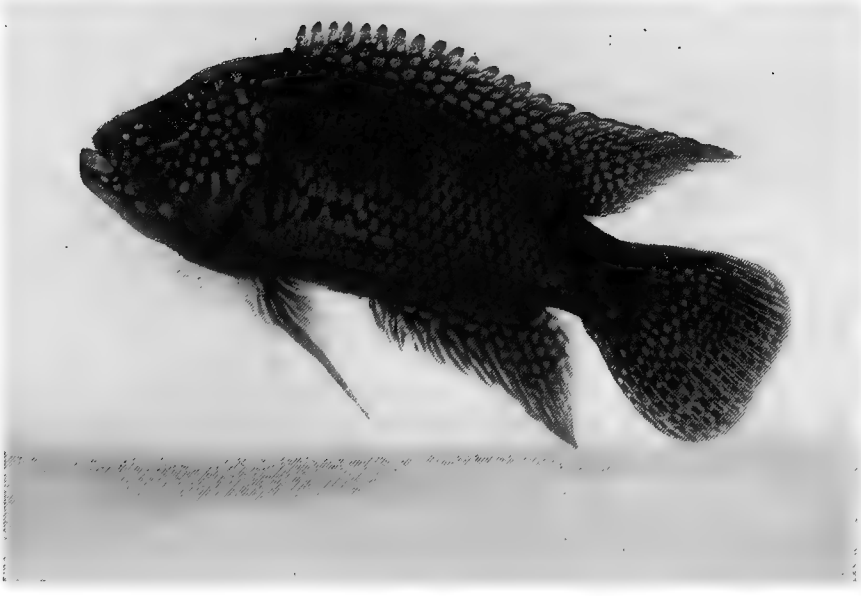


*Fig. 61. Cichlasoma nigrafasciatum*

A fish which varies greatly in color, according to temperature, excitement or state of health. At times the brilliant metallic spots disappear, the background color lightens and dark bars appear much the same as the normal markings of the Chanchito. When the fish is upwards of five years old the brilliant coloring becomes more permanent. This plate is made in slightly reduced size from a three-year-old specimen. Breeding habits on page 254.

*Fig. 62. Pterophyllum scalare (Life size)*

An aristocrat of the aquarium, moving with the greatest of dignity, yet capable of dashing about at lightning speed. It is difficult to breed, and importation from the Amazon River is usually unsuccessful. Owing to these facts and its wonderful style as an aquarium fish, it is likely to remain in the very select class for a long time. Breeding habits, page 259.

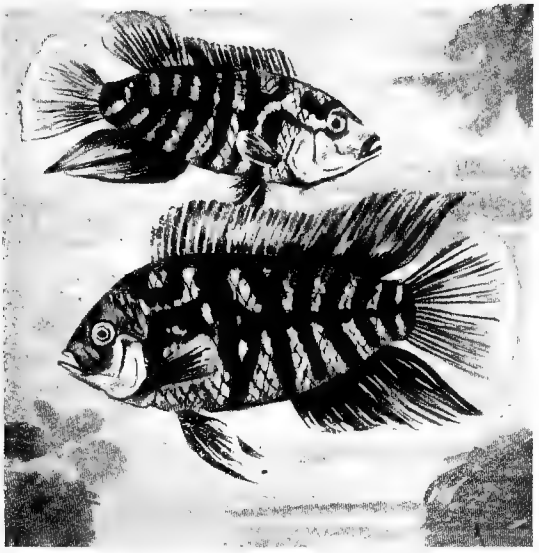


*Fig. 63.* The Chanchito *(Heros facetus)*

One of the most satisfactory of the Cichlid group of fishes. They will survive in moderately cool water and are not so savage as other members of the group. The breeding habits and family life of a mated pair are most interesting to watch. The upper figure shows the more rounded dorsal fin of the female, although it is not always so pronounced as shown here. See pages 254 (B 5) and 261 (N 6).

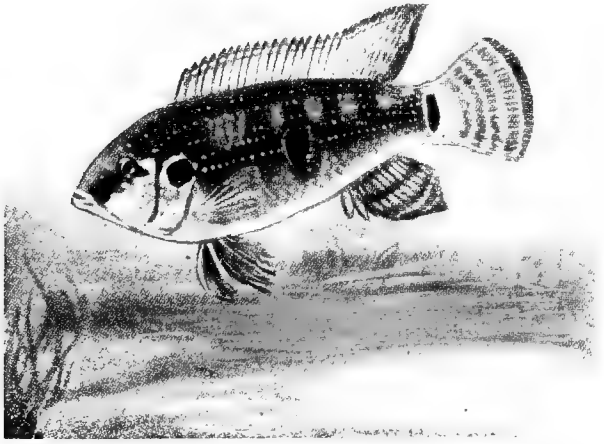


*Fig. 64. Hemichromis bimaculata*
*(Three-fourths size)*

Of the savage Cichlids, *Hemichromis bimaculata* is the fiercest we know. Even small specimens cannot be safely kept together. If the fancier is fortunate enough to get a pair safely mated, he will be rewarded by seeing the male develop the most gorgeous colors. See pages 254 (B 5) and 261 (N 6).

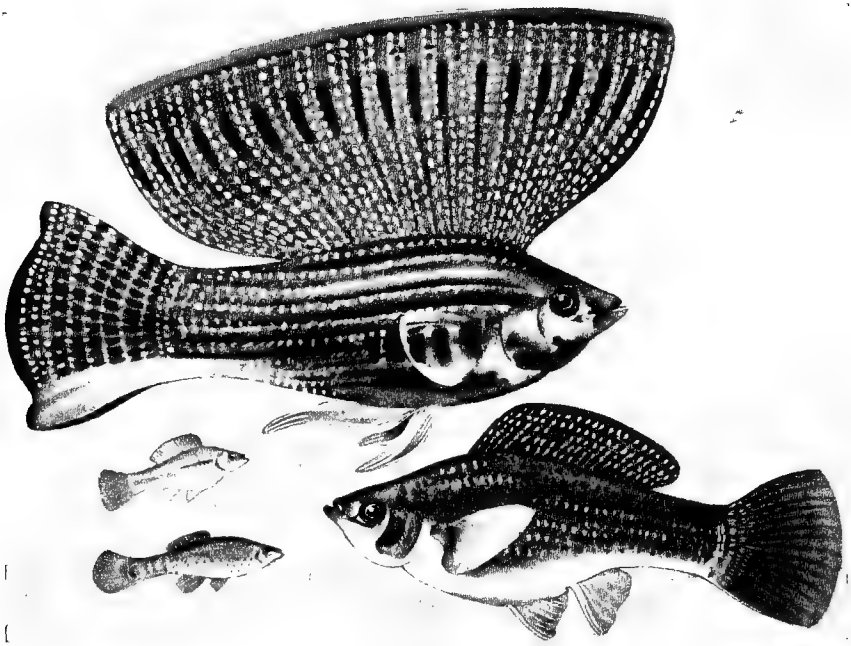


*Fig. 65. Mollienesia petensis*
*(Life size)*

There are two other forms of Mollienesia used largely in the aquarium, *M. latipinna* and *M. velifera*, the principal external differences being in the size of the dorsal fin. The above shows the handsomest and rarest variety. The male has the extraordinary dorsal development, but the fin is only held fully erect in moments of excitement, at which time he is strikingly beautiful. Darwin, in "The Descent of Man," refers to this fish on account of the great difference in appearance between the male and female. The young are born alive. Those shown in illustration are about twelve weeks old. Mollienesias are naturally salt or brackish water fishes. They become fairly well acclimated to fresh water, but do not stand much disturbing after once being settled in an aquarium. Slightly brackish water suits them better. Specimens bred in captivity seldom attain the highest development of the dorsal fin.

Figures 65 to 71 all have their young born alive. As the male reaches the breeding age the anal fin develops into an organ of intromission. This easily distinguishes the sexes. See pages 257 (B 9) and 260 (N 2).

*Fig. 66. Gambusia affinis (Average size)*

Also known as *holbrooki,* these fishes were the first of the live-bearers to be generally introduced into the aquarium in America. They occur as far north as Maryland and have been introduced into some swamps in Southern New Jersey, where they are valuable eaters of mosquito larvae. They tear the fins of other fishes. The darker specimens are the most sought after. Breeding habits, page 257. Dark spot near vent of females is produced by unborn young.

*Fig. 67. Belonesox belizanus* or Viviparous Killifish
*(Slightly reduced)*

These little fish are quite as bloodthirsty as their expression would appear to indicate. After they attain adult size they prefer being fed on small living fish, although worms are taken under protest. See pages 257 (B 9) and 260 (N 2).

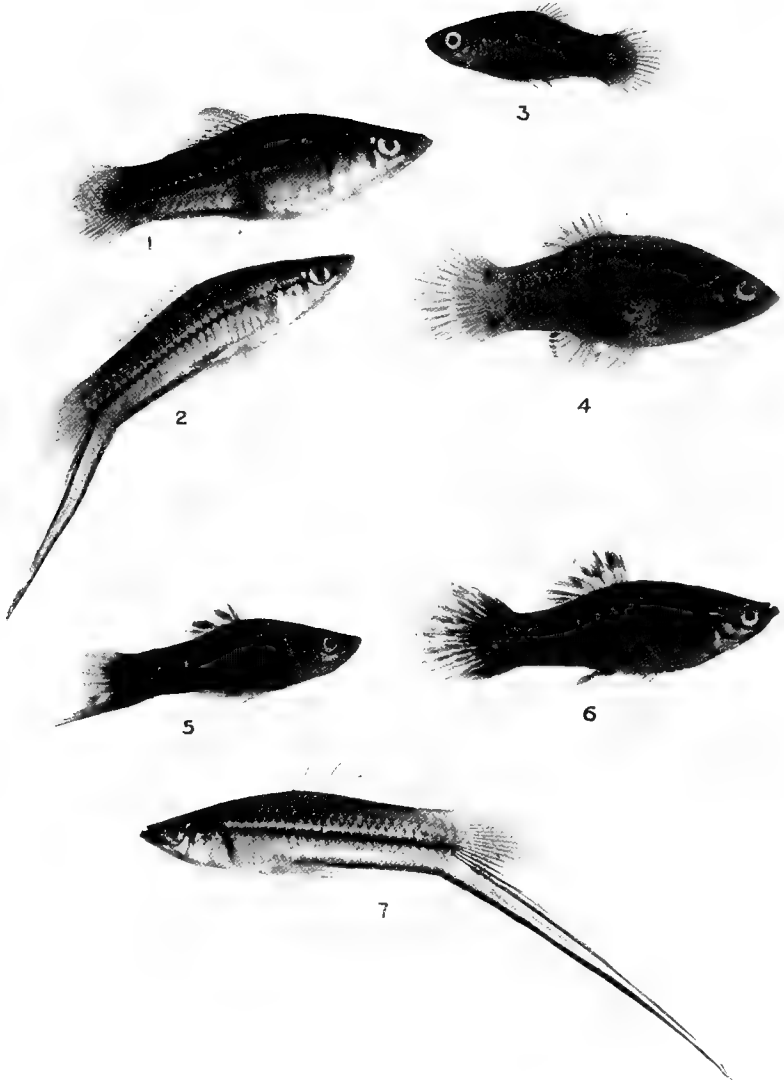



FIG. 68. FACTORS IN PRODUCING HYBRIDS ILLUSTRATED ON OPPOSITE PAGE

*Three-fourths Size*

1. *Xiphophorus helleri* (green), female. 2. *Xiphophorus helleri* (green), male. 3. *Platypoecilus maculatus (rubra)*, male. 4. *Platypoecilus maculatus (rubra)*, female. 5. Hybrid male from crossing Nos. 3 and 1. 6. Hybrid female from crossing Nos. 3 and 1. 7. *Xiphophorus helleri* (orange), male.

Nos. 6 and 7 are the parents of hybrids shown in Fig. 69.

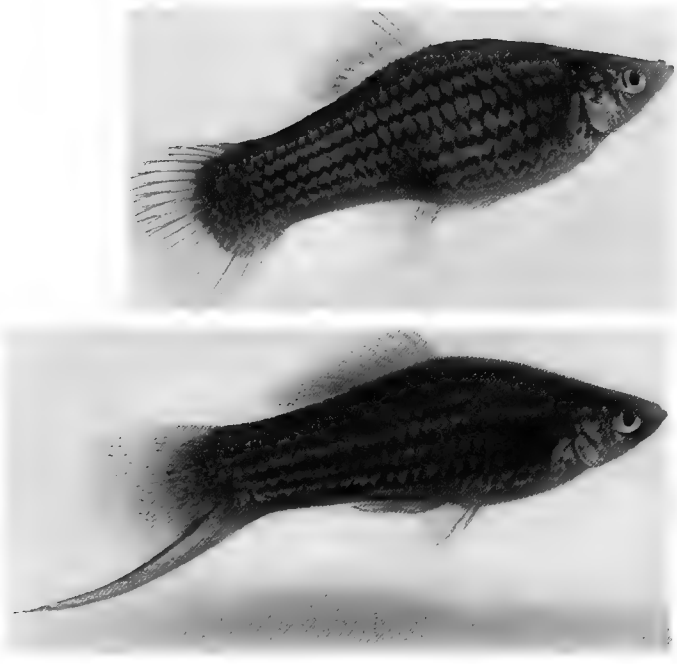


*Fig. 69.* Red Hybrids *(Life size)*

One of the most remarkable productions in hybridization. On opposite page, number 3, is a small, deep-red fish. Number 1 is greenish with some red markings. This cross produces some reddish hybrids, blotched black. When the reddest of these females is bred to number 7, we get a magnificent, large red fish. It grows rapidly and becomes considerably larger than any of its progenitors. These hybrids bred together throw a surprisingly high percentage of reds—well over half. In a few generations of selective breeding we should have a very fine strain of these beautiful fishes. Hybrids in fishes seem to be more fertile than in warm-blooded animals.

The female (upper figure) was "ripe" when the photograph was made, shown by distended outline and by the dark spot near the vent.

The possibilities of hybridization among live-bearing fishes are not fully known, but the subject is receiving careful study. To be sure of known crosses it is best to place the two fishes together before sexual characteristics have developed. If the sexes do not turn out right, one still has virgin fishes to cross with those from other experimental aquaria. A female once impregnated is fertile for four lots of young.

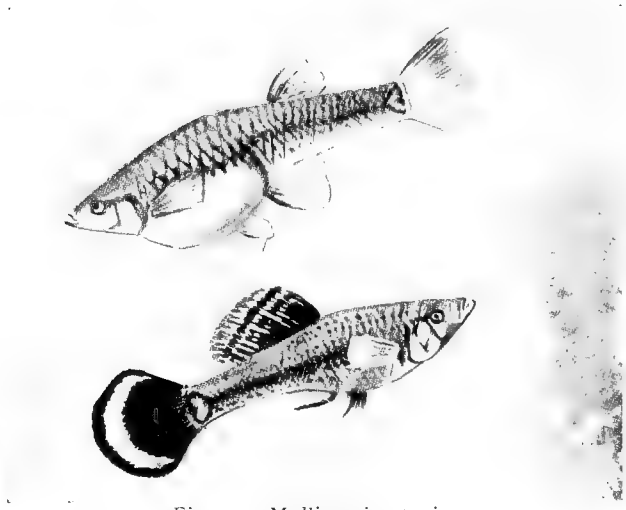


*Fig. 70. Mollienesia species*
*(Life size)*

These fishes well illustrate the pronounced color differences shown between the sexes of some species. To the uninitiated the difference is sometimes so great that a pair would not be recognized as belonging to the same family. See pages 257 (B 9) and 260 (N 2).

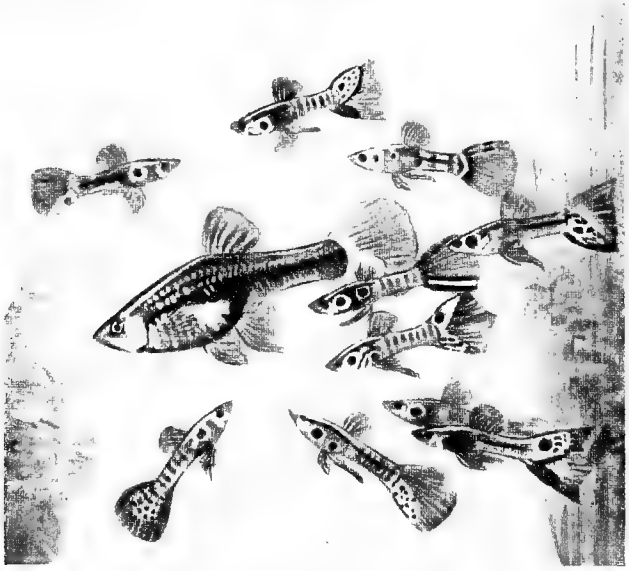


*Fig. 71. Lebistes reticulatus*
(Incorrectly known as *Girardinus guppyi*)
*(Life size)*

The extraordinary variation in the coloring of the males makes this species a never-ending source of fascination. No matter how large the collection, it is practically impossible to find two just alike. They are appropriately called the "Rainbow Fish." The female is much larger than the male, and of a dull olive hue. See pages 257 (B 9) and 260 (N 2).

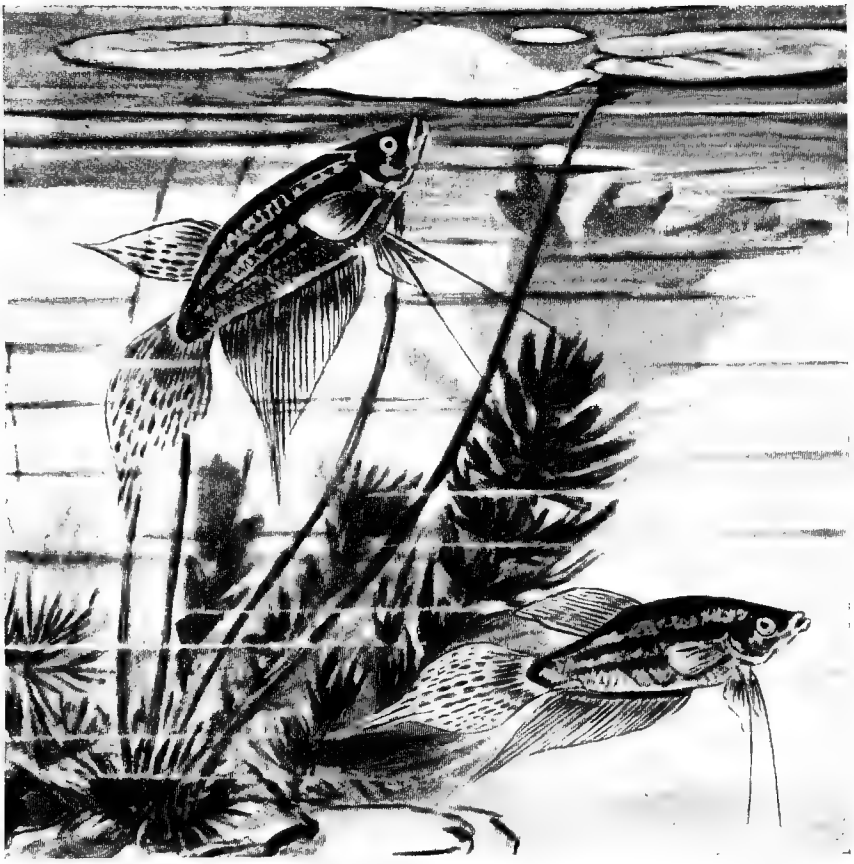


*Fig. 72. Ctenops vittatus* (Croaking Gourami)

The illustration shows one phase of the breeding habits of the bubble-nest builders, of which there are a number. The nest is built of bubbles from the mouth of the male, who takes entire charge of affairs. As the female drops a few eggs he at once fertilizes them, picks them up in his mouth, attaches a bubble, and floats them into the nest, where he guards them valiantly. If in a usual aquarium, the female must be removed after spawning is completed, otherwise he will kill her, so zealous is he in guarding the eggs and young from her possible cannibalism. In outdoor pool culture this does not always appear to be true. We have seen many pairs work together in common interest. Dwarf Gouramis like to interweave bits of vegetation into the nest, such as broken leaves of Myriophyllum. In this work the female helps with apparent enthusiasm. Illustrations 72 to 76 are all nest-builders. Additional breeding instructions on page 255 (Labyrinth Fishes).

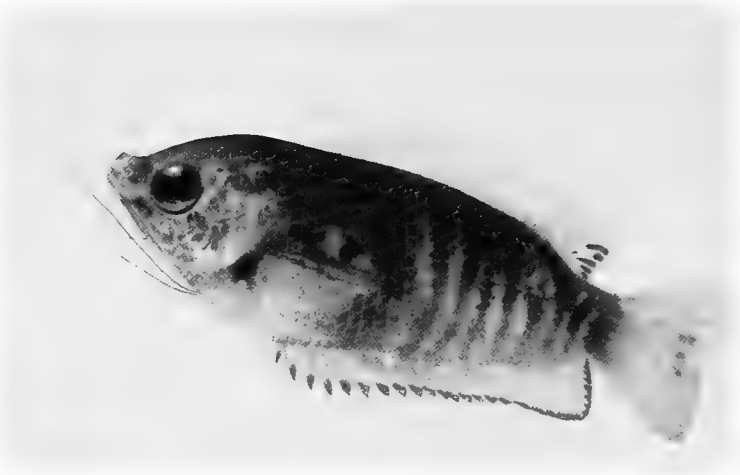


*Fig. 73.* GIANT GOURAMI *(Trichogaster fasciatus)*
*(Average size)*

*Fig. 74.* THREE-SPOT GOURAMI *(Osphromenus trichopterus)*
*(Average size)*

Two of the larger bubble-nest builders, both very handsome. The Giant Gourami is particularly brilliant in breeding season. It is the eye which makes the third spot in the Osphromenus.

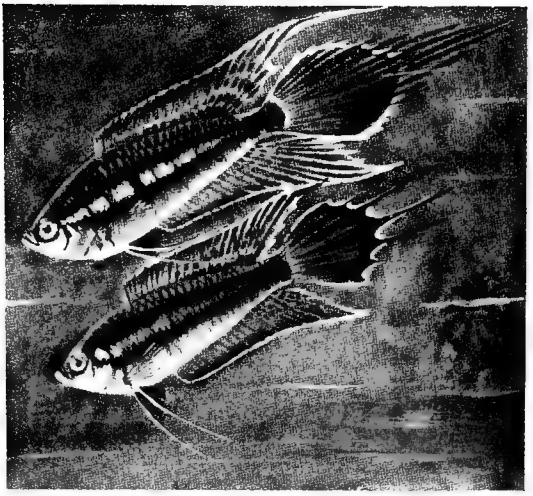


*Fig. 75. Polyacanthus dayi*

Habit description with Fig. 72 applies to both these illustrations. Note the more distinct coloring and longer fins of the upper fish. This is the male.

The scientific designations for male and female are: ♂ male, ♀ female.

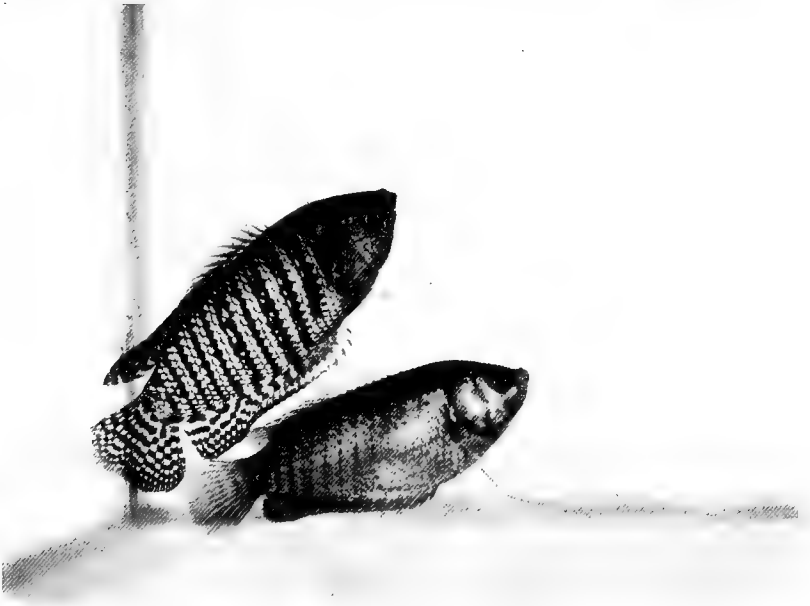


*Fig. 76.* DWARF GOURAMI *(Trichogaster lalius)*
MALE (TOP) AND FEMALE

One of the most pleasing of aquarium fishes, except for being rather timid. The males are exceedingly brilliant when in a warm temperature. Although the Dwarf Gourami has been with us for some time it has never become plentiful.

The light bars are of a brilliant metallic blue, while the dark bars and fin markings are an intense deep orange. Breeding habits, page 255.

*Fig. 77. Haplochilus chaperi*
*(Slightly reduced)*

One of the best-known and easily bred of the topical fishes. Not as large as some of the other Haplochilus division, it is also less likely to be cannibalistic, while in beauty it takes a high place. See pages 257 (B 8) and 261 (N 3).

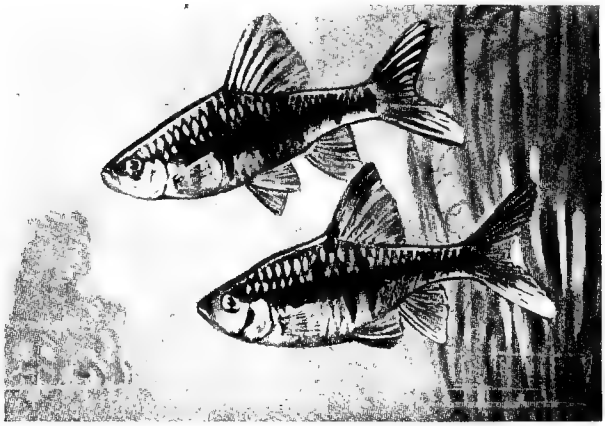
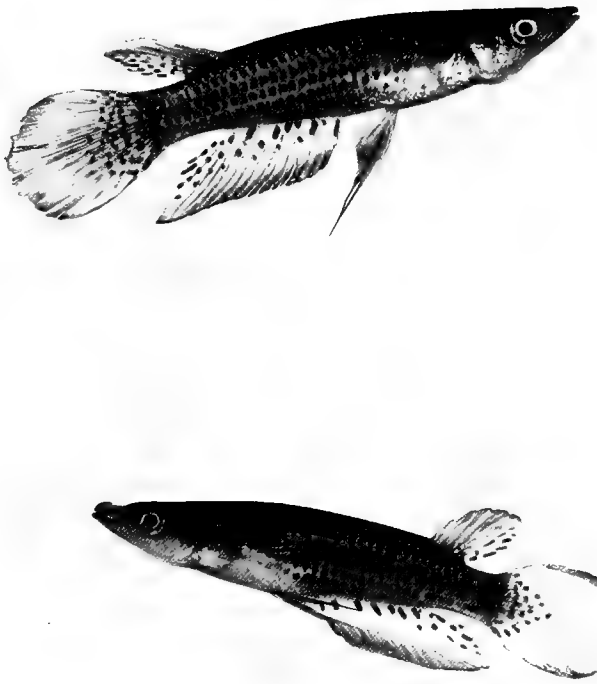


*Fig. 78. Barbus semifasciolatus*
*(Slightly reduced)*

The small Barbels are excellent aquarium fish. They are usually of a warm silver color, marked with black bars or dots. Very gentle in disposition and thoroughly hardy in moderate temperatures. See pages 253 (B 1a) and 260 (N 1).



*Figs. 79 and 80. Haplochilus rubrostigma*
*Upper, male; lower, female. (Life size)*

Larger members of the Haplochilus family. While not attacking other aquarium fishes for the pleasure of fighting, they are not to be trusted with smaller specimens, which might be swallowed. They are inveterate leapers. Considered to be among the handsomest of domesticated fishes. Breeding habits, page 257.

*Fig. 81. Haplochilus cameronensis (male)*

The *Haplochilus* group are all beautiful fishes, but *cameronensis* is the prize beauty of the family, so to speak. In direct sunlight, coming from behind the observer and striking fully on the fish, he is indeed a sight to behold—a combination of harmonious blendings and striking contrasts. They die rather easily, especially if the water gets a little cool. The illustration is of a maximum size not usually reached. Females have rounded tails and are not at all brilliant. Breeding habits, page 257.

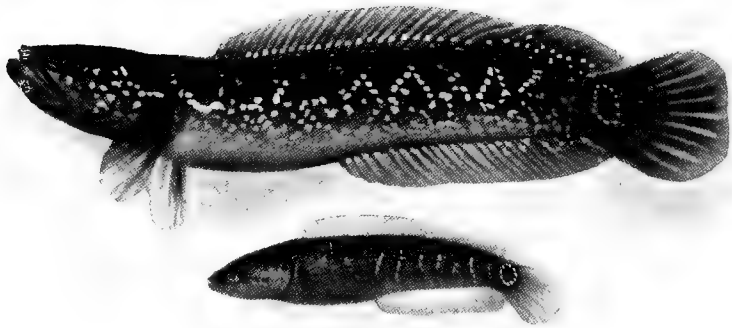


*Fig. 82. Channa fasciata (adult and young)*

One of the more newly introduced fishes, and may be classed as a handsome oddity. The dots are of a silvery whiteness. The zigzag lines divide a greenish color on top from a grayish color below. Gifted with tremendous swallowing capacity and appetites to match, they might prove dangerous associates to other fishes, although willing to eat prepared fishfoods containing a fair proportion of animal matter. They are air-breathing fishes and will survive very bad treatment, but cannot withstand cold. Breeding habits, page 256 (B 7a).

*Fig. 83. Danio rerio*
*(Life size)*

A moderate-sized aquarium, containing a number of *Danio rerios,* placed in a good light, gives us a beautiful picture. Their steel-blue stripes, alterating with white and carried through the fins, make a brilliant effect as the fish play through the water, never still a moment. The males have a slight yellowish cast in the lighter portion of the fins during the breeding season. Easily bred. See pages 253 (B 1) and 260 (N 1).

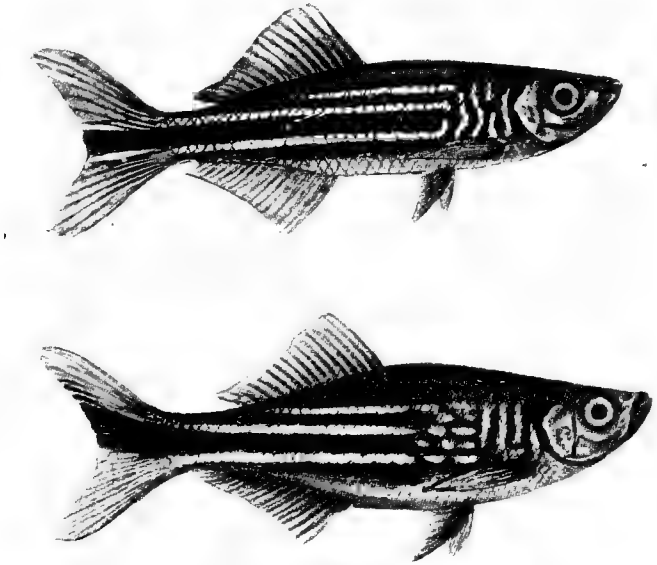


*Fig. 84. Danio malabaricus*
*(Life size)*

In life the colors are not so strikingly marked as shown above. The darker parts are a delightful opalescent color verging towards blue, and must be seen by reflected light to be fully appreciated. The fins are shaded with reddish brown. The males are distinguished by the dark line running straight through the tail, while in the female it takes a slight upward turn. Breeding habits, page 253.

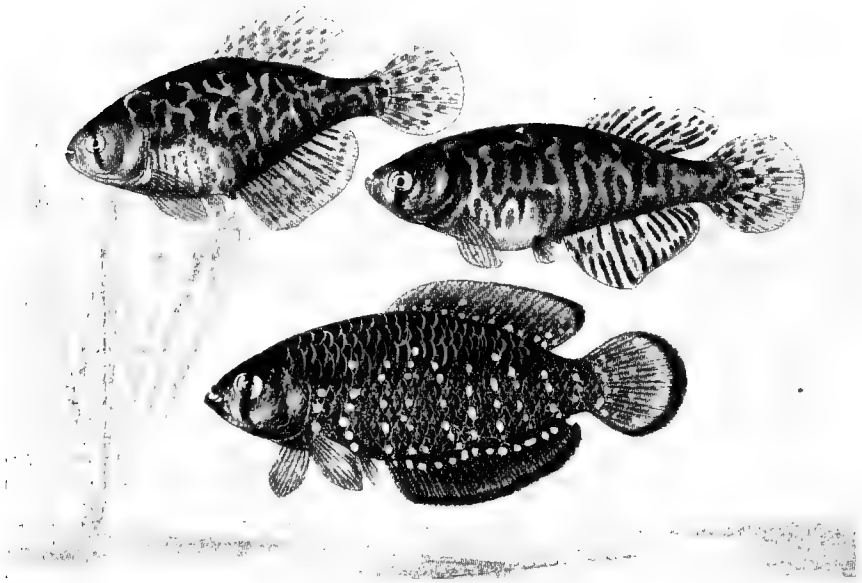


*Fig. 85. Cynolebias bellotti*
*(Natural size)*

The majority of imported aquarium fishes, especially the more handsome ones, come from tropical climates and naturally require fairly warm water. *Cynolebias bellotti* is one of the exceptions. It prospers at a temperature of 68° or lower, and is beautifully marked, especially the male, which is distinguished by clear white pearl-like dots. The prevailing color is blue. See pages 257 (B 8) and 261 (N 3).

*Fig. 86.* MOUTHBREEDER *(Haplochromis strigigena)*
*(Life size)*

There are many breeding methods among fishes which seem almost incredible to the novice, the Mouthbreeder being one of the most striking examples. After the eggs are fertilized the female fills her mouth with them, retains them until hatched, and carries the young about with her in the same way. During this period of several weeks she will touch no food herself, this being one of Nature's clever provisions so she will have no desire to swallow the eggs or young. Even if caught in a net, she tenaciously holds them, neither losing nor swallowing any.

In addition to their interesting breeding habits, these fishes have attractive and very changeable markings. Further details of breeding on page 258.

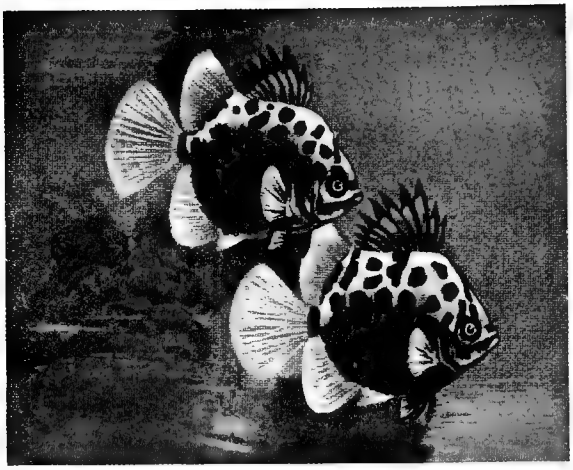


*Fig. 87. Scatophagus argus*
*(Reduced)*

In its native habitat, *Scatophagus argus* is a scavenger fish, living on sewer offal. In the aquarium it will take any food, and its quaint appearance adds a note of novelty to a collection. They are tidewater fishes and are usually kept in brackish water. See pages 254 (B 2) and 261 (N 6).

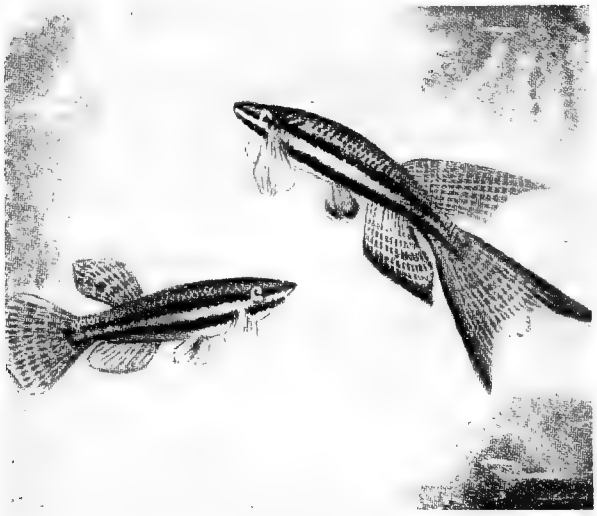


*Fig. 88. Fundulus bivittatus*
*(Slightly reduced)*

One of the most graceful of the Killifishes, known as "top minnows." The general color of this variety is reddish brown, flaked and dotted on body and fins with carmine. As with many other fishes, the male has the higher coloring, and longer, more pointed fins. See pages 257 (B 8) and 261 (N 3).

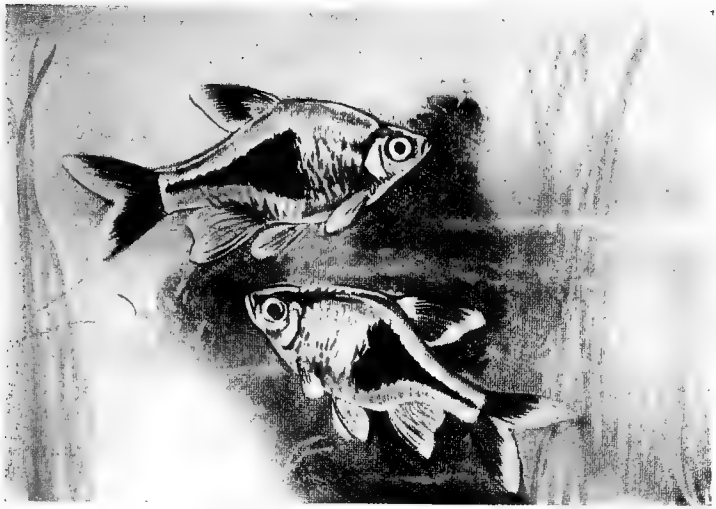


*Fig. 89. Rasbora heteramorpha (Slightly enlarged)*

Of a light reddish color, with a vivid triangle of black on the side, this fish is most striking in appearance, particularly in a small aquarium. It lives for years if kept at a warm temperature, but it is difficult to breed, nobody in the United States having yet succeeded in propagating them. Here is an opportunity for a clever aquarist to accomplish something well worth while. See pages 253 (B 1a) and 260 (N 1).

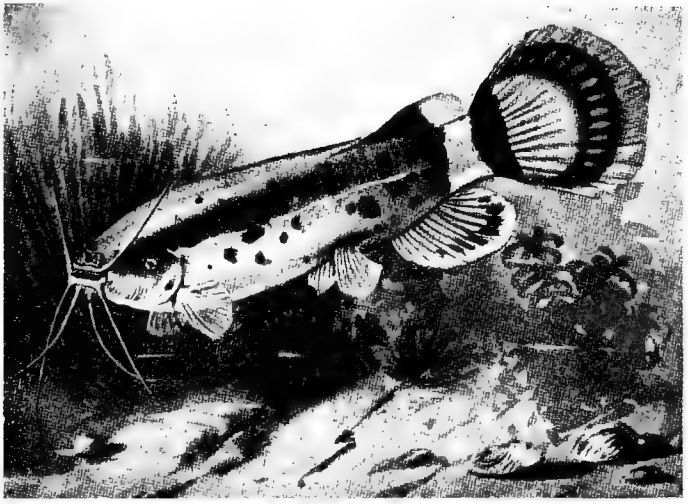


*Fig. 90. Torpedo electricus* (Electric Catfish)

This most curious aquarium fish, when taken in hand, gives an electric shock which may clearly be felt as high as the elbow. How this is accomplished is not clearly understood, as it is supposed to be necessary to touch two electric poles to receive a current. If the head and tail of the fish were the poles, the current would only pass from one part of the hand to the other, instead of up the arm. The fish is able to cause the shock either in or out of the water. This is doubtless a means of self-defense, as the current is scarcely strong enough to kill a victim intended for food. See pages 259 (B 13) and 261 (N 6).

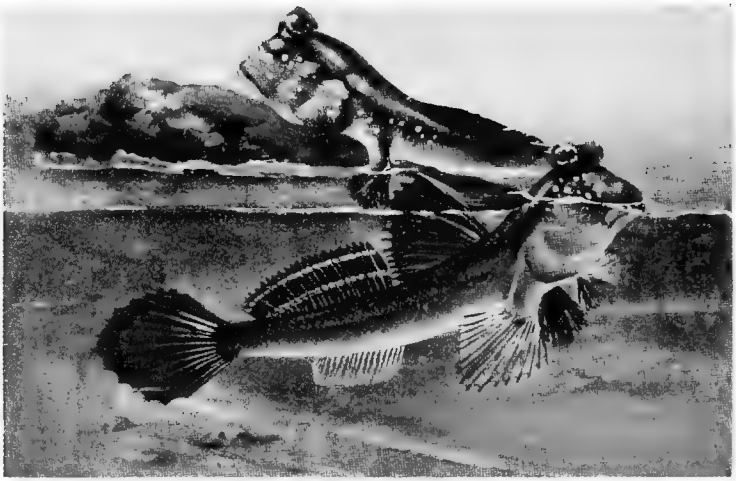


*Fig. 91. Periophthalmus barbarus*
(Incorrectly listed in dealers' catalogs as *P. koelreuteri*)
(Popular names, "Mud Springer" and "Stone Skipper")
*(Two-thirds life size)*

This is one of the most remarkable of fishes and seems to form a connecting link between aquatic and amphibious animals. As the tide recedes, these little fellows make no effort to follow it, but instead come out on the mud flats, stones, and even climb small bushes in search of insect prey, which they are adepts at catching "on the wing." The pectoral fins, nearly developed into legs, are used in vigorous leaping. See pages 255 (B 6) and 261 (N 6).

*Fig. 92.* Climbing Perch "Walking" on Land *(Anabas scandens)*
*(Half size)*

Although this fish has no feet, "it gets there just the same." In its native habitat the ponds have a way of drying up at seasons. If the water becomes very low this fish leaves the pond at night, wriggles its way to a deeper one, and, if the dry spell continues, buries itself in the mud until more favorable times return. The "walking" is done mainly by extending the spiny gill plates and working the body from side to side.

These fishes have air chambers in their gills and are known as "lung fishes." Breeding habits, page 256.



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*Chapter Seven*

# Native Fishes

## NATIVE AQUARIUM FISHES

It seems to be human nature, especially in America, to assume that the best things come from distant lands—the more distant, the better. In this search for the rare and interesting we are apt to overlook excellent material close at hand. We have many handsome native fishes admirably adapted to aquarium purposes. They are easily managed, tenacious of life, varied in habits and easily tamed. Those who have made collections of our own fishes have found much pleasure in this form of aquarium hobby.

## COLLECTING WILD FISHES

There are pleasures connected with the stocking of a wild-fish aquarium which are unknown to those interested only in goldfishes. The actual contact with Nature, the study of the fishes in their native habitat, the ever-present possibility of finding something new, the companionship and health afforded on outings are some of the pleasant assets of the collector. For this work two kinds of nets should be provided.

These consist of a minnow seine and a large landing net of small mesh, fitted with a sectional rod. The seine should be operated by two persons. A pole is used at each end of the net, the sinker and float lines being attached at their respective points. The bottom line should be carried well in front of the top, and while a steady forward motion is necessary, it should not be rapid enough to cause the float line to sink. When working over grassy areas it is a help to have a pole attached to the centre of the lower line, this to be operated by a third man, the idea being to keep the sinker line close to the bottom. Seines of this type are adaptable to streams from 10 to 20 feet wide and to any larger body of water having a gently sloping shore of firm quality and without too many obstacles. If the haul can be ended at a natural recession or "gut" in the bank it will prevent the loss of some fishes.

These small seines as purchased are poorly equipped with floats and sinkers, the former being too heavy and the latter too light. A great improvement can be made by adding large cork floats, binding split pieces together across the top line. The sinkers should be twice as heavy and twice as numerous as supplied. Pieces of half-inch split lead pipe can readily be used to correct this defect.

If fish are at all plentiful the hauls are large. Care should be exercised to immediately return all specimens not wanted, and it will be the part of wisdom to want few. By crowding in cans on the home trip many fishes die and the rest arrive in such poor condition that their lives in captivity are short. The hands should be wet before touching live fish. This is well known among fish culturists.

The ordinary 18-inch folding hand-net is used in small streams where one can make a dash into the deeper depressions by the banks. This is done by an overhead, downward swoop, executed with the greatest possible speed. The net is continued in rapid motion, pulling it over the bottom towards the feet of the operator. This is the only way to achieve any degree of success. The up-scoop is the

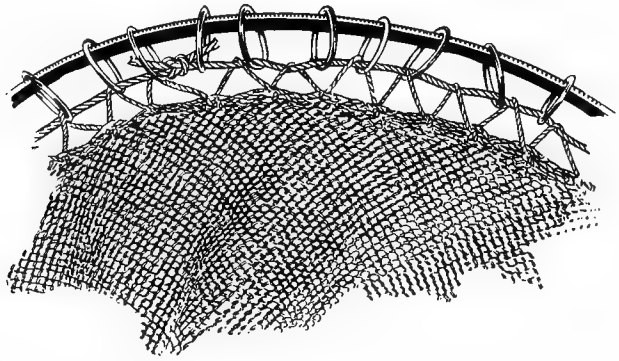

Fig. 93. Proper Way to Connect Hand Net to Metal Frame

natural way to go about it, but this ends in absolute failure. With this net, too, we need some alterations. Take off the net from the folding frame. Slip about 100 of ⅝-inch upholsterers' brass rings on the frame. Now interweave, parallel to the frame, a strong string between the brass rings and the top loops of the net, thus attaching the net permanently. The object of this arrangement is to prevent the cutting of the net when the frame drags over stones and other obstacles. Also the net itself can be improved for our purposes. It should be of a quarter-inch mesh and about 24 inches deep. Dyeing it a dark color is a still further improvement.

FIG. 94. SEINING FOR BLACK-BANDED SUNFISHES

Making the finishing sweep towards an identation in the shore. The centre man is holding down the bottom of the net with an oar because they are hauling over stiff aquatic grasses. Ordinarily two operators are sufficient. Seines for catching bait fish are allowed in most States, but it is safer to get a State permit.

FIG. 95. MALE SILVERFIN
*(Slightly reduced)*

FIG. 96. FEMALE SILVERFIN
*(Slightly reduced)*

FIG. 97. THE RAINBOW DARTER
*(Life size)*

FIG. 98. THE SHINER
*(Average aquarium size)*



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101

FIG. 99. THE COLORED CARP
*(One-third size)*

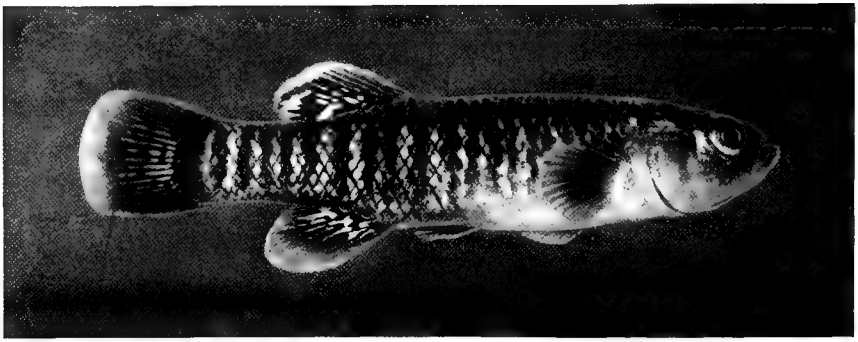


FIG. 100. THE KILLIFISH *(Fundulus diaphanus)*
*(Average size)*

## THE SILVERFIN

*Notropis analostanus*

Of all the native fishes tried in the aquarium by the writer the Silverfin stands out as one of the most satisfactory. For aquarium purposes the male fish should be selected. The ends of their fins are of a whitish, satiny color from May till September. Darting around in the aquarium, their sleek bodies overcast with a pale steel-blue, and sides laced with black-edged scales, they make a most attractive appearance. Two of them will often indulge in what appears to be a game of tag, during which they will chase each other around a short circle, producing the effect of a pinwheel.

A 50-gallon aquarium, with plenty of open space, containing about ten adult male silverfins is most fascinating.

They are very hardy, tame, and will eat any prepared food. Harmless to other fishes.

They may be caught in the open reaches of the fresh tidal portion of the Delaware as well as its upland tributaries.

Silverfins have been kept in aquaria for several years, but unusual care should be exercised to cover with a screen to prevent their leaping out.

## THE DARTERS

With few exceptions the Darters have no swimming bladders and are therefore considerably heavier than water. They move along the bottom in jerky motions somewhat like hopping. When in reach of their prey they make a short leap. Although this seems to be short of the mark they always succeed in getting what they go after. One would imagine them to have a long tongue like a frog, moving with the same invisible rapidity. There is something quaint and droll about the Darters. The majority of them cannot stand warm water.

THE RAINBOW DARTER *Esteoma coerulea* is probably the most brilliantly colored of our native fishes, being barred with red, blue, orange and green in most striking fashion. On account of its brilliant coloring it is known as the Soldier Fish. It occurs in shallow streams of the Mississippi Valley. Extremely fond of daphnia or very small worms, but may become trained to taking shreds of raw meat, shrimp or fish. They can be kept best in cool water and are well worth the effort.

## THE ROACH, OR SHINER

*Abramis crysoleucas*

This fish is one that takes easily to the aquarium and is quite hardy under any reasonable conditions. It is very active. In the

sunlight flashing its bright silver sides, it is a very pretty member of the aquarium family. Of a gentle nature and will take any food. The natural distribution is in the Northern States east of the Rockies.

## THE KILLIFISH

Killifish, both fresh and saltwater forms are among the most hardy of the smaller fishes. Used largely as bait-fish on account of their tenacity of life, they exhibit the same quality in the aquarium, standing very bad treatment before succumbing. The barred sides and fleeting iridescent colors are most attractive, particularly in the saltwater form. They will eat anything and are harmless to other aquarium fishes. Boys usually know this fish in streams as the "bull-head" minnow, while the popular name on the New Jersey coast for the saltwater form is "Mummychog." Average size about 3 inches.

## THE MUD TROUT

*Pygmæ umbra*

Here we have one of the hardiest and most friendly of our small native freshwater fishes. It is not one of the restless kind, seemingly always at high tension, yet it is alert and very much alive to what is going on about it, ready to move to its purpose with the least possible effort. The Mud Trout has a fashion of turning its head deliberately towards the subject of interest in a way that suggests a concentration or mental development beyond that of the average fish. Although their manner is menacing they are perfectly harmless. They may be taught to leap several inches out of the water for a favorite morsel of food, such as a small worm, or a shred of raw beef, held on a toothpick.

Their color is a pleasing brown, slightly relieved by darker lateral lines and some dots.

Found in lowland and swampy waters from Long Island to North Carolina, east of the Alleghenies. Sometimes to be had in pet stores, where they are sold at nominal charges. One should not estimate the aquarium value of such fishes by their market prices.

## THE CARP

*Cyprinus carpio*

The Carp is one of the most widely known of fishes. Its tenacity of life is extraordinary considering that it is not an air-breather or labyrinth fish. When sold as a food fish it is kept alive for a day or two when barely moistened with water. Common goldfishes well wrapped in wet Anacharis or Myriophyllum and packed in a tight tin box can safely be sent on a 12-hour journey or more if temperature is moderate.

A number of varieties of carp are kept as ornamental pond and large aquarium fishes. The principal ones are the Mirror, the Leather and the Golden Carp. There are in this country at the present time some extremely handsome fancy carp of Japanese breeding, being marked irregularly with red, white and blue. They have been propagated here and it is to be hoped the breed will become generally known.

Our photograph was made from one of these colored Carp but for general structure it accurately represents the entire Carp family.

## THE REDFIN

*Notropis cornutus*

In the breeding season the male Redfin is an individual of striking beauty, the entire pectoral and the ends of the other fins being a blazing red. The color continues in gradually lessening degree until cold weather sets in, when it disappears entirely. These fishes spawn together in large numbers, the action taking place while they are massed in the form of a great, seething ball, flashing dazzling colors. It is as a pond or pool fish that they show best, although at a size of 4½ inches they have sufficient color to look well in the aquarium, where they may be kept with other fishes. In the 8- to 10-inch sizes they are used as food fishes, where caught by anglers in most of the Northern States east of the Rockies.

## THE PEARL ROACH

*Scardinus erythropthalmus*

Visitors at the Battery Park Aquarium in New York City have for years been much pleased with the exhibition of Pearl Roach. They are of European origin, where they are fairly common, and are really of no relation to our own Roach or Shiner. There is a general resemblance, except that the ends of the fins in the Pearl Roach are blood red at all seasons.

They were originally introduced here into the ponds of Central Park (New York City), multiplying in large numbers, proving their adaptability to pond culture. They should be a beautiful and generally satisfactory pond fish. The larger sizes run to about eight inches. As they do not develop the red fins much under four inches they would be suitable to aquaria of larger sizes rather than the small. They have gentle dispositions.

The other public aquaria are now generally stocked with Pearl Roach and it is hoped a method of further general distribution of this beautiful fish will be found.

## THE SUNFISHES

The Sunfishes are one of the most widely distributed and best known families of our freshwater fishes, American boys being well acquainted with them. There are a number of varieties. Most of us have seen the tidy, clean spots fanned out by a pair of Sunfishes. This is the "nest" in which the eggs are deposited. Both parents protect the young, attacking all comers in a vicious manner. Excepting the so-called Chaetodon, or banded sunfish, all of the several species are pugnacious, especially when large. They should not be kept with other fishes unable to protect themselves and it is inadvisable to have one much larger than its fellows, as it will "bully" the other inmates of the aquarium. Sunfishes have a decided carnivorous tendency, much preferring live worms or flies to prepared foods. They can be induced to take shreds of raw liver. Of the dry foods, ground dried shrimp is the best for them. The coloring of the Sunfish shows to excellent advantage in the aquarium, and it will be found a very tame and interesting pet. It can withstand severe temperature changes and will survive for years if suitably fed. Particularly destructive to aquarium snails.

Owing to their abundance the beauty of the members of the Sunfish family is usually overlooked. The Blue Spotted and the Long Eared of the Eastern United States, the Orange Spotted of the Mississippi Valley and the Blue Gill from Lake Erie are among the members which rival many of the tropical fishes. The Blue Gill is now widely cultivated in state hatcheries as a food fish, attaining the weight of a pound. It is one of the best fishes with which to stock a private pond.

## THE CHAETODON

*Mesogonistius chaetodon*

Banded Sunfishes (known also as the Chaetodon from its specific technical name, which was applied because the vertical bars or bands suggest the marine Chaetodons or Angel Fishes of tropical seas) build their nests directly among plants off the bottom. These fish are less of fighters and depend more upon hiding their young than upon boldly protecting them. The Chaetodon is one of the most charming of all aquarium fishes. Many of them are exported to Europe, where they are highly esteemed and bring good prices. This fish has quite an individuality—its peculiar markings, precise movements and genteel manners setting it quite apart from most other fishes. It swims principally by use of the pectoral fins, which are so transparent as to be scarcely observable, giving the fish the appearance

FIG. 101. THE MUD TROUT
*(Average size)*

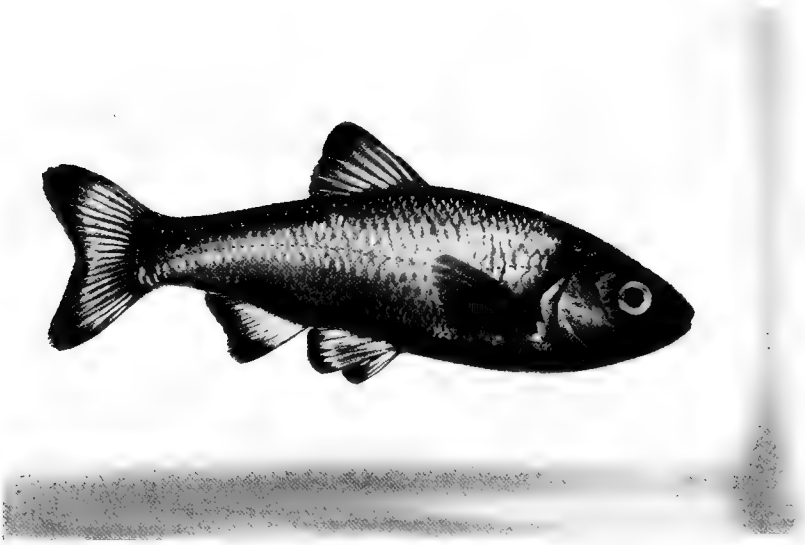


FIG. 102. THE REDFIN
*(Half size)*

FIG. 103. THE PEARL ROACH
*(Two-thirds size)*

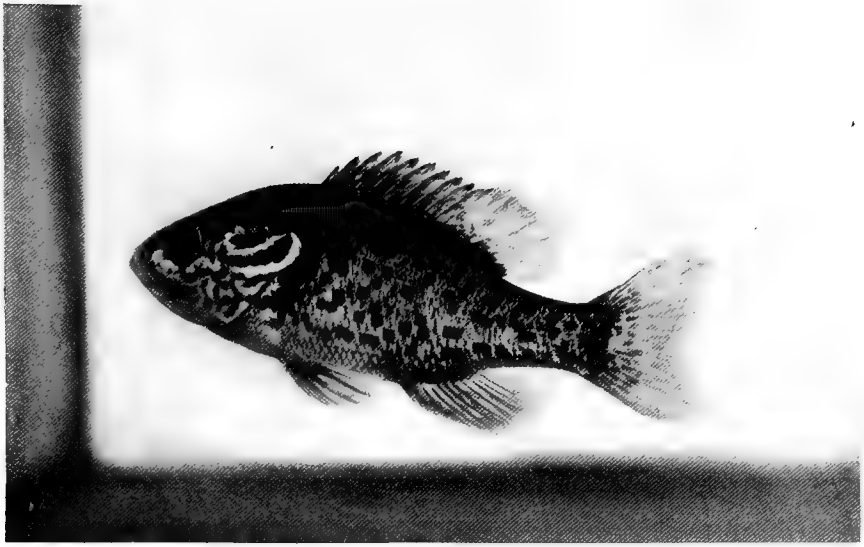


FIG. 104. THE ORANGE-SPOTTED SUNFISH *(Lepomis humilus)*
*(Two-thirds size)*

FIG. 105. THE BLACK-BANDED SUNFISH, OR "CHAETODON"
*(Average size)*

Fig. 106. Mullet or Chub Sucker *(Young)*

Fig. 107. Black-Headed Minnow
*(Life size)*

of moving about by will-power, without physical effort. They greatly prefer live daphnia to all other foods, but do well on scrambled egg or particles of boiled shrimp. The only sunfishes that will not kill snails. Found in ponds and slow-moving streams from Pennsylvania to South Carolina, but in quantity at only a few points. They are partial to the cedar swamps of New Jersey. At May's Landing is an excellent collecting point. The Chaetodon often contracts a fatal fungus soon after capture, so the collector should be particularly careful not to overcrowd them in the carrying pail, and to give them the best possible conditions on arrival home. Once acclimated they are hardy if fed correctly.

## THE MULLET

*Erimyzon sucetta*

Sometimes known as the Chubsucker, the Mullet in the smaller sizes makes a satisfactory aquarium fish, entirely harmless and of rather attractive appearance. The back is green, sides are yellow and abdomen is white. May be fed on ordinary fishfood but has pronounced vegetarian tendencies. The young are sometimes mistaken for Black-nosed Dace, but the difference is easily told by the mouth of the Mullet which is set lower and somewhat resembles that of the Sucker. Habitat, lowland waters of Eastern States.

## BLACK-HEADED MINNOW

*Pimephales notatus*

The Black-headed Minnow is not well known as an aquarium fish. The contrast of black and silver as shown in illustration correctly indicates that the fish adds a note of novelty to a collection. The author kept them for a season and they appeared to be generally satisfactory. Habitat: Central and lower Mississippi Valley.

## THE RED BELLIED DACE

*Chrosomus erythrogaster*

This beautiful fish reaches a length of three inches and is one of the most satisfactory of hardy aquarium inhabitants. During the breeding season the belly, mouth and base of the dorsal fin of both sexes are bright red. There are two black lateral lines on the sides, separated by a band of pale gold, so that even when not in breeding colors, the Red-Bellied Dace is an individual of attractive appearance. It is perfectly harmless, will eat any prepared food and is of active

habits. Native to the small streams of the Mississippi Valley. It is a community breeder, requiring larger space than the limits of most

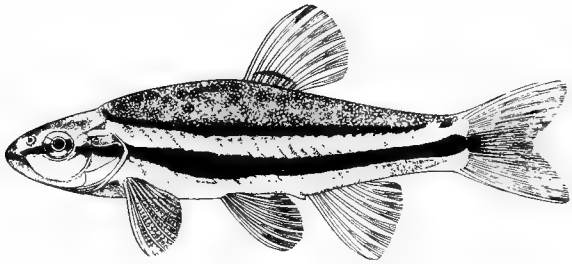


FIG. 109. THE RED-BELLIED DACE *(Life size)*

aquaria. The author placed six of them in a 3 x 5 foot tank in May and several months later took out 30 well developed young, but the breeding was not observed.

Owing to their extreme agility it is necessary to catch the wild stock in a minnow seine.

## THE ROSY-SIDED DACE

*Leuciscus vandoisulus*

One of the less known, but very attractive aquarium fishes is the Rosy-Sided Dace. The general color is silvery to green. A nearly black lateral line runs the length of the body, and below this on the males is a long patch of red, starting from the edge of the gills, as indicated in the illustration. This varies in intensity from day to

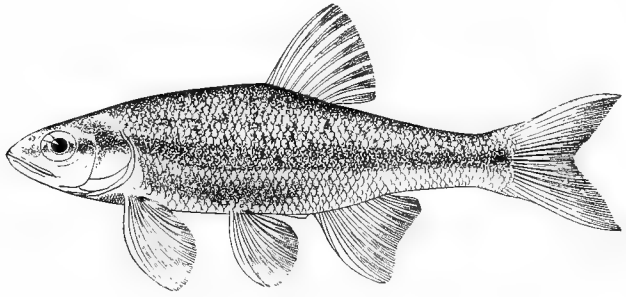


FIG. 110. THE ROSY-SIDED DACE *(Life size)*

day, and is brightest from February until September. As these fishes dart about the aquarium the flame-like appearance of the red

patches is most striking. Even when not in color there is an interesting bronze-green effect to the scales at the lateral line. This is always visible by reflected light, and seems to show mostly at night. If the light is turned on them at night they show very little red color, but in a few minutes it is quite plain.

The Rosy-Sided Dace is a large minnow and takes kindly to the aquarium and is perfectly harmless, but unless plenty of room is provided it will slowly decline. Found in clear cool brooks, from the foothills of the Alleghenies, from Pennsylvania to the Carolinas.

## THE BLACK-NOSED DACE

*Rhinicthys atronasus*

The Black-Nosed Dace is one of the best of our native fishes for aquarium purposes. Found in abundance in small swift-running

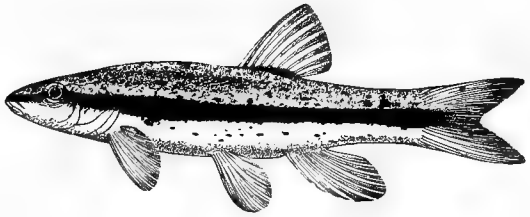


FIG. 111. THE BLACK-NOSED DACE *(Life size)*

streams of the Delaware Valley, and is widely distributed over Eastern North America. It is an extremely active swimmer and not easily caught unless cornered in a small pocket. From constant swimming against the current it has developed some specialized kind of balance, so that when introduced into the still water of the aquarium, the forward part of the body continually drops so a level position is only maintained by an effort. This condition disappears in a few weeks and a new equilibrium becomes established.

The Black-Nosed Dace is well rounded and full of body, the belly is clear white and the black band encircling the body is quite intense. It is perfectly harmless and will take almost any food. It is quite subject to a parasite which embeds itself deeply in the sides of the fish, producing an appearance that can best be described as looking like "fly-specks." This is common to many of the small wild fishes, and while it is not known to have any serious results it is unsightly.

Specimens free from the parasite should be chosen where possible. The usual length is from two to three inches.

They have been known to survive in the aquarium for several years.

## THE CHUB

*Semothilus atromaculatus*

Not usually known as an aquarium fish, the Chub, in the smaller sizes, does very well and may be kept with other fishes whether small or

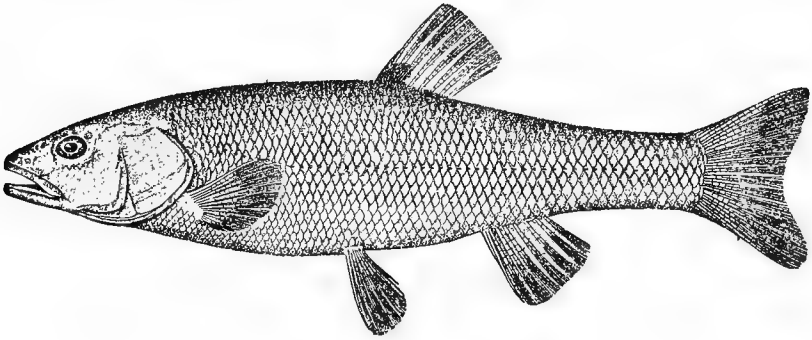


FIG. 112. THE CHUB *(Young)*

large. It is a nest-builder, but requires a much larger space than is to be thought of in an ordinary aquarium. The horned dace, or Creek-chub, is the most lively, and is the best species for the aquarium. Chubs are vegetarians, thriving on boiled cereals or white wafer food.

## THE CATFISHES

Any of the forms of Catfishes are well able to take care of themselves in an aquarium. If not large they will not touch other wild fishes,

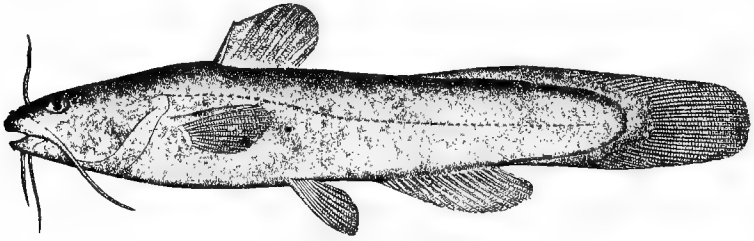


FIG. 113. THE STONE CATFISH *(Schilbeodes insignis)*
*(Slightly reduced)*

but should not be kept with goldfishes, as they are likely to nibble at their long fins. Catfishes like animal food best, but will take boiled cereals or the usual prepared fishfoods.

## THE EEL

*Anguilla rostrata*

Small eels may be kept with a collection of wild fishes, but they look out of place with and are dangerous to goldfishes, having the same habit

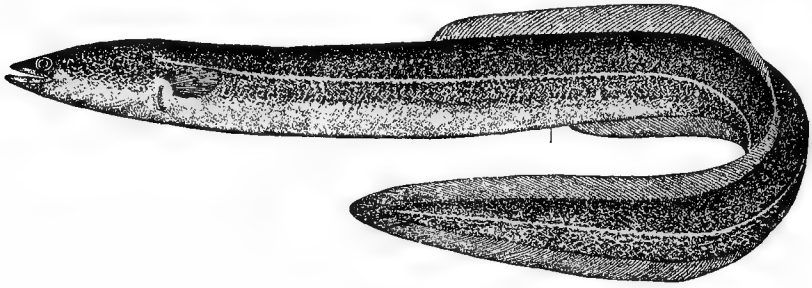


FIG. 114. THE EEL *(Young)*

as the sunfish and catfish of nibbling at the long fins. They are good scavengers, quickly eating any dead snails or other decomposing matter. Nothing is too bad (nor too good) for them to greedily eat.

## THE GOLDEN ORFE OR IDE

*Idus idus*

Originally imported from Southern Germany, the Golden Orfe has become one of the best ornamental pond fishes. They do not stir up the mud as do goldfishes and are more active in avoiding their enemies.

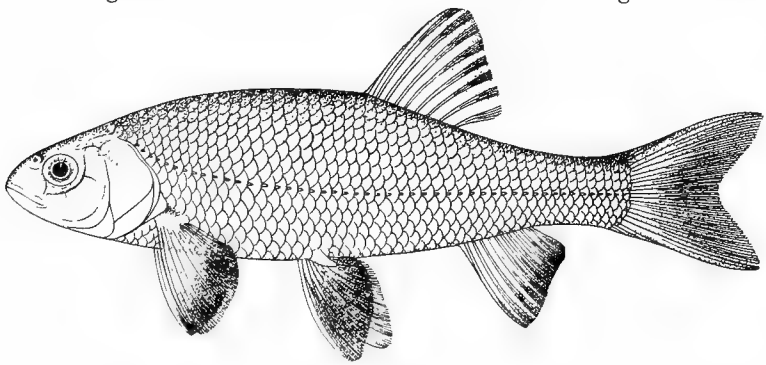


FIG. 115. THE GOLDEN ORFE *(Young)*

The color on the back is orange dotted with black, shading to lighter on the sides and white on the abdomen. The extreme length is two feet, requiring probably ten years of growth under favorable circumstances. The young are suitable for aquarium keeping, but the top must be screened to prevent their leaping out. They do best in running water.

## THE GOLDEN TENCH

*Tinca tinca, aureus*

As a showy fish of golden orange hue the Golden Tench is considered second only to the goldfish itself. Covered with exceedingly fine scales and dotted with black it presents by reflected light an iridescent effect, comparable to that of an opal. By transmitted light they are

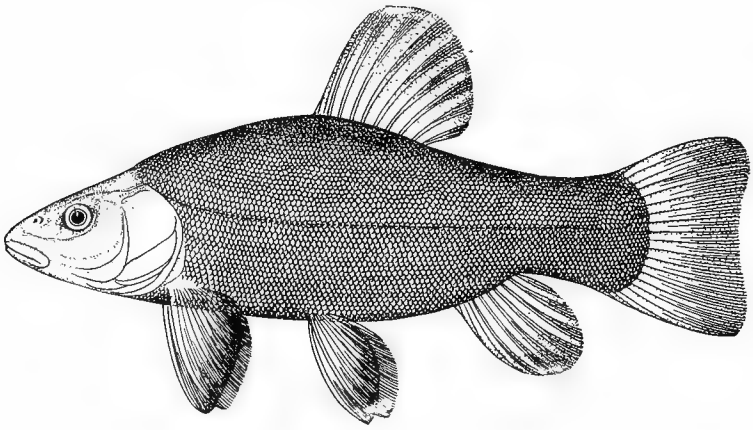


FIG. 116. THE GOLDEN TENCH *(Young)*

sufficiently translucent to show the skeleton and internal organs. Although timid they become quite tame and will live on any kind of fish-food. Harmless to other fishes and otherwise thoroughly desirable. Tenches should be bred in open ponds with mud bottoms.

The Green Tench is the ancestor of the Golden Tench and differs principally in coloring, its color being of a bottle-green character. "Tench-green" is a popularly recognized shade of color in some parts of Europe. Tenches are liberally supplied with protective slime and it is believed by some that fishes injured by accident search out a tench to rub the injured part against. For this reason it has been known as the "Doctor Fish."

## THE SOLE

*Achirus fasciatus*

Among the interesting novelties in aquarium fishes is the Sole, often known as the freshwater Flounder. Aquarists popularly call it the "aeroplane fish" on account of its easy, horizontal progress through the water, the swimming being accomplished mainly by an undulating motion of the fins at the edges of the body, as shown in the two upper figures of the accompanying illustration. The third

figure indicates the under side of the fish, while the lowest shows the Sole as it lies half concealed in the mud. In the aquarium these fishes frequently fasten themselves flat to the sides of the glass by

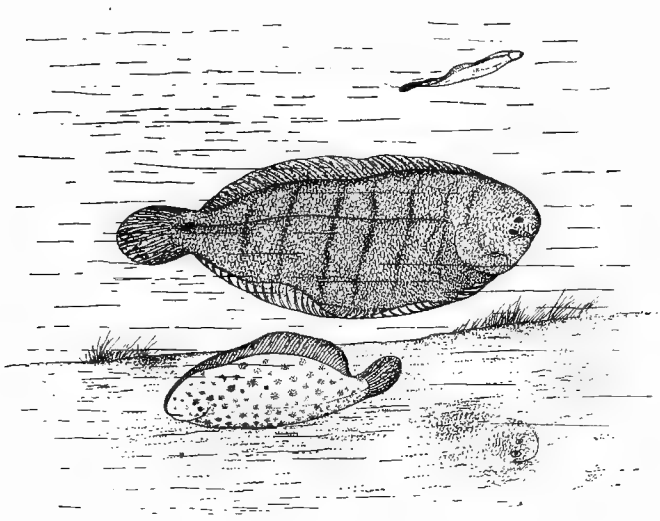


FIG. 117. THE SOLE *(Young)*

suction. They may be gathered from the muddy flats of tidewater streams of the Atlantic Coast. Chopped worms make a suitable diet for them. Sizes such as pictured are good aquarium inhabitants.

## THE STICKLEBACK

*Apeltes quadracus*

Froebel, the writer of kindergarten fame, in telling the children of the civilized world the life story of the Stickleback, has given great prominence to the interesting little European Stickleback. The interest centres chiefly in the breeding habits. Sticklebacks are nest-builders. The male is architect, contractor and workman. He selects a suitable location, and by tireless efforts gathers together bits of plants, refuse, etc., and makes them into the form of a ring with a roof over it, leaving only an opening for the female to enter to deposit her eggs. The nest is glued together by a sticky substance exuded from the body of the male fish, who assumes a bright red color in parts of the fins at this period. After the female has deposited her eggs he drives her away, looking after the nest and young himself until they are about 10 days old. He is very pugnacious at this time and will

attack any living thing that approaches. Different species probably vary somewhat in details of breeding habits. An English authority claims that in Nature the male persuades as many females as possible

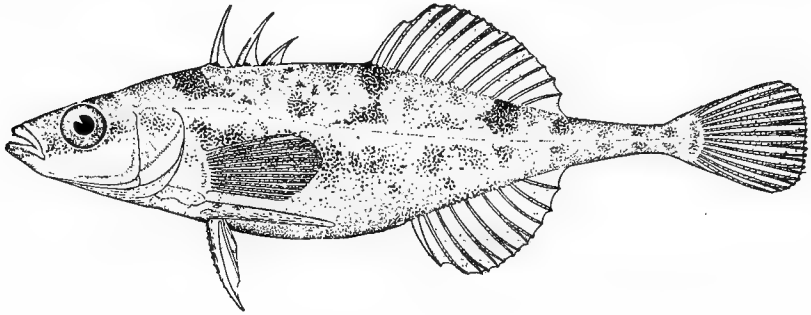


FIG. 118. THE STICKLEBACK *(Enlarged twice)*

to deposit their eggs in his nest. The Stickleback is well known as an aquarium fish, but it should not be kept with other fishes. It prefers to eat chopped salt clams or oysters.

## FEEDING WILD FISHES

The majority of native fishes when first subjected to captivity are timid, shy or resentful. Disturb them as little as possible for several days until they have grown into the confidence that they are in the hands of friends. Try feeding with small bits of tempting prepared fishfoods, small earthworms, white worms (see page 140), particles of canned shrimp or such other food as would seem to be particularly attractive to the kind of fish in question. If everything else fails it will be found that nearly all small fishes will eat live daphnia (figure 120).

A very good practice is to place new wild fish with suitable domesticated ones. They will then learn new ways and to eat new foods surprisingly soon.

*Chapter Eight*

# Marine Aquaria

The maintenance of a marine aquarium is really much simpler than is generally supposed. If aquarium lovers realized the great charm and the unlimited possibilities of a marine tank, there can be no doubt many more would interest themselves in this particular form of the hobby. It is safe to say that not a score of persons in America at this time have saltwater aquaria, although when once established they are as easily kept as the freshwater kinds. Then, too, there is the fascination of collecting from a field of inexhaustible variety, giving the student always something new to work on, with the ever-present possibility of discovering some fact of value to science or to his fellow aquarist. To those living within easy journey to the shore is the added attraction of the trip to the seaside, the pleasures of which are doubled by the pursuit of such a delightful and absorbing study.

**Aeration.** There are just a few points of radical difference between the fresh and saltwater aquaria. We have carefully pointed out the oxygenating value of aquatic plants, and shown how their work is necessary to a "balanced" or reciprocating aquarium. This factor must be left out of consideration in the saltwater aquarium, for marine plants perform this function to so small a degree as to become unimportant. The Ulva, or sea lettuce, is the most satisfactory of the easily obtained plants. It has been known to do well for quite long periods. A few bits of cork placed beneath will cause it to float to the top, where it looks and does best, at the same time shading the water. The beautiful Actiniæ, or Sea Anemones, which are flower-formed animals, present a bewildering array of form and color far surpassing any freshwater plants. These were once supposed to form a connecting link between the animal and vegetable worlds, but this is an error, the beautiful creatures belonging purely to the animal kingdom. Other beautiful attached animals also make up for the lack of vegetable life as far as appearance is concerned.

For the lack of oxygen from plants we have either to depend upon mechanical processes, or to substantially reduce our number of aquarium

inmates. The surface of the water takes up enough oxygen to maintain a few animals, but if our ideas are more ambitious it will be best to install an air pump such as referred to on page 11. This will more than compensate for any plant deficiency, especially if the air is liberated in very small bubbles. In the case of large marine aquaria where the water is constantly pumped out, filtered and returned, the oxygenating is accomplished by a very simple and, at the same time, clever device. The water is discharged with some force from a small pipe into the open end of another pipe just enough larger that the water discharge pipe will fit loosely in it. The second pipe is the liberator, and is carried to the bottom of the aquarium, where it is bent to a right-angle so as to shoot the air somewhat horizontally across the aquarium. If the aquarium is very deep (3 to 5 feet), the intake of liberator pipe should extend about 8 inches above the surface of the aquarium. Otherwise the air in the column of water in the liberator pipe would make it so light that it would back up instead of discharging in the bottom of the aquarium. In shallower aquaria the liberator pipe will not need to stand so high above water-level. By this method the air bubbles are mostly very minute, producing the effect, from a little distance, of smoke. The high specific gravity of marine water enables us to break up the air much finer than in freshwater.

**Marine Aquaria.** While it may not always be possible to entirely avoid having metal come into contact with the water of the marine aquarium, this risk should be reduced to a minimum. Copper, brass and zinc are particularly dangerous. The metal now coming into use, Monel metal, is not entirely free from copper, but, on the whole, is very satisfactory, and has the advantage of great strength as well as a pleasing light color. Marine bronze is also good and not so expensive as Monel. Iron pipes and valves lined with lead are now made, especially for resisting chemicals. These are very fine for carrying marine water to and from the aquarium. For the aquarist working on a comparatively small scale, lead pipe is best.

With the all-glass aquarium we have no metal problem to contend with. Aquaria of the smaller sizes are satisfactory for marine purposes if not overstocked. In the executive officers of the Battery Park Aquarium in New York City, they have in successful operation a number of jar aquaria, one of them having continued without interruption, except for change of animals, since 1900. This should give reassurance to those who hesitate to establish marine aquaria.

In using metal-framed aquaria a narrow strip of glass should be placed over the cement in the corners. A recent improvement is a glass rod of suitable diameter, say about one-quarter inch. This can be pressed through the soft cement all the way to the glass and the surplus cement

wiped away, making a substantial, quick and neat result. The disadvantage of glass strips is that no thin glass is straight, the bend always making an unsatisfactory job. Round rods are better in this respect.

**Lighting.** Another radical difference from the freshwater aquarium is that the marine aquarium requires considerably less light. When we see such intense light at the shore, it is difficult to realize that only a few feet down the light is so absorbed as to produce a very subdued effect; yet such is the case. If a moderately strong light is kept on marine water it will quickly turn green. To clear it will take several weeks of standing in the dark. Requiring only a weak light should, in many instances, prove a strong recommendation for the keeping of a marine aquarium where one has insufficient light for the successful development of freshwater plants.

**Strength of Marine Water.** For some reason not understood, pure ocean water is not as successful in the aquarium as that which has been somewhat diluted. The reason may be that while the fishes can successfully withstand the change to weaker water, many of their microscopic enemies are unable to do so—exactly the reverse of the theory of treating freshwater fishes with a saltwater solution. Be the theory what it may, experienced marine aquarists have obtained better results with diluted water in still aquaria. Naturally, if new seawater can be continuously pumped in, nothing could be better, particularly as this contains the desirable small food otherwise difficult or impossible to supply.

A hydrometer for testing the strength of salt in the aquarium water should be provided. Natural seawater has a strength of 1.023 to 1.031. If this is reduced to about 1.020, the animals will do better than at full strength. It should not go below 1.017, nor above 1.022.

Having established a certain water-level at a proper hydrometer strength, it ought to be maintained at that point by the addition of pure freshwater, never using marine water to make up for evaporation. The salts do not evaporate, but concentrate, and soon the aquarium would be in the lifeless condition of the Dead Sea or Salt Lake. A glass cover will prevent some evaporation, but if an air pump is used, some evaporation will be inevitable. No trouble will be experienced if the water is kept to a level, as suggested, by the addition of freshwater.

**Shipping Seawater.** If seawater must be shipped, careful consideration should be given to the kind of carriers used. The action of saltwater on zinc, copper, brass and iron is rapid, the resultant chemical action charging the water with poisonous metallic salts. Of the metals mentioned, iron is the least injurious and zinc the most, on account of the rapidity of chemical action of salt on this metal. Galvanized iron is to be avoided, as it is zinc-plated. The best metal in which to ship is tin. This, or any other metal, should first receive a coating of asphaltum

varnish. Even galvanized iron when asphaltum-coated is safe for journeys of moderate length, but the asphaltum will eventually chip off and the pail or can should be carefully looked over each time before using. It might be well to say here that the life of tin pails for any water will last much longer if coated with asphaltum varnish. A thin coat spread evenly lasts better than a thick one.

The very best water-shipping medium is a protected glass bottle or carboy. Arrangements can usually be made to rent or borrow a few of these from drinking-water concerns. If possible the water should be taken from several miles out at sea and not near the mouth of any large river. Clear seawater may be stored indefinitely in carboys in a subdued light, although it would be better to first filter it to remove the larger microscopic life.

**Artificial Seawater.** Experience varies regarding the use of artificial seawater. This may be due to difference in the degree of purity of chemicals used or care in their mixing. The author has not been particularly successful with artificial marine water, although some writers claim it to be better than ocean water because of its freedom from impurities and marine bacteria. The following is a correct working formula for artificial seawater. There are other elements in the ocean, but in such small quantities as to be negligible for our purposes:

| | | | | |
|---|---|---|---|---|
| Sodium chloride (Tablesalt) | 2 lb. | 8℥. | 2℥. | 18 gr. |
| Magnesium chloride | | 3℥. | 5℥. | 13 gr. |
| Magnesium sulphate | | 2℥. | 3ʒ. 1℈ | 8 gr. |
| Potassium sulphate | | | 5ʒ. 2℈ | 10 gr. |

and sufficient wellwater to bring the whole to ten gallons.

These proportions of salts, expressed in the Metric system, would be:

| | |
|---|---|
| Sodium chloride | 663 grams. |
| Magnesium chloride | 75 " |
| Magnesium sulphate | 50 " |
| Potassium sulphate | 15 " |

Added to 25 litres of wellwater.

For chemical reasons the salts should each be dissolved separately and enough water finally added to make ten gallons. Any good drinking water will do to mix with, although distilled water is not to be recommended because of its total lack of mineral content. Turk's Island salt is evaporated seawater and has been successfully used by the Government at Washington, although reports from other authorities are not so favorable. In mixing this or in preparing the foregoing artificial water, the final test for strength should be by hydrometer as previously directed. As chemicals vary in strength and in weight owing to different degrees of moisture, the hydrometer used in solutions of about 60° Fahrenheit furnishes the only accurate gauge.

Newly made artificial marine water ought not be used for several days, but be given a little time to ripen. An occasional stirring helps the process.

**Cleaning Marine Water.** It is desirable to keep the marine aquarium crystal-clear, both for the benefit of the inmates and the pleasure of the observer. To this end several factors must be borne in mind. Start with clear water. Do not overcrowd nor overfeed. *Use only subdued light.* Quickly remove decaying plants, dead mussels, anemones, etc. Occasionally siphon off the bottom (see page 228) and, after settling, pour back the clear water or return through filter. Very little loss of water is occasioned if the dregs are thrown away after water has settled, particularly if a tall jar is used. The filter arrangement described on page 233 is very desirable for the marine aquarium.

**Temperature.** This matter depends very largely upon the climate from which the aquarium inhabitants come. For this reason it is not well to mix animals of tropical and temperate zones. Many of the tropical fishes come north in summer and can successfully withstand a temperature of 62° F., but in the confines of an aquarium they will not prosper in the lower temperatures required by the fishes of our own climate. Tropical fishes are happy in a temperature ranging from 68° to 75°. Some of them can succeed when it is even warmer, but it becomes difficult to satisfactorily oxygenate the water.

Fishes and other marine animals of the temperate zone prefer a range from 55° to 68°. It will be noted that the tropicals and temperates meet at 68°, so if the attempt is made to mix them, this is the temperature that should be closely adhered to.

**Collecting Specimens.** The best places for collecting a miscellaneous assortment of marine animals are the back bays, pools, pockets, marshes and small streams where the ocean overflows at high tide and recedes from at low. Rocky coasts furnish particularly fertile fields for the aquatic hunter, and those of New England offer rich attractions in varied and wonderfully beautiful vegetation. Wood's Hole is a particularly famed point for all sorts of marine naturalists and collectors. However, anybody can go to the beach nearest home and gather material that will well repay for the effort. Two persons in bathing suits operating a seine 4 by 14 feet (see page 99) will be surprisingly successful right in the surf anywhere. As before stated, the little sheltered places, pools around breakwaters, piers and rocks should be thoroughly investigated by hand and net. As with freshwater, let the collector not be too ambitious for numbers. *It is better to get a few good specimens home alive and well than have a bucketful of dead and dying.* Unfortunately for those inland there is nobody at the present time in America making a commer-

cial business of marine collections for the household aquarium. We have reason to believe this could soon be developed into a profitable business, such as has been done by many in Europe. Germany has thousands of successful marine aquaria stocked mostly by dealers.

Tropical marine fishes are of dazzling beauty, a fact enthusiastically attested by those visiting any of our large American public aquaria, or by those so fortunate as to travel in Bermuda, or to have seen the beautiful marine aquarium at Miami, Florida. Most of our tropical specimens are collected at Bermuda and at Key West, Florida. The various kinds of kelp and coral fishes make aquarium specimens of such bewitching beauty that any attempted word-description of them would appear extravagant. Anyone wishing to make a collection should employ a local fisherman at the collecting point who knows the haunts and ways of the fishes, and who understands the danger of sudden tropical storms. Such collections should be shipped in a liberal quantity of water and artificially aerated by pump or pouring whenever the train is still for more than fifteen minutes. On shipboard, new water of the proper temperature should be frequently given.

**Stocking the Aquarium.** Perhaps we can repeat to advantage that it is better to under- than to over-stock the aquarium. This is particularly true of the marine aquarium, first, because if we spoil the water by dead animals it is some trouble to obtain more, and second, because the animals are used to more oxygen in the vast ocean than can be had in a crowded aquarium.

Extra vigilance needs to be exercised when the occupants are first introduced, as some of them may not survive the change.

It is best to start with some of the more hardy fishes, such as the marine killifish, to see whether the aquarium conditions are in proper working order. It will be time enough to branch out more elaborately after this is proven. The author some years ago received this same advice from a leading expert and, although loath to follow it, decided that advice worth asking for was worth following. This proved to be of value, for the killifish were all dead in a few days, and the same would have been true of more valuable specimens.

Anemones and other creatures attached to rocks should, if possible, be placed in the aquarium without detaching. Low forms do better if handled with a dipper or spoon. Whether or not mussels are alive can be determined by tapping lightly on the shell with a small stick. In health the shell will promptly close. Gentle disturbances of the water will show whether anemones and other low forms are living, as they will respond by slight movements. Care on this point is of vital importance, as decomposition is very rapid.

**Sea Horses.** Owing to the vastness of the field we cannot here go into a detailed list of marine aquarium inhabitants, but we cannot pass the subject without special mention of those quaint fishes, sea horses (*Hippocampus*). Although appearing like some mythological animal in miniature, they are true fish. They make a very striking appearance in the aquarium, always attracting great attention. Their tails are prehensile and are used much the same as a monkey's, fastening themselves to twigs, bits of grass or any small object, ready to let go in a moment, swim a short distance and fasten somewhere else or perchance socially link tails with another. Their movements through the water might be described as being very sedate. Locomotion is produced mainly by vibration of the dorsal fin, the body being tipped forward at a slight angle. Although the movement through the water is not rapid, it has the appearance of being accomplished entirely without effort. The breeding habits of the sea horse are also most peculiar. The female develops an intromittent organ as the breeding season approaches, while the brood-pouch on the belly of the male becomes thickened and vascular. The fishes face each other, the female advances, places one or more eggs in the pouch of the male, retreats and repeats until the spawning is finished. When the eggs have hatched, the pouch splits slightly and he works the young out of it by gently rubbing against a firm surface. The young are as perfectly formed as the parents.

FIG. 119. SEA HORSE
*(Maximum size)*

Sea horses feed upon small marine crustacea about equal in size to daphnia. Some European aquarists claim to have gotten them to eat dried shrimp, but, so far as we are able to learn, nobody in America has been successful in this. Although different attempts have been made to induce them to eat daphnia, it has seldom been accomplished. The author was fortunate enough to persuade sea horses to modify their ideas to that extent, the process taking much patience. Daphnia can only live about 5 minutes in seawater, so at first they all die while the sea horses are apparently thinking the matter over. By repeated trials the smaller fishes finally started to eat, and the larger ones took the hint from the smaller. Shrimp will eat the dead daphnia, but if much is left over it should be quickly siphoned out or otherwise removed. Sea horses can, no

doubt, be brought to living in saltwater of a hydrometer strength of 1,017, which would probably increase the length of life of daphnia in the marine aquarium to 10 minutes or more. As these strange fishes usually eat by reaching out for food while attached by their tails to a piece of sea-weed, it is necessary to gently circulate the daphnia through the aquarium by the aeration system or other means.

These odd creatures are of world-wide distribution. On the Atlantic Coast they are more plentiful in September than at any other time, when they are often brought up clinging to fishermen's nets. Only one species occurs on our Atlantic Coast. This is the one shown in Fig. 119.

**Feeding in Marine Aquaria.** Practically all marine animals are carnivorous. Chopped oysters, clams, fish, worms, crab meat, scraped lean beef and shrimp form the principal articles of diet. Canned shrimp is convenient and usually very acceptable. As elsewhere stated, it can be had at all seasons. Little oyster crabs, either whole or cut up, make choice morsels for either fresh or saltwater fishes.

Anemones should have small bits of food offered them with forceps (shown on page 229), lightly touching their tentacles with the offering. Three times a week is often enough to feed these lower forms.

The fishes may be fed every day or two, according to temperature, always remembering that animal food not quickly eaten soon fouls the water.

It is rather surprising to find that many of the small marine fishes relish crisp lettuce leaves, finely chopped. This no doubt makes a beneficial change for them.

**Diseased Marine Fishes.** Very little is known about treating the ailments of marine fishes. As salt is the general cure-all for freshwater fishes, it has been discovered that less salt is the best general treatment for marine fishes that are out of condition. Short trials at hydrometer test 1.010 are beneficial, this, of course, being brought about gradually. Otherwise, we see no reason why animal parasites, injuries, etc., should not be treated the same as for freshwater fishes.

*Chapter Nine*

# Fish Foods

## PREPARED FISHFOODS

Nearly all aquarium fish naturally desire a variety of foods, and the nearer we can approximate Nature in this matter, the better will be our results. Whatever foods we employ we should always keep in mind the necessary balance of vegetable, animal and mineral content required. One of the poorest fishfoods obtainable is the white wafer usually sold in pet shops and drug stores. Of recent years many better foods have been placed on the market, most pet stores keeping at least one of them. They are granular in form, usually of a dark color and are composed of a mixture of dried insects, meat, fish roe, flour, codfish and other ingredients. Unless one needs a large quantity of fishfood it is better to purchase a prepared article of the sort described, rather than to undertake its manufacture.

A very good fishfood is puppy biscuit broken up and ground in a coffee mill to small sizes. This is cheaper than regular fishfood and is very satisfactory. It is used as a base by some dealers to which to add a few ingredients and then place it on the market under special labels. If one uses this biscuit in quantity it may be had cheaply in bushel lots from manufacturers who save broken pieces for this purpose and grind it to size.

A food used with considerable success is oatmeal prepared exactly as it comes to the breakfast table, containing the same amount of salt. This is especially recommended for feeding young fish when daphnia have become scarce. *The shape of a goldfish is permanently influenced in its body development in the first few months, and different methods of feeding produce, to a certain extent, different shapes.* The effect of oatmeal, fed plentifully, is to build the short, round body so generally desired. For fish under ten weeks old the oatmeal should be squeezed through cheesecloth to take out the kernels. Let the young fish have as much as they can eat all day, but let none remain over night. This does

not apply to fish in their second year or over, although oatmeal in much smaller quantity is good for them also.

An improvement on boiled oatmeal is secured by adding a moderate portion of powdered shrimp, dried fish roe, dried mussel flesh or powdered shredded codfish. For preparation of ingredients see page 129.

Dried bread crumbs make good food for goldfishes, or for vegetarian wild fishes, especially when Graham or whole wheat bread is used. If out of other fishfood this will be found a convenient and satisfactory substitute.

Practically all fishes enjoy scrambled egg. Beyond doubt it is a fine change from dried foods, possessing both nutritive and laxative qualities. A little Cream of Wheat or Cream of Barley mixed in before scrambling increases the bulk and improves the balance of the food. For those who, like the author, had to learn to scramble an egg, we give the method: Beat the egg, add a bit of salt and a tablespoonful of milk or water to make it more tender. Stir in teaspoonful of the cereal if desired. Pour into saucepan which had been thinly greased with butter and place over a moderate fire, stirring rapidly to prevent sticking. In feeding it should be somewhat broken up. The slight grease on the water does no harm and soon disappears. The mixed egg may be rendered into greaseless flakes by slowly pouring into boiling water while stirring. Add a little salt to the water, as well as the egg. Gather flakes by pouring through tea-strainer.

Finely chopped crisp lettuce leaves are eagerly taken by many fishes, no doubt to their benefit.

Boiled spinach as prepared for the table, chopped finely, is enjoyed by many aquarium fishes, especially goldfishes. It seems to have a distinct laxative effect.

In feeding any kind of dried granular food it is best to use small sizes. Water causes the grains to swell considerably. This sometimes produces indigestion when the food swells after being swallowed. Some fanciers scald dry food just before feeding, which is no doubt a good practice.

It might be well to repeat here that the use in the aquarium of pebbles without sand is inadvisable because granular food lodges in the stones, where it cannot be reached by the fishes, eventually decomposing and fouling the water.

Dried mussel flesh in powdered form is now obtainable. It may be used either without preparation or as an ingredient in a combination food, or it can be moistened, baked and ground to size. Those who have tried it speak well of it. The price is quite low.

For those wishing to make a general fishfood suitable for all except strictly carnivorous fishes, the following recipe will be found to be very good:

Quarter tumbler powdered cod
Three-quarters tumbler powdered shrimp
Three tumblers flour
One teaspoonful Epsom salts
Three teaspoonfuls baking powder
Three teaspoonfuls powdered chalk

Add two raw eggs and sufficient water to make the mixture into the usual consistency of bread dough. Place in pan and bake like bread in oven. When properly baked allow to cool and cut into thin slices. After thoroughly drying slices, grind in coffee mill and sift into desired sizes. *Keep all dry fishfoods well secured in bottles or other actually tight receptacles.* Moths, flies and other insects gain a foothold and soon turn the food into a mass of worms and worthless dirt. If one has a large stock of such food it is a good plan to store it in the coldest possible place over winter, which will either kill or reduce the activity of the insects.

In above recipe the cod is prepared by purchasing a package of shredded cod, drying in a slow oven and grinding fine in a coffee mill. Dried shrimp may be had at Chinese grocery stores. It needs to be broken in pieces, put through a coarse setting of the mill, then well dried for a few days and lastly ground fine. A fine grade of dried shrimp ready for grinding is obtainable from German dealers at low cost. There are several wholesalers in New Orleans, Louisiana.

Whole wheat flour is preferable to white flour.

Powdered cuttlebone or finely ground eggshell may be used instead of chalk.

Those desiring to experiment on a food according to their own ideas of ingredients and proportions may safely use any of the following items, in addition to those already mentioned: Pea flour, rice flour, rye flour, vermicelli, boiled fish, boiled yellow of egg, fine corn meal, ant eggs, chopped earthworms, water crackers, dried bread, dried blood, chopped meal worms, dried mussel flesh, dried and powdered lettuce leaves, dried fish roe and dried daphnia. In preparing the latter two ingredients they should be parboiled with a moderate amount of salt, then placed in cheesecloth; water squeezed out, spread out thin on tin plates and dried quickly in the sun or slow oven. The drying must be thorough and quick. In drying it will be found that the shrinkage in volume will be very great. It should, therefore, be remembered that these ingredients are highly concentrated and be used accordingly. The same is true of dried blood, which may be purchased of seedsmen.

Here is a simple but good formula in use by the author: Two tumblers powdered puppy biscuit, half tumbler powdered mussel flesh, quarter tumbler powdered codfish, two level teaspoons powdered chalk. Mix well and add scalding water to make a thick paste. Spread out thinly to dry on pie plates or other tin. Breaking into small pieces when partly dry helps the drying. When bone dry, grind to size. The author prefers slow oven drying to sun drying because there is less chance of fly eggs being deposited in the food. On the other hand too much oven heat drives some of the virtue out of the ingredients.

An important point about such foods is this: If a quantity is made to last a considerable time, only that part of it should be ground up that will be used in a few months. In coarse pieces it is much less liable to attack by insects and their larvæ.

Dried fishfoods should be sifted through suitable screens to sizes desired for use. There is always a considerable amount of fine powder which is declined by many of the larger fishes, and which is liable to do harm unless found by the snails or other scavengers. The powder and very small grains can be fed to the young stock, as well as to a tank of breeding snails.

When fish have been without fresh or living food for some time it is well to occasionally give them a small quantity of dark, soft part of oysters, chopped and slightly rinsed. Fresh shrimp, obtainable in most fish markets in winter, if passed through a fine meat chopper, makes an excellent change of diet. Canned shrimp has comē to be a fishfood of decided value. Several of the fishes which otherwise demand live food take this readily and thrive on it, notably *Pterophyllum scalare* and the Banded Sunfish, the only other prepared food these two seem to relish being scrambled egg. This is something of a coincidence, as a similarity is often noted between the general appearance and movements of these really very different fishes. After opening a can of shrimp keep contents dry in a covered saucer in refrigerator. It keeps about three days.

A crushed oyster crab suspended from a thread makes a choice tidbit for small tropical fishes to pick at.

## LIVING FISHFOODS

It may safely be said in general that fishes do better on living foods than on an artificially prepared diet. The difference seems to be about the same as that between canned and fresh food in our own experience. The living foods which are really of practical

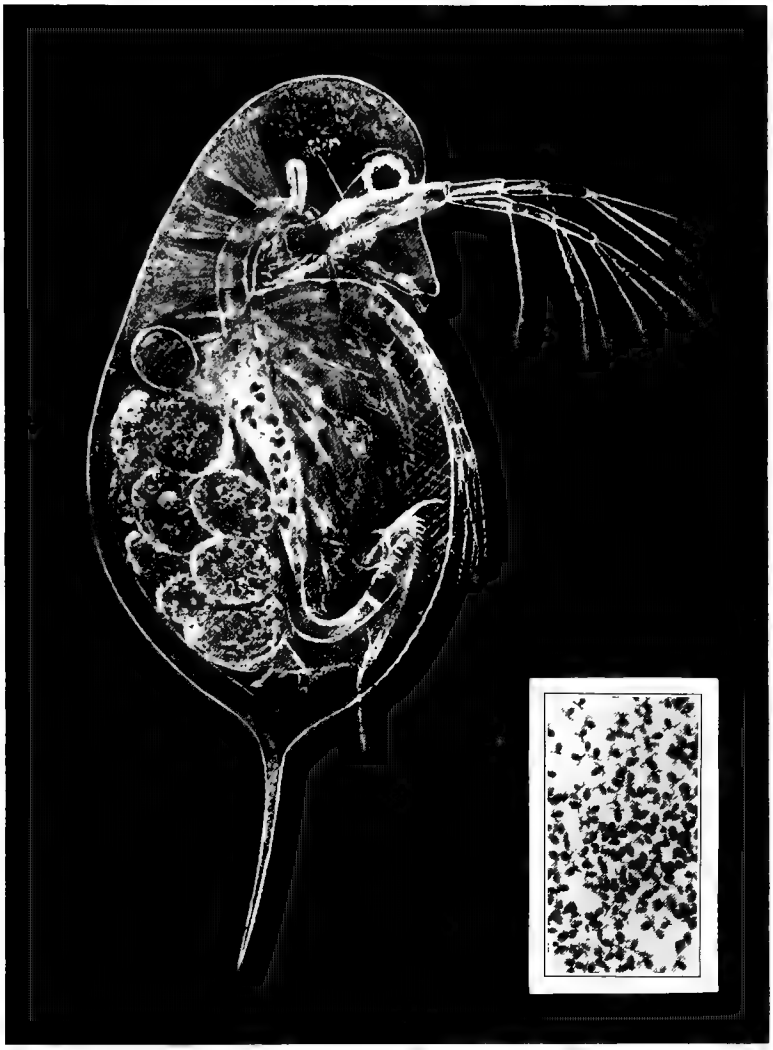


FIG. 120. DAPHNE

A photo-micrograph of the little crustacean of supreme importance as food for young fishes, especially the goldfish. They are taken greedily by practically all the smaller freshwater fishes. Being only the size of a pin-head, it takes a few millions of them to satisfy the appetite of several large goldfishes.

The ovals in the body are eggs, which are carried until hatched. Fishes too small to eat an adult daphne follow it around waiting for it to drop the young. The branched arms are for swimming and gathering food, which is vegetable in character.

The inset shows a characteristic life-size group of daphnia, presented mainly in the interest of numerous readers who would like to collect the "bugs," but who are unable to identify them from Fig. 122 and our limited word description.

FIG. 121. PRIZEWINNING SCALELESS TELESCOPE GOLDFISH
*(Reduced one-quarter)*

This fish won the Diploma of Honor in 1907 as the best fish (any class) owned. Although no special attention was paid to "broadtails" at this time, there were quite a number of them, this being a good specimen.

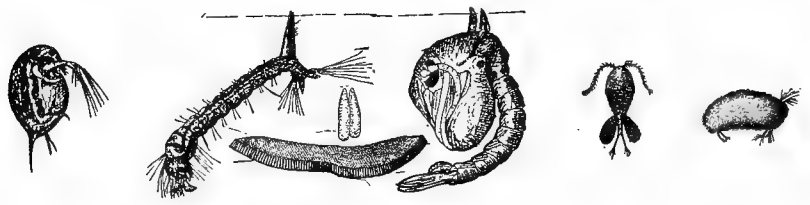
value and which are so universally distributed as to make their mention here of value are few in number. They are infusoria, daphnia, mosquito larvæ, flies and earthworms.

**Earthworms.** Also known as angleworms, gardenworms, rainworms and groundworms. It would be difficult to overstate the value of these worms to aquarium fishes, especially to highly developed goldfishes. They are a one hundred per cent. natural food and are somewhat laxative in effect. Correspondents have many times asked the author to diagnose their fish troubles when all conditions are apparently correct. The usual advice is to try feeding earthworms if possible, and in a majority of cases the trouble disappears. Worms from one to three inches long are best. The large sizes become tough. Personal judgment will have to be used as to whether to cut the worms, and to what sizes. The pieces should be easily swallowed. It is unnecessary to wash or scald the worms, notwithstanding some contrary theories on the subject. Fishes can apparently eat more worms without injury to themselves than they can of prepared foods, but this is also true of the other live foods. All they can consume at a meal does not appear to be too much. The difficulty is more likely to be in keeping up the supply, especially over winter. One should collect as large a stock as possible in the early fall, storing in damp, loose earth in a large box kept cool but not cold. Occasional bits of mashed potato placed in the soil will be eaten by the worms. It should be without salt, preferably.

There are two principal kinds of angleworms, the earthworm or gardenworm here referred to, which is of a solid pinkish red color, and the dungworm, the body of which is marked with red rings, and which exudes an unpleasant yellow secretion when handled or cut. These are not so tempting as bait for wild fishes, and the aquarium fishes show the same preference for the gardenworm. The dungworm is found in manure piles and in heavily manured soil. It has the advantage of being more readily obtained in winter. By placing in moist sphagnum or other moss for a few days it is claimed they lose the unpleasant odor. The writer cannot vouch for this. Earthworms form a satisfactory substitute for daphnia in raising goldfishes if one has the opportunity of securing a large and continuous supply, this of course meaning after the fish is large enough to take finely chopped pieces, which should be in about six weeks.

**Daphnia.** Among the breeders of aquarium fishes, Daphnia holds the supreme place of importance as a fish food. The fish will consume great quantities of these crustaceans without suffering the

usual effects of being overfed. A certain degree of care must be exercised not to place so much daphnia into the aquarium as to suffocate the fish. Daphnia breathe the free oxygen in water the same as do fish and therefore too many will soon exhaust oxygen from water. The fish will die of suffocation sooner than the daphnia. Many beginners have lost fish in this way. A good practice is to give the fish all they can eat in about a quarter of an hour and still leave some few daphnia swimming about.



122 123 124 125

FIG. 122. DAPHNIA *(Greatly enlarged)*
FIG. 123
MOSQUITO LARVA *(Greatly enlarged)*
EGG RAFT AND INDIVIDUAL EGGS *(Greatly enlarged)*
PUPA BEFORE TRANSFORMING TO MOSQUITO *(Greatly enlarged)*
FIG. 124. CYCLOPS *(Greatly enlarged)*
FIG. 125. CYPRIS *(Greatly enlarged)*

A popular name for daphnia is "ditch fleas." This will give a hint as to their appearance, as they are approximately the size and shape of a flea, except that they have two rather long, branched swimming arms which are always in motion and which give the animal a sort of hopping motion through the water. Without this perpetual swimming the daphnia would sink to the bottom, as they are heavier than water and have no air bladder. A greatly magnified illustration is shown in Fig. 83.

Daphnia (pronounced "daffney" in the vernacular) are known among fish breeders as "insects," but they are really not such, being perfect freshwater crustaceans as much as a crayfish. The shell, though soft, contains mineral elements which are very desirable, while the flesh itself is easily digested and nutritious. This little creature is found in freshwater nearly all over the world, principally in still pools where there are no fish. For the practical purpose of catching daphnia in sufficient quantities to feed fish the collector should hunt pools in which there is considerable animal or vegetable decomposition in process. Such conditions are found to perfection in the pools on the ground where city refuse is dumped. When the conditions are favorable the daphnia rise to the surface in such quantities as to color the water, the usual color being a

rusty red. The color varies from this to olive and gray. Fish breeders like to see the daphnia as bright a red as possible, although it is an open question as to whether the red ones are better food. The same individuals will alternate in color, probably due to a difference in food. Usually these crustaceans are not so plentiful as to color the water, and we have to use our eyes more closely to locate them. The collector should provide himself with a cheesecloth net about 12 inches in diameter and 15 inches deep, fastened on a pole or jointed handle not less than 6 feet long. If an examination of the water does not at first reveal any daphnia, the net should be tried anyhow, using a gentle stirring motion back and forth, to stir up the bottom water. Daphnia have very peculiar habits, and one can never tell from day to day just how they are to be found, so that the collector will always have to depend somewhat on his own resources. If an examination of the net after dipping for a few minutes shows nothing, try elsewhere. If a swarm has been located do not take too many into the net at one time, as the weight of the top ones crushes those beneath. A mass that would bulk about equivalent to an orange should not be exceeded. Reverse net into pail of water and repeat until the water is thick with daphnia. In cool weather the pail may be carried in this crowded condition for about an hour. If the day is hot, a piece of ice should be added to the water—enough to keep temperature down until home is reached. Newspaper wrapped about the can helps the ice melt more slowly. As soon as home is reached, add fresh water to the pail and transfer the daphnia to tubs or tanks kept for the purpose. Like fish, the water they are in should have as much air surface as possible. Do not try to keep too many in stock, as overcrowding suffocates a number and these, in turn, decomposing, kill the living ones. The cooler they are kept, the longer they will last. In hot weather they can be kept about three days and in October about two weeks.

In transferring from carrying pails to stock tanks it is well to first pour in small portions to a white enamel basin which enables one to carefully go over the catch and remove any insect enemies. (See page 143.) If the daphnia are too thick to be readily examined, some water should be added. A little care in keeping out the enemies at the start is energy well invested. Most of the enemies and the dirt may be sifted out (under water) by using a screen just large enough for the daphnia to pass through.

A beginner will do well to make the acquaintance of an experienced daphnia collector and go along with him on a trip. There are now aquarium societies in many of the large cities, part of their activities being the dissemination of such knowledge. All those interested should have active or corresponding membership in such an organization.

All beginners seem to develop the idea that sufficient daphnia can be raised in a tub or trough to feed with. This has been tried many times, but never with any degree of success. If the daphnia pools are too far distant to make collecting practicable it is best to try to inoculate some suitable pond nearby, but there should be no fish in the pond. Daphnia, if not crowded, may be shipped quite a distance.

The practical way to raise daphnia for food purposes is described in the chapter on Wholesale Breeding (page 64).

**A method of carrying live food** which is growing in favor is to crate them (without water) in layers in a tin box. Frames about 10 x 12 inches, made of ⅞-in. square wood, are covered on one side with thin muslin. These are floated in the water, the daphnia dropped in, spread out evenly and placed in carrying box, which, of course, needs to be airtight. The

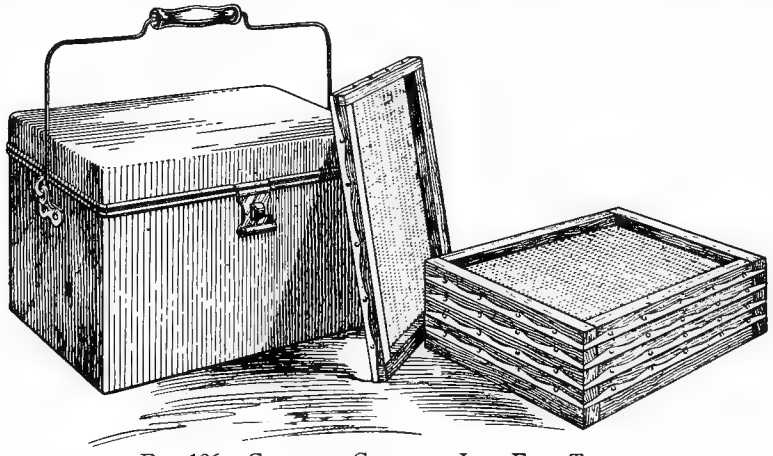


FIG. 126. CARRYING CASE AND LIVE-FOOD TRAYS

number of layers is only limited by the depth of the box. Daphnia may be spread to a depth of about ⅛-inch, but mosquito larvæ may be piled to ¼-inch without injury. This method avoids carrying the great weight of water needed in collecting pails, and, in the experience of the writer, gets a higher percentage of the food home alive. Spread out thinly and in a cool temperature in October they have been kept alive in a moist condition on the rafts in storage for two days. The only disadvantage is the chance that the rafts may blow away while collecting. If the rafts are dried immediately after using and all daphnia cleaned out from between the fabric and the wood, they will last several seasons. The bottom frame is usually blank, so that the slightly sagging cloth on the one above will have drainage and not stand in the shallow water bound to collect in the bottom of can. The

daphnia should be kept only moist, or else in ample water. Drainage could, of course, be had by placing small blocks on the bottom frame.

**Cyclops.** We list these crustaceans because they are so widely distributed and because they are actually a food for those fishes that can catch them. A little smaller than daphnia, they move through the water in straight lines with a jumping motion. The shape is also different, as will be noted in the illustration. The two tabs at the tail are not always present, these being egg pouches which drop off. Cyclops are carnivorous. They devour infusoria. It is also a well established belief that they kill newly hatched fishes, possibly by getting into the gills, so that there is some doubt as to whether this animal should be listed as a fishfood or an enemy. They are introduced into the aquarium with daphnia and are seldom entirely eradicated except by small, active fishes.

**Flies.** While it is usually a difficult matter catching enough flies to feed fishes with, they are really a splendid food and should be used if opportunity offers. Fishes soon get to looking for these delicate morsels after sampling them a few times. Cutting the wings off with scissors is undoubtedly painless and makes the fly "stay put" on the water. Those freshly killed with "fly swatters" are as good as live flies, except for feeding lizards, etc.

Small crickets and small soft grasshoppers are also very acceptable to fishes able to eat them.

**Mosquito Larvæ.** These are often known as wrigglers and are familiar to those who have looked in rain barrels. Their bodies are straight and about a quarter of an inch long. Most of them rest at an angle to the surface of the water as shown in Fig 123 with head down, and are always ready to "wriggle" to the bottom at the first sign of danger. From midsummer on they may be found in still water where there are no fish. They are taken in the same manner as daphnia, except that one has to get them with a quick sweep before they can get down into the water. They can usually be seen floating together in black masses. The city entomologist, whose duty it is to rid a community of mosquitoes, will give information as to where they may be obtained and will be glad to have his burdens lightened by the fish breeder.

Mosquito larvæ may be termed a special food. It can only be had in large quantities towards the middle and end of summer, and is only suited to the fish large enough to easily swallow it. As a food for putting growth on fish an inch long or over it probably has no equal. The main drawback to these larvæ is that those not eaten quickly by the fish are liable to turn to mosquitoes. This difficulty can be minimized by proper management. Keep the stock of larvæ in a tank covered by a

sheet of glass, leaving about two inches at one end not covered. Over this open space place a piece of mosquito netting, drawing it up several inches over the opening into a sort of inverted bag. Then draw a string around top edge of tank to fasten netting down. As the mosquitoes hatch they will fly upward into the netting bag, where they may be mashed before lifting the lid to get larvæ for the fish. The author usually keeps these larvæ in a 5-gallon drinking water bottle, half filled, and with a bit of netting over the top, secured by a rubber band. To use larvæ, remove netting, place hand over opening and quickly invert bottle. The larvæ in their excitement swim downwards into neck of bottle. Release hand and empty the required quantity. Replace netting and add water to make up to former level. When most of the larvæ have been used and a number of mosquitoes remain in the bottle, fill with water (through the netting) and they will be drowned. A netting bag trap secured on neck of bottle will also catch the majority of the mosquitoes.

The larvæ should be kept out of the sun and in as cool a situation as possible so as to retard the hatching of larvæ into mosquitoes. They will stand great crowding, their only requirement being that there is room for them all to get to the surface at one time, for they breathe air. This is one advantage in placing larvæ with fish, for, unlike daphnia, they extract no oxygen from the water. By feeding them to the fish we not only do well for the fish, but serve the interests of humanity by cutting down the mosquito pest. In open pools goldfishes are one of the best agents in keeping the neighborhood free of mosquitoes. Unfortunately the mosquito larvæ can live and hatch in temporary pools and in water too foul for any fish to survive in.

**Cypris.** Incorrectly known as "hardshell daphnia," cypris forms an important article of fish diet. These crustacea inhabit stangnant pools, particularly those well stocked with decomposing vegetal matter. Although capable of swimming freely they are more apt to remain close to the bottom, but more especially to decaying wood. They are of a dull, purplish black or reddish color about the size of an ordinary pin-head. Inexperienced observers frequently mistake them for daphnia. Fishes do not appear to be quite so fond of them as of daphnia, but they are a good second choice. They are extremely hardy and will withstand dense overcrowding in the foulest of water. Under favorable conditions cypris multiplies with astounding rapidity. It has been claimed that they devour spawn and young fishes. This is undoubtedly an error, but they do greatly annoy snails and eventually cause their death by getting into some inner recesses of the animal.

**Blood Worms.** In freshwater pools nearly everywhere can be found deep-red, jointed worms about half an inch long. See Figure 127. They usually stay at the bottom, living chiefly on decomposing vegetal matter. Often they will writhe their way awkwardly through the water in a series of figure eights. They are the larvæ of midges and form an important article of diet for our native fishes. They are often found in

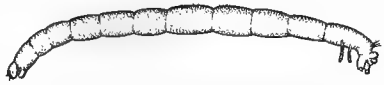


FIG. 127. BLOODWORM *(Enlarged four times)*

large numbers in daphnia pools and should always be taken when possible. If too large for the young fish, they make choice morsels for the older ones.

**Tubifex Worms.** These are small thread-like worms living in mud and sand. They form a tube or case below the surface, extending the upper ends of their bodies from this in search of small organic food,

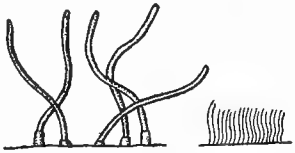


FIG. 128. TUBIFEX WORMS *(Magnified, and as they appear to the naked eye)*

causing a circulation of water about themselves by a constant weaving motion. When alarmed they draw back into the case. They are extensively cultivated in Europe as a food for tropical fishes. A similar variety is often introduced into goldfish aquaria when feeding daphnia, where they become an unsightly nuisance, for goldfishes cannot catch them. To get rid of them it is necessary to boil or renew the sand or else keep other fishes in the aquarium for a long time. The worms have to be eaten off many times before the stock dies. Germicides strong enough to kill them will also destroy the plants, as they can withdraw into the sand. Along the edges of ditches they are often so numerous as to make a solid rusty-red color. If they are scraped up together with the mud and then washed free they are greatly enjoyed by gold and tropical fishes, but it is inadvisable to introduce them where there is sand or soil.

FIG. 129. FRESHWATER SHRIMP *(Enlarged three times)*

**Fairy Shrimp** (*Gammarus*). While freshwater shrimp is not plentiful enough anywhere to feed in large quantities, it is a delicate morsel for

grown fishes and should be taken as opportunity offers. They are found principally in small streams, under stones and around decaying wood. Placed in a large aquarium or tank with plenty of vegetation they will multiply rapidly.

**Water-Asel** (*Asellus*) is found in still or slowly moving water, usually in the mud or clinging to vegetation. It cannot move rapidly

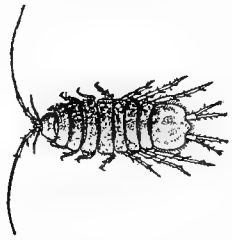


FIG. 130. WATER ASEL *(Enlarged three times)*

like Fairy Shrimp, but both are enemies of very small fry and both are greedily taken as food by larger aquarium fishes, although the shrimp move so rapidly that highly developed goldfishes have trouble in catching them.

**Infusoria and Rotifera.** Of prime importance as food for very small fishes are the Infusoria and other microscopic creatures of still water. Some idea of their minuteness may be had when it is pointed out that

FIG. 131
*Asplanchnopus myrmelco*

FIG. 132
*Pterodina patina*

FIG. 133
*Noteus quadracornis*

TYPICAL ROTIFERS *(Greatly magnified)*

they are the natural food of cyclops and other small crustaceans. All except the very largest of the infusorians will pass through ordinary cheesecloth nets, but silk bolting-cloth of fine texture will hold those which are large enough to be of real use. Further information on this point is contained on page 51. Other infusoria are shown in Fig. 223.

**Enchytrae.** These are thread-like small white worms usually bred in winter as a substitute for daphnia for feeding to tropical fishes. Goldfishes are also very fond of them, but it is a difficult matter to cultivate a sufficiently large quantity to satisfy the appetite of several goldfishes. For some of the smaller fishes requiring living food they are almost indispensable in winter.

The culture of these worms is quite easy and requires very little attention after the start is made. Many dealers and fanciers have a supply of enchytrae, from whom a stock can be procured at a slight expense. These are placed in ordinary garden soil from which all worms and larvæ have been carefully removed. Wooden or earthenware boxes about 15 inches long, 7 inches wide and 6 inches deep may be filled with the earth to a depth of 4 inches. A cover glass must be provided, this setting directly on the soil. Proper feeding is the principal keynote to success. They like thick sour milk, white bread, mashed boiled potato, cheese rinds, etc. In a box of this size, four or five small holes are dug out with a spoon, the food is placed therein and the earth replaced. This is done as often as the food is consumed and in three or four weeks the harvest of worms will be ready. Care should be taken not to overfeed, as this will sour the soil. The soil should be removed from the box about every two weeks, broken up, loosened and returned. This is considerably facilitated if about half the soil is composed of leaf mold. The breeding box does best in an average temperature of about 60 degrees Fahrenheit. Ants and bettles kill these worms, so they should be excluded if possible.

The worms are separated from the earth in a number of ways. If but a few are desired the simplest way is to remove two or three spoons full of soil and place in water just deep enough to cover. In a very short time the worms will come out of the soil and entangle themselves in a bunch near the surface of the water, when they may easily be collected.

Another much quicker method is to take a piece of cardboard (the cover of a shoe-box answers nicely), spreading out a quantity of soil and holding over a mild heat; this soon causes the worms to crawl to the top of the earth, from which they are removed. However, great care must be exercised that they are not injured by the heat, which would destroy them, for the fish prefer the live worms at all times. As soon as they appear and bunch on the surface of the earth, the heat should be removed.

Another method of separating the worms from soil is to place a portion of the earth in an enameled dish, pouring on sufficient water to cover soil, and placing a sheet of glass tightly over dish. Because this will prevent sufficient oxygen from penetrating the dirt or water, the enchytrae will promptly leave the soil, crawl up the sides of the dish and on the underside of the glass cover, clinging to same in a variety of entanglements. The cover can then be removed and the worms washed or scraped off and fed to the fish. This, of course, is a slow process, but by preparing an hour or so before it is desired to obtain the worms, an ample supply may be procured.

Still another way to remove them from the soil is to take a section of blotting paper, placing the earth on it, and in a short time it will be noticed that they will have gathered in a ring around the outer edge of the soil, free from the dirt.

It is not advisable to feed all of the worms thus obtained as, when a considerable number are placed in a tank at a single time, some are bound to escape from the bunch and, burying themselves in the gravel or sand, die and pollute the water. They can exist under water for about forty-eight hours and it has been noted that the larger specimens are usually the first to succumb.

**Mealworms.** These are rather hard, glossy, light brown worms about an inch long. They are good food for the hard-mouthed fishes, of fair size, such as the Sunfish and the Cichlids. Lizards thrive on them and they are about the only obtainable food to carry insectivorous reptiles and toads over the winter unless maintained in a hibernating condition. Pet stores sell them as bird food. They feed on bran or other meal in which they are kept. If undisturbed and kept in a liberal supply of bran they presently turn into small beetles which in turn lay eggs and hatch into a new and much larger stock of mealworms.

*Chapter Ten*

# Fish Enemies

Among the troubles that beset the fish culturists, not the least are caused by insects and their larvæ. This applies both to the propagator of food fishes and those interested in fancy aquarium pets. We use the term "insect" here in its popular sense and not according to exact scientific definition.

Some of these enemies are much more readily detected than others, but most of them may enter the rearing tanks when so small that detection is practically impossible. Wire screen or netting will keep out those that fly, or a large enemy in the water can be separated from daphnia or other living food by passing the "catch" through a fine wire gauze under water, but despite these precautions it is essential in the summer season to be ever on the lookout for any of the pests which may have gotten by our keenest observation. Fortunately for the aquarist, there are not many kinds of insect enemies with which he is actively concerned. There are only three, all of them being larvæ. While the others are none the less savage or fatal, they are not so often met with, or else are so easily detected that they are not such serious factors with which to reckon.

**Water Tiger.** This is the larva of the Predaceous Diving Beetle *(Dytiscus)*, itself also a very powerful but easily detected enemy. The Water Tiger is easily the most rapacious, savage and insatiable enemy

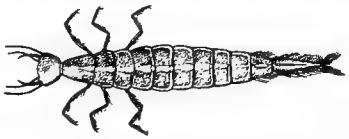


FIG. 134. WATER TIGER *(Life size)*

of young fishes. It does not wait for its prey to pass nearby, but adopts business-like methods of going after its unwary victims. The flat head is furnished with a strong pair of hollow mandibles, through

which it sucks enough blood to kill its victim and then wantonly goes after another. In this way a single individual may kill an entire hatching of fish over night. This larva can usually be recognized by its spindle-shaped body; flat, strong head; pale translucent brown color and a steady progress through the water, coming to the surface frequently to breathe a moment through the rear end. Although growing to a length of 2½ inches, at which time it attacks larger fishes and any small aquatic animals, it is the smaller sizes with which we are principally concerned. From a length of ¼ to 1 inch they are not so easily seen, but are capable of doing great mischief.

**Spearmouth.** While not quite so common as the Water Tiger, its habits are similar and it grows to an even larger size, reaching 3 inches. The body is thicker and the mandibles are shorter. From

FIG. 135. SPEARMOUTH *(Life size)*

the aquarist's standpoint both these larvæ could be classed as one. The Spearmouth is the larva of the large Water Scavenger Beetle *(Hydrophilus)*.

**Dragon-Fly Larvæ.** Almost everyone who raises fish outdoors is familiar with these unpleasant individuals. There are two reasons why they are difficult to altogether avoid. When newly hatched they

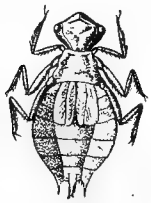


FIG. 136
NYMPH OF DRAGON FLY

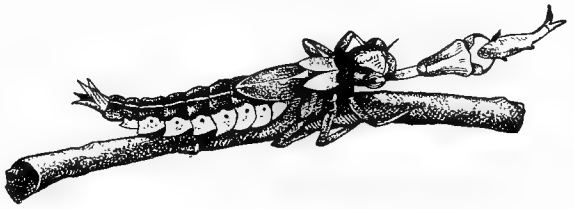


FIG. 137. DRAGON FLY LARVA CATCHING YOUNG FISH *(Life size)*

are very small and will go through the same strainer as daphnia; furthermore, the mother Dragon Fly *(Odonata)* is an excellent flier and may deposit her eggs in any body of water that provides proper facilities for her needs. These larvæ live more by their cunning than by any agility as swimmers. Waiting on a dirty pond-bottom or attached to sticks, aquatic grass or other object, they mark time until a victim comes within close reach. Then they quickly pounce forward, extend-

ing a vicious, pincer-like organ called the "mask," rarely missing the object of attack. The method of propulsion through the water is peculiar, being brought about by a series of expulsions of water from the hinder end. This enables them to make a very sudden leap towards a victim. The "mask," shown in Figure 137, when not in use is folded before and under the head. Dragon Fly larvæ are strictly carnivorous at all periods and will attack any pond creature reasonably near its own size. If given enough time a single individual will destroy an entire hatching of fishes, growing by what it feeds upon so as to be able to devour the remaining fishes which are also becoming larger.

**Predaceous Diving Beetle** *(Dytiscus)*. Fortunately this beetle is of such size that it can scarcely escape notice, especially as it is obliged to come to the surface for air, which it takes at the end of the abdomen. It is rapacious in extreme degree and is a good swimmer. A

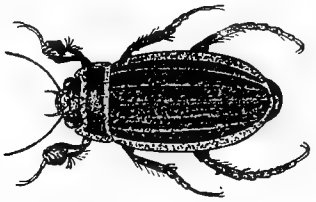


FIG. 138. PREDACEOUS DIVING BEETLE *(Life size)*

large specimen was once placed in an aquarium for observation. It so quickly attacked a goldfish that the scales fell in a small shower and the fish died before it could be rescued. The males may be distinguished by the ball-like development on the forelegs. They are usually of such a dark brown as to appear black, but are sometimes marked or bordered with yellow.

**Water Scavenger Beetle** *(Hydrophilidæ)*. We mention this beetle here because of its resemblance to the large predaceous diving beetle. It swims differently, using its legs alternately, while the diving beetle moves opposite pairs together. The Scavenger Beetle is also different in that it breathes at the surface from the mouth. Instead of long antennæ, they have palpi looking like club-shaped antennæ. This beetle lives chiefly on decomposing vegetal and animal matter, although taking soft living plants such as Nitella. It has been claimed to be predaceous, but there is doubt about their attacking fishes.

They have been kept in aquaria with them without doing damage. On general principles, however, it is best to exclude all beetles, large or small.

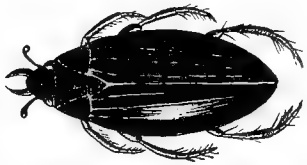
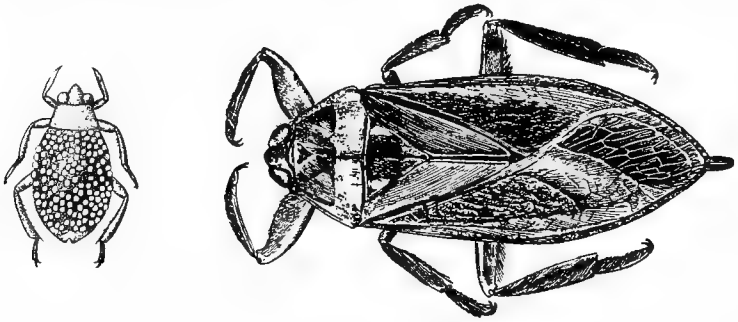


FIG. 139. WATER SCAVENGER BEETLE *(Life size)*

**Giant Water Bug** *(Belostomatidæ)*, also known as the Electric Light Bug, is one of our common bugs, both on land and in water. Flying clumsily but strongly before electric lights, or patiently awaiting a victim at the bottom of a pond, the bug is one and the same. They are fiercely predaceous and very powerful. The smaller sizes



140 **141**

FIGS. 140 AND 141. GIANT WATER BUGS *(B. serphus and B. americana)*. THE SMALLER A MALE WITH EGGS ON BACK *(Life size)*

are the more to be feared, as they are not so easily seen. While this is a vicious enemy, it is not one that frequently gets into the fish tank except by flight, and as only the adults fly they are easily detected by their size. In large outdoor rearing pools or lakes they are a very practical menace. The colors range from clear, dark reddish brown to dull olive. With some of the smaller genera, *Serphus* and *Zaitha* it was supposed that females lay the eggs on their own backs. Some writers have accepted this popular misconception without investigation. It has been fully established that the female fastens her eggs on the back of an unwilling male, who only submits to the indignity after a struggle.

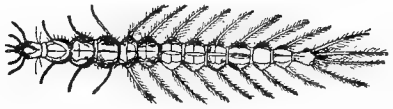
**Water Scorpion** *(Nepidæ)*. We have here another of the insects spending most of its time in aquatic dirt and rubbish awaiting inno-

cent passersby who, for their unwariness, will pay with their lives. Water scorpions depend upon their obscurity to get near their prey,

FIG. 142. WATER SCORPION *(Life size)*

which they quickly seize with their modified forelegs. While this insect is common enough to the naturalist, it is not one with which the fish-culturist need be seriously concerned.

**Whirligig Beetle** *(Gyrinidæ)*. This well-known beetle is common to many slow-flowing streams and pools, keeping up a perpetual movement on the surface of the water, on which it glides apparently



FIGS. 143 AND 144. WHIRLIGIG BEETLE AND LARVA *(Enlarged three times)*

without effort. On account of its size and shape it is often called the coffee bug. The breeder of fishes is not harassed by this insect, but occasionally an aquarist will be tempted to introduce one in a fish-tank. This is a mistake. They are predaceous and can inflict a severe bite. The larva, which is not so well known, is also predaceous. This little beetle when held in the hand emits a faint but pleasant odor.

**Water Strider** *(Hydrometridæ)*. Another of the predaceous aquatic insects is the Water Strider. Quite as well known as the

FIG. 145. WATER STRIDER *(Life size)*

Whirligig Beetle, it adopts somewhat the same methods of securing its prey, darting over the surface of the water, waiting for the stream to bring down some helpless insect victim that has fallen overboard. They are capable of catching young fishes which come to the surface.

**Mites** *(Hydrachna)*. These odd-looking little balls of intense red are sometimes placed in small tropical aquaria with fishes. This is in-

FIG. 146. WATER MITE *(Enlarged about four times)*

advisable, as they are parasitic. It is doubtful whether they actually kill their host. They are common in the still water of lily ponds.

**Hydra.** Although Hydra is not an insect, we include it here as an important enemy of young fishes. Hydra is a polyp which attaches itself to plants, stones or the sides of the aquarium. Being thread-like in appearance, it is apt to be overlooked, especially by the inexperienced. It is usually introduced with living food caught from

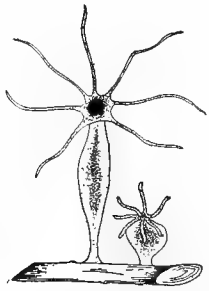


FIG. 147. HYDRA *(Greatly enlarged)*

pools. The spores are so small as to be unrecognizable, and therefore they cannot be avoided. The animal itself has a cylindrical body with from 5 to 12 tentacles surrounding a mouth. The shape varies so amazingly that an accurate description is difficult. The two figures shown are of the same individual. When alarmed the tentacles are entirely withdrawn, making recognition still more difficult. The figure at the left is the usual form when not alarmed. In this condition it reaches from ⅛ to ¼ inch in length, but the body may be considerably thinner if food is scarce.

Propagation is by budding, by spores and by division. If one of the tentacles be cut off it will develop into a perfect hydra.

They rapidly deplete an aquarium of daphnia and newly hatched fishes. When a school of fry under 5-16 inch long is disappearing without apparent cause, it will be well to take a sharp look for some harmless-looking hydra.

Hydra possess a poison which quickly stupefies their prey, and to fish large enough to eat the hydra this poison doubtless has an unpleasant taste. There is no fish known which will eat them. To get rid of this pest, remove all fish, snails, etc., from the tank and place in it one tablespoonful of household ammonia to five gallons of aquarium water. Allow this to stand for two hours, change water and replace fish. This treatment will not kill plants.

## LARGER ENEMIES OF FISHES

It should not be understood that the foregoing are the only serious enemies of pet fishes. In the greenhouse, outdoor pool, or even the library, misfortune is liable to descend in various guises. Chief among these are the cat, rat, muskrat, snake, heron, kingfisher and small boy. Fishes are also taken by the sandpiper, horned owl, crayfish, and blackbird. The latter specializes on picking out the eyes of telescope fishes if the water is near enough to the edge of tank for him to reach them. Frogs will eat fishes of nearly their own size. Slow-moving fancy goldfishes are easy prey for them and inexperienced fanciers have lost many of their best specimens through ignorance of this menace.

The owner of the fish will have to use his personal ingenuity to combat these enemies as occasion arises. The author must here content himself with pointing out the possible sources of trouble.

**Water Boatmen and Back Swimmers** *(Corixidæ* and *Notonectidæ)* are found everywhere in still or slow-moving water. A considerable injustice seems to have been done the Water Boatman by writers on the aquarium, including the author, who have accused it of being an active enemy of young fishes. Many goldfish breeders have

FIG. 148. WATER BOATMAN *(Slightly enlarged)*

remarked that they never knew Boatmen to do any harm. The author on this account conducted an exhaustive series of experiments, the outcome of which is the vindication of the suspect, notwithstanding eminent authorities to the contrary. Many hours and much eyesight have been wasted picking small Boatmen out of collections of live food. They are capable of inflicting a severe bite when handled, but this is not sufficient reason to assume that they are predaceous. Large hard-mouthed fishes like to eat them.

*Chapter Eleven*

# Fish Diseases and Their Treatment

Even in a state of Nature fishes are sometimes attacked by disease and parasitic enemies. It is little wonder, then, that aquarium fishes, weakened by inbreeding and kept under artificial conditions, should be subject to a number of maladies. The wonder is that the majority of the diseases can be so successfully treated, under the circumstances.

Half the battle is won by taking the trouble in time. The aquarist should always be on the alert to detect when his pets are a little out of condition. As elsewhere stated, this is shown by listless movements, loss of appetite, drooping dorsal fin (when the fish is in the habit of holding it erect), congested or frayed fins, white slime on body and bubbles in excrement. When a fish is even suspected of being in doubtful condition it should be observed carefully for a day or two, and, if improvement is not noted, given the required treatment—*promptly*.

Affected fishes should be immediately removed from their fellows. There is always the possibility that they are suffering from a contagious disease which may quickly spread. Great care should be exercised not to use the same nets in handling sick and well fishes unless they are sterilized after exposure to disease germs.

**Salt Treatment.** In Nature the sick fish seeks brackish water or saline earths, and we cannot do better than to follow this hint. Most of the disease-producing bacteria of fresh water are unable to live in moderate salt solutions. The point, then, is to find the strength of solution that will kill the bacteria without injuring the fish. As the salt treatment is the main one for curable diseases, we shall go into this at some length.

Kind of Salt. Ordinary table salt is likely to contain chemicals to prevent caking in damp weather. These are injurious to fishes. However, if no other salt is obtainable, this can be made to do. The

very best medicine is real sea water, properly diluted. The next best is Turk's Island salt, which is the residue from evaporated sea water. Where the fish shows a tendency to constipation, one-quarter of the salt content may be Epsom salts. Some writers recommend this addition in all cases.

Strength of Salt Solution. Common practice among the uninformed is to throw a sick fish into a strong brine solution, leaving it there a few minutes until it shows signs of expiring. This treatment is perhaps better than none at all, but is unnecessarily severe and is not so successful as milder solutions. In fact, the strong salt takes the protective slime off the fish and leaves it in a condition where it is liable to be quickly again infected, and in a weakened condition where treatment is not likely to again be effectual. The usual practice of the author is to make a solution in which salt is just discernible to the taste. As the sense of taste varies in individuals, this is not a very accurate rule to give others. A suitable proportion is one ounce of salt (approximately two heaping teaspoonfuls) to each gallon of water.

Methods of Treatment. Nearly all sick fishes do best in shallow water and out of bright light. A shallow enamel tray is very good, or a well-seasoned tub filled to a few inches is suitable. In placing the patient in the medicated water, see that there is no considerable change in temperature. In warm weather a change to very slightly cooler water is stimulating and probably does no harm. In winter, when a fish is generally run down, the temperature during treatment should be gradually brought up to about 68 degrees. Except for the air-breathing species (Paradise fish, etc.), a sudden change to several degrees warmer water is liable to produce suffocation, warm water holding less free oxygen than cool. Aquarium fishes can live indefinitely in the solution described, but in two days a salt solution begins to smell stale and needs to be changed. A daily change is better. Should the patient not show signs of improvement in four days, gradually increase the strength of salt solution for two or three days until it is up to two ounces (four heaping teaspoonfuls) to each gallon of water. After remaining in this for two days the salt proportion is slowly weakened down again to the first formula.

**Ammonia Treatment.** A popular treatment among European fish culturists for fungoid diseases is the ammonia method. This has not been generally accepted in the United States, but has been tried with remarkable success in some instances where other treatments have failed. We feel, however, that it should only be tried as a last resort. To one gallon of clean water add ten drops of ordinary household

ammonia. (Unfortunately, this varies somewhat in strength.) Place the fish in this for five minutes, but take out sooner, should it turn over. Remove to plain water and then back to its tank. The treatment may be repeated at intervals of three days if necessary.

**Special Attention.** All fish should, if possible, be placed, after any chemical treatment, in a healthy tank containing green water. Sometimes this is, indeed, the only treatment required.

Another very good after-treatment which may be used in summer is to place the hospital tank under a small stream or drip. In making the final change from salt back to fresh water, this is a very good way to accomplish it. Dripping water may do all that is necessary, especially if a fish is only on the doubtful line, which is more often the case than not.

Summer offers one more treatment when all others fail—place the affected fish in a shallow mud-bottom tank or pool. This is especially beneficial to goldfishes.

When a skilled aquarist finds a fish a little out of condition, but with apparently nothing radically wrong, his first treatment is to remove the fish to another tank if he has one available. This often has the stimulating effect of a change of climate and usually wards off more serious trouble that might be developing. *As with ourselves and all animals, it is much better to prevent an ailment, if possible, by improved conditions, rather than by recourse to drugs or chemicals.*

The foregoing is general in character but will be found useful in most of the diseases that can be cured. We will now deal specifically with the diseases and ailments.

**Fin Congestion.** This is the commonest of all fish troubles, and is especially liable to attack the highly developed fins of fancy goldfishes. Their long fins are no doubt deficient in circulation, causing low powers of resistance. As soon as the fish is slightly indisposed through overfeeding, sudden chill, protracted low temperature or other causes, fin congestion is usually the first symptom of trouble. The fins of fancy goldfishes may be considered very good barometers of the condition of the fish. The appearance produced by the disease is well indicated by the name—fin congestion. The fins are more or less red and streaked with veins. In advanced cases they commence to split and fray, particularly the tails.

TREATMENT. Fin congestion, as well as being the commonest of goldfish diseases, is also the most easily cured. The salt-water treatment described previously is without a superior. Another method is to paint the fish with coal oil, keeping the head and gills wrapped in a moist cloth. Usually lighter feeding and plenty of room in fresh

water will be all that is necessary if taken in time. Two grains of permanganate of potash to the gallon of water is a successful treatment for goldfishes, but is dangerous to tropicals. It is best to use this in an enamel or a glass receptacle. Organic substances, such as wood or floating particles of dirt, quickly decompose the chemical. The fish may be given the permanganate treatment several hours at a time, but a fresh solution should be made daily.

An entirely different kind of fin congestion is sometimes prevalent in the fall, especially when the fishes are first taken in, young fishes being more liable to attacks. The base of the tail and other fins becomes suddenly blood-red, the color sometimes extending to the body immediately adjoining. If allowed to continue, this form of the disease is rapidly disastrous. Fortunately, it yields with surprising quickness to either salt water or permanganate of potash treatment. When alternatives to salt-water treatment are suggested, the fancier will certainly be on the safe side by giving the salt the first trial, particularly if carefully followed out as we have directed.

**White Fungus.** This is next to the most common disease among goldfishes, and is responsible for the majority of deaths, except among very young fry. It begins on the tail and other fins, extending over

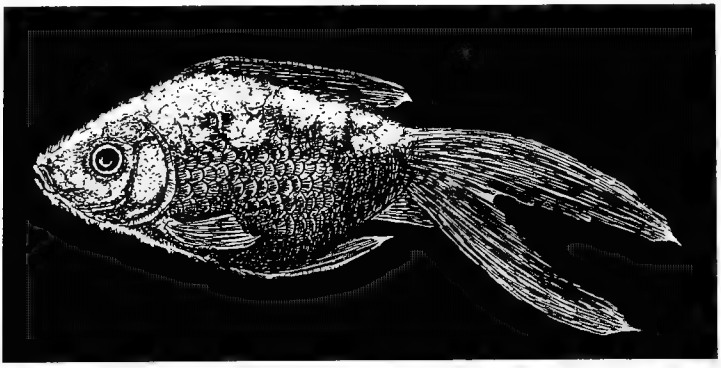


FIG. 149. FISH AFFECTED WITH WHITE FUNGUS

This illustration is characteristic of sick fishes in general. The fins are collapsed and the general appearance is one of listlessness.

the body and into the gills. When it reaches this stage it is usually fatal. The progress of the disease is marked by the development of a white scum which destroys the fins, prevents the natural functions of the skin, and when the parasite enters the gills causes death by suffocation. The latter stage is not always reached, the fish often becoming so emaciated as to die in the second stage of the malady. The fungi causing this disease are present in virtually all water, but can

make no inroads on a fish in good condition. A weakened fish once infected will breed so many bacteria that they can successfully attack the remaining well fish. White fungus, therefore, is contagious, and the sufferer should be removed from its fellows at once. This disease is caused by overcrowding, overfeeding, lack of proper plant life, sudden temperature changes and by bruises in shipment.

TREATMENT. Fishes suffering from white fungus should be treated exactly the same as those having fin congestion. If the fins have become very much frayed and it is necessary to trim them, this can best be done by a sharp knife, using a board to cut on. Scissors make a very poor result. It is well to treat the new cut edges with a permanganate solution of one grain to a glass of water. By grain we of course always mean a certain quantity of weight, and not simply a small particle.

Sometimes raw spots are left after the fungus has been removed. These or similar spots from other causes can be greatly helped by the following method: Wrap the head and gills of the fish in a moist rag, dry the affected spot and apply some Turlington's Balsam with a small piece of absorbent cotton. Allow to dry for three or four minutes. This will not endanger the life of the fish so long as the gills are kept moist.

**Black Fungus.** Many have supposed this disease to be invariably fatal, but this is not the case. If taken in time, the majority of cases can be cured. The great trouble is that the fish is in a run-down condition before contracting the disease and has little power to withstand the necessarily severe treatment. This disease manifests itself more on the body than the fins, at first presenting a dark gray appearance, later turning black and peeling off, leaving raw spots. A common place for the first appearance is the center of the gill plates, and also on the sides of the fish where they would be most likely to rub, for the parasites are conveyed principally by contact. The protozoans causing this serious complaint are animal parasites which soon lodge themselves so deeply in the skin of the fish as to make treatment difficult. If they get into the gills the case is considered hopeless.

TREATMENT. Start at once on the increasing salt method described on page 151, only carrying it further. Over a period of from three to four days the strength of solution should be carried to two and one-half ounces to the gallon. Goldfishes can stand a great deal of salt if brought to it gradually. (The same is true of most other aquarium fishes.) As before noted, the strength should be slowly reduced before returning to normal water. After the maximum strength of solution is reached the fish should be pencilled on the

affected spots with a 50 per cent. solution of peroxide of hydrogen for a few moments (being careful not to slop over on the healthy parts). The next day the spots may be treated with Turlington's Balsam as described for White Fungus. Feed on good nutritious substances, such as daphnia or chopped earthworms. If the fish seems to be standing it satisfactorily, keep in the strong salt for about one week, changing the water daily and relying on accurate measurements for salt quantities. A progressive permanganate of potassium treatment may also be used, but should not be continued as long, five days being about the maximum for a fish in poor condition. Start at one grain to the gallon and go up to three. With this chemical there is no need of gradually reducing the strength, but a new solution should be mixed daily, and twice daily is better, always remembering not to change temperature of water. Happily Black Fungus is not as prevalent as formerly, owing probably to the fact that we now have many more American wholesale breeders, thus doing away with the necessity of purchasing so many fishes that are in a thoroughly bad condition from hard trips across the Pacific Ocean, and shorter but equally hard travels across the American Continent.

**Itch.** The Itch is one of the more common complaints in the aquarium. The fishes are observed to quickly rub their sides against the firmer objects in the aquarium, often against pebbles on the bottom. The affection is caused by different fish parasites.

TREATMENT. Although this trouble is caused by different organisms, they all yield to the progressive salt treatment (page 151). The aquarium should be cleaned out before fish are returned, and care exercised to keep it in a cleaner condition, paying particular attention to seeing that no uneaten particles of food are left lying about. The introduction of more snails and a small Weatherfish or two will help to avoid a recurrence. It is not improbable that mussels consume a large number of suspended parasites and bacteria of various kinds.

**Constipation.** Among the highly-bred, short-bodied fishes, constipation, as well as other mechanical disorders, are naturally common. The much shortened bodies throw the internal organs out of position, give rise to swimming bladder troubles and tie up the muscles which must discharge eggs and also the excrement of the fishes. Lack of proper exercise in the cramped confines of the aquarium and too highly concentrated foods are other causes leading to constipation. The excrement should be of a brown color and free from bubbles or any slimy appearance. In health it usually is seen in long sections.

TREATMENT. An equal mixture of sea salt and Epsom salts, made to a strength of one ounce of salts to the gallon, will usually prove

beneficial. It is better not to feed the fish during the period of treatment—about two days. The trouble may be due to overfeeding, and in any case a short fast will probably do good.

Goldfishes readily eat Epsom salts. A pinch dropped in the aquarium once weekly is beneficial to the fishes, and at the same time replaces some of the mineral content of the water depleted by the plants and fishes drawing constantly upon it for the chemicals necessary to sustain life. This practice has a tendency to prevent constipation.

Chopped earthworms will be found a mild laxative. In severe cases some fanciers place a drop of castor oil well down the throat of the fish by means of a dropper. The author has never been convinced that the fish swallows any medication administered in this way, but results are claimed for the method. Scrambled egg, salted with Epsom salts, undoubtedly is a splendid laxative.

**Tail-rot.** This disease first affects the end of the tail and other fins; the appearance is one of being frayed and split. If allowed to continue until the base of the tail is affected, the fish will die. Taken in time the trouble is easily corrected. It must not be supposed that every case of split and ragged tails is one of tail-rot. This is often a manifestation of a generally run-down condition, and in addition to the regular treatment for tail-rot, also requires a general building-up under improved environment.

TREATMENT. The same treatment as that for white fungus is indicated. Dipping the tail in a 10% solution of peroxide of hydrogen is beneficial. Should the ends be hopelessly frayed, they may be eaten off by a 50% peroxide solution. On returning to the water the treated parts will be full of bubbles and will slough off in a few days, leaving a less sharp line than when cut with a knife.

**Consumption.** It is doubtful whether this is a real form of tuberculosis, but the wasted appearance of the suffering fish is such as to suggest it. The body becomes thin and so shrunken that the head appears to stand out from the body. Listlessness and loss of appetite are accompanying symptoms.

TREATMENT. This trouble seems to be deeply seated and is difficult to treat successfully. Unless the fish is a particularly valued one, it had best be destroyed. Place fish in an ample supply of green water or fresh water containing ½ ounce of sea salt to the gallon. Feed well on daphnia, chopped earthworms and soft bits of oyster. Placing fish in a shallow muddy pond or tank may be beneficial.

For fishes that are slightly run down, a reliable correspondent informs the author that diluted whisky dropped in the throat of gold-

fishes effects a wonderful cure. He dilutes the whisky with five times the volume of water and drops four drops in the throat of the fish twice daily. (Although this is written since prohibition went into effect, we refrain from any witticism on the use of whisky, although the opportunity seems a favorable one.)

**Dropsy.** The cause for this distressing complaint is not known, but it is considered to be due to a disordered liver. It is more apt to attack fancy goldfishes and tropicals, *Trichogaster lalius* being particularly susceptible. The manifestations are a swelling of the body and the scales standing out at an angle. This can best be seen from a top view. Strangely enough, the victims do not seem to feel depressed until within a few days of death.

TREATMENT. No cure is known for dropsy in fishes. They have been known to improve under absolute starvation lasting several weeks, but a recurrence is likely to take place. There is a current belief that a few drops of digitalis in the water sometimes effects a cure. The author has never been able to verify a single such case. If the fish is valuable, its life may be prolonged by "tapping" it. This is done by inserting a fine needle beneath the skin, holding needle nearly flat to the body so that it again emerges in about a quarter inch. After repeating this at a number of points, enough liquid can be drawn off to relieve the fish temporarily. The operation can be repeated when necessary.

**Swimming Bladder Trouble.** As before stated, highly bred, short bodied fishes are the more susceptible to this not uncommon disorder. Sometimes the victims are unable to rise from the bottom except by a violent effort, or again they may lie at the top of water at an angle, or even upside down. Scaleless varieties are the more susceptible, particularly the light colors. Reduced temperatures, even when brought about slowly, are responsible for most cases.

TREATMENT. No sure cure for swimming bladder trouble is known, but it is sometimes relieved by placing in very shallow, slightly salt warm water. If the fish is benefited it will always have to be kept in temperate water, preferably shallow.

It should be borne in mind that not all cases of loss of equilibrium are due to bladder trouble, but may be caused by accumulated gases resulting from indigestion. Treatment for constipation will relieve these cases, but such fishes will have to always be watched carefully thereafter. The author has had some remarkably good results in these cases by feeding earthworms.

**Gill Congestion.** There are two forms of gill congestion. The most important, generally known as "gill fever," is that attacking fry

from two to five weeks old, and is easily responsible for more losses among goldfishes than all other causes combined. The gills become inflamed and swollen, presenting a distended appearance. Owing to the minuteness of the fish at this period a further observation is difficult except with a magnifying glass, which shows white threads like bristles sticking from the gill plates and openings. The disease is highly contagious, so that if one affected fish is found in a thousand, it is very difficult to save any of them, even though the sick fish be removed at once.

The other form affects mainly young fishes about 2 inches long. The gills swell rapidly, the infection spreading to the throat and producing a gray or whitish appearance. Without treatment, death is sure to come quickly. This was formerly a common disease among fancy fishes, but for some unknown reason has largely subsided; we hope permanently.

TREATMENT OF FRY. Innumerable experiments have been tried to cure this devastating disease, but without consistent results. So fatal is it considered by many expert fanciers that when they find a few affected fishes they destroy them, together with perhaps thousands of their fellows in the same tank without attempting a cure, throwing out bad and apparently good alike. The tank is then disinfected with strong salt water or more powerful germicides. The great trouble is that any chemical which will kill the parasites is also very apt to kill the delicate fry. However, it is almost certain a cure can be found, and it is a great pity to neglect an opportunity for experimenting. Cases have been cured, but exact data are lacking. Nevertheless, we have two experimental points to start from. The first and more likely is with permanganate of potash. A well-known and thoroughly reliable breeder claims to have cured over one thousand fry by making the water a "pale purple" with this chemical, leaving the fish in it. To gauge a permanganate solution by color is most difficult. If one looks through 12 inches of water, the color will be 12 times as deep as through 1 inch. We would suggest trying ½ grain by weight to the gallon. This just flavors the water. (Tasting without swallowing will do no harm.) If fishes not yet affected are removed from their diseased companions and placed in such a solution for half a day, it is reasonably sure that many, if not all, could be saved, taking care, of course, not to return to an infected tank. Here it might be repeated to advantage that small fry should be lifted with a spoon and transferred carefully, avoiding pouring or any violent movements.

The other basis for experiment is with sulphate of copper in extremely diluted form—about 1 to 10,000 or weaker. Copper is fatal to all forms of life and therefore the treatment should only be temporary. We would suggest finding a strength that would kill the fry in an hour, then use that strength for 15-minute treatments for remaining fishes. Reports of cures by copper are current, but details are entirely lacking.

TREATMENT OF LARGER FISHES. This form of gill congestion has also been considered necessarily fatal, but such is not the case. The fish should be placed in strong salt water (3½ ounces to the gallon) until it rolls over from exhaustion. It is then transferred to a tank of gently running water which overflows. It appears as though the salt loosens the disease-germs and the running water carries them off while they are weakened. If this is a correct theory the cure could no doubt be hastened by pouring fresh water in the under side of the gills after the salt treatment, thus also helping to revive the fish. Treatment is repeated daily until improvement is noticed.

**Eye Inflammation.** The protruding eyes of Telescope fishes are quite subject to injury, especially against the sides of cans in travel. Painstaking treatment can go far to relieve this condition and ward off permanent blindness.

TREATMENT. Make a saturated solution of boracic acid in tepid water. This is gently applied daily to the affected parts by a bit of absorbent cotton. The fish should be placed, if possible, in a large tank free from obstructions, that the injured eyes may not be further irritated.

Instead of boracic acid, the eye may be swabbed with a mixture composed of one part of tincture of iodine with nine parts of glycerine. One treatment is usually enough. It takes about two weeks to clear up. This mixture is a most efficient home remedy for applying to cuts or other open wounds, giving all the benefits of iodine without its burning qualities.

## ANIMAL PARASITES

There are only four of these of sufficient importance to keepers of aquarium fishes to require mention. Food fishes and all wild species are more or less subject to numerous parasites, many of them serious or fatal. No doubt aquarium conditions are not favorable to their propagation; otherwise we would have more trouble in this direction on account of the large numbers of wild fishes being imported for aquarium purposes from so many parts of the world.

**Leeches.** There is a small white leech about ¼ inch long occasionally introduced with living food (daphnia), more particularly in the spring. This attacks the bodies and gills, and if the fish is only a few weeks old the results are fatal. In an aquarium it is easily possible to see them on the glass and the breeder should be on the lookout for them. If any are discovered the fishes should be carefully removed to an aquarium where they can be kept under observation. The aquarium should be disinfected by the ammonia method (page 149). These and larger leeches can be removed from the gills of larger fishes by the injection of strong salt water, or by the progressive salt water treatment previously described (page 150).

**Fish Lice.** While not very common, and seldom fatal, this crustacean parasite is very annoying. It is about ⅛ inch in diameter, very flat, of a nearly rounded outline and is quite translucent, but distinctly

FIG. 150. FISH LOUSE *(Enlarged four times)*

showing handsome iridescent colors under a good magnifying glass. They are free swimmers and are able to hold most tenaciously to their hosts. So tight is their hold that even after death by poisoning they still adhere where fastened. Owing to their translucent quality they are difficult to see. The fishes will scratch themselves much the same as in cases of the "Itch," but one can notice small irritated spots, particularly on the tail and fins. The body, however, is not free from attack. The lice adhere tightly but can be picked off. If touched with an equal mixture of turpentine and kerosene they will come loose.

**Flukes.** The detection of flukes is not easy without the aid of a microscope, the cause being a small parasite worm *(Gyrodactylus elegans)*, chiefly infesting the gills. The fish breathes unnaturally fast, frequently coming to the surface of the water for air. The fins twitch and occasionally the fish will dash wildly and aimlessly about the tank, coming to a rest after exhaustion. Before death the body becomes thin and emaciated.

If the fish is not too far gone it will stand the formaldehyde treatment, which will usually effect a cure. Place the fish in a solution of 5 drops of formaldehyde to the quart of water. Add one drop per minute (per quart) until there are ten drops to each quart. Allow the fish to remain in this for ten minutes unless it shows signs of

exhaustion sooner. Return to a thoroughly disinfected tank and repeat the operation next day. Two or three treatments will usually be sufficient. As a rule, all the fishes in a tank are affected, so if this parasite is positively identified, it will be well to treat every fish that has been exposed.

We can see no reason why the formaldehyde treatment should not be applied to any of the parasitic ailments. If carefully used it will at least cause no trouble.

**Ichthyopthirius.** This parasite causes small whitish dots all over the fish. It is more apt to affect tropical fishes and has killed many fine specimens. Until recently it has been considered incurable, but two cures are now positively known. The fish should be placed in a plain glass or enamel container and have the water changed (keeping temperature even) every eight hours, *disinfecting container each time.* It is best to use two containers, so the water can stand in one while the other is in use. This takes a few days. It is claimed that plain water is as good as salt for this treatment, but the writer has had better success with brackish water, gradually increasing the strength and then as gradually reducing.

The second method of treatment is only suited to goldfishes. This consists of treatment in water in which two grains to the gallon of permanganate of potash have been dissolved. In a few days the old mucous coating of the fish peels off and leaves a new, healthy surface.

**Diseases of Tropical Fishes.** Tropical fishes cannot stand the different chemicals and treatments recommended for goldfishes. The principal cause for their lack of condition is too low a temperature. If placed in a uniform warmer temperature, with one ounce of sea salt to each gallon of water, and fed up on daphnia, small chopped earthworms, or white worms (described on page 140), they will usually improve rapidly.

The most common disease among them is Ichthyopthirius, described above. The treatment is worthless unless changes of water are made on time. Aside from chill this epidemic kills more tropical fishes than any other cause. It has long been considered incurable, but recent careful study of the life history of the parasite has evolved the very simple treatment described and there is no reason for further serious losses in this direction. This has been fully proven by the author and has been amply attested by the uniform success of many readers of former editions of this work.

*Chapter Twelve*

# Terraria

The terrarium has not as yet aroused any marked degree of interest in America, but as we have followed Europe in the cultivation of exotic fishes, it is not unlikely that we shall yet follow their study of exotic amphibians and other inhabitants of the terrarium and aqua-terrarium. Certainly the subject can be made one of absorbing interest, offering special attractions to those fond of making their own collections. Unfortunately, even in Europe, the terrarium itself has not been developed into a thing of beauty. Most of the numerous designs shown for sale are stiff and clumsy-looking, but this may be largely overcome by artistic planting. Undoubtedly there is still plenty of room for individuality of treatment which would give one more the feeling of a bit of Nature transplanted to the home rather than a miniature prison.

The variety of animals which may be kept is extremely large and many of them are of distinctly attractive appearance, even to the novice or outsider. Those of us who have learned to admire the telescope goldfish should suspend judgment on some of the apparently less attractive specimens in the terrarium, for it may be that both standards operate on the same general principle, that is, the *more hideous, the more attractive!*

Aside from the matter of beauty there is a wonderful range for observation, study and original research in the terrarium. In looking over the European catalogs one is struck with the large number of lizards, frogs, newts, turtles, reptiles, etc., which are exported from North America. It will be seen therefore that we do not have to leave our own shore to obtain good collections.

Terraria are divided into four natural divisions, according to the needs of their occupants: dry-temperate, dry-tropical, moist-temperate, and moist-tropical. The differences in these will readily suggest themselves to the mind, being matters mainly of ventilation, moisture and

FIG. 151. ENCLOSED AQUA-TERRARIUM

FIG. 152. THE AMERICAN CHAMELEON *(Anolis carolinensis)*
*(Two-thirds size)*

The range of protective coloration in our chameleons is not unlimited, as is usually supposed. They mainly alternate between the brown here shown (a good average earth-color) and a bright leaf-green, which is extremely difficult to distinguish against foliage.

FIG. 153. PINE-TREE LIZARD *(Sceloporus undulatus)*
*(Half size)*

The Pine Tree Lizard in its variations is of wide distribution in the United States. It does well in the terrarium and becomes quite a pet. These and other lizards are more numerous than is generally supposed. This is due in a measure to their cleverness in keeping out of view, having much the same habit as squirrels of hiding on the opposite sides of trees and branches from the observer.

FIG. 154. SIX-LINED SKINK *(Cnemidophorus sexlineatus)*
*(Slightly reduced)*

Six-Lined Lizards possess a remarkable grace and attractive coloring, especially the males, whose under-sides are barred with brilliant metallic blue, carried partly up on the side, adding to the sleek, corseted effect of the animal. They are native to the Southeastern States.

No lizards should be caught or picked up by the tail, as they will purposely lose them in order to escape the hold.

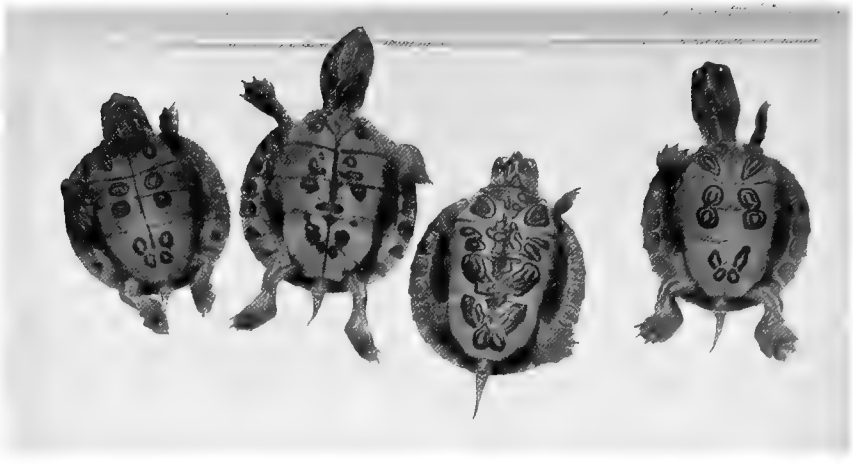


FIG. 155. GEOGRAPHIC TURTLES *(Young)*

The undermarkings are as different as the thumb-prints of human beings, no two appearing to be alike. The backs are usually a pleasing shade of green. Distributed in large quantities in pet shops in the spring.

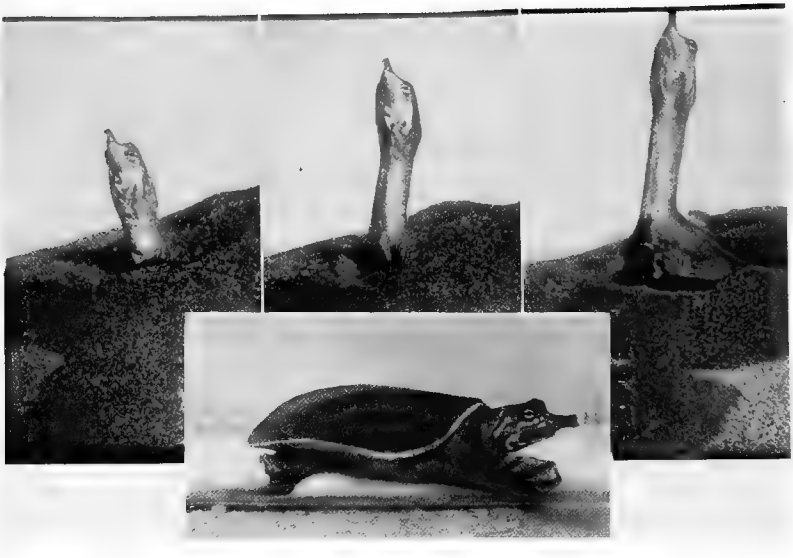


FIG. 156. SOFT-SHELLED TURTLE *(Young)*
*(Trionyx spinifer)*

These curious creatures make interesting pets, and when small can be kept in close quarters. When alarmed they dig into the sand, but must eventually come out for a breath of air. If the surface is within reaching distance they will do the original "rubberneck" act as above, rather than leave the sand. Soft-shelled turtles are very aquatic and have broadly webbed feet, which enable them to swim rapidly.

artificial heat. The sides are usually of glass, one of them, as well as the top, being removable in order to work inside or to introduce or take out specimens.

FIG. 157. SWAMP AQUARIUM

The dry-temperate terrarium is naturally the simplest in construction, the principal requirements being open ventilation and a small drinking pool with cement edge and mirror bottom. This seems to be necessary to some of the creatures, as they are accustomed to seeing the sky reflected in water and without this they do not at first recognize it as water.

The moist-temperate form is only slightly ventilated and is supplied with a larger water pool, as the animals are usually amphibians. It is well to be able to drain this off without removal of water container.

Tropical terraria, whether moist or dry, are heated artificially from below, the heating device being concealed beneath a false bottom. The heat may be applied either to a pan of sand or water or used in the form of a miniature hot-water heating system as indicated in figure 55 for heating tropical aquaria. The pipes are not carried over the top, but through or around the bottom.

The forms of terraria are quite diverse, according to requirements or fancy. Quite a number are divided into two halves, one side containing a shallow pool with tall bog plants, the other side being for terrestrial plants, the two sometimes being connected by a sloping ladder over the division, so that the animals may cross at will. The same arrangement is further developed into the aqua-terrarium by having the moist side in regular aquarium form and filling about two-thirds deep with water. Where tree frogs or other climbing animals are kept there should be a ladder or other arrangement to enable them to seek varying levels at different times, as this desire seems to be an important part of their nature. Tree frogs in some parts of the world are better known as "weather frogs." They are kept where they may either remain in water or climb to different levels at will, and are regarded as good barometers to foretell approaching weather conditions. Undoubtedly the state of the atmosphere has something to do with their movements in this respect.

Terraria for moths and insects usually have three sides of screen and one side of glass for clear observation.

**Aqua-terraria** may be considered a higher development of terraria, since their possibilities are so much enhanced on account of accommodating both terrestrial and aquatic animals and plants. One of the most interesting kinds is devoted to the observation of aquatic insects. These only contain a few inches of water, in which are placed bog plants, so that the leaves stand well out of water. Very few of the aquatic insects spend their entire lives in the water and some such provision is needed for them to climb out. It is important that stones or other creeping-out places be provided for turtles, frogs, newts and other amphibians, for it is cruelty to oblige them to remain constantly in the water.

Quite artistic effects can be obtained in the arrangement and planting of the terrarium and the aqua-terrarium. Natural bridges, lakes, waterfalls, archways, ledges, hollows, cliffs, caves and other details may be used to good purpose, but care should be exercised not to combine the incongruous nor introduce objects out of keeping with the general scheme. Stones cemented together are capable of good pictorial effects. For moist terraria, pumice or other porous stone will be found useful, as it retains so much moisture and makes a good foothold for ferns and creeping plants.

An aqua-terrarium constructed for pictorial effect is made in the form of an ordinary aquarium with terrestrial plants arranged in the rear corners, thus giving the effect of a complete bit of landscape. The great possibilities of this treatment are shown in the illustration on page 163. This has the earth in slate containers reaching all the way to the bottom, but in a form devised later the soil is in cement pans 6 inches deep which are hung by hooks on the top edge of the aquarium proper, thus giving more light at the bottom of the aquarium.

Swamp aquaria have received little attention, although they can be made very picturesque, as will be seen in Fig. 157.

**Plants.** Most of the plants flourishing in greenhouses will prosper in the moist terrarium, so that the selection is very large. The dry terrarium is much more limited in this respect, the possibilities being confined practically to cacti, agaves, aloes, houseleeks and certain hardy ferns which have come from dry situations.

**Planting.** The main point in planting the terrarium is to procure proper drainage by the use of pebbles or broken charcoal. Plants can be set either directly in soil above the pebbles or in pots. Fertilizer may be used in the lower part of soil, but very sparingly in moist terraria. In planting it is well to keep in mind the natural surroundings of the animals and to provide, so far as possible, those conditions which are agreeable to their natures. For instance, the reptiles like to sun themselves in open, dry spots, and in planting for them this can easily be arranged. Amphibious animals like to secrete themselves and hide from the light at times in thick vegetation, a provision easily made in the moist terrarium. These same considerations will present themselves when it comes to selecting a place for the terrarium. The snakes delight to sun themselves for hours, so in planting it is well to use only such plants that will stand plenty of direct sunlight. Terraria have one important advantage over aquaria in that at least the smaller sizes may be shifted from one place to another with very little effort, so that light conditions may be changed at will and hours of sunshine increased as opportunity offers.

**Occupants for Terraria.** The large majority of cold-blooded animals of suitable sizes may be introduced. In the moist terrarium the principal animals used are young alligators, newts, salamanders, tadpoles, frogs, water snakes, turtles, aquatic insects and their larvæ. For the dry terrarium we have tree toads, hop toads, horned toads, beetles, spiders, lizards, chameleons, tortoises, snakes, butterflies, moths and other insects.

**Feeding in the Terrarium.** The different occupants of the terrarium naturally require a varying range of foods. Those containing chameleons, frogs, toads, tree toads, do well on flies. It is a good plan to have a fly trap which can be emptied into the terrarium. It is quite an amusing thing to see the animals waiting for the flies to emerge after they have learned that they are fed in this manner. The dexterity with which they are caught and eaten is a never-ending marvel. While these animals can live on little, they ought to be well fed in warm weather, giving them once daily all the flies they can consume, which will be found to be a considerable number. In winter when flies are scarce they may be fed on meal worms and meal bugs, which are easily cultivated in bran flour, once a small stock is started. Particular care should be taken not to allow any of the meal breeding stock to escape into the house, as it is liable to become a pest in the kitchen. Roach traps are useful adjuncts in providing food for the larger lizards and insectivorous snakes.

Alligators, carnivorous turtles, newts and salamanders are fed on bits of meat, fish, oysters, scrambled egg and worms.

Snakes and lizards require large and small insects, worms, small live fish, toads and animals.

Box tortoises select their food from a large menu. They like almost anything that man eats and a few things besides, including, in the last, slugs and earthworms. Thick, sour milk is taken eagerly.

As with the aquarium, particular care should be exercised not to allow any excess of food which is liable to decay, all such surplus being removed immediately after the feeding hour.

*Chapter Thirteen*

# Aquarium Plants

Whether aquaria are kept for scientific study or for the enjoyment of the beautiful, aquatic plants will always be found a useful, if not indispensable, adjunct. The fact that plants give off oxygen under the influence of light has been mentioned at several other places in this volume, but the principle is so important that it would be difficult to over-emphasize it. Aquaria containing good plant growth may be tightly covered and if placed in a good light they will support a fair number of fishes, the life-giving oxygen in such an experiment being supplied almost exclusively by the plants.

That the roots of healthy aquatic plants absorb the products of decomposition in the bottom of the aquarium is an established fact. When an aquarium has been established for some time, the sand has become a little dirty and the plants have spread so that the roots of some are against the glass, a close observation will show a condition similar to that pictured in Figure 158. The sand near the roots is distinctly whiter than that beyond their reach.

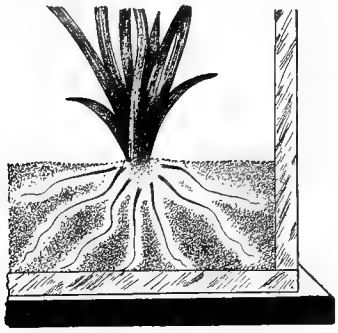


Fig. 158

Absorption by Plant Roots

No arguments need be put forward to establish the æsthetic value of plant life in the household aquarium or the pool in summer. Without them no one could attempt to reproduce the effects of Nature. So well understood is the value of aquatic plants that aquarists are constantly on the lookout for anything new which might enhance the beautiful results already achieved. Occasionally something of real merit is found. We are pleased to be able to list several of these newer species here,

together with the better-known favorites. Only those plants having been proven satisfactory are described, but naturally in such a large range it will be found that the same conditions are not suited to all.

It is a good general rule to select young plants. They transplant better and sooner adapt themselves to new conditions. If old plants are used, the dying leaves should be removed.

**Sand or Pebbles?** Much discussion has been brought out as to the best methods of planting, principally as to whether to use soil, sand or pebbles, or whether, in some cases, planting is necessary at all. Success has been attained in many ways. The author believes in the use of coarse sand, either with or without a mixture of pebbles, this latter being a matter of taste only. The disadvantage of pebbles is that they are likely to get into a siphon and clog it. Pebbles without sand collect dirt and food particles which cannot be removed nor reached by fishes or snails. While it rarely happens, fishes have been known to strangle on a pebble. There are no experienced advocates of sea or other fine sand. It packs too hard for the roots to penetrate.

**Quantity of Plants.** Beginners reading of the merits of vegetation in the aquarium sometimes expect magical results from two or three plants. The fact is that each plant makes a very small contribution towards the desired end. It takes a battery of them to obtain an appreciable result. Three sides of the aquarium should be planted somewhat closely, but allowing for multiplication from such runners as Sagittaria and Vallisneria put out under favorable conditions. In short, there is no danger of overplanting so long as the fishes can move about freely, and the view is not obscured.

## PLANTING

Planting is usually done directly in the sand or grit. Some aquarists prefer planting in miniature pots or special earthenware or cement trays, so that when it is desired to clean the aquarium it will not be necessary to uproot the plants. In potting plants in this manner a few pebbles should be placed in the bottom of the pot and then a layer of soil, preferably from a pond or stream. Spread the roots well into the soil and then cover with about one-half inch of sand, so that the earth cannot become free and cloud the aquarium water. An inverted piece of turf may be used instead of aquatic soil. As a rule, it is not advisable to use any soil in planting the aquarium itself.

The first operation in planting an aquarium is to see that the sand or grit is thoroughly clean. This can only be brought about by a long

FIG. 159. *Sagittaria natans (Reduced one-third)*

and thorough washing. After the water runs clear from the sand, spread the bottom of the aquarium to a depth of, say, half an inch. If rockwork is to be introduced, place this now. Next fill with about two inches of water. Now take the roots of Sagittaria, Vallisneria, or other rooted plants, and spread them out well. After the proper arrangement of plants is made, add from an inch to two inches of coarse sand, being careful not to completely cover any of the leaves. Do not make the sand deeper than sufficient to hold the plants in position. Now fill the aquarium and with a slender stick lift any leaves which have been held down by the sand. After the leaves have been brought into an upright position, take hold of them and pull upwards until the crown of the plant comes just to the surface of the sand. Aquatic plants with crowns seem to do better if the crown is not quite covered. The crown is the point from which the leaves put out. Such plants should be inserted singly and room left for young plants to spread from runners.

Plants that have become uprooted in a filled aquarium can best be replaced by the use of planting sticks described on page 229.

Care is needed in planting not to allow the leaves to become even partially dry. This can be prevented by frequent sprinkling, and the work should be completed as rapidly as possible.

Bunches of Anacharis, Cabomba, Myriophyllum and other plants can be added last. These need to be weighted down with bits of lead or tin wire. In filling the aquarium it is a good plan to place a piece of paper in the center of the aquarium and let the water strike on this. By this method the plants will not be seriously disturbed. The use of a watering pot for filling will also prevent any considerable disturbance of the planting. The aquarium should be allowed to stand at least a day before the fish are introduced; but a week would be better, so that the plants may become established and active in time to be of real use to the fish.

Some aquarists use a thin sprinkling of powdered sheep manure in the sand just below the plants. Like the little girl with the curl, when the results are good they are very good indeed, but when they are bad they are horrid. The bad results—mainly the fouling of the sand—are probably produced by an excess of the fertilizer. Hence the writer hesitates to recommend this plan to the general public, although it can be very stimulating to plant growth. Where the vegetation has not prospered in favorable conditions of light, etc., it might be well to try the fertilizer method. If the water is clouded for a week or two after planting, it will do no harm.

FIG. 160. *Sagittaria gigantea (Reduced one-half)*

There is simply no end to the possibilities of arrangement and planting effect in the aquarium. Miniature boulders, natural bridges and grottos of stone form charming settings for plants. All stones should be free from sharp edges, which would be liable to injure the fishes.

Worn stones, arranged to imitate the whims of Nature, will be found much more satisfactory and appropriate than any silly submerged castles or other misplaced bric-a-brac.

## SAGITTARIA

This plant in the three described species comprises the most important group of aquarium plants. It has not the commercial importance of Cabomba, because the latter is convenient to use in small bunches in the "fish globes" seen everywhere; but to those who plant in real aquaria, Sagittaria receives first consideration.

It is a plant with bright green slender leaves of grass-like form, so that it is popularly referred to by aquarists as "grass." It takes its name from the arrow-shaped summer-leaves which stand above the water, Sagittarius being the sign of the archer in the Zodiac. The white flowers are the shape of miniature cups, with yellow centres, standing above the water. Although seeds are formed, the principal means of reproduction is by runners. Small tubers or corms are also formed among the roots, particularly in crowded situations. These produce plants.

A number of species are distributed throughout the United States, many of them quite large, frequently with leaves extending well above the water. These are only useful as bog plants, and even for this purpose they are difficult to transplant successfully. The majority of wild Sagittarias are not suited to the aquarium.

There has been much discussion as to the classification of Sagittaria into a number of doubtful species. Environment makes such radical changes in its appearance that there is a tendency to claim new species when there is in reality no botanical distinction.

*Sagittaria natans*, known also as Ribbon Arrowhead, is perhaps the most important of the group to the aquarist. It is of moderate size and is suited to the average aquarium on that account. Multiplying rapidly, growing the entire year, supplying a large amount of oxygen and thriving under varying conditions, it is very valuable. When an aquarium is uprooted on account of Sagittaria or Vallisneria becoming too thick, it will be found that the sand is not foul-smelling, showing that the matted roots purify the soil.

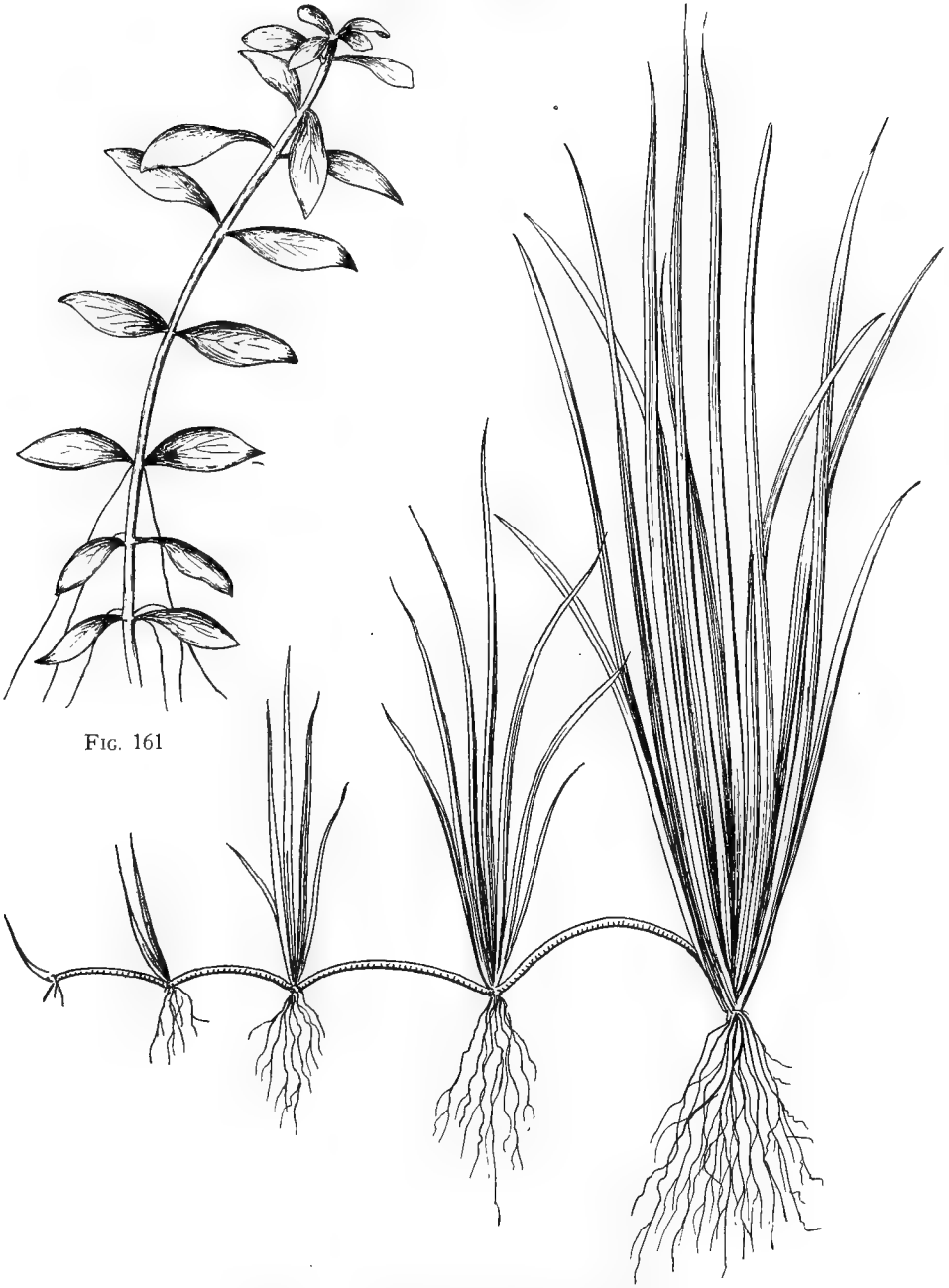


FIG. 161

FIG. 161. *Ludwigia glandulosa (Natural size)*

FIG. 162. *Sagittaria subulata (Natural size)*

*Sagittaria gigantea* is believed to be a cultivated variety of *S. sagittæfolia.* Its leaves are broad and stocky, having a decidedly substantial quality, and is one of the easiest plants to succeed with. A healthy specimen is quite light in weight, and on this account must be well planted with roots extending in different directions. Once established, it holds well and will stand more rough usage from contact with fish-nets, etc., than any other aquatic. Height, 10 to 15 inches. It is better suited in appearance to a large aquarium than a small one, but a single Giant Sagittaria in the centre of a smaller tank, surrounded by some of its lesser cousins, makes a good effect. So popular has this plant deservedly become that dealers have difficulty in supplying it, and they are always ready to buy up any surplus stock.

*Sagittaria subulata* has recently come into popularity on account of its small size. Fanciers of tropical fishes, now becoming so plentiful, generally use numerous small aquaria, and in order to produce a symmetrical picture it is necessary to introduce plants of suitable proportion. The leaves are of a rather dark shade of green, narrow and thick through, presenting a strong, wiry appearance. *Sagittaria subulata* grows from 3 to 7 inches, the stronger the light, the shorter the leaves. It multiplies rapidly from runners and soon carpets the aquarium, making either a good spawning bed or a miniature thicket in which young fishes may hide from cannibalistic parents. Can be had from some dealers and is collected in the coast-wise States from New York to Alabama. It is incorrectly know as *S. pusilla.*

## VALLISNERIA

Vallisneria *(Vallisneria spiralis)* is another of the grass-like plants, having strap-shaped leaves of the same breadth their entire length. It is known as Channel Grass, Eel Grass and Tape Grass. Appearing somewhat like Sagittaria, it has a distinct individuality of its own. The leaves are of a lighter green and have a more translucent quality than Sagittaria. Also the plant tends more to rise vertically in undulating lines, which produces a very pleasant decorative effect, being of a less spreading contour than Sagittaria. The leaves may also be identified by the margins being of a slightly different shade of green. By reflected light the margins appear the darker, but if held up to the light, the centre is the darker when viewed by transmitted light. Vallisneria is probably without a superior as an oxygenator. For use in large aquaria, particularly where artistic effects are striven for, it is without an equal. The aquarium shown in colors (opposite page 7) is featured principally by this plant, although printing ink falls short of giving an adequate idea of the radiant, silky green leaves.

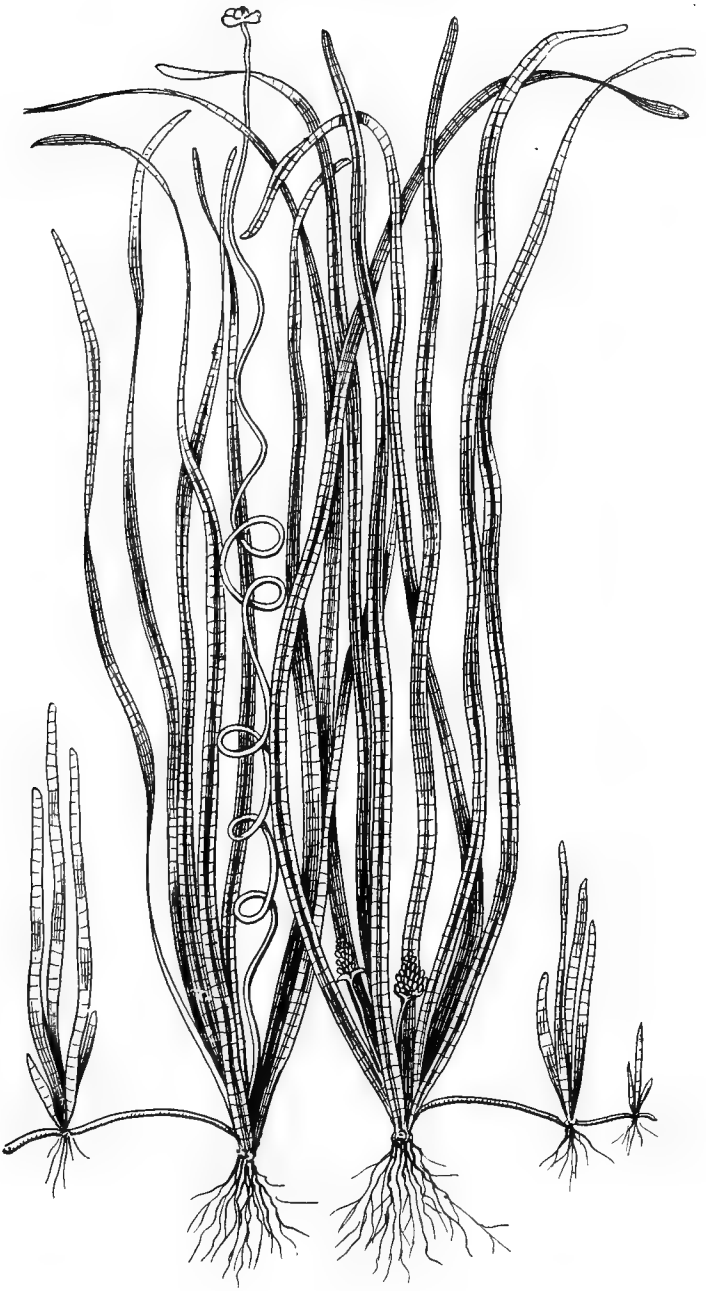


FIG. 163. *Vallisneria spiralis (One-third size)*

For some years American aquarists depended upon plants gathered locally from rivers, creeks, mill races, etc. Owing to the long-established habit of dying down to the tuft in winter, the plant had a strong tendency to keep to the schedule, even when kept in a warm aquarium over winter. In order to overcome this difficulty a search was made for a stock growing in a climate without severe winters. This plan was successful. We were fortunate enough to secure a small stock from Italy which, by careful propagation and distribution among leading aquarists, has now multiplied itself into many thousands. There is every reason why it should establish itself in further favor among those having large or fairly deep aquaria. It grows and multiplies constantly and the runners lie close to the bottom, not requiring to be pushed down like young Sagittaria plants. Contrary to the views of some writers, we advise against deep planting. It is important that the crown be not covered, but just at the surface. The plant is not well suited to small aquaria, as it grows from 18 to 36 inches, according to conditions. If closely confined it is likely to get into a tangled mass whenever a fish has to be caught. Allowed to rise to the surface and then extend horizontally on it for some distance it produces a luxuriant picture. Rising from either end of the aquarium and trained over the surface towards the centre, Vallisneria makes the best of frames to show off the more brilliant colors of the fishes. The sexes are separate in Vallisneria, fertilization taking place in a peculiar manner. The female flower, small, cup-shaped and white, floats at the end of a long spiral scape on the surface of the water. The male flower on another plant comes only a short distance from the crown. It is a case containing pollen balls. When the case splits the pollen floats to the top, where, by the action of wind, insects or other chance, fertilization is accomplished. Few of these plants in the aquarium start from seed. In propagation by runner only one sex appears along a line, males and females producing only their own kind. The first plants imported were all females. No males were seen for several years. These were likely propagated from the seeds.

For one or two large plants to dominate the centre of the aquarium, nothing is better than Giant Vallisneria, now brought from the Southern States by some of our leading dealers. Its leaves are as wide as those of Giant Sagittaria, but much longer, varying from two to four feet, according to conditions. This variety is also a constant grower. Stocks of Vallisneria or Sagittaria suited to the aquarium do not do well outdoors in direct sun, the old leaves dying and the new ones only developing a few inches in length.

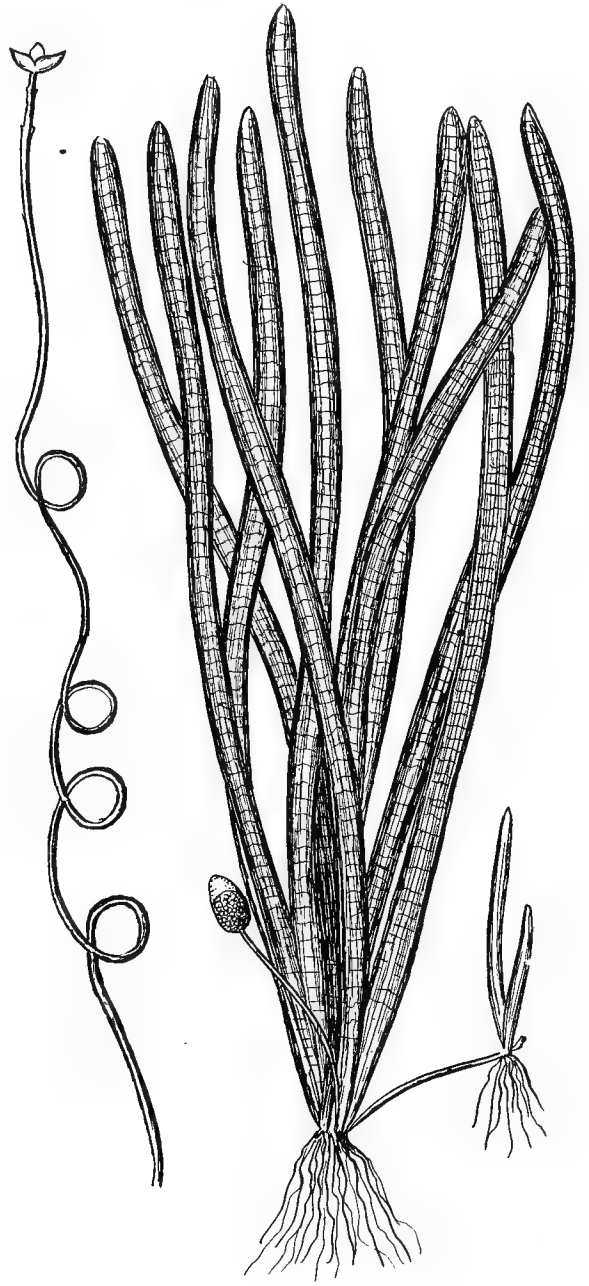


FIG. 164. GIANT VALLISNERIA *(One-quarter size)*

## CABOMBA

Commercially there is no doubt Cabomba is the leading aquatic plant. Its finely-cut, fan-like, bright green leaves make a very good first impression, although it does not live so well in the aquarium. It is brittle and the fishes if active soon pick it to shreds. Even though this does not occur, it becomes long, spindly, and degenerate. Enormous quantities are gathered from ponds, some of them purposely planted, from Maryland to North Carolina.

The plant under natural conditions is a good producer of oxygen, but in the aquarium its activity in this respect is doubtful.

*Cabomba caroliniana* is the species usually sold in bunches in pet shops. It is well known as Washington Grass, Fanwort, and Watershield. In habit it is purely aquatic and propagates mainly by branching. The stems in nature attain a length of several feet.

*Cabomba roscafolia* is a species whose principal distinguishing characteristic consists of a distinct reddish hue on the stems and lower sides of the leaves. It, too, is a handsome plant when first introduced.

## ANACHARIS

Known to American aquarists as Anacharis and in Europe as Elodea, it is also popularly called Ditchmoss, Water Pest, Water Thyme, and Babbington's Curse. Some of the rather uncomplimentary titles are due to a characteristic which, at least in the aquarium, should be considered a favorable point, that is, rapid growth. It may generally be taken for granted that if an aquatic plant is thriving it is doing good work for the aquarium. In form it is moss-like, the leaves growing on a fragile stem, the entire plant being completely submerged at all periods. Several species are distributed throughout the United States and Southern Canada. A cultivated variety, probably derived from *A. canadensis*, is considerably larger than the common local specimens to be found. The closeness of the leaves together depends upon the strength of light in which the plant is kept, the difference being so pronounced that sections of the same plant divided and kept in strong and weak light conditions will soon appear so different as to be scarcely recognizable as the same stock. The plant grows several feet in length, sending off occasional shoots and a few roots at random that reach down into the soil. In the aquarium it is best to only retain from 6 to 15 inches of the newer growth, cutting away the old ends, rebunching and replanting. Planting is a matter of little concern to Anacharis. In a well-lighted aqua-

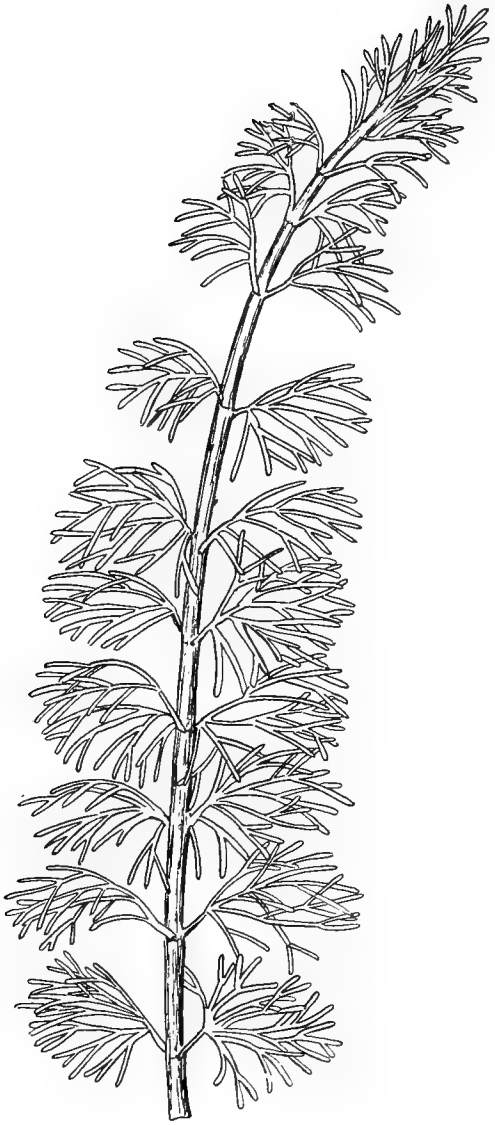


FIG. 165. CABOMBA
*(Life size)*

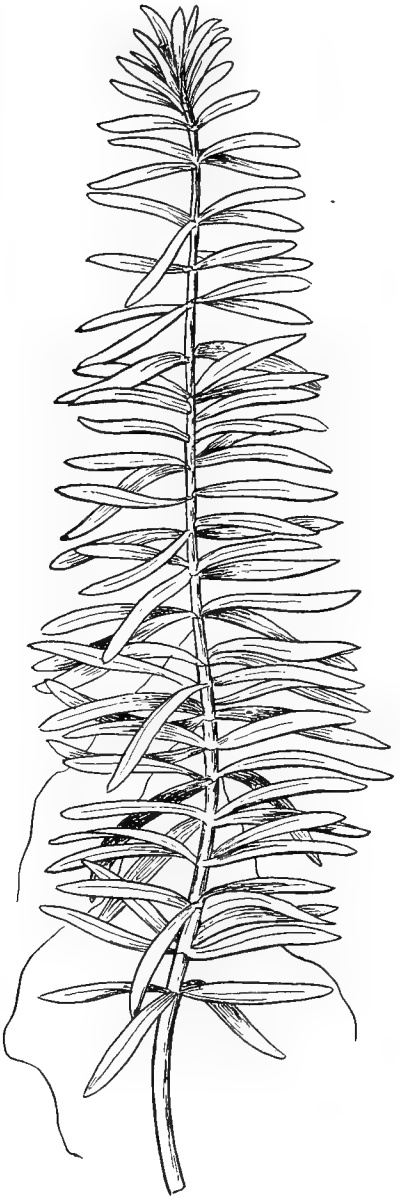


FIG. 166. CULTIVATED ANACHARIS
*(Life size)*

rium, where it will not be nibbled at by large fishes, it will prosper whether planted or not, particularly if not kept too warm. Anacharis is an excellent oxygenator and is a good plant for the beginner or for those who want to add variety to their aquarium vegetation. Allowed to grow into a mass it forms perfect hiding places for young fishes, as it does not grow so close but that they may move about in it. While Anacharis and other plants of this general type are usually planted in bunches, it is really better to make a slight separation of the individual stems. As the plant grows yellow at the roots it should be lifted out, pinching off the yellow and replanting the fresh green portion. To be had of dealers generally.

## MYRIOPHYLLUM

Here we have another plant which at first looks well in the aquarium, but which deteriorates. It has, however, a strong redeeming feature, the very finely divided hair-like leaves being ideal for receiving the spawn of goldfishes. For this purpose it has grown more and more into favor. It is used either in the bunches as they are sold, or made into a spawning-ring as shown on page 56. As a spawn-receiving plant it has one advantage over Water Hyacinth in that the individual pieces may be spread out so as to give all the eggs a similar amount of sun, whereas with Hyacinth one side is usually much more protected than the other, making the eggs hatch at different times. Before using Myriophyllum to spawn on it should be well washed off by moving it about in clear water, being careful to remove all insects, snails and snail eggs. When hatching is finished the plant might as well be thrown away.

There are a number of generally distributed species throughout America, all having the same general characteristics, but some are better than others as "spawning grass" on account of closer and longer leaves. They are all popularly known as Water Milfoil.

*Myriophyllum verticillatum.* This is the best American species and is found in both shallow and deep ponds throughout the United States and Lower Canada. Its leaves are dense and crowded, making an excellent spawning plant. *M. nietschei* is a cultivated variety of the same, the leafy filaments developing from 1½ to 3 inches in length.

*Myriophyllum proserpinacoides* or Parrot's Feather is a partially submerged form which should be allowed to creep on the surface of the water, where its blue-green, feathery leaves display a charm exclusively their own. Does well in the greenhouse or established on the edges of partially shaded lakes, where it becomes very robust and looks strikingly beautiful. The roots are not winter-killed.

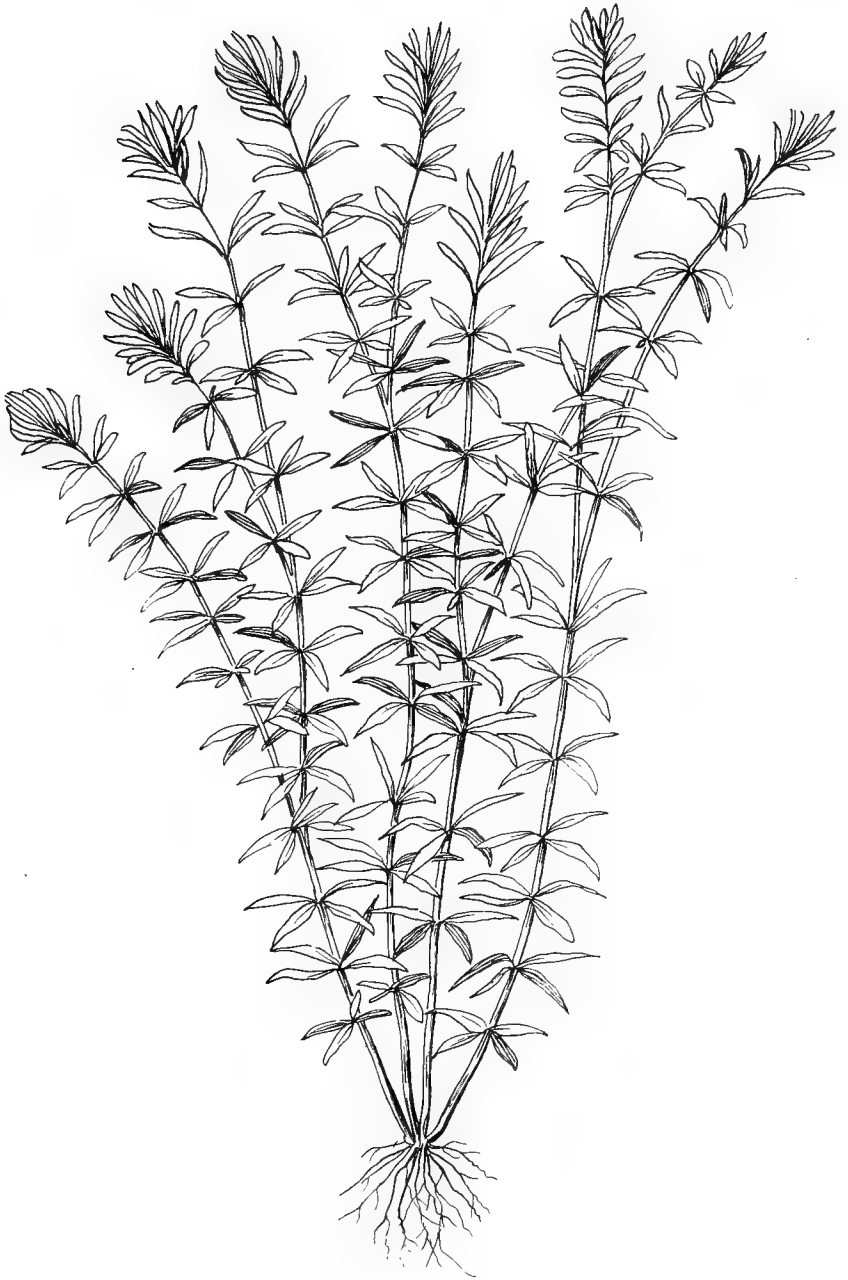


FIG. 167. WILD ANACHARIS

## CERATOPHYLLUM

Hornwort, as it is generally known, is mentioned here on account of its resemblance to Myriophyllum, for which it is sometimes gathered. It is an extremely poor aquarium plant, being very brittle and liable to rapid decomposition. Besides its characteristic of being fragile, it may also be recognized by having practically no roots, absorption taking place in the leaves.

It is found principally in ponds and slow-moving streams, where it washes about freely with the current.

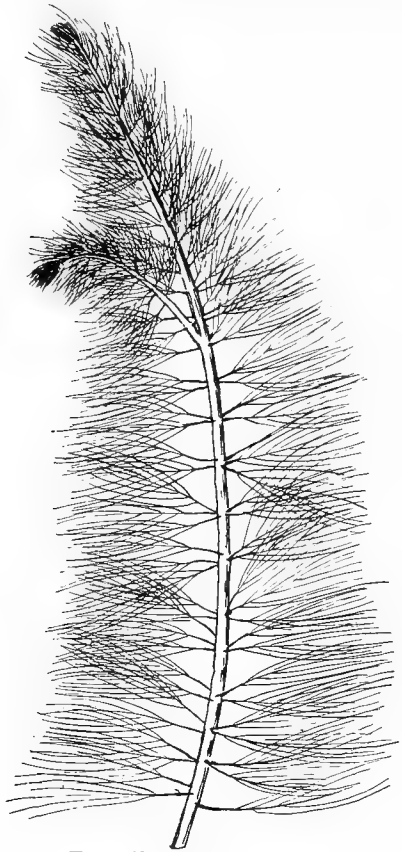


FIG. 168. MYRIOPHYLLUM

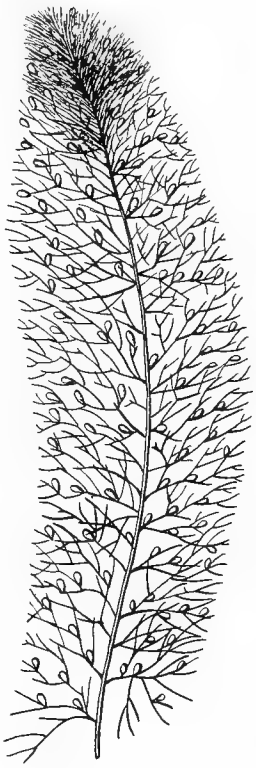


FIG. 169. GREATER BLADDERWORT

## UTRICULARIA

Many kinds of *Utricularia,* or Bladderwort, are distributed in the Temperate Zone. They have somewhat the appearance of the finely-divided leaves of Myriophyllum, but may be identified by the small bladders dotted throughout. Our figure 169 of *U. vulgaris* gives a good

idea of the general type. They thrive in the aquarium if given plenty of strong light. The Bladderworts are carnivorous plants, trapping the microscopic lower forms of animal life in their bladders, where they are digested. It has been claimed that they can trap extremely small fishes, such as the young of Dwarf Gourami, but we do not know that this has ever been definitely proven. There can be no doubt, however, that the plant *does* take living food which would be useful to young fishes, and to that extent is objectionable.

## HAIR GRASS

*Eriocaulon septangulare*, a dainty hair-like aquatic of recent introduction, fills small tropical aquaria in an agreeable manner. It is another of those plants forming a useful adjunct to the breeding of tropical fishes. It multiplies rapidly from short runners and is a good

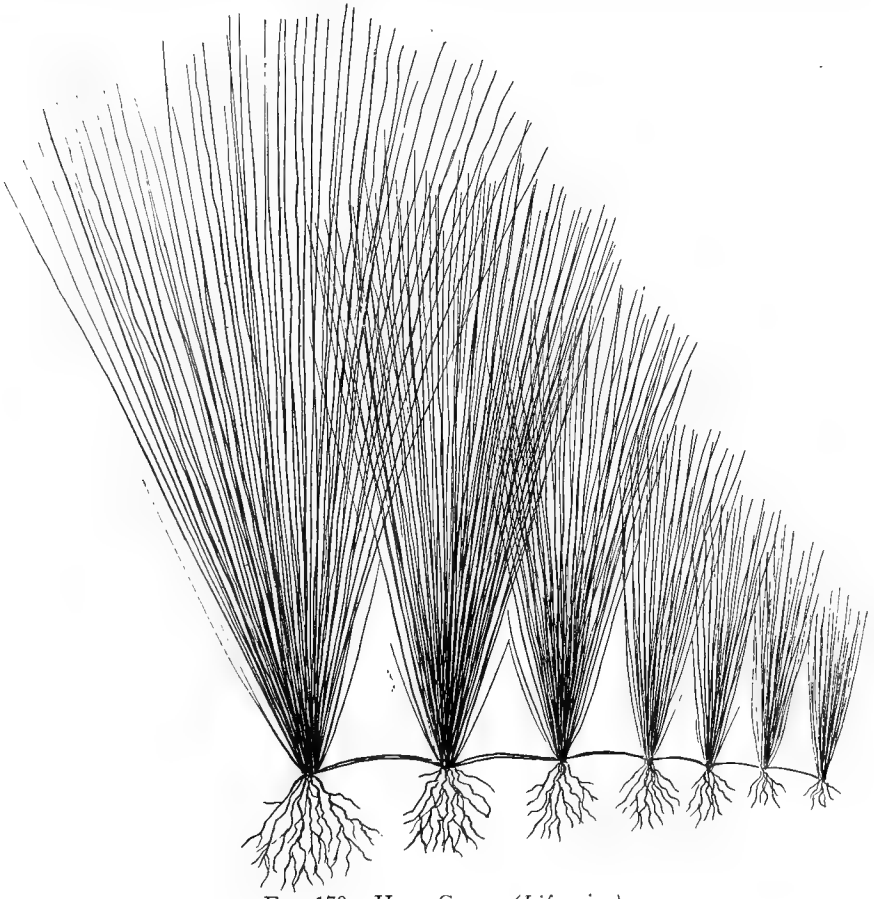


FIG. 170. HAIR GRASS *(Life size)*

oxygenator. Of a pleasing shade of light green, it makes a contrasting group among other plants in a large aquarium, but it shows to best advantage in a small aquarium by itself. It grows from 3 to 8 inches and is native to ponds in the Middle Atlantic and Southern States.

## POTAMOGETON

In strong contrast to the foregoing dainty plants is *Potamogeton densus*, or pondweed. As will be seen from illustration, these leaves are broad and robust. In color they are a bright green. This variety is said to be of European origin, but is now common in ponds in the United States. If established in soil in flat pots it flourishes in a well-lighted aquarium. Pieces collected from the wild may be introduced by fastening into the sand. They present a very attractive appearance and will last for quite a time, but should only be regarded

FIG. 171. *Potamogeton densus*
*(Half size)*

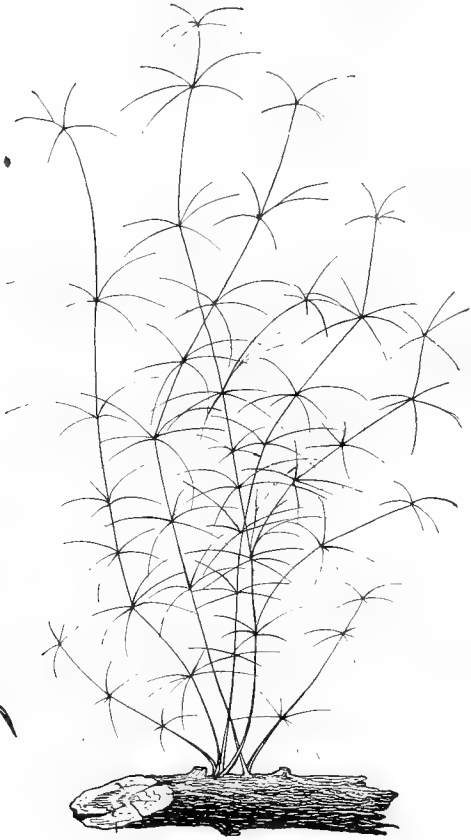


FIG. 172. *Nitella gracilis*
*(Two-thirds size)*

as temporary and when the leaves begin to turn yellow should be removed. There are many widely distributed species of Potamogeton, all looking quite attractive in a state of nature, especially *P. crispus* with curly leaves. They look very tempting, but none seem to survive long in the aquarium except *P. densus*, and that only when established just to its liking.

## NITELLA

Of the slender-leaved aquatics, *Nitella gracilis* is one of the best. Figure 172 gives a good idea of its dainty form. It is not freely distributed, but is found occasionally in ponds and streams in the Eastern States, usually attached to bits of stick or stone. From this it receives its popular name, Stonewort. In removing the plant to the aquarium, it is best to take also the base upon which it roots. If placed in a situation to its liking, Nitella prospers wonderfully in the aquarium and is a fine oxygenator. Under the microscope the leaves show the circulation of protoplasm .better than any other plant. Requires plenty of light.

## LUDWIGIA

Popularly known as Swamp Loosestrife, this plant in about twenty-five species is widely and thickly distributed in North America, mostly growing at the edges of streams, like Watercress. Although in reality more of a bog-plant than a pure aquatic, it does well in the aquarium, particularly if kept in the earth of the pot in which it was propagated from a cutting. Propagation is very easy in the greenhouse. About five short cuttings are placed in a two-inch pot, having a top layer of sand. This is not done under water, but the pots need to be kept saturated and the air very moist. They soon root, and when they have developed about an inch of new growth should be placed in the aquarium.

Ludwigia is one of the more important aquarium plants on account of its decorative value and pronounced individuality. When kept in a strong light the under sides of the leaves become a beautiful red color. Wild stock is not altogether satisfactory. It throws out too many roots to make a pleasing appearance, and in the aquarium becomes attenuated in character. A cultivated variety said to have come from South America is better in every respect and is easily obtained, for it is the kind propagated by dealers in aquatics. As it is sold in the original pots before being plunged into water, it can safely be sent long distances. Growing to a length of several feet if untrimmed, it is suited to large aquaria, but may also be kept small by pinching back. Unlike Anacharis, it should not be trimmed at

FIG. 173. CULTIVATED LUDWIGIA *(Life size)*

the root end unless the stock has become quite old and no longer prospers. Does best in strong light and may also be propagated in the aquarium from cuttings. A little Ludwigia can be seen in our illustration of a concrete aquarium. (Page 6.)

## SPATTERDOCK

Among the newer introductions into the aquarium are the submerged Spatterdocks. The large arrow- or spade-shaped leaves make

FIG. 174. SOUTHERN SPATTERDOCK *(Half size)*

a very characteristic appearance. Seedling plants gathered from lakes and ponds in the fall will do well in the aquarium over winter. If summer leaves appear and become too large for the aquarium the plant had best be removed. The Southern Spatterdock, *Nuphar sagittæfolia,* does not develop aerial leaves, but they gradually lengthen as the warm season progresses. The illustration shows the plant in

March. Later the stems and leaves will be longer. In October a new growth starts close to the thick, running root or rhizome. The leaves of this Spatterdock are of the brightest green hue and do not darken in strong light. Where the rhizomes, or thick runners, have been broken off they have a tendency to rot, eventually killing the plant. This seems to be overcome by planting in good soil.

FIG. 175. JAPANESE SPATTERDOCK *(Half size)*

The Japanese Spatterdock, *Alisma spec.*, has leaves of a considerably darker sage green, broader at the base. It is a continuous grower, has no aerial leaves and multiplies readily at the rhizome. Altogether a satisfactory plant for the large aquarium.

## FONTINALIS

Known as Willowmoss, these plants are found attached to stones or other substantial objects. They are of a pleasing dark-green color and have the advantage of doing well in a subdued light, although a moderate amount of direct sun does them no harm.

*Fontinalis antipyretica* grows in long-branching form, with leaves closely adhering to the stem. It occurs in cold-water streams. Very plentiful in some localities, but not freely distributed.

*Fontinalis gracilis* is very much smaller and thread-like, the leaves being so small as to appear like a roughness on the stem. In the

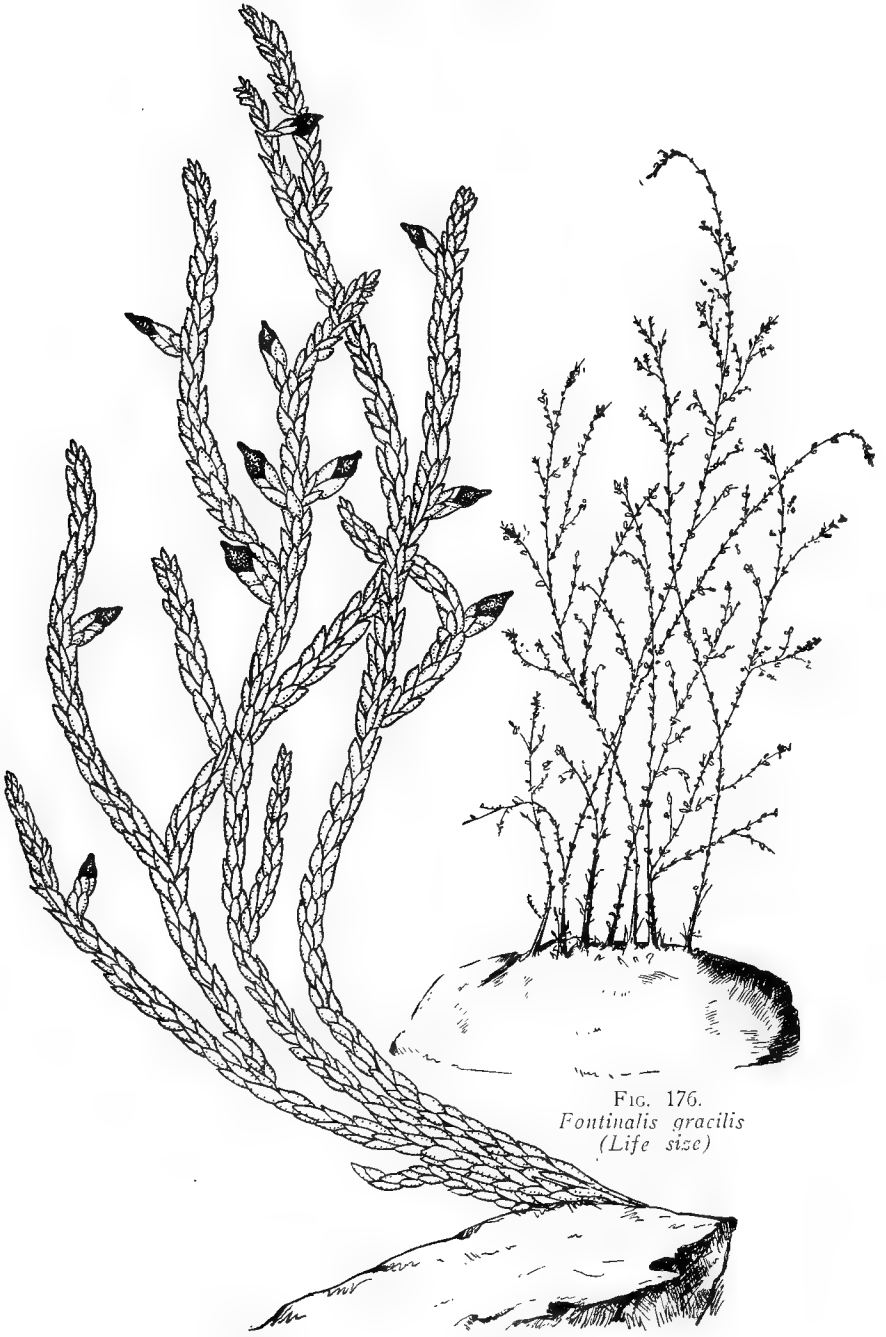


FIG. 176.
*Fontinalis gracilis*
*(Life size)*

FIG. 177. *Fontinalis antipyretica (Life size)*

aquarium this plant seems to have a faculty of soon becoming covered with sediment. Indeed, some aquarists find it useful to clear the water. As soon as the plant becomes well covered it is taken out, rinsed off and returned. As the stems are strong, they stand this treatment successfully. A stone containing a thick bunch of *Fontinalis gracilis* is an attractive feature in the aquarium. It is a slow grower. The new leaves are bright green, but soon turn to a dark sage color.

## HERPESTIS

*Herpestis amplexicaulis* bears a general resemblance to Moneywort, but in essential characteristics is quite different. It is a pure aquatic with thick leaves and a stout stem. Native to the ponds of Southeastern United States as far as Florida. It is one of the best of recent additions to aquarium plants. On account of being a slow grower, its introduction is not likely to be rapid, but once established it does very well, holding its bright green leaves a long time. When out of the water it has a faint, pleasant odor. Being of Southern origin, it will prosper in the temperature of tropical aquaria where some plants will not do so well, although it thrives in cool water also. Incorrectly known as *Bacopa*.

## CALLITRICHE

Floating in small, cool streams throughout the United States and Lower Canada, one will find patches of brilliant, light-green, small leaves. Examination will show them to be the floating leaves of a long-stemmed plant growing in the mud. These are various forms of Callitriche, or Spring Starwort, sometimes also called Water Fennel. When the plant is loosened we find it disappointing, for the lower leaves are thinner and quite different in appearance. The stems are tangled and difficult to disengage.

*Callitriche verna* is the commonest form, as well as the most easily established in the aquarium, but it shows to best advantage in shallow tanks, where a top view can be had of the surface leaves. It should, however, only be kept with tropical fishes unless it is intentionally given to goldfishes to eat, as they are fond of it. The stems and roots when taken are usually swarming with various aquatic insects and crustacea. Although many of these are fishfoods, it is best to rinse this and all other plants before placing in the aquarium.

## HIPPURIS

Formerly used as an aquarium plant, Mare's Tail has been overlooked of recent years, possibly on account of its tendency to stand above the water. Used in a suitable way, this feature could be util-

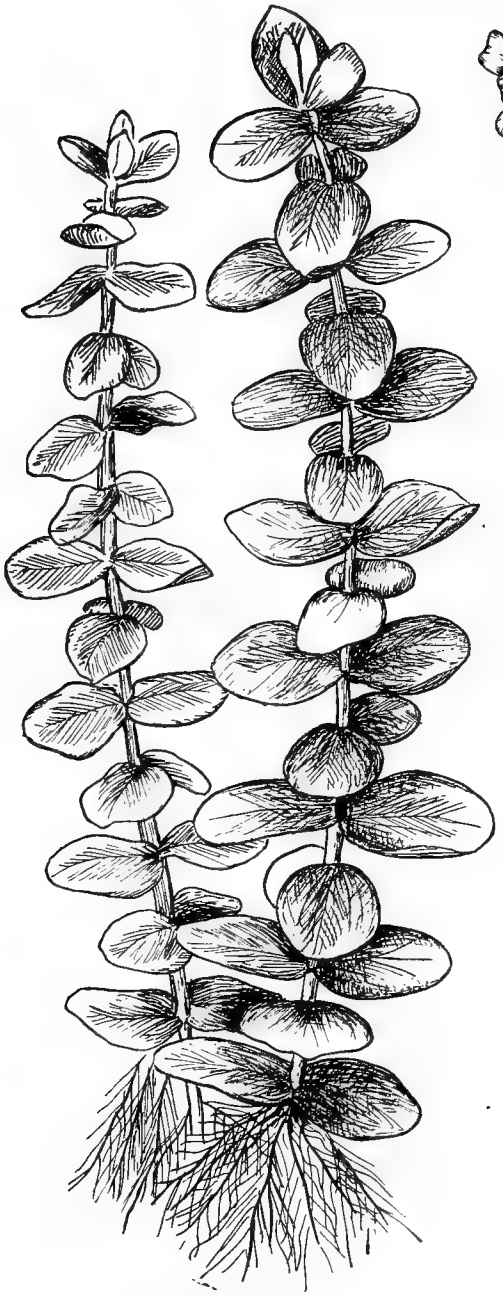


FIG. 178. HERPESTIS
*(Life size)*

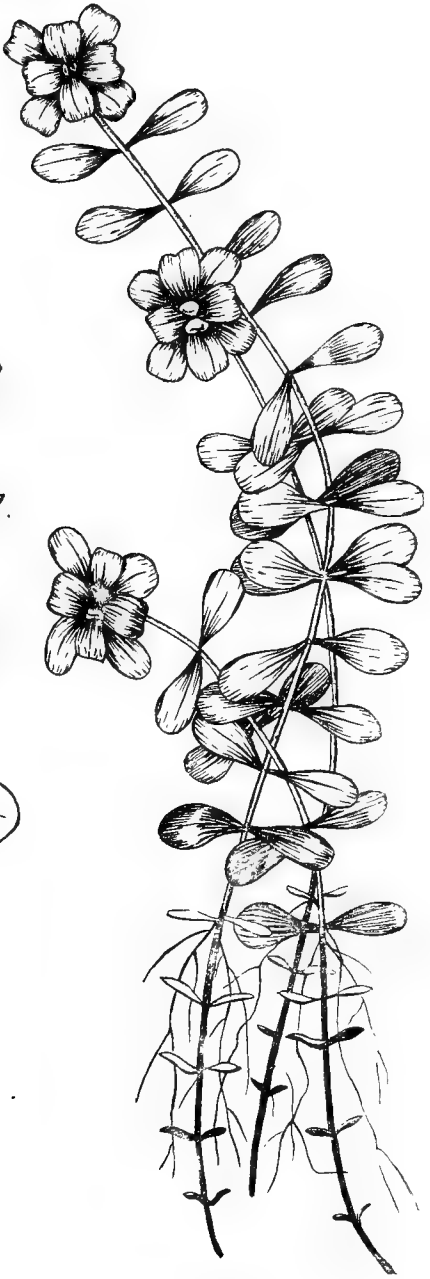


FIG. 179. SPRING STARWORT
*(Life size)*

ized to advantage. It transplants well and will thrive under varying conditions, but does best in ample light. Occurs in swamps from Labrador to Maine, and also on the Pacific Coast.

## QUILLWORT

*Isoetes* is a widely distributed genus of a number of species. It is found in the mud and sand at the edges of streams and ponds. In size it varies from a few inches to several feet. The small submerged species are worth trying in the aquarium, as they are tenacious of life.

The leaves rise from the centre of a circle or rosette, producing a very pretty effect. Quillwort should be placed in a good light. It is eaten by some snails and fishes.

FIG. 180. QUILLWORT *(Half size)*

## MONEYWORT

*Lysmachia nummularia,* or Moneywort, is also known as Wandering Jew, Creeping Jenny and Herb-twopence, the latter name and

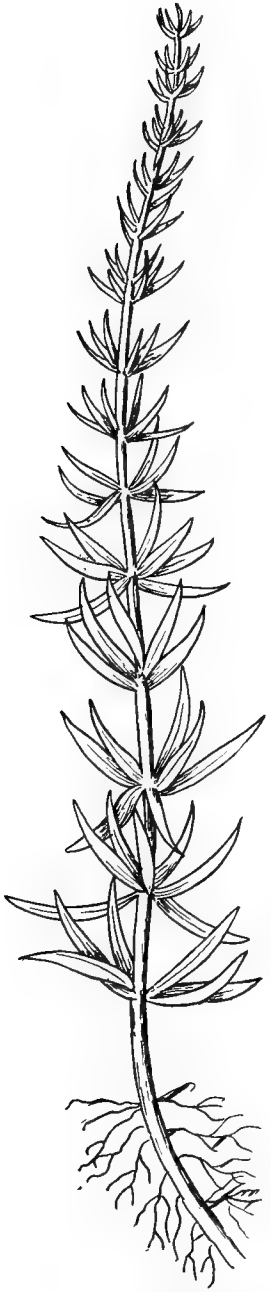


FIG. 181. MARE'S TAIL
*(Life size)*

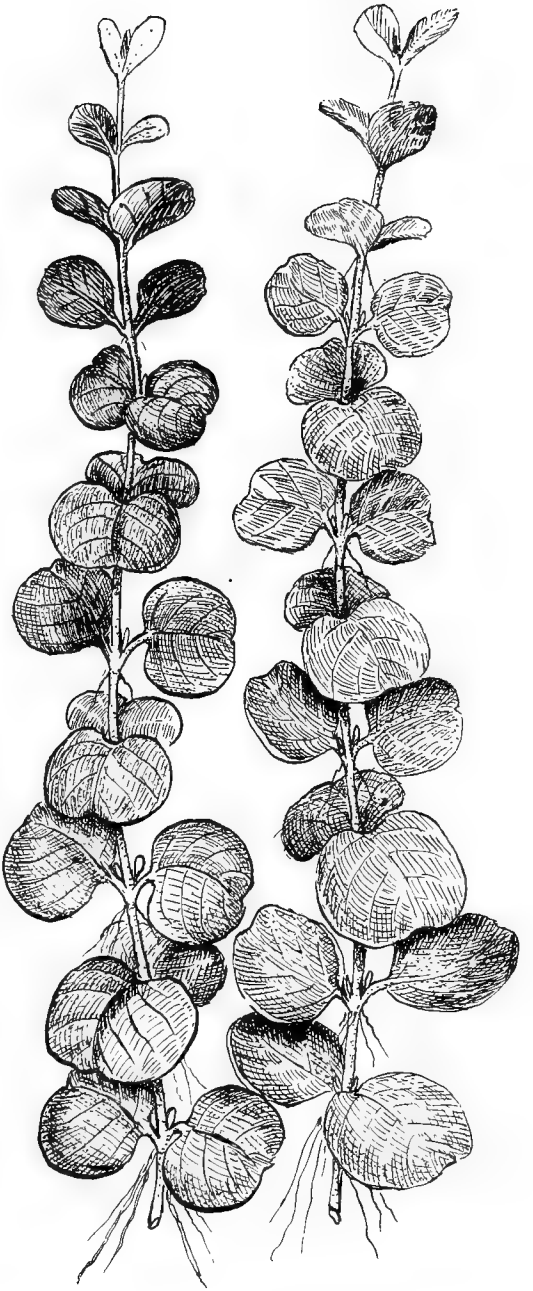


FIG. 182. MONEYWORT
*(Life size)*

Moneywort no doubt being derived from the rounded shape of the leaves. It is common in all the Eastern States, growing in damp places, usually near or bordering streams. Considering that it is scarcely even a bog plant, it does remarkably well in the aquarium, where it grows straight up to the surface of the water, regardless of where the light comes from. It is a fair oxygenator, but if kept submerged the leaves gradually dwindle in size, so that it is best to gather a new stock once a year, August or September being the best season to secure vigorous plants.

## HETERANTHERA

*Heteranthera zosterœfolia* is a very light green plant, slightly resembling Anacharis, but with longer, more widely separated leaves. It is a rapid grower, soon reaching the top, where it lies limp on the surface of the water. A good oxygenator, but has never become very popular on account of its rambling, untidy habits. Can occasionally be had of dealers.

## LACE PLANT

This extraordinary plant, *Ouvirandra fenestralis*, is a native of Madagascar. Its dark-green skeleton leaves appear very fragile, but

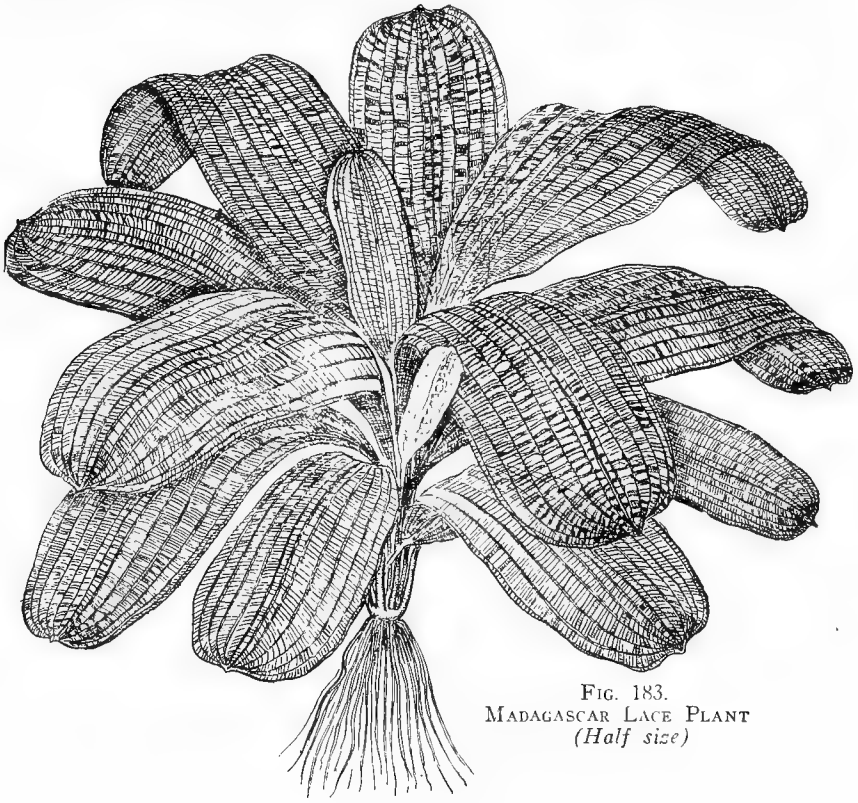


FIG. 183.
MADAGASCAR LACE PLANT
*(Half size)*

in reality they are the toughest-leaved aquarium plant we know of. They are slow of growth and prefer a subdued light. Propagation is by division at the root. This sometimes takes place in the aquarium,

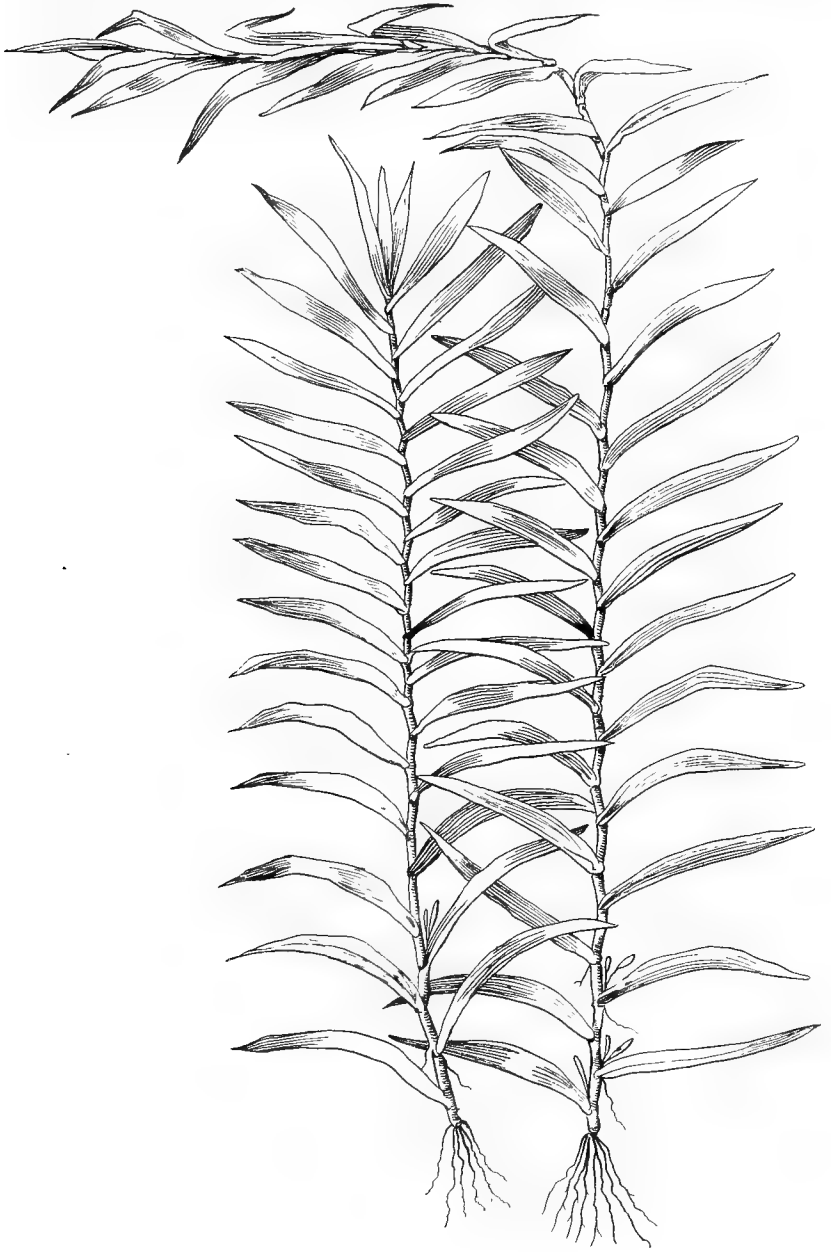


FIG. 184. HETERANTHERA *(Life size)*

but they do best in wooden tanks. At best they are slow growers, which in a way is an advantage, for they eventually become rather large. The Lace- or Lattice-leaf plant is used purely for ornamental purposes, its qualities as an oxygenator being negligible.

## CRYPTOCORNE

This attractive aquarium plant is an importation from Europe. Although introduced several years ago, it has never received the attention it seems to deserve. It is of an agreeable size and flourishes well in a good light if not disturbed. Propagation principally by runners. The crown is at the surface of the sand.

FIG. 185. CRYPTOCORNE *(Half size)*

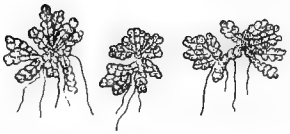


FIG. 186. AZOLLA
*(Life size)*

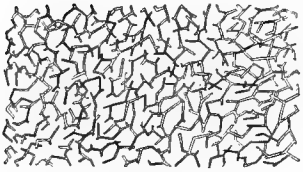


FIG. 187. CRYSTALWORT
*(Life size)*

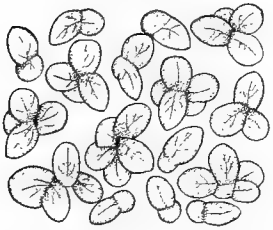


FIG. 188. DUCKWEED
*(Life size)*



FIG. 189.
WATER POPPY
*(Half size)*

## WATER POPPY

*Limnocharis humboldti*, owing to its generally satisfactory qualities, has become one of the most popular plants in the indoor and outdoor tank, as well as the large aquarium. It grows very rapidly and continuously sends out new plants, which have groups of buds. Usually a new bud blooms every day. The three-petaled yellow flower with a brown eye or centre only lasts a few hours, but is a most pleasing and artistic feature. The parent plant should be potted, preferably not very deeply in the water. The new plants run at the surface, occasionally sending down strong stems to obtain a fresh rooting.

## AZOLLA

*Azolla caroliniana* is one of the less used of small floating aquatics. It is not in any way a brilliant plant, but has a rather quaint charm. The leaves are of velvety appearance and range from a dull sage-green to dark red, according to age and the conditions of light. To be had of dealers. Native to the Southern States.

## CRYSTALWORT

*Riccia fluitans* grows in masses in small, angular shapes, resembling crystal formation. It floats just beneath the surface and is valuable in the propagation of small tropical fishes, some depositing eggs in it, and the new-born young of the live-bearing varieties using it for hiding places. Native to the Eastern States and may be had of dealers in aquatics.

## DUCKWEED

This commonest of all floating plants is found in several species in still pools everywhere. From the middle of summer until cold weather many ponds are completely covered with this green mantle, greatly interfering with the work of collecting daphnia for fishfood. Duckweed itself is a good food for goldfishes large enough to eat it, and has a laxative effect beneficial to the finer breeds. The form most commonly found is *Lemna minor*. Propagation is by offshoot extensions.

## SALVINIA

Of the small floating aquatics Salvinia is one of the best. The heart-shaped leaves with bristle-like growth on the upper surface seem like bits of velvet connected by a thread. The roots are naturally

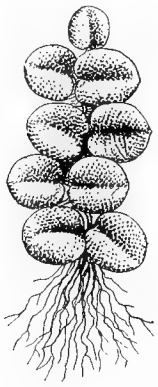


FIG. 190. SALVINIA
*(Life size)*

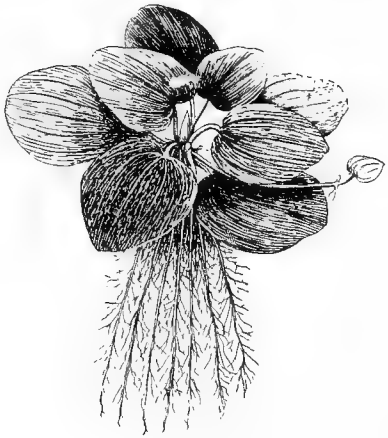


FIG. 191. TRIANEA
*(Slightly reduced)*

long for the size of the plant, but fishes usually eat them down to about half length, which interferes with a full development of plant. In the greenhouse, where they have a moist atmosphere and no interference, they develop with great rapidity. The variety illustrated, *Salvinia natans,* is native to Europe and is the form commonly used.

Although it is claimed that neither Salvinia nor the common wild Duckweed performs any oxygenating function, the author and others have many times seen aquaria completely covered with either of these plants and, with no other plants in the aquarium, the fishes were getting along perfectly well—a state of affairs which would be impossible if the water were blanketed over by an inert substance.

## TRIANEA

*Trianea bogotensis* is an attractive, small floating plant with thick, heart-shaped leaves. It needs a moist warm atmosphere and not too much direct sun. Under these conditions it thrives and is a valued feature in the summer pool or greenhouse tank. It is not found locally in temperate climate, but may be had of dealers.

## FROGBIT

*Hydrocharis morsus-ranæ,* requiring the same conditions as *Trianea bogotensis,* deserves more attention than it is receiving. Of very pretty

FIG. 192.
FROGBIT *(Life size)*

appearance when in flower, readily obtained from dealers, there is no reason why it should not be better known. As will be noted in illustration, it propagates from runners, but the seeds also germinate under favorable conditions. The plant is of European introduction.

## WATER LETTUCE

*Pistia stratiotes* is a floating plant with fluted, light-green, velvety leaves, forming a rosette. It likes plenty of heat, a moist atmosphere and protection from the sun. Under favorable conditions it grows to a diameter of about four inches or more and is very attractive indeed. The roots sometimes attain a length of eighteen inches, but they are not sufficiently dense to use for spawning purposes. Multiplies rapidly in a congenial environment, but degenerates and dies out in a dry atmosphere.

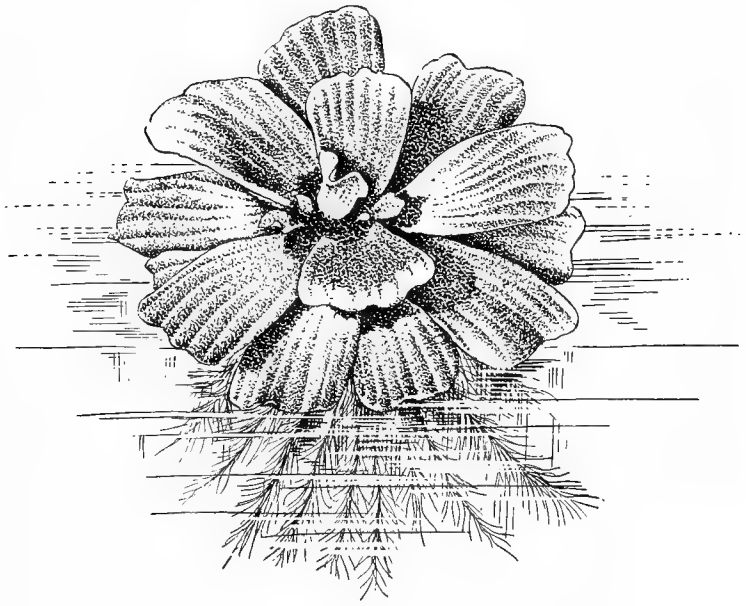


FIG. 193. WATER LETTUCE *(Two-thirds size)*

## WATER FERN

Not looking particularly fern-like, the Water Fern, *Ceratopteris thalictroides,* is the only truly aquatic species of the fern family. It is of comparatively recent introduction into the aquarium and indoor pool, it being more suited to the latter. In a partially shaded position in the greenhouse it grows into floating masses a foot or more in

diameter, piling up to some height on account of its peculiar means of reproduction, the new plants springing directly out of the parent leaves, as pictured in illustration. Ordinarily the plants are about six inches in diameter and are of very pleasing appearance. Native to the tropics around the world.

FIG. 194. WATER FERN *(Reduced one-half)*

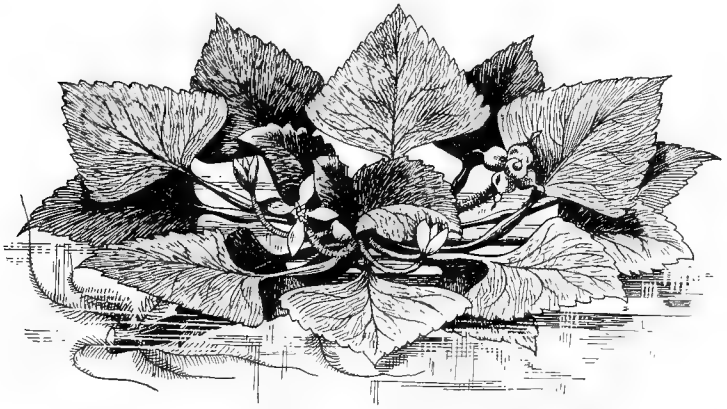


FIG. 195. WATER CHESTNUT *(Two-thirds size)*

## WATER CHESTNUT

Probably obtaining its popular name from the serrated edges of the leaves somewhat resembling those of the Chestnut tree, *Trapa natans* forms one of the pleasing varieties among floating aquatics. It is an annual doing well in exposed outdoor positions. New plants are produced each year from large, hard seeds. The big, black, two-horned seeds sometimes sold in Chinese stores are of a closely related species of *Trapa*. Can be had of dealers after May 15.

## WATER HYACINTH

Although Water Hyacinth, *Eichhornia*, is considered a pest in its native habitat on account of clogging up rivers and lakes, it is none the less a favorite with the aquarist, especially the breeder of goldfishes. Its long, finely divided, dense roots are admirable for receiving the eggs of any fishes that spawn on plants. The pale purple flower-spike only blooms for a single day, but is quite beautiful, having the general form of its namesake, the Hyacinth. Propagation is by runners at the surface of the water. Water Hyacinths do best if their roots can enter or drag in soil. Outdoors they do not like to be blown about nor to strike against the sides of a tank, although apparently not minding how closely they are crowded together. This plant does well in a warm greenhouse the year round. Unless supplied with plenty of light and heat during the winter they degenerate very much.

## WATER LILIES

Fish pools or large tanks standing in the sun should have water lilies growing in them. They are of easy culture and not only give protection to the fish from excessive sun and from bird enemies, but add greatly to appearances. Small or large varieties may be had, according to the needs of the space. Water lilies are divided into tender and hardy varieties, and the tenders are sub-divided into day-blooming and night-blooming kinds. The tenders are more free-blooming and the day-blooming tenders are the most fragrant, as well as presenting the greatest range of color. They usually open in the fore part of the morning and close in mid-afternoon. The night-bloomers open in the evening and close about nine in the morning. They are not fragrant nor as elegant as the day-bloomers, but they are called the business man's water lily, because he can see them in bloom in the evening and in the morning.

Water lilies need extremely rich soil. A mixture of half clay and half cow manure suits them very well. An inch top layer of sand

Fig. 196. Water Hyacinth, Showing Offshoot of New Plant

FIG. 197. NELUMBIUM SPECIOSUM

The Sacred Lotus of the Orient, from 4 to 7 feet in height, is easily the most magnificent of aquatics with leaves and flowers above the water.

FIG. 197A. HARDY WHITE WATER LILY *(Tuberosa richardsoni)*

FIG. 197B. WATER SNOWFLAKE

*(See Page 210)*

will prevent any of this soil from getting into the water. The crown of the plant should not be covered and ought to be about 12 to 14 inches below the surface of the water. They need an abundance of sunlight.

Before freezing weather sets in the tender plants should be taken up. Close to the main root will usually be found a few tubers about the size of shellbarks. These are the starts for next season's plants. They are to be broken off and kept in cool water or moist sand. In April they may be laid in shallow, warm water until sprouted, then placed in submerged pots, and later permanently planted out in June.

Hardy water lily roots only need be kept moist and from actual freezing. In a pond they may be left out. In early spring they form a number of new crowns. The parent root should be cut up into pieces, allowing a crown to each piece. Plant only one crown to a pot. Let all water lily pots be as large as space will permit. Most tenders will grow and bloom in a seven-inch bulb pan in an ordinary tub, but they are dwarfed from lack of space. They will do better in a box about a foot deep by thirty inches square, or in a hole 18 inches wide and 20 inches deep, as shown in Figure 204. Tropical water lilies show a surprising degree of intelligence in adapting themselves to the size of the pool they are in, reducing leaf and flower to accommodate themselves to the available space. The ordinary hardy water lilies if given as much space as they can use will have a surface diameter of about four feet. The usual tropicals vary from 10 to 15 feet, but will do well in pools of six-foot diameter.

We present a list of the most satisfactory varieties in each class.

**Hardy**

WHITE: Gladstoniana, Marliacea albida, Richardsoni.
PINK: Marliacea rosea.
YELLOW: Marliacea chromatella.
RED: Paul Hariot, Gloriosa, Aurora, James Brydon.

**Tender Day-Blooming**

WHITE: Gracilis.
PINK: Mrs. C. W. Ward.
BLUE: Pennsylvania, Wm. Stone, Pulcherrima.
PURPLE: Zanzibariensis.

**Tender Night-Blooming**

WHITE: Dentata magnifica.
PINK: O'Marana.
RED: Rubra, Devonensis.

**Winter-Blooming (Indoor)**

BLUE: Mrs. Woodrow Wilson, Panama Pacific.

**Small Hardys**

Pygmaea (white), Pygmaea helvola (yellow), **Laydeckeri lilacea (rosy lilac), Laydeckeri rosea (pink to red).**

## OTHER POND PLANTS

**Lotuses (Nelumbiums).** Album grandiflorum (white), **Luteum (yellow), Speciosum (rose), Pekinensis (red).**

The culture of Nelumbiums requires more root-space than for water lilies. Planted in a shallow pond where they have plenty of space for the strong roots to branch out and travel, they prosper amazingly. They are hardy over winter, and if it is desired to confine them to a certain space or locality they should be boarded in or otherwise divided from the rest of the pond. The roots go several feet deep. The Lotus is one of the most beautiful of all decorative plants. Its magnificent leaves and flowers swaying majestically in the summer breezes convince us that this plant well deserves the prominent place it has been accorded in the literary classics throughout history.

**Water Snowflake** is one of the most charming of the small floating aquatics. White, star-like flowers of 1-inch diameter are freely borne above the water. Parent plant should be rooted in soil near surface.

**Bog Plants.** Among the best of the bog and pond plants are Variegated Sweet Flag, Cape Pond Weed, Marsh Marigold, Umbrella Plant, Cyperus papyrus, Water Arum, Pickerel Weed, Sagittaria japonica, Sagittaria montevidiensis, and Lizard's Tail.

## ENEMIES OF AQUATIC PLANTS

The most serious enemies are muskrats. These eat the roots of several hardy aquatics, particularly over the winter season. They are partial to the roots of the small yellow water lily, *Pygmaea helvola.*

A leaf-cutting worm *(Hydrocampa),* sometimes becomes quite a nuisance. It cuts a piece from the edge and, laying it on the leaf, attaches the two together and uses the two pieces as a cocoon. Loose

FIG. 198. AQUATIC CUTWORM

bits of water lily leaves, Sagittaria, etc., observed floating around will, if pried apart, often be found to contain this white worm. The illustration is life size. They should be hunted out and destroyed.

*Chapter Fourteen*

# Construction

## AQUARIUM CONSTRUCTION

The amateur aquarist with a little talent for things mechanical can find profit as well as pleasure in making an aquarium according to his own ideas and requirements. The few necessary tools either are, or ought to be, a part of every household equipment.

Naturally the first consideration is that of the space to be occupied by the aquarium. In determining this it is well to be influenced, as far as conditions will permit, by the needs of the aquarium inmates. As to proportions, it will be found that most aquarium fishes do best in shallow aquaria with plenty of water surface. However, for artistic arrangement and symmetrical plant growth we must have a certain amount of depth. Twenty inches deep is sufficient even for large aquaria. For all-round purposes, bearing in mind both the artistic and the useful, a good general rule is to make the aquarium in the form of a double cube. That is, the width and height identical, and the length twice that of either. Unless an aquarium is to be viewed only from the top, it is not advisable to make the width over twenty-five inches, as even a slight cloudiness of the water considerably obscures the fishes when there is so much of it to look through. Within reason, make the aquarium as large as possible, but nothing over a seventy-gallon size is to be recommended for the household. An accidental breaking of the glass, even at this size, is too great a catastrophe to contemplate with composure. Since it is very little more trouble to keep a large-sized aquarium than a small one, and the results are so much better, at least with goldfishes, we would unhesitatingly say to those weighing the merits of two sizes, *take the larger.*

For most varieties of tropical fishes, a number of small aquaria will be found preferable. These will be treated of hereafter in the present chapter.

After the considerations of size and proportions, which we have already touched upon, we will now take up in order the points of construction, laying particular emphasis on the factor of safety.

**Bases.** The best material for general use in aquarium bases is slate. It is inexpensive, durable, easily worked, free from cleavage cracks, and in every way reliable. The requirements for thickness are from ¾-inch for sizes up to 30 gallons, to 1¼ inches for 130 gallons. Polished Tennessee marble makes a handsome and durable base. White marble is too glaring and besides is easily chipped in moving an aquarium about. Also when brought into contact with aquarium cement it absorbs and spreads the oil, making a bad appearance.

Aquarium bases usually extend from one to one and one-half inches beyond the frames on all sides. Slate or marble bases ought to be beveled sufficiently on the upper edges and corners to take away the sharpness. The necessary holes through which the frame is to be clamped on can be drilled with an ordinary metal drill, but it costs very little extra to have the slate-worker do this when he is finishing the base. Aquaria up to 10 gallons require 4 bolts, 20 gallons 6, and for the larger sizes they should be placed about 10 inches apart.

**Frame Metals.** Angle brass, iron or aluminum form the best metal aquarium frames. For the amateur worker, brass offers the most advantages. It is easily sawed, drilled and soldered, besides making a handsome appearance when polished and lacquered or nickel-plated. If nickeled it should be heavily coated. Angle iron is not so attractive in appearance, but is undoubtedly more rigid. It cannot so well be soldered. Consequently the four corners of the upper and lower frames have to be riveted through connecting elbow pieces on the inside or special castings on the outside, and then the whole riveted to the uprights. Aluminum has seldom been used, but makes an attractive frame. As the soldering of this metal is of doubtful durability, it is safer to rivet the same as with iron.

For aquaria up to 25 gallons, ⅝-inch angle metal is suitable; up to 50 gallons, ¾-inch; up to 75 gallons, 1-inch; up to 125 gallons, 1¼-inch. The author prefers seeing as little of the frame as possible and for many years has successfully used a 60-gallon aquarium constructed with only ⅝-inch angle brass, but he would not care to make this as a general recommendation. It is mentioned so that if others have the same idea they will know that it is a mechanical possibility.

Unless constructed of heavy angle iron, it is best to carry a light rod across short dimension of the centre of top frame of aquaria over 30 inches in length, to prevent bulging by water pressure.

**Frame Construction.** A hack-saw with fine teeth for metal-working will be needed to cut the proper lengths of angle metal. After carefully determining proportions desired, cut the four uprights and then the material for top and bottom frames. If working in brass, the latter should each be left in one piece. By accurately beveling the two ends and preparing right-angle cuts at three points, as shown

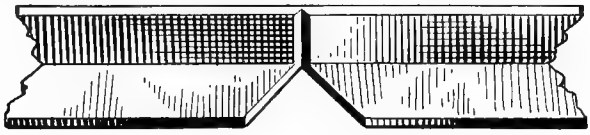


FIG. 199. CUT, PREPARATORY TO BENDING ANGLE BRASS

in above figure, the whole can be bent into a frame that will produce very neat corners and make soldering easy. The right-angle cuts should be finished with a square file and carried within about 1/32-inch of going through. This leaves the bar very weak at these points and considerable care is necessary in handling in order that some accident does not break them apart before it is time to bend. If one breaks it is not a very serious matter, only the corner will not have quite such a neat appearance. In practice we find it best to bend each cut as soon as finished and roughly fasten with solder. When all three bends have been completed, place within it a wooden form, as shown below. Except for the corners being cut off (to allow for

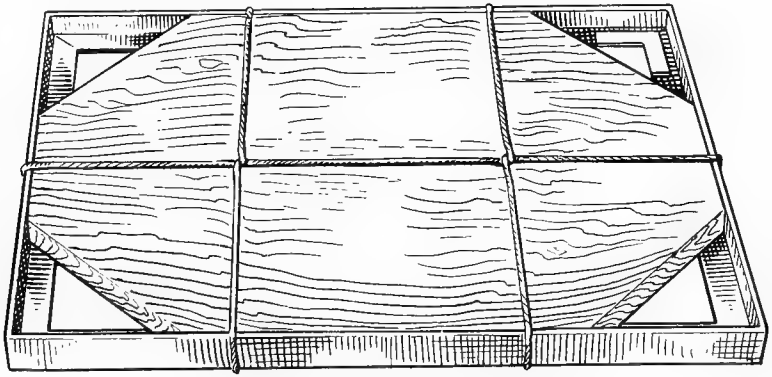


FIG. 200. FRAME SECURED ON WOODEN FORM
NOTE REINFORCEMENT IN UPPER RIGHT CORNER

soldering), the edges of form should be perfectly rectangular and fit closely. Now secure quite firmly with stout twine. After all corners are trued up with the board, apply the permanent solder. Melt

solder from any corner that does not stand true without forcing and re-solder. In the upper-right corner of illustration will be noted a right-angle flange reinforcement, cut from a flat piece of 1/16-inch brass. It is advisable to use these. They add greatly to the strength and actually make the work of soldering easier. After preparing the surfaces with solder-flux it is only necessary to place solder on the frame, lay the flange on top of it and apply torch beneath. When solder melts, press flange down and into exact position with a small stick of wood. It is better to have flanges sufficiently narrow to allow the uprights to fit in back of them.

The same form can be used for upper and lower frames. Should there be any irregularity in shape, they will both be alike, and so far as strength is concerned, it will only be necessary to keep corresponding defective corners parallel with each other, so as not to make any twisting strain on the glass—a force which, sooner or later, will cause it to break. If the frame is too large for a board, it may be trued by lines drawn on floor or table to lay it over. The use of forms, however, is so desirable to the amateur that we recommend having boards rabbeted together in order to secure sufficient width.

To test the squareness of upper and lower frames, lay them on the floor, make marks at the corners and turn completely over, trying both length and width in this way. Tests by squares at corners are only approximate, as the angle metal is seldom perfectly straight, especially lighter brass. Before leaving the subject of bending the frames to right-angles, we strongly suggest that an experimental bend first be made with a waste piece of angle brass. A little practice will be necessary to learn just how thin a particular lot of brass must be filed in order to make a good bend.

The next step is to bore holes in the lower frame where it is to be bolted through the base, countersinking for depression of bolt or rivet head, and allowing enough room not to interfere with the glass. Now solder in uprights at perfect right angles to inside of top and bottom frames, being careful not to use enough heat to melt former soldering.

It will be observed that the glass will be supported by the upright posts, but not by the top nor bottom frames. This is corrected by soldering, about every eight inches, a small piece of brass (cut from the same material) to the horizontal frames next to where the glass is to come, thus giving it even support or bearing on all four edges. The pieces are soldered down perfectly flat, and if high should be filed down. Before the glass is finally inserted it must be laid in the frame to see that the points of contact are even. Deficiencies can be made up by a drop of solder on the brass, and filed down as required.

The frame being trued up, it is now bolted through the base, aquarium cement being liberally supplied in the bolt holes and between the frame and the base, all surplus being immediately wiped away.

**Soldering.** The ordinary amateur is equipped neither with the facilities nor the experience to use a soldering iron to advantage. The author has engaged in considerable aquarium construction and has usually been able to get along very well without an iron, its main use being to clear surplus solder away more quickly than can be done with a file. Before soldering, the surface is properly prepared by scraping and the application of a flux composed of hydrochloric acid which has dissolved as much zinc as possible. An alcohol blow-torch is satisfactory for small work, but for the heavier construction a gasoline torch is better. When the heat is applied and the liquid of the flux has boiled away, touch the heated surface occasionally with soft solder wire. Apply a little more heat after first sign of melting, withdraw flame and proceed to quickly solder. Where work is in a position so that it is difficult to hold the pieces steadily in place while solder cools, an assistant can instantly "set" it by pouring on a little water. Small "C" clamps are most useful in holding uprights and side frames together while soldering. They may be obtained for twenty-five cents or less. If acid flux darkens the hands where it touches, the stain can be removed by dilute ammonia water.

**Small Aquaria.** Very compact, neat and substantial aquaria can be made in the foregoing manner, but without projecting base—in fact, without slate at all. The bottom is self-contained concrete. The top frame and upright corner posts are of ½-inch angle brass, and the bottom frame of 1-inch size. In the inside edges of bottom are soldered a few brass screws. Now prepare a mixture of one part of Portland Cement to two of clean sand, brought to a thick, mushy consistency by addition of water. Lay the frame on a good, flat piece of glass and pour in the cement to a depth of ¾ inch, seeing that it lies smooth, particularly where the aquarium glass is to rest.

After the cement is poured and smoothed, it should be covered to be allowed to dry slowly. In about two days the frame and base can be slid off the glass. The screws soldered on inside will always bind the concrete base securely in place. To prevent free chemicals washing out of cement into the aquarium water, it is well to waterproof the inside of base before setting glass in. This may be done by melting chips of paraffine on the concrete under a blow-torch.

After making one of these aquaria the knack becomes very easy. A row of them of uniform size presents a neat appearance and can be used in a small space, since there is no projecting base. This style of construction is suitable for aquaria with bases up to 11 by 18 inches.

If the frames are to be nickeled, this should be done before pouring the cement base.

**Glass for Aquaria.** Although double-thick window glass may be used for aquaria up to the 25-gallon size, plate-glass is so much handsomer and costs so little more it seems like a wise investment. If window glass is used, the imported kinds will be found best. Plate-glass is now made in 3/16 inch thickness. This is suitable for aquaria under 50 gallons. For those for 50 to 75 gallons, the best thickness is ¼ inch, and for the still larger sizes up to 120 gallons, is ¼ inch, and for the still larger sizes up to 120 gallons, ⅜ inch.

**Cutting the Glass.** A firm, flat surface, a good straight-edge, a sharp wheel cutter and a steady hand are the essential needs in this work. Bear on firmly but not heavily. If the wheel does not make a continuous scratch, go over the missed portion, but *do not again pass wheel over former scratch, as this ruins the wheel.* If glass does not divide easily, tap the under side of scratch with solid part of cutter until small splits occur along the line. It will then be safe to break. Large plate glass is best broken by placing the scratch line over the straight edge of a table and bearing down on glass.

**Setting the Glass.** The edges of the glass should be carefully cleaned with whiting, ammonia or alcohol to remove any grease. It is well to first coat the edges which are to come into contact with the cement with gold size, allowing this to set for a day or two. This is more particularly needed with large plate-glass aquaria. Apply a liberal coating of aquarium cement to the inside of frame, and a thin but well-covered coat to the contact edges of the glass. Press into place slowly but firmly, cleaning away at once all surplus cement. Light sticks cut of a length to brace across inside of aquarium should be used to maintain an outward pressure on the glass for several days until it is fairly set. After the glass is well set, it is advisable, especially with the larger sizes, to run a line of aquarium cement up the inside corners and along the bottom edges, covering with a narrow strip of glass, or, better, embedding a glass rod of from ¼- to ⅜-inch diameter in it, pressing in as far as possible and wiping away the surplus cement.

Fill slowly in about a week and change water several times in two weeks before putting in fishes.

**Stopping Leaks.** Large aquaria nearly always leak a little at first, or after moving them, or even after emptying without moving. This usually corrects itself within a few days, but, as elsewhere directed, it can nearly always be stopped by making the water very muddy. The particles of dirt get into the leak and choke it up. This may require several days. The water should be stirred occasionally.

**Aquarium Cements.** The prime requisites of an aquarium cement are resistence to water, adhesiveness, moderately quick setting without ever becoming stone-hard, and being non-poisonous. A cement combining these qualities is composed of one quart polishing or other fine sand, one quart Plaster of Paris, one pound litharge, two ounces powdered resin; mixed with boiled linseed oil to a consistency of putty suitable for glazing. This cement has been found to be good for both fresh and marine water aquaria. A durable cement for those who cannot obtain fine sand is made of equal parts by weight of zinc white, whiting and litharge, mixed with boiled linseed oil to a firm but tacky consistency.

## CONCRETE AQUARIA

The making of concrete aquaria opens a new and an unlimited field. Those who have felt that the metal-frame aquarium is hopelessly restricted and commonplace can here find more room for individual expression, design and achievement. The illustration facing page seven gives an idea of possibilities along this line.

As individual ideas will vary so widely in the design of concrete aquaria, only a few (yet important) directions can be given. Cement should be of the highest grade, fresh and free from lumps. A mixture of one part cement to two of clean, sharp sand is about right. Wooden forms ought to be soaked with water just before using, or else thoroughly paraffined. Cement mixture should be wet enough to just pour, and needs to be well tamped to avoid bubbles. Reinforcement rods (¼-inch diameter) are essential, especially around the top edge, where a continuous band should be formed. Through the bottom the bars should be wired together, forming 4-inch squares. Do not be in a hurry to get the forms off. The whole job should be moistened for a day and allowed to stand for two more days if their removal is going to cause any strain. Glass must not be embedded directly in the concrete, but provision made for later setting it in with ordinary aquarium cement. If sides do not support the glass evenly they should be cut away or built up until they do. Otherwise glass is sure to crack when the soft aquarium cement yields to the water

pressure. After base is finished it is well to paraffine it as described on page 215. All cement pouring should be done at one operation.

## CONSTRUCTION OF WOODEN TANKS

Many fanciers are of the opinion that for the welfare of fishes there is no receptacle equal to a well-seasoned wooden tank. For breeding purposes they are especially valuable, but in no case should tanks be used at once. Occasional changes of water for eight weeks make a new wooden tank safe for fish. Matters may be hurried by the lime-slaking method as described on page 223 for concrete pools, rinsing thoroughly and using in a few days.

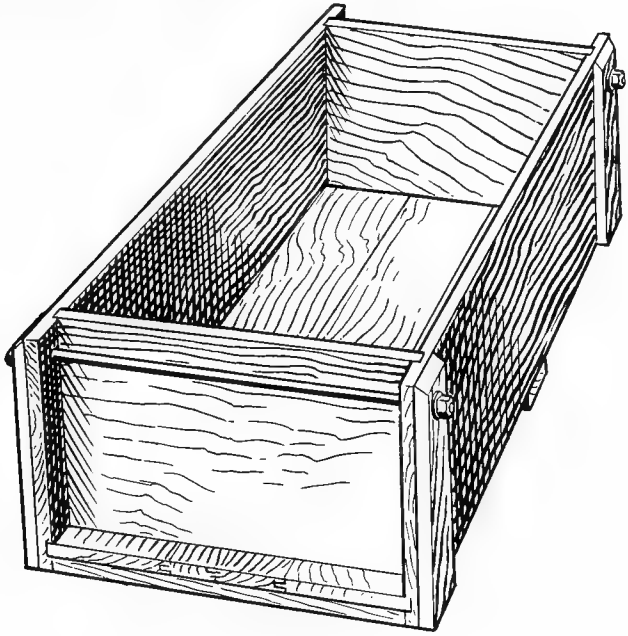


FIG. 201. WOODEN TANK

The best wood for tanks is well-seasoned cypress, the natural habitat of the tree being in wet places. Any size tank may be made, but there are two sizes found quite convenient and which cut to good advantage out of the lumber. The larger measures 16 inches high, 30 inches wide and 48 inches long. The smaller one measures 9 inches high, 24 inches wide and 32 inches in length. For the larger size 1¼-inch lumber is used, which is about 1⅛ inches when dressed. Here a board 16 inches wide is used, avoiding seams in any of the sides, and being but one in the bottom. The side and bottom boards

are rabbeted to ¼-inch depth and 1½ inches from edge to receive the ends. Bottom boards are tongued and grooved. All joints should receive a preliminary coating of white lead paint. After this is dried, a thicker coat should be applied just before putting joints together. The tank is then clamped and 1¾-inch screws inserted through the sides into the bottom and ends, and through the bottom into the ends. Cleats 3 inches wide are placed across centre of bottom and all the way around the ends. Through the top of latter is passed an iron rod ¼ inch thick, then secured and tightened with washer and nut at ends. The smaller tank is constructed in the same manner, except that cleat across centre bottom and the iron rods are omitted.

While painting the outside improves the appearance, it has more of a tendency to rot a tank than preserve it, as the paint prevents the evaporation of the moisture naturally gathered from the inside. Leaks will usually correct themselves in a few days, but should they not do so, a few handfuls of earth stirred in the water and allowed to stand several hours or days will make the job tight. Occasional stirring of the dirty water helps. The white lead should be allowed a day to harden before filling with water.

## CONSTRUCTION OF TANKS AND POOLS

For outdoor purposes it is better to dig holes in the ground and puddle them with clay rather than make poorly-constructed concrete basins or pools of any size. Unless the work is properly done, the frost is certain to crack it, and even the weight of the water may be sufficient to bring about this result. Repaired work is never satisfactory, and the next winter will open more seams, making continual expense, dissatisfaction, loss of water and of fishes. With indoor concrete tanks, too, thorough construction is a good investment.

The main points in the construction of such work are good foundations, thorough reinforcement, good cement properly mixed, and one continuous job for the finishing coat. The concrete centre ought also be poured within the space of one day. There is some difference of opinion as to the necessity for a base of cinders. The author favors them. If used, they should be the hard kind, wetted down and packed solid to a depth of one foot or more. For tanks of moderate size—say 11 x 22 feet—reinforcement should be by use of ¼-inch steel rods, crossed on squares of 8 inches. The bottom needs two layers of these bars, one near the upper and one near the lower surface. This protects against both inside and outside pressures. The lower frame of bars is bent up at the ends to form a cradle, thus reinforcing the

side walls. The ends are finally again bent over at right angles, running in the direction of the wall, and laced together. Above this are two continuous bands of the steel. Figures 202 and 204 will indicate

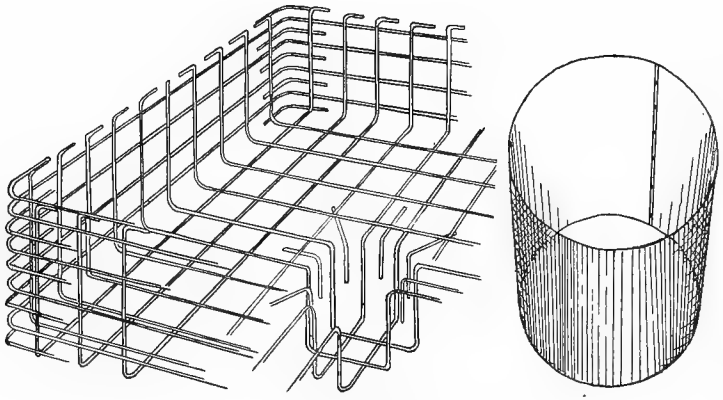


FIG. 202. ARRANGEMENT FOR REINFORCING STEEL; ALSO GALVANIZED IRON FORM FOR WATER LILY POT

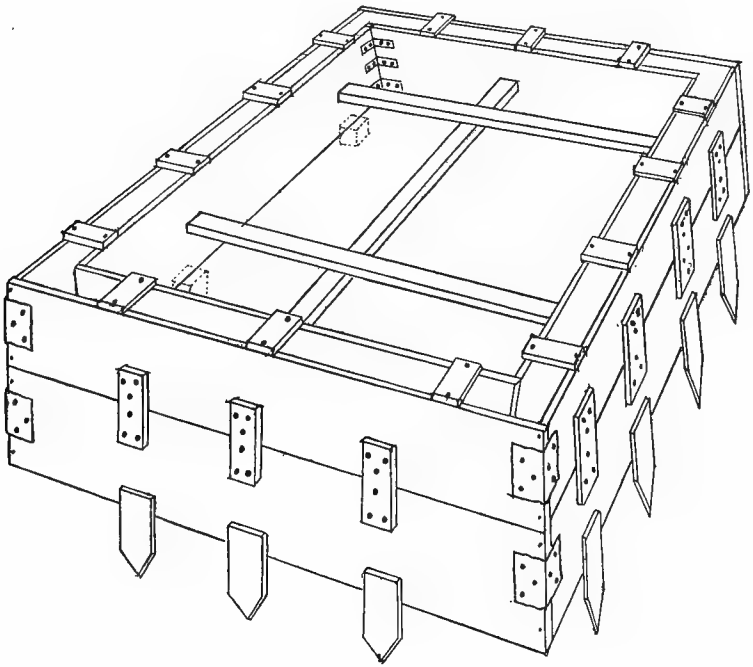


FIG. 203. WOODEN FORM READY FOR CONCRETE MIXTURE. DOTTED BRICKS SHOW SUPPORT FOR INSIDE FORM

these points. The corners are always the weakest sections. As the concrete is poured, lay in extra right-angle pieces of 12 inches total length, that is, 6-inch elbows.

The pouring of the concrete makes a great strain on the forms. These need to be thoroughly braced in the beginning, for it is impossible to improvise means of looking after these points once the pouring has started and the walls have bulged or the corners sprung. The outside bottom stakes are merely driven into the ground and not otherwise fastened. Outside corners, in addition to being nailed, are secured by pieces of tin, nailed through. Inside corners are held by iron elbows (to be had at hardware stores). They are secured by screws. The nails fastening side-cleats should be driven through and turned over. Concrete walls had best be thicker at the bottom, putting all the slope on the inside. A good inside depth for ordinary purposes is 15 inches, filling to 13½ inches with water. If an overflow is to be made through side, make a removable core of soft wood and saturate it with water so that it will contract upon drying. For outdoor pools an inside slope of 2 inches is about right. This would be, for a 7 x 9-foot pool, a top thickness of 4 inches, with 6 inches at the bottom. Base, 6 inches thick. For larger sizes add 1 inch of thickness to walls and base. Indoor pools require no slope. In making all calculations, allow ⅜ inch for thickness of finishing coat.

The forms should be leveled up and made absolutely true in the beginning. It is a bad plan to depend upon the finishing coat to correct inaccuracies. It seldom does it. Some considerable care is necessary to establish the four corners at perfect level. Select one corner and measure each of the other three from that. If the spirit-level is attached to a board, its trueness should be tested by reversing the ends. In any case, the level should be reversed on each test.

The concrete is mixed 1 part cement, 2 parts sand, 4 parts ¾-inch crushed stone or round stone. This is poured to within ½ inch of top of form, beginning with the base, and must be well tamped to avoid bubbles and open spots. Those wishing to secure the best possible results first place a thin skin of cement over the cinders, so the water in concrete will not seep into the cinder base, it being desirable that all concrete work dry slowly in order to crystallize perfectly. This preliminary skin is as thin as possible and is applied the day before. It is composed half each of sand and cement. If this is used, the lower layer of reinforcement may be laid directly upon it.

The finishing coat should be applied within twenty-four hours after concrete work is done, and is made 1 part cement, 2 parts sand. Finish one side at a time, top edge first, inside surface next, then out-

side, and the bottom lastly. Begin by filling in the finishing coat to top of form. Now take off inside form *from one side only.* Lay a piece of perfectly straight board along top edge. This makes an infallible gauge for thickness and straightness of finishing coat for the side. (Figure 207.) Here we might say that it is advisable to have an experienced finisher do this work, but a resourceful amateur can manage it. Now do the outside in the same manner, the idea here

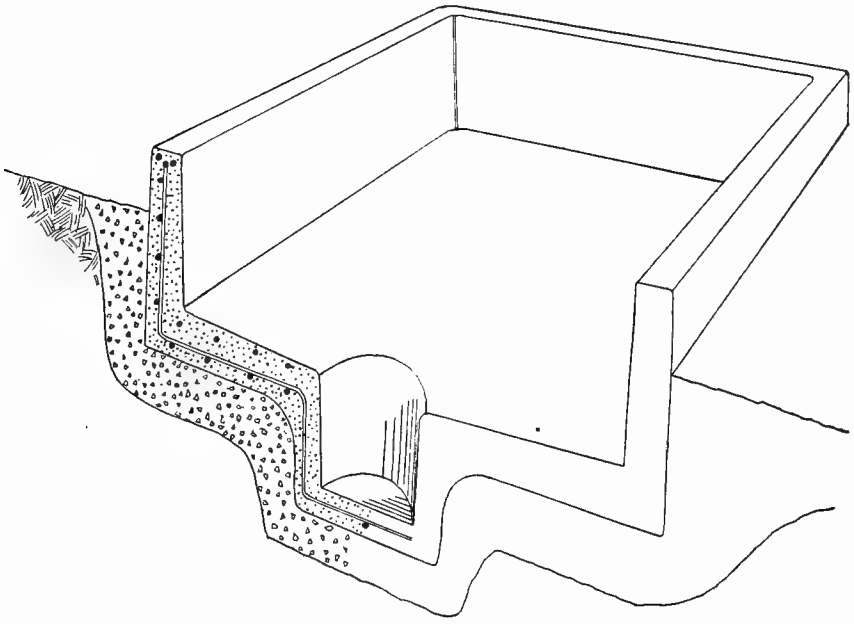


FIG. 204. CROSS-SECTION OF FINISHED POOL

The lowest layer represents cinders. We have indicated here the upper layer of reinforcement in the base, impossible to show in Fig. 202.

being to have the top bind with both sides while fresh. The outside being done last is less likely to be kicked. Try to protect the job from rapid drying in the sun.

It is very nice to sink a hole in the centre for the reception of a water lily plant. This adds considerably to the planning and labor, but the result is worth it in satisfaction if one is fond of beautiful aquatics. At the same time the bottom can be drained towards the centre; a good point when it comes to the annual cleaning-out. Figures show this. The hole ought to be about 18 inches wide at the top, 15 at the bottom and 17 deep. The galvanized iron form is removed by bending it inwards at one point. This form is of *thin*

metal and has no bottom, it being impossible to withdraw a bucket on account of suction.

Another added attraction for those caring for the æsthetic side is the addition of tiles in the edges. To try to push these into the finishing coat is to court certain trouble and a botch job. As soon as the concrete is poured the tiles should be set on little mounds of cement as indicated in Figure 205, seeing that they come to exactly

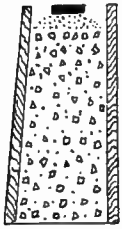


FIG. 205

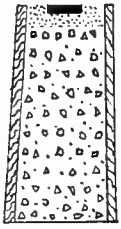


FIG. 206

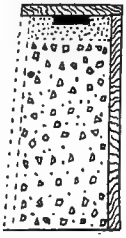


FIG. 207

Fig. 205. Tile set on cement mound. Fig. 206. Top finishing coat brought to level of form. Fig. 207. Guideboard in position for inside finishing coat. (Whether or not tiles are used, this is the best method of finishing.)

the right level, fixing the four corner ones first. Next day the finishing coat is filled around them, and they help to establish the correct level. The cement will slop over on them a little, but this is no matter. Most of it can be wiped off with water, and the balance after drying, with dilute hydrochloric acid.

The author is not partial to drain-pipes. They may become dislodged and let the tank run dry, or, on the other hand, they may get sand in them and not go back into place. However, this is a matter of personal preference. When the tank must be emptied, it is easily done by siphoning with a garden hose carried to a lower point. See page 228. In two days after the finishing coat is applied, a little water may be run in. On the fourth day fill completely.

**Seasoning Cement Tanks.** All cement containers should be seasoned before the fishes are introduced. This can be done by changing the water six times over a period of two weeks. This is not thorough and a longer time is better. Seasoning can be accelerated by different chemical processes. The safest is to fill the pool and slake a large piece of lime in it. In a pool 8 x 12 feet, slake about half a bushel. There is no danger of using too much. After slaking, stir every few hours and clean out thoroughly in two days. Another method is to place a piece of blue litmus paper (obtainable

in drug store) in the water after it has stood a day and been stirred up. Then slowly add and stir in commercial sulphuric acid until the paper shows a faint pink hue. Allow to stand another day, and if the paper goes back to blue, repeat addition of acid. When the pink shade remains draw off water, clean thoroughly and use. Enough acid to turn the paper a distinct pink or red should not be used. Always stir water well before determining color of paper. This test is only for the acid process.

The lime seasoning process can also be used to improve new wooden tanks.

**Aquarium or Tank Capacity.** To ascertain the gallon capacity of any rectangular tank, multiply the length, breadth and depth together in inches. Divide by 231. The result will be in gallons.

A gallon weighs 8 1/3 pounds.

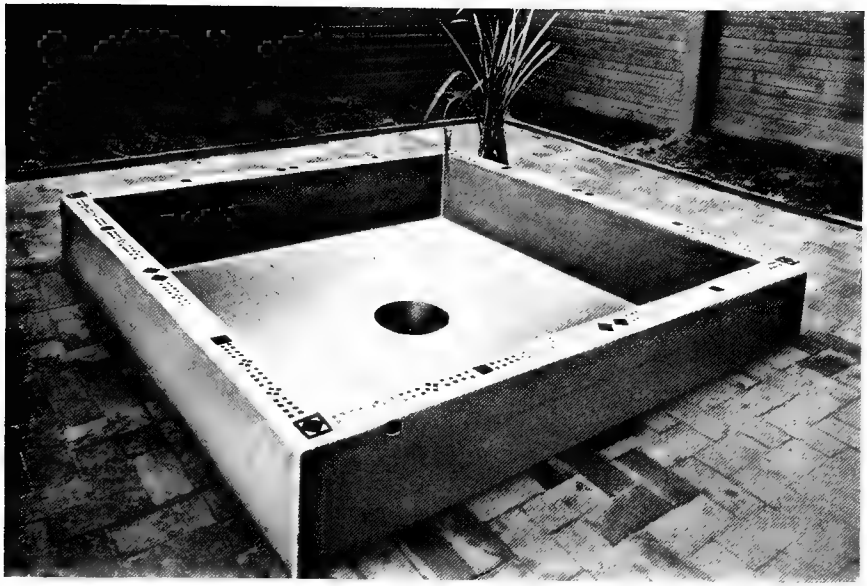


Fig. 208. Finished Pool, Showing Sunken Lily Pot

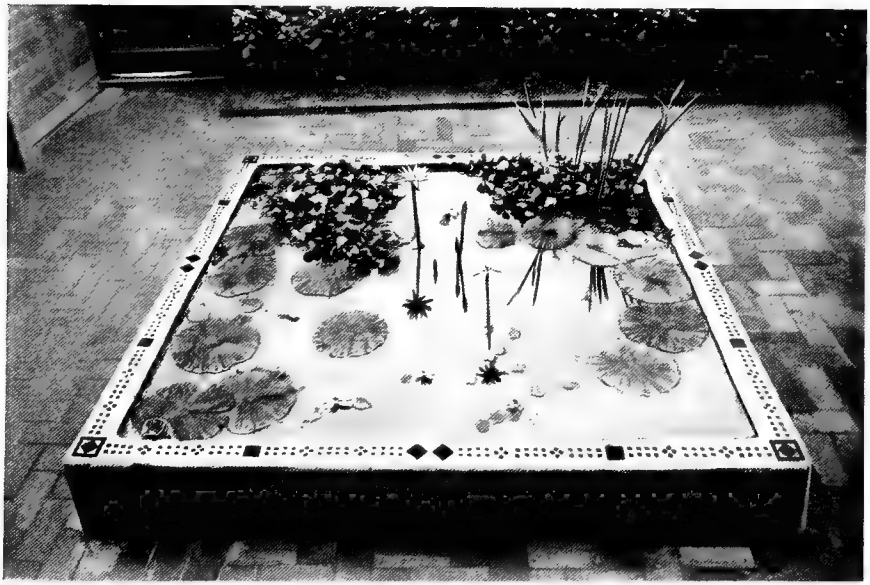


Fig. 209. Same in Use

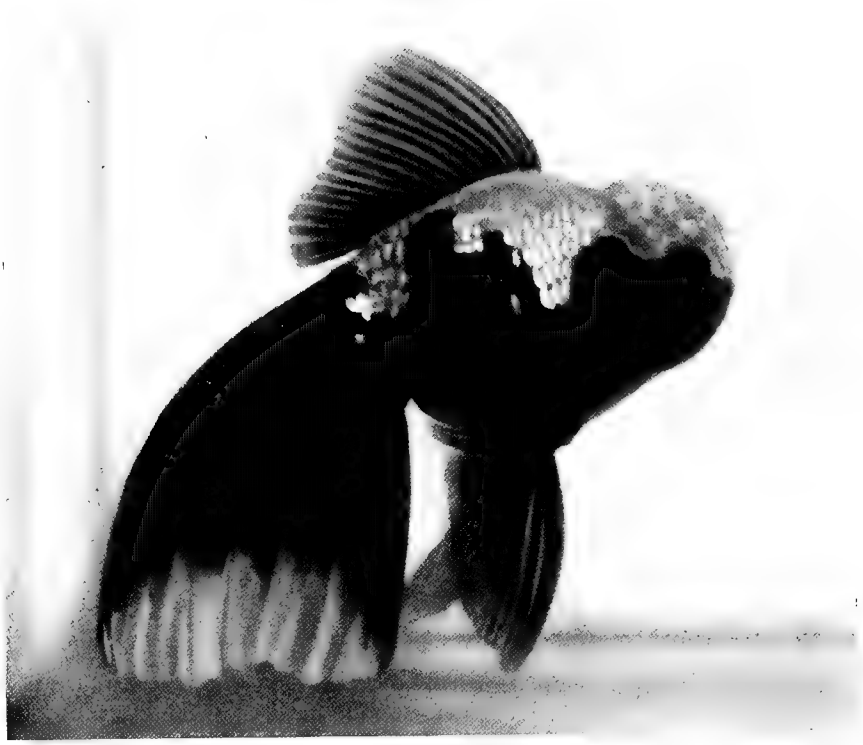


FIG. 210. PRIZEWINNING ORANDA GOLDFISH

Chapter Fifteen

# Aquarium Appliances

**Nets.** The most important device in aquarium work is a net with which to catch the fish, yet in most instances it is of faulty construction. The scales of a fish are easily knocked off by the hard knots in the coarse threads composing nets usually sold. This is very bad for the fish. A far better material is Brussels netting of a mesh such as is used on window curtains—not too fine.

When fish have to be caught from a globe, a round net is convenient, but for a straight-side aquarium, a square or oblong net is very much better. Usually these cannot be purchased, but to make

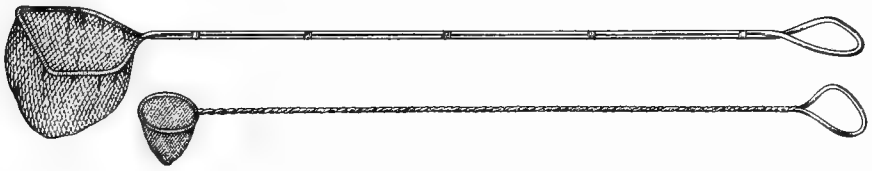


Fig. 211. Proper Nets for Goldfishes and Young Tropicals

one is a simple matter and well repays for the effort. Perhaps the easiest way is to purchase a round net, remove netting, bend wires to an oblong form and re-cover with Brussels netting. The larger kind shown is bent from a single piece of ⅛-inch galvanized wire, the ends beveled and soldered at the handle. The two strands of wire are tied together at intervals by fine copper wire secured by a little solder. A net about 5 inches wide and handle about 16 inches long is generally satisfactory.

**Glass Cleaners.** The best device for cleaning the inside glass of straight aquaria is a safety razor blade secured in a stick and riveted through. First rivet or wrap end of stick with fine copper wire to prevent splitting, place razor blade firmly in iron vise and drive down

stick to proper point. A blade may be used directly in the hand, but in this case it is better to dull one edge first in order to avoid cutting the fingers.

FIG. 212. SAFETY RAZOR BLADE AQUARIUM GLASS CLEANER

A dime rubbed flat against the glass will clean it. For cleaning globes a piece of thick felt is very good, although any piece of clean fabric will do.

**Dip Tube.** Sometimes particles of food remain too long after feeding. Also dirt collects in spots. Such places can easily be cleaned by use of a dip tube. Any tube of from one-quarter to three-eighths inch inside diameter and about six inches longer than the depth of the aquarium will do. Glass is preferable. Hold the thumb firmly over one end, place other end near particles to be lifted. Remove thumb, allowing water and particles to rush into tube. Replace thumb, lift out and empty. The capacity of the tube can be considerably increased by heating the centre over a Bunsen flame and blowing a sort of belly. A blown dip tube, with a specially designed section enlarged to about the size of a duck's egg, may be purchased from stock.

**Siphon.** When much dirt needs to be removed or the aquarium emptied, a siphon should be used. This consists simply of a hose sufficiently long to reach from the bottom of the aquarium, up over the edge and down again to a point near the floor. The longer the drop, the more rapid the flow. Fill tube with water, close both ends by finger pressure, insert one end in the aquarium and hold the other as low as possible. Release the ends of tube and the water will flow as long as there is water in the aquarium at a higher point than the discharging end of tube. Care should be taken not to draw in fish or snails.

**Forceps.** A pair of forceps for aquarium work forms a most handy tool. Their construction is very simple. Take a piece of ⅛-inch brass wire thirty inches long and bend to shape shown in figure 213. Where the wire crosses, hammer out a small flat space through which a rivet can be fastened. A small section of brass wire or a copper tack can be used as a rivet. When the forceps are otherwise completed, flatten out the ends by hammering on an iron vise or

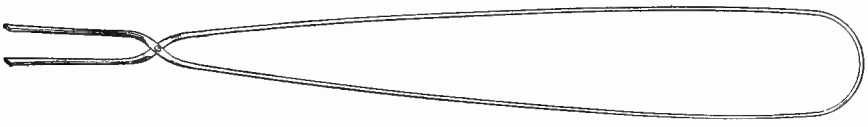


FIG. 213. AQUARIUM FORCEPS

other firm surface. The jaws of the forceps automatically remain open. Pressure on the upper loop closes them. They will be found quite handy in adjusting plants and lifting out snails, stones or other small objects.

**Planting Sticks.** To secure the roots of plants in sand would seem a very simple matter, but when the aquarium is filled it is most difficult to set them without the help of one or two planting sticks. These are as simple as they are useful, being merely thin sticks with

FIG. 214. PLANTING STICK

a dull notch in the end. About three-eighths of an inch is a suitable size diameter for the sticks. The notch should be slightly rounded on the edges to avoid cutting the roots as they are forced into the sand. Two sticks are better than one. Plants like Giant Sagittaria should be pressed down from two sides. After the plant is placed to the proper depth, it should be held with one stick while the other is used to push sand over the roots and to press down straggling roots which have not been covered. Aquariums should not be planted while filled, but sometimes a few plants ride loose on the first filling or some are added later. For such occasions planting sticks are most handy. A pair of rulers will do for an emergency. Almost anything is better than the fingers.

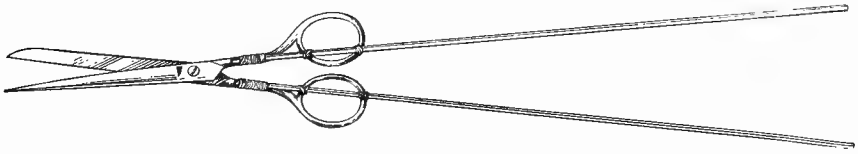


FIG. 215. AQUARIUM SCISSORS

**Scissors.** A pair of scissors with a 15-inch rod securely wrapped to each handle is useful for trimming dead leaves from plants. With this tool plants can be reached without disturbing anything, and one can get a better view of what is to be done than when working elbow-deep in the water.

**Live-bearing Traps.** With most varieties of viviparous (live-bearing) fishes it is desirable to promptly separate the mother and other fish from the young in order that they will not be eaten. One simple method is to take a glass funnel about six inches across the top, file a nick where funnel joins stem, break off tube and place a

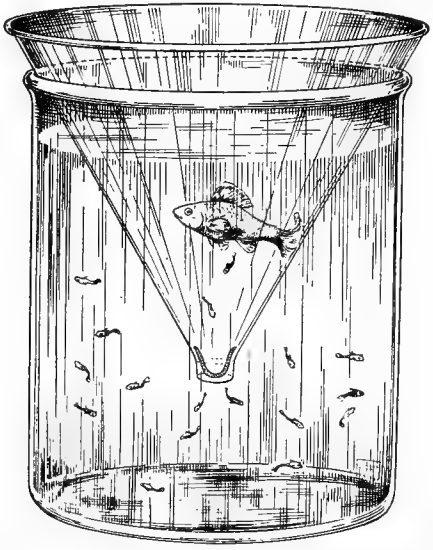


FIG. 216. FUNNEL TRAP FOR LIVE-BEARING FISHES

The obstruction in neck of funnel represents a piece of bent wire, and is, therefore open on either side.

small piece of U-shaped wire in the opening, so that the wire divides the hole in half. The funnel is then placed in a cylindrical jar or other aquarium of a size that will suspend it by the edge, bring the water as high as possible in funnel, place female fish in funnel and cover over with screen, so she cannot leap out. The small wire previously mentioned will prevent the mother fish from becoming jammed in the outlet, but will allow the young to pass through and collect in the lower portion of jar.

Another very simple and effective arrangement is shown in Figure 217 being merely two pieces of glass laid in an aquarium at a sloping angle and set into two blocks so cut as to leave a slight space between the glasses at the bottom of the V. This opening should be just large enough for the young fish to pass through. The plan has the advantage of giving the female plenty of space. In fact several females could be kept in such a "maternity ward" at one time. Unless feeding on daphnia, a small butter dish or similar object should be placed across the bottom of glasses to catch the falling food until the

fish can eat it. Also a number of snails in the lower part of the aquarium or jar will be needed to consume the food that falls through the opening. Snails must breathe air, so keep water level a little

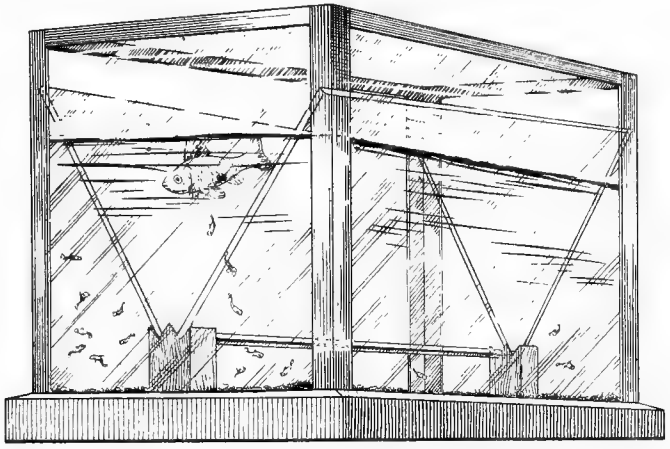


FIG. 217. AQUARIUM TRAP FOR BABY FISHES

below top edges of the sloping panes. An important point is to rub off the sharp edges of the glass, as the fish, if alarmed, may injure herself trying to get through the small separation.

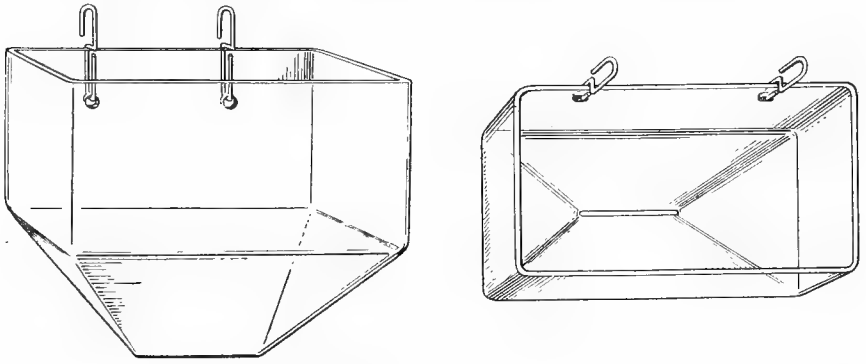


FIG. 218. LIVE-BEARING JARS, SHOWING ESCAPE SLIT

Very excellent breeding glasses come from Germany. These have a long, narrow slit in the bottom, as shown above, and may be hooked on the inside of any receptacle.

**Spawning Net.** In the spawning season aquarium space is often limited, particularly among amateur breeders who have perhaps a single aquarium. The breeding fish should be separated from the others, as the idle fish would eat the spawn. An easy way over this difficulty is the use of the spawning net. This is simply an oblong bag

of cheesecloth suspended in the aquarium. The illustration will show how this may be done. The four corners should be weighted down with bits of lead or stone sewed in. The plants and spawning fish are simply transferred into the net. Confined in this compara-

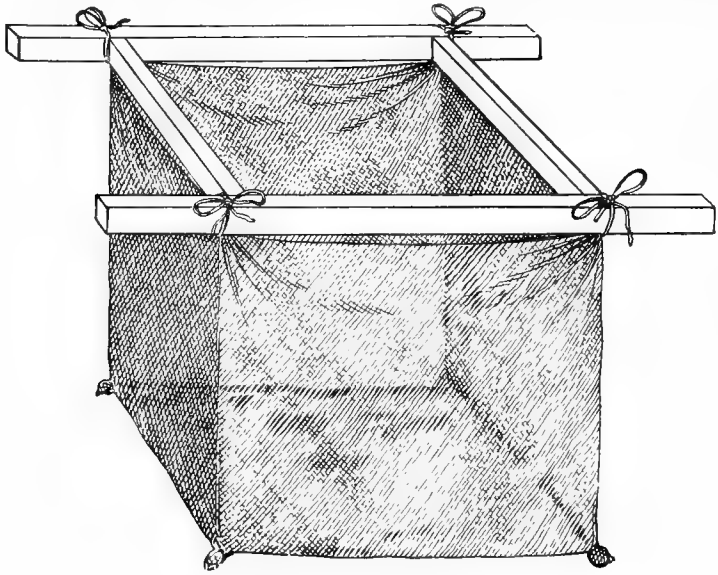


FIG. 219. SPAWNING NET

tively small space, the chances of the eggs becoming fertilized are increased, while the netting is sufficiently open to allow the aquarium water to flow slowly through it and prevent suffocation. In this way the large amount of dirt usually stirred up in an aquarium at spawning time, and which can do the adhesive eggs no good, is entirely avoided. The size of the net will depend somewhat on the proportions of the aquarium, but the capacity of net (portion in water) should be about twelve to eighteen inches long, ten inches wide, and ten inches deep. In constructing, allow extra material for space between top frame and surface of water.

**Constant Aquarium Filter.** This device is for use in connection with the air pump referred to on page 233. It is capable of a number of variations, once the principle is understood. There are two columns of water in the tubes, one solid and one punctuated by air bubbles, thereby making it the lighter. This causes it to rise and therefore establish circulation as long as air is supplied. A ⅜-inch diameter glass surgical drain is shown at A. This should contain about eight small openings and be suspended two inches above the

sand. This is connected by a short piece of rubber tubing to the rest of the system, which is of glass tubing from 5/16- to ⅜-inch inside diameter. The dark sections represent rubber joints, making the system more flexible, less liable to breakage, less expensive in case of break and makes cleaning of each section easy. (The tubes require an annual cleaning.) Air is injected under pressure at C, which should be five inches above lowest point of pipes. This starts the flow, which is discharged into D, a small filter suspended in the corner of the aquarium, and just above water level. It may be made

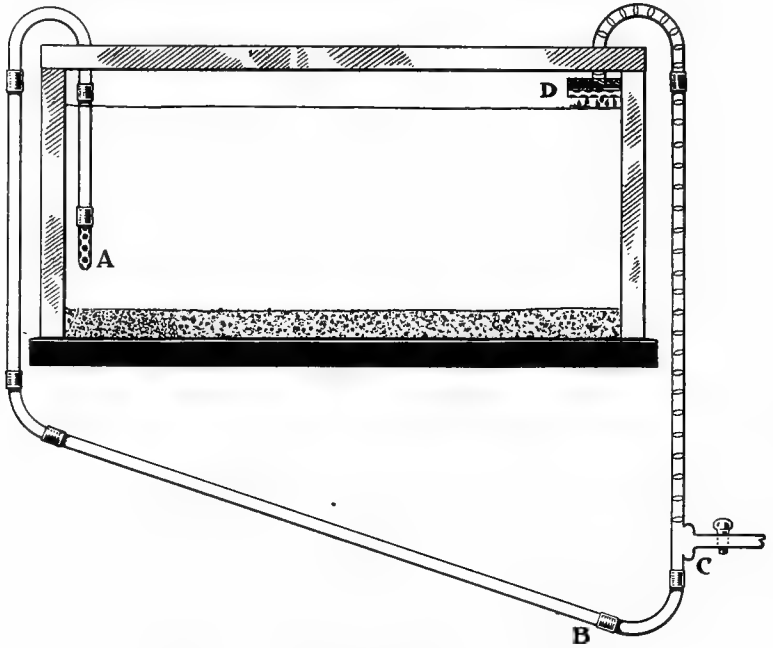



FIG. 220. WATER CIRCULATION BY AIR PRESSURE

of glass, aluminum, porcelain or earthenware, and should approximate in size five inches in diameter by two deep, the bottom having a few perforations. The best filtering medium in this work is absorbent cotton, which should be laid on a few pebbles, glass bars or bits of charcoal for good drainage. The force of air and the distance between C and the surface of water determines the speed at which the water travels. The lower the point at which air is injected, the greater the speed. To start the system, disconnect at B, suck with the lips to start siphon, re-connect while water is running. After water in rise tube has reached aquarium level, turn on air-cock at C. This cock should always be closed when air is not wanted and pump

not working, in order to prevent water backing up into air supply pipe. All rubber joints should be tightly secured by wrapping with thread or narrow strips of electric tape. Rubber cement spread on connecting surfaces helps make a good job.

This arrangement both filters and aerates the water. If filtering is not needed, the filter can be removed and aeration will go on.

Water can be raised by this method from fifteen to twenty-five inches above level. To secure the greater height, use ¼-inch inside diameter tube, take plenty of drop and allow eight inches from lowest point to C. By this means and a little ingenuity a return fountain can be made. To secure a uniform flow it would require a small tank to receive the discharge from the pipe, and from this an overflow to aquarium in case the water supply comes too rapidly for discharge rate of fountain.

It is not necessary to carry pipes over edge of aquarium as shown in diagram; they may be carried through the bottom, carrying dirty water directly down. The rise tube should be brought up through inside, over edge of filter. Short pieces of tubing long enough to reach above the sand and to extend an inch below the aquarium base should be used for passing through the slate. A very effective means of securing these in permanent position is to melt by alcohol blowtorch some chips of gum shellac. This melting is done in the aquarium directly around the tube and is continued until a small mound is formed. A piece of wet cardboard will protect nearby glass from the heat. Gum shellac has perfect resistance to water. It will adhere to almost anything and is of special value in connecting glass to metal. When cool it is quite hard.

**Fish-Carrying Case.** A box similar to illustration, built to hold the standard straight-side candy jar is a great convenience in carrying fishes for short distances. It may safely be used for tropicals in moderately cold weather if the jar is completely wrapped in several thicknesses of newspaper before placing in box, provided the exposure is not unreasonably long. Many of these cases are in use. The height is about 14 inches.

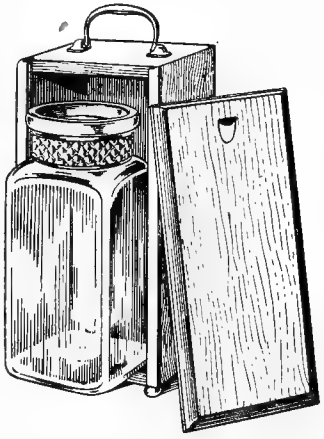


FIG. 221. CARRYING CASE

**Feeding Rings.** Many aquarists prefer training their fishes to look for their food at a certain place in the aquarium. One way of doing this is by use of a feeding ring, in which floating food is placed. It has the advantage of confining the food to one spot, and that when it sinks it can be over a cleared space where it will easily be found. Telescopic-eyed goldfishes are nearsighted, and a feeding ring helps them locate the food. It must in truth be said that such fishes find their food largely by the sense of smell, and that they will, in nearly all cases, eventually locate it, but they come to it with more certainty, having once learned the use of the ring.

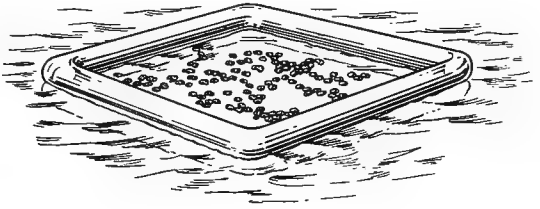


FIG. 222. GLASS FEEDING RING, WITH FOOD FLOATING IN IT

The illustrated subject is three inches in diameter, and is made of bent glass tubing. Sold by the dealers in aquarium specialties. They may be made from a piece of cork, with a large hole cut in the centre. After the cork becomes partially water-logged one can sow grass seeds on it. When the grass has become about an inch high the cork is turned upside down so the fish can enjoy themselves nibbling it off.

*Chapter Sixteen*

# The Microscope in Aquarium Work

Aquarium work in general and fish breeding in particular can be made both more interesting and more successful by the use of a microscope. For most purposes a very cheap instrument is satisfactory. In fact, a low power lens is preferable to a high in examining water for infusorian food.

All aquaria contain various beautiful and highly interesting forms of microscopic life, some harmful, some negative, but mostly beneficial to fishes. The constant changing of varieties and quantities presents a vast field for new study, but we are here mostly concerned with the practical points of raising young fish. On page 51 we refer to the use of infusoria as food for young fish. To determine the presence of this food, touch the tip of the finger lightly to the surface of the water, preferably to the side nearest the source of light. This is because they are mostly at the surface and they seek the light. Place this drop on a glass slide and observe under a good magnifying glass or a low-power microscope. The latter is rather preferable, as the focus can be changed as required, and it is fitted with a mirror to facilitate observation. In the absence of a microscope the small pocket folding lens known as a "thread counter" will do. In using this the frame of the counter should be laid directly on the glass containing the drop of water, and the whole placed over a mirror held at the proper angle to reflect light upwards, but too strong a light should not be used. A little experimenting will soon show the best light to work by.

The creatures which are of value as food to newly hatched fishes are generally of a size just too small to be detected by the naked eye, or at most they look like specks of dust. At the same time they are plainly observable under a good magnifying glass or low-power microscope. There is a great deal of life in the water of a smaller size than will be shown in this way and which probably has no food value to fishes. The high-power microscope would show many of

these organisms and thus be apt to deceive the observer as to the actual food value contained in the water. Also with high magnification the field of vision and the area of sharp focus are smaller, while movements are apparently much more rapid, making observation difficult.

The majority of the valuable organisms are rotifers. These move in a steady, revolving or rotating manner. On page 51 will be found instructions for propagating these organisms for purposes of feeding young fish. Most rotifers can be readily identified as such because they swim through the water by means of circlets of hairs

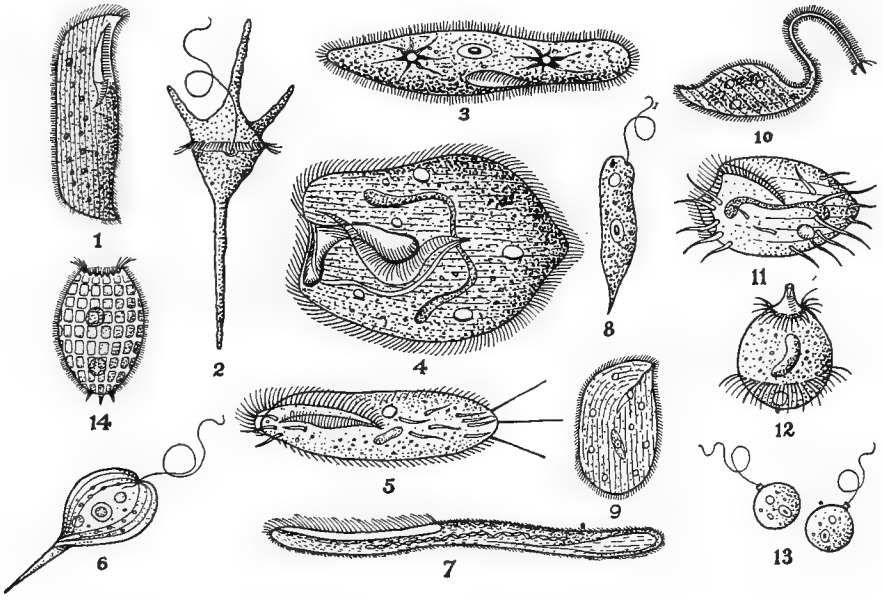



FIG. 223. COMMON FORMS OF MICROSCOPIC ANIMAL LIFE IN FRESH WATER
*(Greatly magnified)*

1. LOXODES, a very common form.
2. CERATIUM, a very common form, especially in ponds and lakes.
3. PARAMAECIUM, a very common form, the slipper animalcule.
4. BURSARIA, a very common form, one of the largest.
5. STYLONYCHA, a very common form, found everywhere.
6. PHACUS, not so common as the above numbers.
7. SPIROSTOMUM, common everywhere.
8. EUGLENA, common everywhere.
9. CHILODON, common everywhere.
10. TRACHELOCERCA, common everywhere, the swan animalcule.
11. EUPOLOTES, not an aquarium in America without examples.
12. DIDINIUM, predaceous, feeds on paramaecium and others.
13. TRACHELOCERCA, small but plentiful.
14. COLEPS, the barrel animalcule, common.

or cilia arising from the front of their heads, by the vibratile action of which they swim and disport themselves through the water. In fact, rotifers derive their name from the wheel-like appearance produced by the motion of the circlets of cilia while feeding and swimming. For culture water to have practical food value a single drop should contain at least half a dozen living objects that can be seen in the manner suggested. Water rich in life will show rotifers so thickly that they almost touch one another—probably two hundred in a small drop. In taking water from the culture tank to feed the fish it should be skimmed from the surface or the animals extracted from the water by a plankton net, which is nothing more than a small net of the finest bolting cloth.

Besides the examination of water for living food there are many other interesting possibilities for the microscope in aquarium work. Diseases, the development of eggs, plant structure, algæ, the structure of daphnia, cyclops and other crustacean foods are a few of the subjects which may be taken up with profitable interest.

A study of the microscopic world within the aquarium will prove a most fascinating pursuit. An instrument equipped with a 16 m.m. (2/3 inch) objective and a high- and a low-power eyepiece will show everything needed, giving satisfactory magnification.

Those wishing to explore this field a little further will find the following works to be helpful: "Aquatic Microscopy for Beginners," by Stokes; "Marvels of Pond Life," by Slack; "Evenings at the Microscope," by Gosse.

FIG. 224. PRIZEWINNING CALICO COMET GOLDFISH

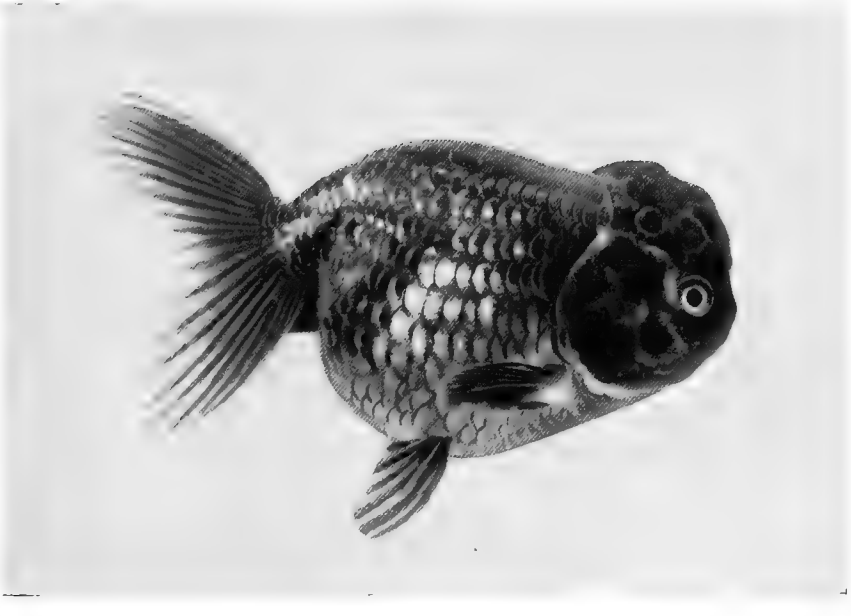


FIG. 225. PRIZEWINNING LIONHEAD GOLDFISH

These two specimens show perhaps the greatest extremes in the accomplishments of fancy fish breeders. It is almost incredible that they were both derived from the same root-stock.

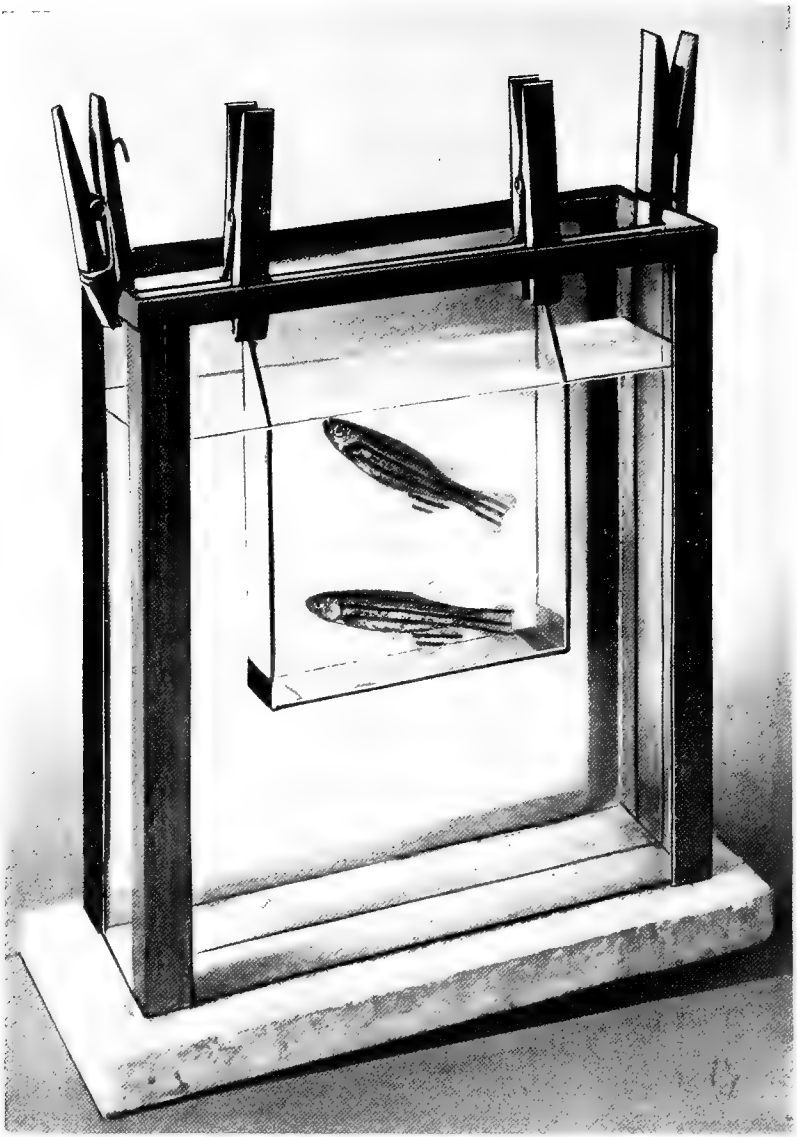


FIG. 226. PHOTOGRAPHING AQUARIUM

The outside clips hold the dividing partition forward. On this partition the inside clips hold the smaller glass form, selected according to size of fish to be photographed. To remove fish, allow partition to fall back. When fish swim out, remove entire partition and lift fish with a small net.

*Chapter Seventeen*

# Photographing Fishes

It is obvious how important, as well as interesting, photographic records of fishes can be. In writing on the subject in the hope of having others enter this unlimited and fascinating field of work, the author presupposes a fair photographic technique to start with. The main requirements are a small aquarium with a front of thin plate glass and an adjustment for keeping the subject in focus, a few card backgrounds of different shades, a board on which to focus the camera by sliding the whole instrument (preferably, but not necessarily, of back-focus design), and a lens working at about F5 to F6. The author does his own work on a shutter, the ends of which are laid on the seats of two chairs, fastening a piece of cardboard to the back of one of the chairs to act as a background. The aquarium, with a front seven inches square and a depth of two and one-half inches, is usually stood about a foot from the background, to keep it out of focus and to avoid shadows from the edges of the aquarium. The fishes are kept in the focal plane by use of an adjustable glass partition. For holding small fishes in place the following simple arrangement is used: three pieces of glass are cut about twice the width of the thickness of the fish, and of a length from three to five inches, according to requirements of length of fish. The ends are fastened together with adhesive tape like three sides of a square. The free ends are given a cut to end them off at about forty-five degrees or less. These free ends are fastened to top edge of partition by clips, first filing a nick in the beveled surface for the clip to catch in. The glass partition with three-sided cage attached (open at top) is then pushed up against the front glass and the apparatus is ready to receive the fish. This not only confines the fish strictly in the focal space, but keeps it out of the corners of the aquarium, where it seems to delight in exhausting the patience of the photographer. It is a good plan to have a number of these little cages made up to different sizes to suit the measurement of the fish to be photographed.

Photographing to about two-thirds size is usually satisfactory. Larger than this cuts down speed and focal depth too much. Water absorbs much of the light, so that only bright days should be used. The angle of the sun at noon is a little too much overhead to strike fully on the side of the fish, although this can be remedied and the speed much increased by the use of a reflecting mirror in addition to the direct sun. This sometimes makes a beautiful effect on a silvery fish. Our photographs of *Pterophyllum scalare*, *Osphromenus trichopterus* and the Banded Sunfish were done in this way.

When a black background is wanted, procure the darkest medium obtainable and construct a ledge above it, so that the sun cannot strike directly on it. The water should be as free from particles as possible, particularly when using a dark background.

It is desirable to cover the camera with black velvet to prevent reflections in the aquarium.

Some operators use flashlights, but to the writer nothing seems as good as direct sun.

In photographing down through the top of an aquarium it is necessary to suspend a glass at the surface, so that the bottom of it is wet and the top dry. This obviates blurring caused by refraction due to ripples. Where clear waters prevail there is no doubt that fine photographs of the natural bottoms of the shallower bodies of water can be made through a glass-bottom aquarium, slightly submerged in the water.

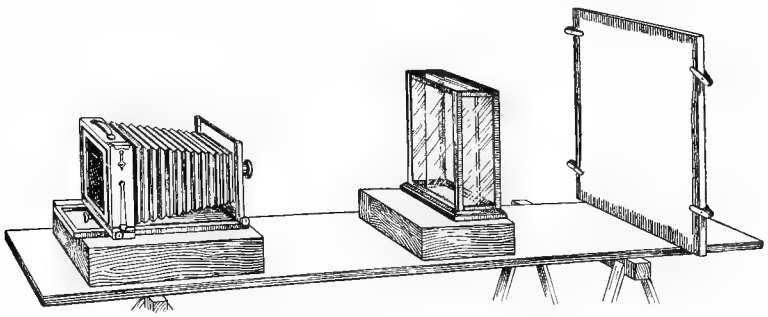


FIG. 227. PHOTOGRAPHING ARRANGEMENT

The distance between aquarium and background should be sufficient to prevent a shadow falling on background. The aquarium is raised so that the board below will be out of the picture.

*Chapter Eighteen*

# Principal Aquarium Fishes

Alphabetical List from Tropical and Temperate Waters, followed by a Description of their Requirements, Peculiarities and Breeding Habits

Note.—A number of the foreign dealers in their catalogues use obsolete scientific names of fishes. As these books have heretofore been the only source of information to many fanciers, we include the old designations in this list, bracketing them, as far as possible, with the correct names.

# Alphabetical List of Aquarium Fishes

*For detailed description corresponding to key numbers in "Breeding" and "Nature" columns, see pages 253 to 261.*

| Scientific Name | Popular Name | Home | Length (Inches) | Temperature Celsius | Temperature Fahr. | Breeding Habits | Food | Nature |
|---|---|---|---|---|---|---|---|---|
| Acanthophthalmus kuhlii | Acara | E. India | 3″ | 25 | 77 | B 13 | Omnivorous | N 1 |
| Acara bimaculata | Acara | Brazil | M. 6″; F. 5″ | 23 | 74 | B 5 | Carnivorous | N 6 |
| Acara coeruleopunctata | Acara | S. America | M. 4″; F. 3½″ | 25 | 77 | B 5 | " | N 6 |
| Acara festiva | Acara | Amazons | 3″ | 23 | 74 | B 5 | " | N 6 |
| Acara nassa | Acara | Amazons | 3½″ | 25 | 77 | B 5 | " | N 6 |
| Acara tetramerus | Acara | Amazons | 3″ | 25-30 | 77-86 | B 5 | " | N 6 |
| Acara thayeri | | Amazons | 3″ | 24 | 75 | B 5 | " | N 6 |
| Achirus fasciatus | Sole; Hog-choker | E. Coast Streams | 1½″-6″ | 20 | 68 | B 1 | " | N 1 |
| Alestes chaperi | | Nigeria | 2½″ | 23 | 74 | B 4 | Omnivorous | N 3 |
| Alfaro amazonum | | Amazon River | 2″ | 23 | 74 | B 9 | Omnivorous | N 2 |
| Ambassis lala | | E. India | 1½″ | 23 | 74 | B 1 | Live food | N 6 |
| Ambloplites rupestris | Rock-bass; Red-eye | N. America | 4″ | 20 | 68 | B 2 | Carnivorous | N 6 |
| Amblyopsis spelaeus | Blind fish | Kentucky | 2″ | 16 | 61 | B 9 | Omnivorous | N 1 |
| Ameirus nebulosus | Catfish | N. America | 24″ | 20 | 68 | B 13 | " | N 6 |
| Anabas africanus | Climbing Perch | W. Africa | 4″ | 18-25 | 64-77 | B 7A | " | N 4 |
| Anabas fasciolatus | Climbing Perch | W. Africa | 3½″ | 18-25 | 64-77 | B 7A | " | N 4 |
| Anabas scandens | Climbing Perch | India | 5″ | 18-25 | 64-77 | B 7A | " | N 4 |
| Apeltes quadracus | Four-spined Stickleback | Atlantic States | M. 1¼″; F. 2″ | 20 | 68 | B 14 | " | N 6 |
| Aphredoderus sayanus | Pirate Perch | N. America | 5″ | 15 | 55 | B 2 | " | N 1 |
| Apomotis cyanellus | Green Sunfish | N. America | 8″ | 20 | 68 | B 2 | Omnivorous | N 6 |
| Badis badis | | E. India | 2″ | 24 | 75 | B 15 | Live food | N 6 |
| Barbus camptocanthus | | W. Africa | 3″ | 26 | 79 | B 1a | Omnivorous | N 1 |
| Barbus chola | | E. India | 3″ | 23 | 74 | B 1a | Live food | N 1 |
| Barbus conchonius<br>Barbus pyrrhopterus | | E. India | 3″ | 23 | 74 | B 1a | " | N 1 |
| Barbus fasciolatus | | W. Africa | M. 2″; F. 3½″ | 18-25 | 64-77 | B 1a | Omnivorous | N 1 |
| Barbus lateristriga | | E. India | 2″ | 20-24 | 68-75 | B 1a | " | N 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Barbus maculatus | | E. India | 3" | 18-25 | 64-77 | B 1a | " | N 1 |
| Barbus pentazona | | E. India | 2½".... | 25 | 77 | B 1a | " | N 1 |
| Barbus phutunio | | E. India | 1½" | 25 | 77 | B 1a | " | N 1 |
| Barbus semi-fasciolatus | | W. Africa | M. 2"; F. 3½" | 18-25 | 64-77 | B 1a | Omnivorous | N 1 |
| Barbus ticto | | E. Asia | 2½" | 25 | 77 | B 1a | " | N 1 |
| Barbus vittatus | | E. Asia | 2" | 25 | 77 | B 1a | " | N 1 |
| Barilius neglectus | | E. Asia | 3" | 23 | 74 | B 1a | " | N 1 |
| Belonesox belizanus | | Central America | M. 3"; F. 3½" | 25 | 77 | B 9 | Live Fish, &c. | N 2 |
| Betta bellica | Fighter | Sumatra | 4" | 25 | 77 | B 7 | Omnivorous | N 4 |
| Betta pugnax | Fighter | Singapore | 3½" | 22 | 72 | B 10 | " | N 4 |
| Betta rubra | Fighter | Siam | 2" | 25 | 77 | B 7 | " | N 4 |
| Betta splendens | Fighter | Siam | 2" | 25 | 77 | B 7 | " | N 4 |
| Boleophthalmus pectinirostris | | E. Asia | 3½" | 25 | 77. | B 6 | Live food | N 6 |
| Boleophthalmus viridis | | E. Asia | 3½" | 25 | 77 | B 6 | " | N 6 |
| Channa fasciatus | | China | 6" | 22 | 72 | B 7a | Omnivorous | N 6 |
| Callichthys callichthys | Panther fish | E. S. America | 3" | 23 | 74 | B 13 | " | N 1 |
| Capoeta damascina | Damascus carpling | Asia Minor | 3" | 24 | 75 | B 3 | Omnivorous | N 1 |
| Carassius auratus, &c. | Goldfish | China & Japan | 12" | 15-25 | 59-77 | B 3 | " | N 1 |
| Carnegiella strigata | | Brazil | 3" | 23 | 74 | B 4 | Carnivorous | N 3 |
| Centrarchus macropterus | Round Sunfish | Ill. and South | 5" | 22 | 72 | B 1a | " | N 3 |
| Chilodus punctatus | | S. America | 3" | 22 | 72 | B 4 | Omnivorous | N 3 |
| Chirodon arnoldi | | Mexico | 3½" | 24 | 75 | B 8 | " | N 3 |
| Chirodon nattereri | | S. America | 2" | 24 | 75 | B 8 | " | N 3 |
| Chrosomus oreas | Painted Dace | S. E. U. S. | 3" | 18 | 64 | B 1 | " | N I |
| Chrosomus erythrogaster | | Middle West | 3" | 20 | 68 | B 1 | " | N 1 |
| Cichlasoma aureum | | C. America | 3"-4½" | 23 | 74 | B 5 | Carnivorous | N 6 |
| Cichlasoma bimaculata | | C. America | 3"-4½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma facetum | | C. America | 3"-4½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma fenestratum | | C. America | 3"-4½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma mojarra | | Yucatan | 3"-5½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma nigrofasciata | | C. A. & S. A. | 3"-4½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma salvini | | Guatemala | 3"-4½" | 22 | 72 | B 5 | " | N 6 |
| Cichlasoma severum | | Brazil | 3"-6" | 22 | 72 | B 5 | " | N 6 |

| Scientific Name | Meaning or Popular Name | Home | Length (Inches) | Temperature | | Breeding Habits | Food | Nature |
|---|---|---|---|---|---|---|---|---|
| | | | | Celsius | Fahr. | | | |
| Clarias angolensis | Eel Cat | W. Africa | 6″ | 23 | 74 | B 13 | Carnivorous | N 6 |
| Clarias magur | Eel Cat | E. India | 6″ | 23 | 74 | B 13 | Omnivorous | N 6 |
| Cnesterodon decemmaculatus | | E. S. America | 1″-1½″ | 23 | 74 | B 9 | " | N 1 |
| Cobitis fossilis | Weatherfish or Loach | Europe | 8″ | 20 | 68 | B 13 | " | N 1 |
| Cobitis taenia | Loach | Europe | 4″ | 20 | 68 | B 13 | " | N 1 |
| Copeina arnoldi | | S. America | 2″ | 23 | 74 | B 12 | " | N 3 |
| Copeina callolepsis (see Pyrrhulina nattereri) | | S. America | 2½″ | 23 | 74 | B 4 | " | N 3 |
| Corydoras macropterus | | S. America | 4″ | 23 | 74 | B 13 | " | N 3 |
| Corydoras paleatus | | S. America | 3″ | 23 | 74 | B 13 | " | N 3 |
| Corydoras undulatus | | S. America | 3″ | 23 | 74 | B 13 | " | N 3 |
| Crenicichla lepidota | | Brazil | 3″-4½″ | 26 | 79 | B 5 | " | N 6 |
| Crenicichla notopthalmus | | Brazil | 3″-4″ | 26 | 79 | B 5 | " | N 6 |
| Ctenops vittatus | Croaking gurami | Further India | 1½″-2″ | 26 | 79 | B 7 | " | N 6 |
| Cynolebias belotti | | La Plata | 2½″-3″ | 20 | 68 | B 8 | Live food | N 3 |
| Cyprinodon dispar | | Asia Minor | 1½″-2″ | 23 | 74 | B 8 | Omnivorous | N 3 |
| Cyprinodon variegatus | Pursy Minnow | E. N. A. | 1¾″-2¼″ | 20 | 68 | B 8 | " | N 3 |
| Cyprinus carpio | Carp | N. America | 4″-16″ | 16 | 61 | B 3 | " | N 1 |
| Danio albolineatus | White-lined Danio | E. Indies | 1¼″-1½″ | 25 | 77 | B 1 | " | N 1 |
| Danio anali-punctatus | With Spotted Damo | E. Indies | 1″-1¼″ | 25 | 77 | B 1 | " | N 1 |
| Danio malabaricus | Malabar Danio | E. Indies | 2″-3½″ | 25 | 77 | B 1 | " | N 1 |
| Danio rerio | Zebra Danio | Ceylon | 1″-2″ | 23 | 74 | B 1 | " | N 1 |
| Dormitator maculatus | Sleepy Goby | Mexico and South | 2″-12″ | 23 | 74 | B 6 | " | N 1 |
| Elassoma zonatum | Pigmy Sunfish | S. E. U. S. A. | 1¼″ | 22 | 72 | B 2 | Carnivorous | N 2 |
| Eleotris lebretonis | | W. Africa | 2″ | 24 | 75 | B 6 | Omnivorous | N 3 |
| Eleotris marmoratus | | E. India | 4″ | 25 | 71 | B 6 | Carnivorous | N 4 |
| Enneacanthus gloriosus | Blue Spotted Sunfish | E. U. S. A. | 3″ | 12-22 | 53-72 | B 2 | Omnivorous | N 6 |
| Enneacanthus obesus | Sphagnum Sunfish | E. U. S. A. | 3″ | 12-22 | 53-72 | B 2 | " | N 6 |
| Epicyrtus microlepsis | | S. America | 2″ | 23 | 74 | B 2 | " | N 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Etroplus maculatus | | E. Indies | 3"-4" | 24 | 75 | B 5 | Carnivorous | N 6 |
| Eupomotis gibbosus | Sunfish | N. America | 4" | 10-20 | 50-68 | B 2 | " | N 6 |
| Fitzroyia lineata | | Argentine | 3" | 16-22 | 61-72 | B 9 | " | N 2 |
| Fundulus arnoldi | | W. Africa | 2" | 26 | 79 | B 8 | " | N 3 |
| Fundulus bivittatus | | W. Africa | 3" | 26 | 79 | B 8 | " | N 3 |
| Fundulus catenatus | Stud-fish | S. Central U. S. | 3" | 22 | 72 | B 8 | " | N 3 |
| Fundulus chrysotus | | S. N. America | 3" | 23 | 74 | B 8 | " | N 3 |
| Fundulus diaphanus | Barred Killifish | E. N. America | 3" | 22 | 72 | B 8 | Omnivorous | N 3 |
| Fundulus dispar | | N. America | 3" | 22 | 72 | B 8 | Carnivorous | N 3 |
| Fundulus gularis | | W. Africa | 3½" | 25 | 77 | B 8 | " | N 3 |
| Fundulus heteroclitus | Mummichog | N. America | 3½" | 22 | 72 | B 8 | " | N 3 |
| Fundulus lönnbergi | | W. Africa | 3" | 25 | 77 | B 8 | " | N 3 |
| Fundulus notatus | | Central U. S. | 3" | 25 | 77 | B 8 | " | N 3 |
| Fundulus nottii | Star-headed Minnow | Florida | 2½" | 23 | 74 | B 8 | " | N 3 |
| Fundulus pallidus | | N. America | 3" | 22 | 72 | B 8 | " | N 3 |
| Fundulus seminolis | Seminole Minnow | Fla. to La. | 2" | 23 | 74 | B 8 | " | N 2 |
| Fundulus sjöstedti | | W. Africa | 3" | 25 | 77 | B 8 | " | N 3 |
| Gambusia affinis<br>Gambusia holbrooki<br>Gambusia patruelis | Top Minnow | S. U. S. A. | M.1½";F.2½" | 23 | 74 | B 9 | " | N 2 |
| Gambusia bimaculata | | C. America | 2½" | 24 | 75 | B 9 | " | N 2 |
| Gambusia episcopi | | C. America | 2" | 24 | 75 | B 9 | " | N 2 |
| Gambusia nicaraguensis | | C. America | 2" | 24 | 75 | B 9 | " | N 2 |
| Gasteropelecus fasciatus | | Brazil | 1½" | 23 | 74 | B 4 | " | N 2 |
| Gasteropelecus stellatus | | Brazil | 2" | 23 | 74 | B 4 | Omnivorous | N 2 |
| Geophagus braziliensis | | Brazil | 3½" | 24 | 75 | B 5 | Carnivorous | N 6 |
| Geophagus gymnogenis | | Brazil | 4" | 23 | 74 | B 5 | " | N 6 |
| Geophagus jurupari | | Brazil | 3½" | 23 | 74 | B 5 | " | N 2 |
| Girardinus caudimaculatus | | Brazil | 1½" | 23 | 74 | B 9 | " | N 2 |
| Girardinus decemmaculatus | | Brazil | 1½" | 23 | 74 | B 9 | " | N 2 |
| Girardinus denticulatus | | C. A. & W. Indies | 1½" | 23 | 74 | B 9 | " | N 2 |

| Scientific Name | Meaning or Popular Name | Home | Length (Inches) | Temperature Celsius | Temperature Fahr. | Breeding Habits | Food | Nature |
|---|---|---|---|---|---|---|---|---|
| Girardinus reticulatus<br>Phallopticus januarius | | Brazil | M. 1″ ; F. 1½″ | 23 | 74 | B 9 | " | N 2 |
| Glaridodon latidens | | C. America | 2″ | 24 | 75 | B 9 | " | N 2 |
| Gobius pleurostigma | | Sumatra | 2″ | 22 | 72 | B 6 | " | N 4 |
| Gobius xanthozona | | Borneo | 1″ | 23 | 74 | B 6 | Carnivorous | N 4 |
| Haplochilus cameronensis | | W. Africa | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus chaperi | | W. Africa | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus calliurus | | W. Africa | 1½″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus fasciolatus | | W. Africa | 3″ | 23 | 74 | B 8 | " | N 3 |
| Haplochilus grahami | | Africa | 2″ | 23 | 74 | B 8 | " | N 3 |
| Haplochilus latipes | | Japan | 1¾″ | 20 | 68 | B 8 | " | N 3 |
| Haplochilus longiventralis | | W. Africa | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus macrostigma | | Congo | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus celebensis | | Celebes, Java, etc. | 1¼″ | 25 | 77 | B 8 | " | N 3 |
| Haplochilus panchax | | E. India | 2½″ | 23 | 74 | B 8 | " | N 3 |
| Haplochilus rubrostigma | | E. India | 3″ | 23 | 74 | B 8 | " | N 3 |
| Haplochilus schoelleri | | Nile region | 2″ | 22 | 72 | B 8 | " | N 3 |
| Haplochilus senegalensis | | W. Africa | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochilus sexfasciatus | | W. Africa | 3″ | 23 | 74 | B 8 | " | N 3 |
| Haplochilus spilauchen | | W. Africa | 2″ | 24 | 75 | B 8 | " | N 3 |
| Haplochromis moffati | | W. Africa | 3″ | 24 | 75 | B 11 | " | N 6 |
| Haplochromis strigigena<br>Paratilapia multicolor | | Africa | 2″ | 23 | 74 | B 11 | " | N 3 |
| Hemichromis auritus | | Africa | 3″ | 20 | 68 | B 5 | " | N 6 |
| Hemichromis bimaculata | | Africa | 3½″ | 23 | 74 | B 5 | " | N 6 |
| Hemichromis fasciatus | | W. Africa | 3″ | 23 | 74 | B 5 | " | N 6 |
| Hemigrammus unilineatus | | N. S. A. Trinidad | 2″ | 23 | 74 | B 4 | Omnivorous | N 2 |
| Hemirhamphus fluviatilis | River Half-beak | Sumatra | 2½″ | 24 | 75 | B 9 | " | N 2 |
| Heros facetus | Chanchito | S. America | 3″-4½″ | 18 | 65 | B 5 | Carnivorous | N 6 |
| Heros spurius | | S. America | 3″-4½″ | 22 | 72 | B 5 | " | N 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Heterandria formosa<br>Girardinus formosus | Mosquito Fish | Florida and N. Carolina | M. ¾"; F. 1"; | 23 | 74 | B 9 | " | N 2 |
| Heterogramma agassizi | | S. America | 2½" | 24 | 75 | B 5 | " | N 6 |
| Heterogramma corumbae | | S. America | 2½" | 24 | 75 | B 5 | " | N 6 |
| Idus idus | Golden Orfe | Germany | 2-8" | 16 | 61 | B 3 | Omnivorous | N 1 |
| Jenynsia lineata | | S. America | 2" | 23 | 74 | B 4 | " | N 2 |
| Jordanella floridae | Florida Minnow | Florida | 2½" | 22 | 72 | B 2 | " | N 2 |
| Krefftius adspersus | Purple-striped Gudgeon | Australia | 5" | 20 | 68 | B 1a | Carnivorous | N 2 |
| Lebias sophiae | | Persia | 2" | 23 | 74 | B 8 | Omnivorous | N 3 |
| Lebistes reticulatus<br>Acanthocephalus r.<br>Girardinus guppyi | | N. S. America<br><br>W. Indies | M. 1"; F. 1½"; | 23 | 74 | B 9 | " | N 2 |
| Lepomis auritus | Long-eared Sunfish | U. S. A. | 4"-8" | 20 | 68 | B 2 | " | N 6 |
| Lepomis megalotus | | U. S. A. | 4"-8" | 20 | 68 | B 2 | Carnivorous | N 6 |
| Leporinus melanopleura | | S. America | 3" | 23 | 74 | B 4 | Omnivorous | N 2 |
| Leporinus nattereri | | S. America | 3" | 23 | 74 | B 4 | " | N 2 |
| Loricaria parva | | S. America | 4" | 22 | 73 | B 13 | " | N 1 |
| Macrones vittatus | | India | 3" | 23 | 74 | B 13 | " | N 2 |
| Macropodus ctenopsoides | | Hankow | 2½" | 23 | 74 | B 7 | " | N 4 |
| Macropodus cupanus (Polyacanthus) | | Farther India | 3" | 23 | 74 | B 7 | " | N 4 |
| Macropodus viridi-auratus | Paradise Fish | China | 3" | 23 | 74 | B 7 | " | N 4 |
| Mastacembelus argus | | Siam | 4" | 23 | 74 | B 13 | " | N 1 |
| Mesogonistius chaetodon | Black-banded Sunfish | E. U. S. A. | 3" | 23 | 74 | B 2 | Live food | N 6 |
| Mesonauta insignis | | S. America | 1½-3½" | 25 | 77 | B 5 | " | N 6 |
| Metynnis unimaculatus | | S. America | 3" | 23 | 74 | B 4 | Omnivorous | N 6 |
| Mollienisia formosa | | Mexico | 1½" | 23 | 74 | B 9 | " | N 2 |
| Mollienisia latipinna | Wide-fin | S. U. S. A. | 2½" | 23 | 74 | B 9 | " | N 2 |
| Mollienesia petenensis | | Yucatan | 3" | 23 | 74 | B 9 | " | N 2 |
| Mollienisia velifera | | S. U. S. A. | 3" | 20 | 68 | B 9 | " | N 2 |
| Monocirrhus polyacanthus | | N. S. America | 3" | 23 | 74 | B 2 | " | N 6 |
| Myletes maculatus | | S. America | 3" | 23 | 74 | B 4 | " | N 6 |

| Scientific Name | Meaning or Popular Name | Home | Length (Inches) | Temperature | | Breeding Habits | Food | Nature |
|---|---|---|---|---|---|---|---|---|
| | | | | Celsius | Fahr. | | | |
| Nanacara taenia | | S. America | 2″ | 23 | 74 | B 5 | Carnivorous | N 6 |
| Nandus marmoratus | | S. E. Asia | 3″ | 23 | 74 | B 2 | Carnivorous | N 6 |
| Neetroplus carpintis | | C. America | 3″ | 23 | 74 | B 5 | Omnivorous | N 6 |
| Nanostomus eques | | S. America | 2½″ | 23 | 74 | B 4 | " | N 3 |
| Notropis bifrenatus | Bridled Minnow | Me. to Va. | 2½″ | 20 | 68 | B 1 | " | N 1 |
| Notropis metallicus | Metallic Minnow | S. U. S. A. | 3″ | 20 | 68 | B 1 | " | N 1 |
| Nuria danrica | | E. Indies | 2¼″ | 23 | 74 | B 1a | " | N 1 |
| Ophiocephalus marmoratus | Snake-head | Singapore | 5″ | 22 | 72 | B 7a | " | N 4 |
| Ophiocephalus punctatus | Snake-head | E. Indies | 3″ | 23 | 74 | B 7a | " | N 4 |
| Oryzias latipes | Medaka | Japan | 1¼″ | 20 | 68 | B 8 | " | N 1 |
| Osphromenus cantoris | Cantor's Gourami | Singapore | 5″ | 23 | 74 | B 7 | " | N 4 |
| Osphromenus trichopterus | Hair-fin Gourami | E. Indies | 3½″ | 23 | 74 | B 7 | " | N 4 |
| Pantodon buchholzi | | W. Africa | 3½″ | 23 | 74 | B 7a | Live food | N 1 |
| Paragoniates microlepsis | | S. America | 2½″ | 23 | 74 | B 4 | Omnivorous | N 3 |
| Parosphromenus deissneri | | E. India | 2″ | 23 | 74 | B 7 | " | N 4 |
| Pelmatochromis arnoldi | | Africa | 3″ | 26 | 79 | B 5 | Carnivorous | N 6 |
| Pelmatochromis subocellatus | | Africa | 3″ | 26 | 79 | B 5 | " | N 6 |
| Pelmatochromis taeniatus | | W. & M. Africa | 3″ | 26 | 79 | B 5 | " | N 6 |
| Periophthalmus barbarus | Mud Springer | Asia & Africa | 4″ | 23 | 74 | B 6 | Live food | N 6 |
| Petersius spilopterus | | W. Africa | 3 | 23 | 74 | B 4 | " | N 3 |
| Platypoecilus maculatus | Spotted Moonfish | Mexico | M. 1½″; F. 2″; | 23 | 74 | B 9 | " | N 2 |
| Platypoecilus nigra | Black Moonfish | Mexico | M. 1½″; F. 2″; | 23 | 74 | B 9 | " | N 2 |
| Platypoecilus pulchra | Attractive Moonfish | Mexico | M. 1½″; F. 2″; | 23 | 74 | B 9 | " | N 2 |
| Platypoecilus rubra | Red Moonfish | Mexico | M. 1½″; F. 2″; | 23 | 74 | B 9 | " | N 2 |
| Plecostomus commersoni | | S. America | 4″-20″ | 23 | 74 | B 13 | " | N 6 |
| Poecilia amazonica | | Amazons | 1¼″ | 24 | 75 | B 9 | " | N 2 |
| Poecilia caucana | | Columbia | 1¼″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia dominicensis | | W. Indies | 1½″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia dovii | | W. Indies | 1½″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia heteristia | | Brazil | 1¼″ | 23 | 74 | B 9 | " | N 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Poecilia mexicana** | Mexico | 1½″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia poecilioides | Barbadoes | 1¼″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia reticulata | Barbadoes | M. 1″; F. 1½″; | 23 | 74 | B 9 | " | N 2 |
| Poecilia sphenops | Mexico | 2½″ | 23 | 74 | B 9 | " | N 2 |
| Poecilia unimaculata<br>Poecilia vivipara | Brazil | 2″ | 23 | 74 | B 9 | " | N 2 |
| Poecilichthys coerulea<br>Etheostoma coerulea } Rainbow Darter | N. America | 2½″ | 18 | 65 | B 6 | Carnivorous | N 4 |
| Poecilobrycon trifasciatus | S. America | 3″ | 23 | 74 | B 4 | " | N 3 |
| Poecilobrycon unifasciatus | S. America | 3″ | 23 | 74 | B 4 | " | N 3 |
| Polyacanthus dayi | E. Indies | 2½″ | 23 | 74 | B 7 | " | N 4 |
| Polycentropsis abbreviata | W. Africa | 2″ | 26 | 79 | B 7 | " | N 6 |
| Polycentrus schomburgki | S. America | 2″ | 24 | 75 | B 15 | Live fish | N 6 |
| Prochilodus binotatus | S. America | 2″ | 23 | 74 | B 4 | Carnivorous | N 1 |
| Prochilodus insignis | Brazil | 13″ | 26 | 79 | B 4 | Omnivorous | N 3 |
| Pseudocorynopoma doriae | Brazil | 2″ | 23 | 74 | B 4 | " | N 3 |
| Pterophyllum scalare Wing-fin | Amazon River | 5″ | 23 | 74 | B 15 | " | N 6 |
| Pyrrhulina australis | Argentina | 2″ | 23 | 74 | B 4 | " | N 3 |
| Pyrrhulina guttata | Brazil | 2″ | 23 | 74 | B 4 | " | N 3 |
| Pyrrhulina filamentosa<br>Pyrrhulina nattereri (see Copeina) | N. S. America | 2″ | 23 | 74 | B 12 | " | N 1 |
| Rasbora cephalotaenia | E. Indies | 3″ | 23 | 74 | B 1a | " | N 1 |
| Rasbora daniconius | E. Indies | 3″ | 23 | 74 | B 1a | " | N 1 |
| Rasbora elegans | India | 4″ | 23 | 74 | B 4 | " | N 3 |
| Rasbora heteromorpha | Further India | 2″ | 23 | 74 | B 1a | " | N 1 |
| Rasbora maculata | Further India | | 23 | 74 | B 1a | " | N 1 |
| Rhinichthys atronasus Black-nosed Dace | E. N. America | 2½″ | 18 | 65 | B 2 | " | N 1 |
| Rivulus flabellicauda | Mexico | 3″ | 23 | 74 | B 8 | " | N 3 |
| Rivulus harti | Venezuela | | 23 | 74 | B 8 | " | N 3 |
| Rivulus ocellatus | S. America | 3″ | 23 | 74 | B 8 | " | N 3 |
| Rivulus poeyi var. rubra | Brazil | 3″ | 23 | 74 | B 8 | " | N 3 |
| Rivulus strigatus | Brazil | 2″ | 23 | 74 | B 8 | " | N 3 |
| Rivulus urophthalmus<br>Rivulus poeyi | Brazil | 3″ | 23 | 74 | B 8 | " | N 3 |

| Scientific Name | Meaning or Popular Name | Home | Length (Inches) | Temperature | | Breeding Habits | Food | Nature |
|---|---|---|---|---|---|---|---|---|
| | | | | Celsius | Fahr. | | | |
| Saccobranchus fossilis | | India | 4″-24″ | | | B 13 | " | N 6 |
| Scatophagus argus | | E. India | | 23 | 74 | B 2 | Carnivorous | N 6 |
| Stegophilus maculatus | | S. America | 12″ | 22 | 72 | B 13 | Omnivorous | N 6 |
| Tetragonopterus aeneus | | C. America | 2½″ | 23 | 74 | B 4 | " | N 3 |
| Tetragonopterus ocellifer | | Brazil | 3½″ | 23 | 74 | B 4 | " | N 3 |
| Tetragonopterus rubropictus | | N. S. America | 1½″ | 23 | 74 | B 4 | " | N 2 |
| Tetragonopterus rutilus | | Mexico and South | 1¼″ | 22 | 72 | B 4 | " | N 3 |
| Tetragonopterus ulreyi | | S. Brazil | 1½″ | 23 | 74 | B 4 | " | N 3 |
| Tetragonopterus unilineatus | | N. S. A. Trinidad | 1½″ | 23 | 74 | B 4 | " | N 2 |
| Tetrodon cutcutia | | Further India | 3″ | 23 | 74 | B 5 | Live snails | N 6 |
| Tetrodon fluviatilis | | Sumatra | 3″ | 26 | 79 | B 8 | " | N 3 |
| Tilapia microcephala | | W. Africa | 5″ | 23 | 74 | B 5 | Carnivorous | N 6 |
| Tilapia nilotica | | Egypt | 4″ | 23 | 74 | B 5 | " | N 6 |
| Tilapia tholloni | | Congo | 4″ | 23 | 74 | B 5 | " | N 6 |
| Tilapia zilli | | Egypt | 4″ | 23 | 74 | B 5 | " | N 6 |
| Tinca Aurata | Golden Tench | Europe | 12″ | 18 | 60 | B 3 | Omnivorous | N 1 |
| Tinca viridis | Green Tench | Europe | 12″ | 18 | 60 | B 3 | " | N 1 |
| Torpedo electricus<br>Malopterus electricus | Electric Cat | W. Africa | 4″-12″ | 23 | 74 | B 13 | " | N 6 |
| Trichogaster fasciatus | | India | 4″ | 23 | 74 | B 7 | " | N 4 |
| Trichogaster labiosus | | India | 2½″ | 23 | 74 | B 7 | " | N 4 |
| Trichogaster lalius | Dwarf Gourami | India | 2″ | 23 | 74 | B 7 | " | N 4 |
| Trichopodus trichopterus | (See Osphromenus trichopterus). | | | | | | | |
| Umbra krameri | Kramer's Mud-minnow | Hungary | 3″ | 18 | 65 | B 8 | " | N 3 |
| Umbra limi | Mud minnow | N. America | 3″ | 18 | 65 | B 8 | Omnivorous | N 3 |
| Umbra pygmaea | Mud minnow | N. America | 2½″ | 14 | 55 | B 8 | Carnivorous | N 3 |
| Xiphophorus rachovii | Swordtail | Mexico | 2½″ | 23 | 74 | B 9 | Omnivorous | N 2 |
| Xiphophorus strigatus<br>Xiphophorus helleri | Swordtail | Mexico | 3″ | 23 | 74 | B 9 | " | N 2 |

**For detailed explanation of "B" and "N" columns, see following pages.**

## DESCRIPTIVE KEY

### to the

## BREEDING AND OTHER HABITS

### of the Foregoing List of Aquarium Fishes

For all practical purposes the breeding habits of known aquarium fishes may be classed under 18 headings. Instead of needless repetition, each of these is described but once. By matching the following key letters and figures with those in the preceding Alphabetical List, sufficient information regarding any of the listed fishes may be had.

*EXPLANATION: The letter B stands for "Breeding," and the number accompanying this letter in preceding list of fishes indicates to which breeding group each fish belongs.*

*The letter N stands for "Nature" or disposition of the fish, particularly with reference to whether it may be kept with other fishes, and if so, under what conditions.*

### B1 GROUP

DANIO GROUP. All fishes of this group drop their eggs freely in the water, while actively swimming alongside their mates, frequently more than one male participating in the (external) fructification of the eggs as extruded. This group of fishes have a tendency to devour their eggs as soon as dropped, and under aquarium conditions this should be guarded against by providing shelter for the eggs to fall amongst, such as small stones, densely-growing vegetation, etc. The eggs are non-adhesive and can be moved by the action of the water or otherwise at any period during development, which lasts only from 3 to 5 days, according to the temperature of the water. The young fish hang like "commas" against the glass sides of the aquarium in which they hatch (the parent fishes having been removed immediately after spawning was completed), and after a couple of days they adopt the position of normal adult fish, swimming horizontally in search of food, such as infusoria, etc., and later small daphnia and cyclops. Young fishes of this group take kindly to finely powdered dry fish foods and do well on it. Temperature of the water should be maintained at the maximum given herein or slightly higher and so kept until at least two months of age.

### B1a GROUP

BARBEL GROUP. Same as the preceding, except that the eggs are adhesive to the plants, stones or glass aquarium sides.

### B2 GROUP

THE BASS OR THE SUNFISH GROUP. Eggs are deposited in a hollow excavated in a sandy bottom by the adults for this purpose and carefully guarded by the male until they hatch and also after the young fish first emerge and are defenceless against their enemies. Microscopic live food in the form of infusoria must be abundantly provided for the young fish, who, even later, do not take kindly if at all to prepared dry foods.

### B3 GROUP

THE CARP FAMILY, including all the varieties of the Goldfish. Spawning habits same as Group B1a, differing only in respect to the fact that the fish under B3 deposit their eggs all over the plants, mainly at the surface. Fish of Group B1a usually deposit their spawn near the bottom. For elaboration of the breeding habits of this family, see page 47.

### B4 GROUP

THE CHARACIN FAMILY, mostly distinguishable by the small adipose or fat rayless fin situated on the back between the dorsal fin and tail. Spawn like Group B1a.

### B5 GROUP

THE CICHLID GROUP. Fish of this family are savage wooers, sometimes tearing each other to pieces, so that they need to be closely watched at this time. Some breeders first separate the proposed pair by a glass partition until they seem to display friendly intentions towards each other, then letting them together. If there is not an open combat they may presently interlock mouths in what seems to be either a tug-of-war or a protracted kiss. The outcome may not be told at once. The twinship of love and hate will never be shown more clearly! After the action is repeated several times it will either end in a happy marriage or murder, unless human interference steps in. It is preferable to try to mate fishes of the same size. Otherwise the smaller is likely to lose heart and make a retreat. Males and females seem to be equally "temperamental," which is a polite way of describing a nasty disposition. In justice to them it should be said that in large pools none of these fatalities occur. They deposit adhesive eggs on stones or, in the aquarium, on the convex side of a large flowerpot laid on its side, or on the glass. Eggs hatch in 3 or 4 days, during which period the parents take turns in swimming over the eggs and fanning fresh water over

them constantly. When the young hatch, the parents carry them in their mouths and deposit them in a depression previously made in the sand at the bottom, where they jealously guard them against all comers—terrestrial or aquatic—frequently removing dirt from the "nest" and transferring the baby fish to new nests three or four times a day. For the first ten days after hatching, the young fish eat nothing, but live in a swarm at the bottom, while they absorb the contents of the egg sac or bag of yolk-of-egg-like fluid beneath the abdomen. At the end of this period they begin to look like fish and then they all get up off the bottom and swim around their parents who continue to guard them closely. From this time on they require "baby" fishfood—small daphnia, etc., though they will eat dried fish-food if finely powdered. Ten days after they begin to feed, the parents should be removed. They may not eat the young, but it is safer. The Cichlids dislike and destroy plants, so none should be provided, but they require clean, pure water, so some should be changed occasionally (siphoning all dirt from the bottom), replacing it with hydrant water, blended hot and cold to same temperature as that in the aquarium, which should be of a uniform summer heat.

## B6 GROUP

THE GOBY FAMILY (Gobiidæ). These include bottom fish from all over the world, occurring in shallow streams or shallow shore-waters—marine, brackish and fresh. Little is known of their spawning habits, beyond the fact that some spawn among—and on—the stones on the bottom. Others—small species—will spawn on the inside—i.e., concave side—of a piece of drain pipe laid on its side in the aquarium and others spawn among the weeds (roots) on the sand or mud. Some protect their spawn. Others do so but little if at all. As to rearing the young, aquarists must experiment and persevere, as very few have had much success with them and those who have reared any have been European aquarists with abundant time and patience.

## B7 GROUP

LABYRINTH FISH (possessed of an air-cavity or cell beneath each gill-cover, in which a supply of air is stored for breathing). These fish are all air-breathers, coming frequently to the surface to replenish the air in this storage chamber. Most of these Labyrinth fishes build "bubble nests," i. e., form a secretion in their mouths, and

blow air-bubbles formed of this substance, which float in a mass in which the male places the eggs, immediately after fertilization, which takes place in mid-water, the parent fish intertwining their bodies immediately under the nest of bubbles at frequent intervals, extruding a few eggs at a time. Then as the fish relax their embrace, the male catches the eggs in his mouth and blows them—each one separately —into the air-bubble nest.

As soon as all the eggs have been extruded from the female and fertilized in the external embrace of the parent fish, the male having gathered all eggs into the floating nest, he then drives the female to as distant a corner of the aquarium as possible (as he knows that she will eat the eggs if she gets a chance) and for about 48 hours the male fish guards the nest and eggs, re-arranges and adds more bubbles where required. Towards the end of the hatching process, the male spreads the nest out as much as possible, to give the hatching young as much air surface as he can and indeed it is difficult for the newly hatched young to escape from the air-bubbles, as they are held there by the attraction of cohesion. Within the next three days they become independent and scatter from the nest, whereupon the male fish must at once be removed. The female should be removed as soon as she is observed to have finished spawning and has been driven away from the nest by the male. The temperature must be kept high—mid-summer temperature as in a hot-house—for at least two or three months after the young hatch. The young fish being microscopic must be well supplied with infusoria—the microscopic dust-like form of living creatures native to most old, standing water, which in turn must be cultivated. See page 51. Do not disturb the young fish. They must remain in the aquarium in which they hatch at all events until they are plainly recognizable as fish of their own species and at least a quarter of an inch long. As soon as they seem to have assumed solidity, i. e., dark, round bodies, which they should have at ⅛-inch long—they should be fed with finely-strained young daphnia and from that time on the growth is rapid. All young fish—of whatever kind—which outgrow their fellows, must be separated into other aquaria or compartments, as otherwise they starve or eat the smaller ones.

### B7a GROUP

LABYRINTH FISH WHICH BUILD NO NESTS but deposit their spawn loose and floating in or on the water. This class includes the Snake-heads (Ophiocephalidæ) and the Climbing Perch (Anabantidæ). Hardy fish, generally accustomed to living in cooler water

than the Nest-building Labyrinth Fishes—though at the breeding season the temperature should be raised to at least 80 degrees Fahrenheit and kept high for the first two or three months of the existence of the young fish. Parent fish both to be removed as soon as eggs appear—if they do appear—for it is difficult to get these fishes to spawn. Care of young fish same as that indicated for the young of Nest-Building Labyrinth Fishes.

### B8 GROUP

KILLIFISHES (oviparous or egg-laying group).—These include Haplochilus, Fundulus or "Top-Minnows," largely native to our American streams, Cyprinodonts, Lebias, Cynolebias and Rivulus. Haplochilus mostly spawns at or near the surface on floating bushy plants. So does Rivulus, and most varieties of the Fundulus. Lebias and Cynolebias bury their eggs separately in the bottom and they take seven to eight weeks to hatch, so not much success can be expected from them. Eggs of Medakas adhere in bunches to vent of female until scraped off on plants.

The general rule with Haplochilus and Rivulus is to keep sexes separated and then put the pairs together for three or four days in warm, sunny aquaria with dense plant growth, such as Riccia, the small, light green Utricularia, Anacharis, bushy Thread-Algæ or Willow Moss (Fontinalis). Then remove parent fish, keep separate again for ten days and repeat—each time using a separate aquarium and plants for receiving spawn. Eggs take about ten days to hatch at summer temperature with Rivulus and Haplochilus and individual young fish must be fished out with a teaspoon and kept in the same aquarium water at same temperature at which they hatch and fed first with infusoria and later with small daphnia.

### B9 GROUP

LIVE-BEARING KILLIFISHES. All the fishes belonging to this class are natives of America—the Southern States of the United States, Central America and South America (Northern). They are generally easy to keep and breed in the aquarium, require mostly uniform summer temperature and clean water, and if well fed and kept in well-planted, spacious aquaria, reward their keeper abundantly with frequent large families. When the females are seen to be "heavy" with young (indicated by a dark patch in the abdomen and great fulness of that part) and when they act restlessly, seeking to avoid their mates and getting into the thickest vegetation in the aquarium.

then these females may be considered as about to give birth to their young. They must then be placed preferably in large straight-sided cylinder jars (8 inch), with thick floating vegetation occupying at least 2/3 of the jar and that placed toward the light in a sunny place and covered over with a piece of glass or a plate. When the young are born, they instinctively seek shelter from their cannibalistic parent and swim toward the light. If the vegetation is toward the light, most of the young ones will be safe from the mother until discovered, when the mother fish can be returned to the aquarium, most of the plants removed from the jar and the young fed on powdered fishfood. The breeding arrangements shown on pages 230 and 231 do away with the necessity for plants or other shelter for the young.

Females after being impregnated can have four broods without further fertilization.

### B10 GROUP

MISCELLANEOUS FISHES. While wonderful strides have been made in ascertaining the breeding habits of those fishes which have become domesticated there are and no doubt always will be a number whose life histories have not been revealed. Those which remain unknown at present are listed under this heading.

### B11 GROUP

MOUTHBREEDERS. The fish should be provided with a moderate sized aquarium with about two inches of clean sand in the bottom. The fish prepare a shallow nest in the sand, where the eggs are first laid and fertilized. In most varieties the eggs are then taken in the mouth of the female, who, by a chewing movement of the jaws, keeps a constant flow of water among the eggs. The parent not carrying the eggs should be removed. So large is the volume of eggs that the head of the fish has a noticeably distended appearance. The hatching takes from fifteen to twenty days. After the young are hatched it may be several days before one may see them, for the mother at first only allows them to swim out in search of infusorian food at night. At the first sign of alarm they rush back into her mouth. When about a week to ten days old they are able to look after themselves and the mother should be removed and the young fed on microscopic food, daphnia, etc. The best breeding temperature is about 75 degrees Fahrenheit. From the time of spawning until separated from the young the female should be offered no food. As this is a drain on the health of the fish, they should not be bred oftener than twice a year.

**B12**

PYRRHULINA FILAMENTOSA AND COPEINA ARNOLDI are the only fish listed in this work having the peculiar breeding habits here described. Both fish leap out of the water and adhere for several seconds to the sides or cover of the aquarium, which should be somewhat rough. Ground glass or slate will do. Fifteen or twenty eggs are deposited at a time until from 100 to 200 are laid. When spawning is completed the female should be removed. The male, by swift movements of the head and tail, splashes water on the eggs at short intervals. The eggs hatch in from two to four days, after which the male parent should be removed. Feed young on infusoria and later on small daphnia.

**B13**

EGGS ADHERE ON GLASS sides of aquariums or stones or plants, remaining there until hatched in a few days. The young swim in a shoal around the old ones as in B5 Group. Feed in similar manner.

**B14**

STICKLEBACK male builds nest from bits of plants, glued together. After female deposits eggs he drives her away and assumes entire parental responsibilities. See also page 117.

**B15**

POLYCENTRUS SCHOMBURGKI spawns on upper concave side of small flower-pot, laid on its side. Newly hatched young hang from leaves by means of a hook on the top of their heads. Eggs and young protected by male, as female is apt to eat them, and should be removed.

Badis badis spawns on the inside of a small, upright flower-pot, sunk half way in the sand. Remove both parents when young are first observed.

**B16**

PTEROPHYLLUM SCALARE spawn like B5 Group, except that eggs are deposited on broad-leaved plants. Eggs hatch in 2½ days. The best results are secured by removing the plants and eggs to a receptacle where a small stream of warm water can run in such a way as to maintain a gentle circulation around them. The water may be artificially heated if necessary, or the circulation can be furnished by the liberation of compressed air in the bottom of the tank. In captivity the parents have a strong tendency to eat both

eggs and young. Once hatched they are easily grown by the same methods as used for other tropical fishes. Breeders should be well fed up on mosquito larvæ, young tropical fishes or freshwater shrimps. They also eat Water-boatmen. Breeding temperature, from 75 degrees to 80 degrees. The female develops an egg-laying tube just prior to spawning. Otherwise there is no known way of distinguishing the sexes despite much study of the subject.

## INDEX TO NATURE OR TEMPERAMENT OF FISHES

*Different persons will have varying experiences with the same kinds of fishes under apparently identical conditions. In fact, one's own observations will sometimes change from year to year. The writer, for instance, has heretofore always found that Mexican Swordtail fishes kill Coral Snails, yet this year they are living together in perfect accord. Therefore, we bespeak the indulgence of those whose observations do not agree in all details with the statements here published. The data have been gathered from the most experienced experts the world over, and while some minor points may, from time to time, be open to question, the main facts stated are authentic and should form a practical guide for the handling of nearly all known varieties of aquarium fishes.*

### N1 GROUP

Indicates that fish so marked are of a generally peaceful disposition, not disposed to hunt trouble nor to persecute or devour other species kept with them. This fact applies mainly to the Barbus group among tropical fishes and the Cyprinoid minnows in the temperate division. However, large fish of any kind take advantage of their size and tyrannize over their associates more or less and also monopolize the food. So, even if a fish is indicated "N1," it is as well to keep only such fish as are of approximately the same size together—just as large young fish should be separated from smaller ones of the same species.

### N2 GROUP

Fish of this class are generally amiable and peaceable and are mainly of the live-bearing tooth-carp group. Some of these, again, such as Gambusia affinis and varieties, Pseudoxiphophorus bimaculata, Phalloceros caudimaculata and Belonesox belizanus, should only be kept with their own species. Males which "rule the roost" will fight with their

rivals as roosters in a barnyard. Dense vegetation and sufficient space are the best protection for weaker fish, and females which have just had young should be isolated for several days before being placed with their males, or they may be persecuted to death. With the exceptions of the species herein specified, most live-bearers will live together in harmony in a large aquarium.

### N3 GROUP

Members of this group are mostly egg-laying, such as Haplochilus, Fundulus and Rivulus. These can be kept in large numbers together, if of approximately same size, but otherwise are best kept in pairs. The larger species, such as Haplochilus sexfasciatus, rubrostigma, etc., are best kept only with their own species, as their tendency is generally war-like. They eat their own and the young of other species.

### N4 GROUP

Fish of this classification are more or less inclined to hunt trouble, but when kept in numbers together, each fish is afraid of a rear attack from his fellows and consequently nothing happens. This refers to the labyrinth fish or bubble-nest builders and is noticeably manifest among Paradise fish, Polyacanthus cupanus and dayi, Osphromenus, etc. The Dwarf gourami is exceptional in this class for his peaceable nature.

### N5 GROUP

Very large goldfish and other members of the carp family sometimes eat their smaller brethren, but in the main they are peaceable and devoid of the combative element. Except for a scavenger fish or two it is better to keep highly developed goldfishes by themselves.

### N6 GROUP

This group includes the most savage species, such as the Cichlids. Out of breeding season and in a large aquarium ranging from 65 to 70 degrees, they may be kept together, especially in numbers, but danger is always present. It is very necessary to provide places of shelter for the pursued, such as flower pots laid horizontally, crockery, small clay soil pipe or rock arches. It is best to keep known mated pairs together. Solitary confinement seems to increase the severity of the nature of these fishes.

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*NOTES. The temperatures given in the Alphabetical Index are average for the species indicated. Breeding, especially among the tropicals, usually requires a little more heat.*

*Fishes classed as "Omnivorous" eat a variety of foods. They are likely to thrive on a diet composed of vegetable and animal ingredients.*

## Chapter Nineteen

# In Short

Don't overfeed.
Don't overcrowd.
Don't use very deep aquaria.
Don't delay treating sick fishes.
Don't start with expensive fishes.
Don't expose an aquarium to coal gas.
Don't use fishglobes except temporarily.
Don't attempt to move filled large aquaria.
Don't fail to replace covers on tropical aquaria.
Don't always blame the dealer if your fishes die.
Don't keep very large and small fishes together.
Don't use coarse nets. Brussels netting is better.
Don't leave the fish outdoors until frost threatens.
Don't introduce plants without thoroughly cleansing.
Don't heat with oil stoves if anything else can be had.
Don't fail to sterilize a net after lifting a diseased fish.
Don't entrust the feeding to another if this can be avoided.
Don't be too sure the family cat won't fish in the aquarium.
Don't as a beginner disregard the greater experience of others.
Don't sell surplus stock for a song. It had better be given away.
Don't slide all-glass aquaria. Scratches may cause them to break.
Don't forget that most fishes enjoy an occasional variation in food.
Don't assume that ordinary artificial light is a substitute for daylight.
Don't experiment with rare tropicals to see how cool they may be kept.
Don't suddenly change the temperature of the water, either higher or lower.

Don't use running water. Balance the aquarium with growing plants instead.

Don't overwork the aquarium hobby. It will last longer in moderation.

Don't neglect an opportunity to feed the fishes on chopped or small earthworms.

Don't allow unconsumed food to remain in the aquarium. Remove with dip-tube.

Don't use unmixed raw water from the faucet. The excess of oxygen is undesirable.

Don't be stingy, but give away a few interesting fishes to those who might become fanciers.

Don't tear up the plants in trying to catch a fish. A little patience will avoid later regrets.

Don't fail to thoroughly disinfect an aquarium in which there has been a contagious disease.

Don't suppose that a few plants can do much water-purifying. A liberal number is required.

Don't place daphnia in the aquarium without first looking carefully among them for insect enemies.

Don't throw away dead rare fishes. Preserve in alcohol. Scientific institutions are glad to have them.

Don't keep goldfishes and tropicals together. They may not quarrel, but the appearance is not good.

Don't worry about a slight leak in an aquarium. Probably some muddy water will stop it in a few days.

Don't, as a beginner, purchase goldfish with very long fin development. They are usually past their prime.

Don't place new fishes with yours until certain that they are not diseased. A week's quarantine is desirable.

Don't attempt to grow aquatic plants in a very subdued light. They cannot prosper, and do more harm than good.

Don't always use chemicals on a fish a little out of condition. A change of aquarium or of food may be all that is necessary.

Don't overlook the great possibilities of the native fish aquarium, both freshwater and marine. The terrarium, too, is well worthy of attention.

Don't keep fishes in galvanized iron or zinc receptacles, nor have copper or brass in contact with aquarium water. Unseasoned wood is bad; unseasoned concrete, fatal.

# Illustrations and Their Sources

Frontispiece. Photograph from Life by the Author. Coloring by Franklin Barrett. Fish owned by C. C. Vowinkel, Philadelphia.

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# Cross Index

Star indicates that subject is accompanied by illustration.