THREE-TIME PRIZEWINNING AQUARIUM

Length, 50 inches. Capacity, 60 gallons.

See page 218

Goldfish Varieties and Tropical Aquarium Fishes

A Complete Guide
to Aquaria and
Related Subjects

BY

WILLIAM T. INNES

FORMER PRESIDENT OF THE AQUARIUM SOCIETY OF PHILADELPHIA

INNES & SONS
Publishers
PHILADELPHIA, U. S. A.

CONTENTS

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 and for those who simply love pets. Modern research, by the discovery of a few simple principles, has enabled us to absolutely 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 300 other 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 subject. 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 something 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. Herman Burgin, Mr. Wm. H. De Nyse, Mr. Richard Dorn, Mr. Henry W. Fowler, Mr. Joseph Froelich, Mr. Frank J. Myers, Mr. Wm. L. Paullin, Mr. W. A. Poyser, Mr. Fred. Schaefer, Dr. C. H. Townsend and Mr. Charles E. Visel. Mr. W. L. Brind should receive credit for his assistance in the preparation of the list of Exotic Fishes, his knowledge and specialized technique as a translator proving of particular value.

Chapter One

The Freshwater Aquarium

AQUARIUM MANAGEMENT

The principles involved in successful aquarium management are really simple, and if applied success is bound to follow. 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. 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. A great many unscrupulous and short-sighted dealers, in order to increase sales, recommend the use of more fish than should properly be put into an aquarium of given size. The beginner also wishes to have as many fishes as possible, 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 fish, or five two-inch or two five-inch fish. 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 stocked with too many fish, some of them should be disposed of or a larger aquarium secured. Should the fish get into poor condition from overcrowding it will be difficult to save any of them.

Gasping. 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 fish become seriously affected or perhaps suffocate. A partial change of water or the removal of some of the fish 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 the fish seem hungry they are fed. This is a very great mistake. In

Nature the food is scarce and difficult to get. Therefore the fish have to exercise 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 fish.) 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 the fish swim coaxingly to the near side of the aquarium it is 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.

Changing the Water. 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.

With the foregoing conditions carefully observed and carried out there should be no need to change water except at rare intervals, when the aquarium gets dingy looking or overcrowded with plants. Experienced aquarists replant about once a year, occasionally 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. However, it can do no harm and may do good.

In cases of overcrowding, a partial change of water should be made

daily, the amount depending on the degree of overcrowding. Here, again, a little personal judgment should come into play.

A sprinkling pot is excellent for adding water to the aquarium. The small streams oxygenate the water 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 running water when placed in still water should at first be given ample room.

Plant Life. Fish live by absorbing oxygen, and they give off carbon dioxide as the waste product of their chemical life. Plants, under the influence of light, do the exact opposite, so that what is poison to one is life to the other. This explains why healthy plants are so desirable, and accounts for the phrase "balanced aquarium," because there is a self-maintaining interchange established.

Still water takes up a certain amount of oxygen from the air. The fishes, however, consume more oxygen than can be supplied in this manner, and if oxygen-liberating plants are not used the fishes become restless, come to the surface to breathe the air, and may finally die of suffocation unless the water is changed.

The term "balanced aquarium" is not accurately descriptive, as an exact balance is never maintained. In practise we always endeavor to have the oxygenating element the more active, since any excess of oxygen goes off harmlessly into the air, while an excess of the poisonous carbon dioxide cannot be quickly taken up by the plant life. A more correct term might be "reciprocating aquarium."

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, Bacopia, Fontinalis, Potamogeton, Ludwigia and others, which will be more fully described later.

Light. As just stated, plants require light in order to do their work. 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. A range of between 50 and 75 degrees F. is safe.

Green water is caused by the presence of a microscopic form of vegetable life suspended in the water. Their growth is usually promoted by a combination of too much direct sunlight and a large number of fish 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

or other means, take some fish out of the aquarium. 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 benefitted 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 will clear water in a few days.

How to Know When the Fishes are Sick. The first signal of distress in most fish 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 overdeveloped that the fish even in health has not sufficient strength to hold it erect. When such fish 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, blooshot at base of fins, 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. 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 back to clear water again it will do no harm if a little of the permanganate solution 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.

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 in two or three weeks a level teaspoonfull to 20 gallons of water will prove beneficial. Usually the fishes will greedily swallow these salts as they sink to the bottom, which acts as a mild cathartic with them.

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. 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.

Pieces of coral, sea-shells, etc., look out of place in a fresh-water aquarium, and many of them are sufficiently rough to injure the fishes if they chance to be knocked against them.

A Word to Beginners. It is much the better plan to start with a few fishes of the hardier varieties until the rudiments of aquarium keeping are well understood. If one can keep common goldfishes in perfect health and experience practically no losses, then it is time to branch out into the more varied and interesting breeds. Some beginners, having more enthusiasm than experience, lose valuable fishes at the start and turn away in disgust from a fancy that, if properly understood, would have afforded them many hours of pleasant recreation.

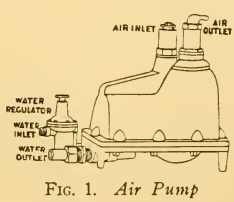


FIG. 1. *Air Pump*

Aeration. In Nature there is always sufficient plants or air surface to keep the fish well supplied with oxygen, but in the aquarium, particularly on dark days when the plants give off little oxygen, it is impossible to keep the fish from coming to the surface without the help of some artificial means. This is best accomplished by means of compressed air liberated at the bottom of the

aquarium. As the air passes through the water there is sufficient oxygen absorbed to keep the fish always in good condition. This is also very helpful to the fish at night.

There are many varieties of pumps that can be used for this purpose, but the cheapest and most satisfactory are those which are operated by water power. The type known as "beer pumps" are the best. These operate on a very simple principle, having a minimum of working parts and therefore little to get out or order. Air is forced out of an air-chamber by the entrance of water. When the air is all expelled, an internal float stops the supply of water and starts a siphon working which empties the pump preparatory to the next filling. As this operation takes about a minute it is advisable to have a small storage tank for the air to pass through in order to equalize the flow. A very small stream of air running through the aquarium will keep the water sweet even though the aquarium is somewhat overcrowded. Overcrowding, however, is not to be encouraged at any time.

The air should be liberated in as small bubbles as possible. Liberators are made especially for this purpose, but a good home-made plan is to place a piece of bass wood or other open grained wood in the end of a tube to force the air through it. In case the liberator becomes clogged up, allow it to dry out for a day or two.

An air pump may also be used to operate a filter for the aquarium or to make a fountain without the use of water other than that already in the aquarium. (See Chapter on Aquarium Appliances.)

Scavengers. Nature has supplied us with means of getting rid of most of the harmful offal and decomposition in the aquarium. These con-

FIG. 2. *African*

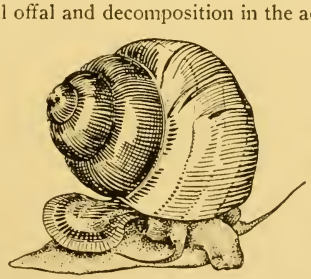


FIG. 3. *Japanese*

FIG. 4. *Red Ramshorn*

THE THREE BEST FRESHWATER AQUARIUM SNAILS (*Life size*)

sist 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 (*Viviparous malleatus*), the so-called African paper shelled

snail (*Lymnaea auricularia*) and the red variety of the European Ramshorn Snail (*Planorbis corneous*). These are all active in eating 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. The Japanese snails are very interesting in that they bring forth fully developed young about the size of a pea. 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 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. The young hatching from the spawn of these snails make a food regarded by the fish as a delicacy, as is evidenced by the fact that none of these snails ever get beyond the early stages of development if kept among the fish. It is therefore apparent that to breed these snails successfully they need to be kept by themselves until the young are about half grown. With the Japanese snails no such precaution is necessary, as the young are furnished with a fairly hard shell at the time they emerge.

The European Red or Coral Snail (*Planorbis corneous*) is a 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 to an artistic aquarium, and is an active worker. The snail is easily bred if the young are kept away from fish. In breeding snails in small aquara or receptacles it is desirable to give them some extra food. Rice wafers, powdered fish food of almost any variety, lettuce leaves dried and powdered, boiled oatmeal or raw cream of wheat will serve the purpose. Eggs are deposited on plants and glass, and do best at from 70 to 80 degrees Fahrenheit.

To those interested in identifying species of native snails we would recommend a very excellent work published by the State Department of Public Education at Albany, N. Y., entitled "A Monograph on the Snails of New York State," by H. A. Pilsbry. The book is profusely illustrated in color and to all practical purposes covers the species east of the Rockies.

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 fresh water 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,

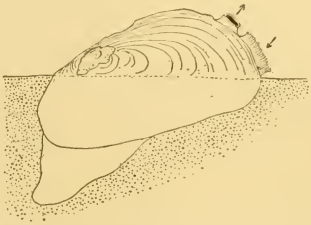


Fig. 5. Freshwater Mussel, Showing Water Intake and Outlet; Also "Foot" With Which They Burrow and Travel

by which they suck in water in one opening and 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 but useful scavenger is an eel-like fish called the Weatherfish. Varieties are native to Europe and Asia. They are freely imported

Fig. 6. The Weatherfish (*Cobitis fossilis*)

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

Another scavenger fish is the Sacchobranchus 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 Weather-fish is most excellent to introduce with such fishes, even a single small one keeping the sand in a large aquarium loose on the top.

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 in 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 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 in by the single-tail goldfish.

PLANTING

Planting is usually done directly in the sand or grit. Some aquarists prefer planting in miniature pots 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 the bottom of a pond. 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. 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 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. Next fill with about two inches of water. Now take the roots of Sagittaria,

Vallisneria, or other rooted plants, and spread them out well. (See chapter on Plants.) After the proper arrangement of plants is made, add from an inch to two inches of sand and pebbles, being careful not to completely cover any of the leaves. Now fill the aquarium and with a slender stick lift up 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.

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

Bunches of Cabomba, Anacharis 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 serious 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 active in time to be of real use to the fish.

The use of pebbles only in the bottom of an aquarium is not to be recommended, because particles of food may fall between the stones where neither the fish nor snails can reach them, and the decomposition thus set up is liable to foul the water.

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 removing or standing dry. These leaks can usually be corrected 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 of water. The convex form acts as a lens to perpetually focus light into the eyes of the fish. Even the side light of a straight-side aquarium is known to be less desirable than top-lighting in an opaque tank. What then must be the effect of a focused side-light? A proper plant growth in a small globe is almost impossible. All of these evils are multiplied by the apparently universal over-crowding 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 to the top, nor stand in the summer sun; and to establish growing plants. If this point can be reached it is a step to the abandonment of the "globe" for a real aquarium, where the chances of success are so much greater.

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.

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 are not always suitable for this, as they are 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 confervæ about the thickness of horse-hair 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 confervæ is left. If the smallest bit remains the growth will soon be as bad as ever.

FIG. 7. 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.

Fig. 8. Prizewinning Veiltail Moor (*Reduced one-third*)

This is considered to be one of the finest black goldfishes ever bred. The short, deep body, the sail-like dorsal fin, the large, clear eyes, the broad flowing tails, the velvety black color combined with good lines and style make this remarkable fish a pattern which we might hope to equal but hardly to surpass.

Chapter Two

Goldfish Varieties

THE GOLDFISH

There are two root-stocks from which the goldfishes of to-day 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. Of this more will be said later.

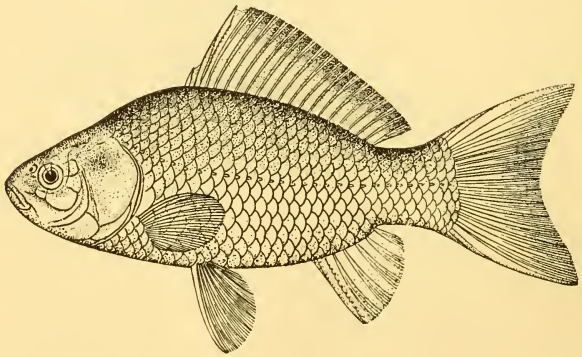


FIG. 9. THE COMMON GOLDFISH (*Carassius auratus*)

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 the 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 goldfish to revert to the ancestral stock.

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, is easily tamed and is a prolific breeder. The body is rather long and 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.

Under pond culture they will, in several years, reach a length of 16 inches and live for eighteen years or more.

Colors in Goldfishes. In color the fish varies from a smoky drab or olive to metallic red, yellow, white or partially black. Indeed a combination of all these colors is not infrequent, once the first carp-color is gone. 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. 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, although he is told by a reliable authority that there was one a number of years ago.

We have referred to "scaled" goldfishes. There is another division not known to the general public but which plays a highly important part

in the goldfish fancy. This is the "scaleless" variety. These fishes are really not without scales, but the scales are of such transparent character that they are scarcely observable 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 scaleless fishes. 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 31 and in the chapter on judging Goldfish Competitions, page 43.

Another important peculiarity of the scaleless 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. Their 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 scaleless goldfish 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 (hereafter in this work 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 a long life. This we would call ten years in a highly-bred fish. 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 the "runts" of the batch. 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 until the next spring, when the death toll is rather heavy again, but a fair number pass it successfully and they are likely to live several years more to an age of from four to six years. Anywhere from six to twelve years can be considered a long life for a fancy goldfish, although well authenticated instances exceeding this are known.

Early Variations. 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*.

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 young. In a lot of a thousand young scaleless fishes there may not be two alike, and none may resemble either parent. That this, however, is not always so is a self-evident fact, else selective breeding would be without results.

The accomplishments of Oriental breeders seems 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 occured in the preparation of the present volume. The engraver who made the plate for the goldfish design on the outside cover 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 to-day 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 aesthetic 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 individuality of our own. 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. 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 sent out is well attested by travelers to-day 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 easiest characteristic 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 spring. The Comet makes the most beautiful and generally satisfactory pond goldfish where a dec-

orative 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

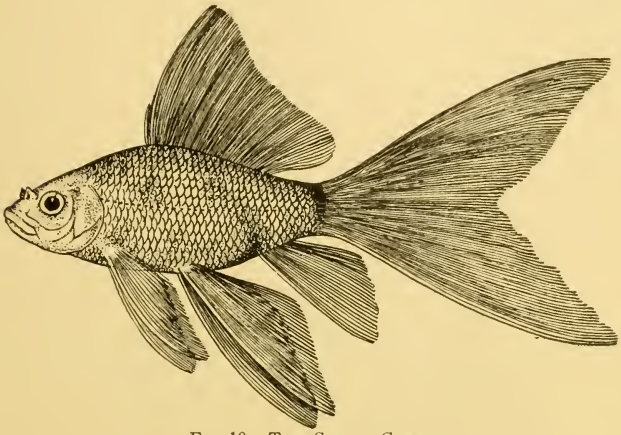


Fig. 10. The Scaled Comet

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.

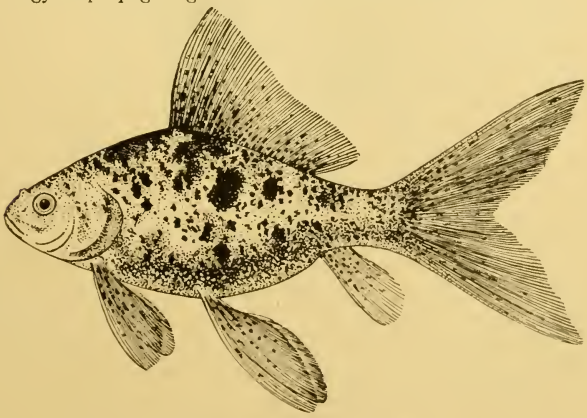


Fig. 11. The Shubunkin

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 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 Japanese stock has quite short fins, but those bred in America are a little more developed in this respect, the illustration showing the American style.

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 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

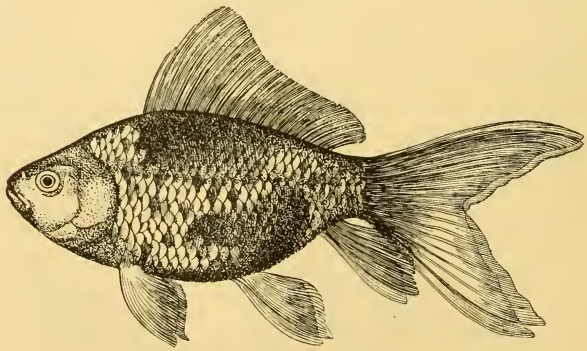


Fig. 12. The Fantail

agile swimmers. This means that in the contest for life they are able in most cases to hold their own with the hardy single-tailed variety. Since the price for "fantails" is considerably 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 fish, made by its owner, Mr. Franklin Barrett. A few words regarding this,

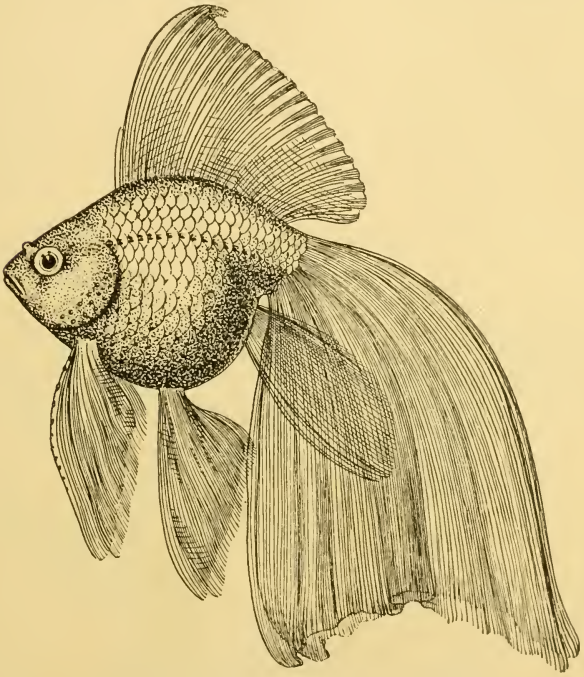


FIG. 13. THE JAPANESE FRINGETAIL (*Veiltail or Broadtail style*)

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 Mr. Barrett's 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 majestically 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 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

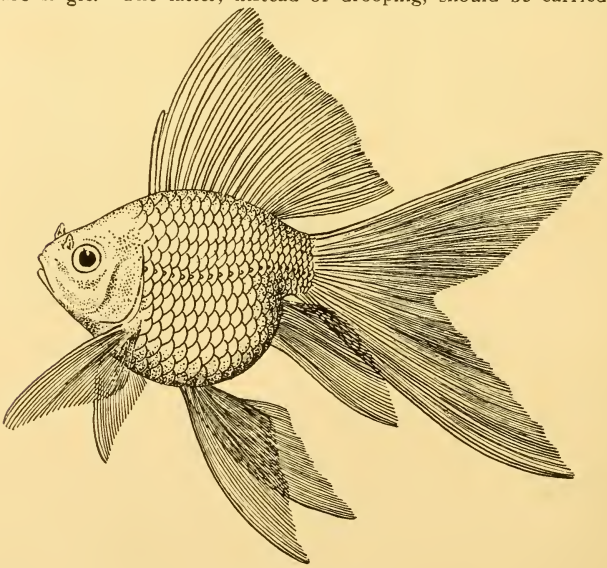


Fig. 14. The Nymph

straight, and well spread. This fish is usually a "sport" from fringetail stock. Although seldom deliberately bred, fine specimens are very attrac-

tive 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. These make

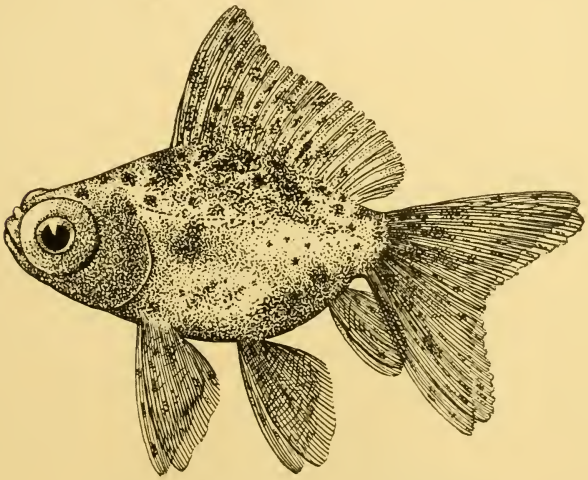


Fig. 15. Early Style Chinese Telescope

a very weird appearance, and almost without exception produce a shocking impression on being seen for the first time. So perverted or educated do our tastes later become that we find our admiration increasing in proportion to the degree of malformation attained in the fish. Telescope eyes vary 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.

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.

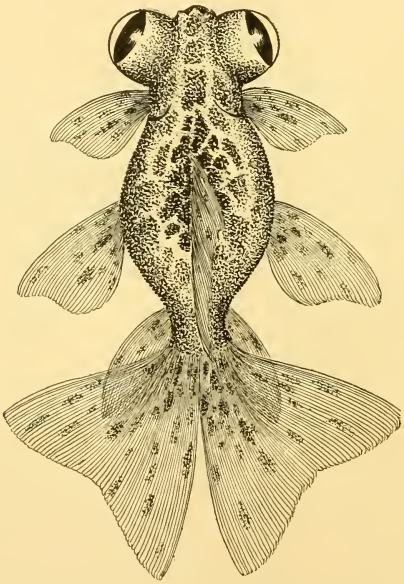


Fig. 16. Chinese Scaleless Telescope (*Dorsal view*)

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 ox-blood 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 by the delicate hand of a water-color artist. These fishes have white fins. 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 woefully 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 has witnessed a gratifying development of general interest in the better aquaria and fancy fishes of all kinds.

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

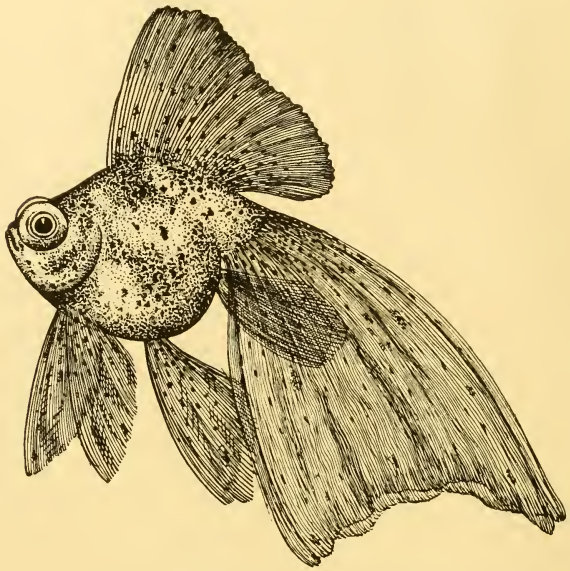


Fig. 17. Perfect Calico Veiltail Telescope

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.

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 ten weeks they developed ordinary telescope eyes in the regular way. Later they gradually turned towards the top of the head as shown in Figs. 18 and 39.

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.

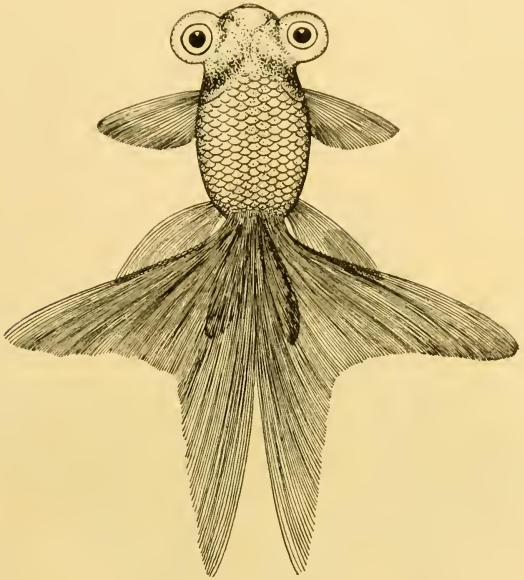


Fig. 18. The Chinese Celestial

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

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, of 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 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 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

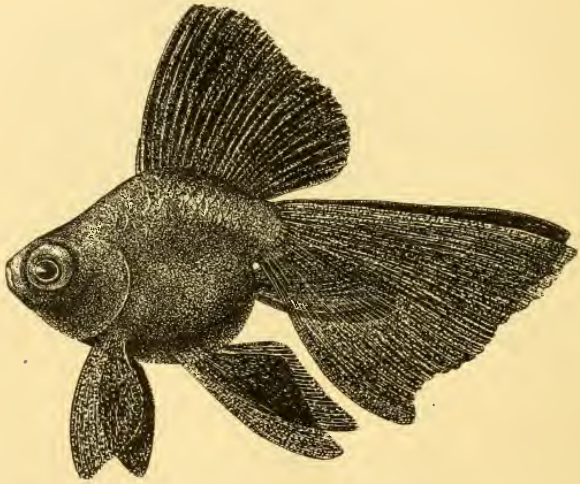


Fig. 19. Young Chinese Moor (*Veiltail*)

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 18, will give a better idea of the color.

THE JAPANESE LION-HEADED GOLDFISH

In point of grotesqueness and the amazing accomplishments of breeding fancy goldfish, probably nothing surpasses the so-called Lion-

head. 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

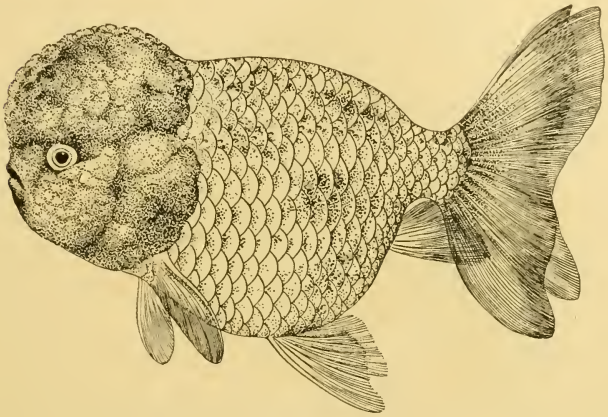


Fig. 20. The Lionhead, or Buffalohead

and sometimes never appears. It is well developed in two 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.

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

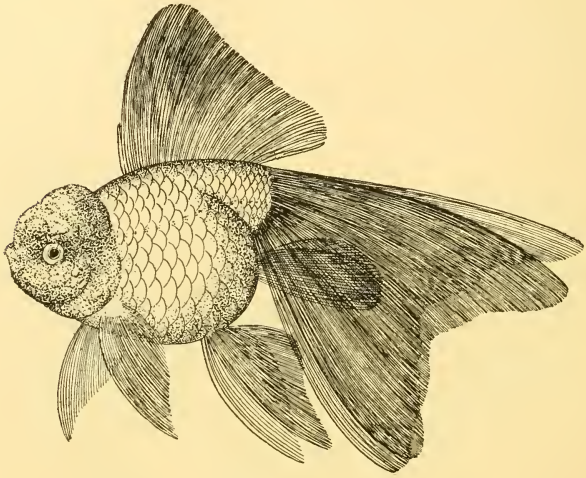


Fig. 21. The Oranda

to form. However, it is recognized as a variety and is accorded a place in goldfish shows. The fins and body are usually longer than in the Lionhead.

THE CHINESE TUMBLER GOLDFISH

Among other breeds of Chinese goldfish never popularly known in America is the Tumbler. The peculiarity of this fish is that of somersault gyrations comparable to those of tumbler pigeons, caused by the spine curving backwards. A fish performing in this manner is occasionally seen in a hatching of any short-bodied stock, and is usually killed to relieve it of the misery of existence. We cannot imagine that a breed of this sort would ever become popular in this country, for it would be too suggestive of troubles we already have in fishes caused by internal derangements, chiefly of the swimming bladder.

In addition to the few specimens seen in this country, a similar fish is described by de Sauvigny.

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

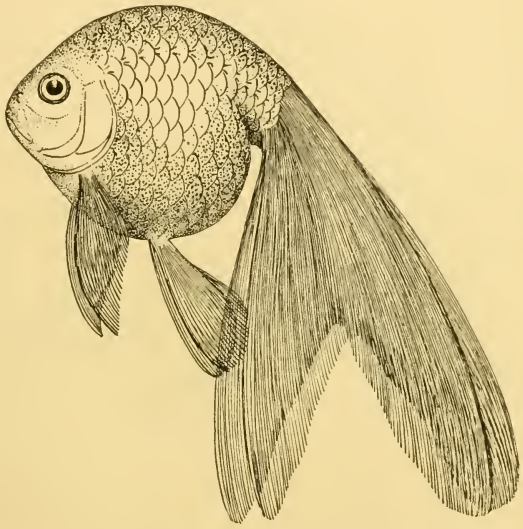


Fig. 22. The Chinese Eggfish

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 Veil-tail Moor Telescope. The breed is recognized in Europe.

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 oxalate of iron or dilute hydrochloric acid.

THE METEOR, OR TAILLESS GOLDFISH

In breeding for long-tailed fishes a strange perversion sometimes occurs in the form of a tailless fish, the other fins being well developed. The anal is single. Some of these have recently been bred together, and

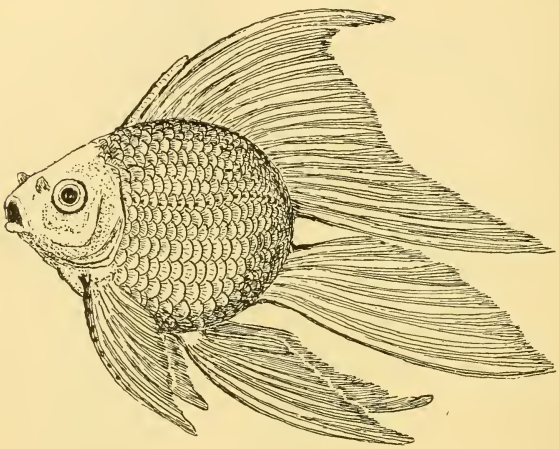


Fig. 23. The Meteor

by a few generations of selective breeding the type has become quite well fixed. At first regarded as a mere freak, the Meteor has been accorded a place in a number of competitive exhibitions. A specimen such as illustrated can swim better than would be imagined, and makes quite a streaming effect passing through the water.

Chapter Three

Judging Goldfish Competitions

JUDGING GOLDFISH COMPETITIONS

Among aquarium socieites 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 sometimes 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 43 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 definitely 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 "veil-tail" is adapted from the German Schleierschwanz, and is more truly

FIG. 24. 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. 25. Medal of The Aquarium Society of Philadelphia
(Exact size)

The first medal offered by an American Aquarium Society. It is awarded annually 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.

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 a deep, purple-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.

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.

OFFICIAL CHARTS

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

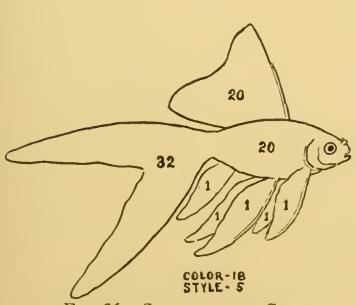


Fig. 26. Swallowtail Comet

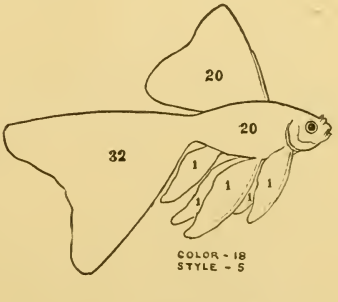


Fig. 27. Veiltail Comet

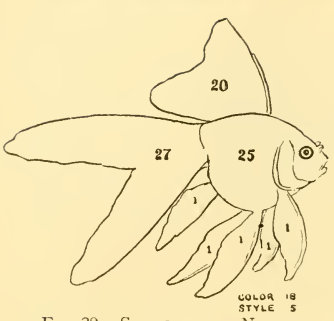


FIG. 28. SWALLOWTAIL NYMPH

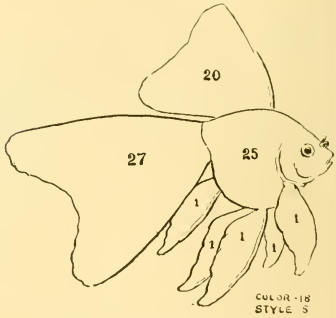


FIG. 29. VEILTAIL NYMPH

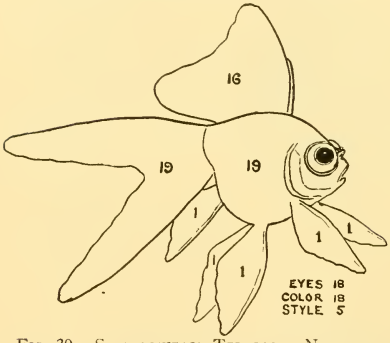


FIG. 30. SWALLOWTAIL TELESCOPE NYMPH

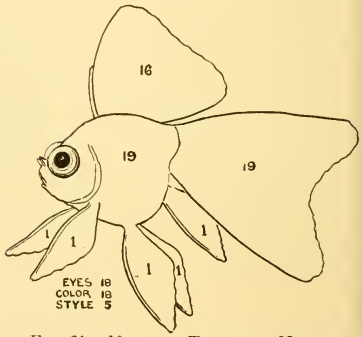


FIG. 31. VEILTAIL TELESCOPE NYMPH

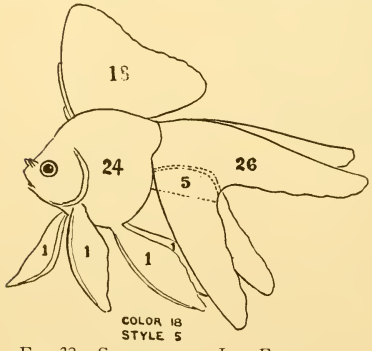


FIG. 32. SWALLOWTAIL JAP. FRINGETAIL

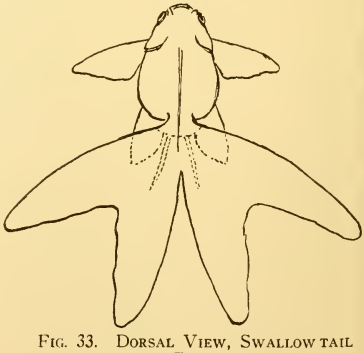


FIG. 33. DORSAL VIEW, SWALLOWTAIL JAP. FRINGETAIL

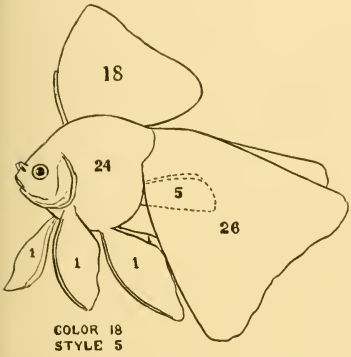


FIG. 34. VEILTAIL JAP. FRINGETAIL

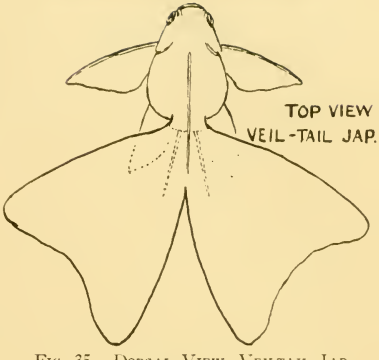


FIG. 35. DORSAL VIEW, VEILTAIL JAP. FRINGETAIL

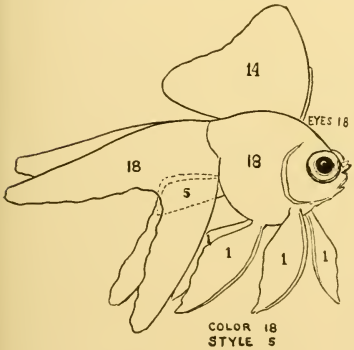


FIG. 36. SWALLOWTAIL TELESCOPE

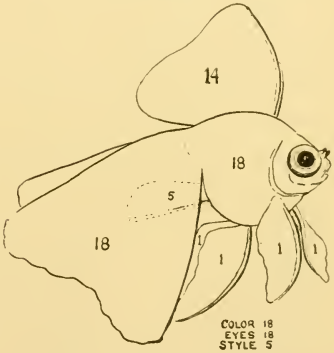


FIG. 37. VEILTAIL TELESCOPE

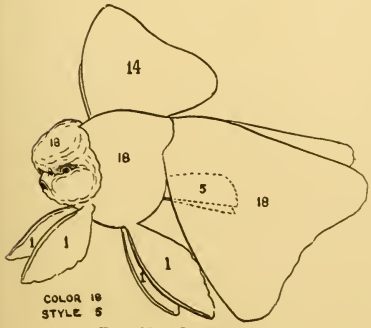


FIG. 38. ORANDA

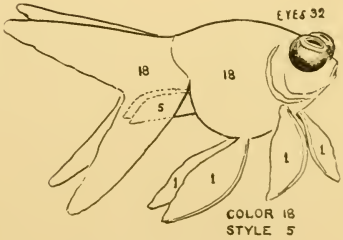


FIG. 39. CELESTIAL

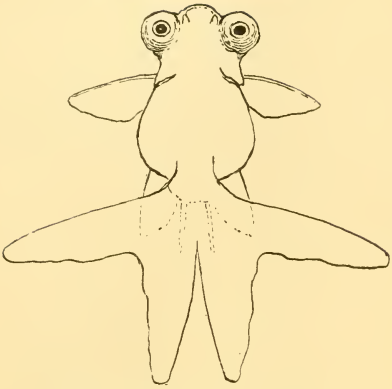


Fig. 40. Dorsal View, Celestial

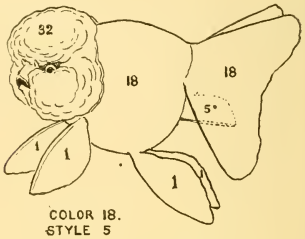


Fig. 41. Lionhead

TABLE OF POINTS FOR ALL CLASSES

	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

Chapter Four

Propagation of the Goldfish

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. 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 27 and lower photograph on page 56.)

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 fishes' 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.

BREEDING

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. 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 has 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 batch will come true, but will be qualified by slight defects. The balance may be anything at all, single-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.

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. 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 fish. These are more showy than the young, but should not be selected as breeders. In fact, none but the expert fancier who knows well what he is about should purchase any fish over one year old.

The fish often show signs of breeding early in the year. As previously stated the young males will start "driving" the females. 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. 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 delayed by separating the sexes and by keeping the fish in cool water.

As spawning time approaches the fish should be well fed on nourishing food. Finely chopped earthworms, carefully rinsed, are excellent. Live daphnia are even better. When the breeders have been selected they should be placed togther 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 231.

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. 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 middle afternoon. It may be repeated every few weeks until the first of August, but the first spawn of the season is the largest.

Goldfish 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 an ejection of spermatic fluid. They are of a mucilaginous character and adhere to the plants. The eggs are about one-sixteenth of an inch in diameter and are of a pale, amber hue. 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. These plants should be removed to enamel trays about 4 inches deep and 12 to 20 inches in diameter, containing clean water of the same temperature as breeding tank. 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. These appear on the second day to be milky white and later become covered with large balls of fungus. The fertile eggs are of a pale amber color and are not easily seen. This fact together with the marked prominence of the infertile eggs often gives the beginner the idea that the eggs are all bad. He is generally surprised, therefore, to see what a large number hatch.

FIG. 42. 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 do their elder brethren.

FIG. 43. 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 eggs on Hyacinth roots is shown in a characteristic manner.

Fig. 44. Goldfish at Two Weeks

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. 45. Goldfish at Six Weeks

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. 46. TELESCOPE GOLDFISH AT TWELVE WEEKS

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.

Fig. 47. Prizewinning Telescope

Fig. 48. Prizewinning Scaleless Telescope

Goldfish Over One Year Old, Fully Developed

The development of the embryo under the microscope is plainly observable and is extremely interesting. The hatching time is from three to fourteen days, according to temperature. At a temperature ranging from 70 to 75 degrees Fahrenheit they should take from four to five 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 a temperature below 60 degrees. Goldfish at any age should be partially protected from the direct glare of the sun, so that they may at will go into the sun or shade. 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 weatherbeaten, 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 too much heat, and temperatures above 85 degrees, even temporarily, are to be avoided if possible. Fish under eight weeks old can stand more heat than can older fish.

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 is the umbilical sack 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 umbilical 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 fishfood it is necessary to have conditions favorable to their culture. This consists mainly of vegetable decay. Dried and powdered lettuce leaves or duckweed, 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 140). 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 daphnia or other crustaceans. One species, *Brachionus rubens,* sometimes occurs so thickly that the surface of the water appears to be covered

by a thin, rusty scum. Small pools about a cattle yard are particularly favorable, 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 a 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 130.)

While the fry are being fed on infusoria, however, no daphnia should be introduced. The daphnia, as well as the small fish feed on infusoria and are more skilled than goldfish in catching them. Where daphnia have been for a few hours, no infusoria can be found, so thoroughly do they clear the water of them. In other words daphnia and goldfish up to the age of about ten days for the fish are competitors for the same living food.

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 drain 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 a drain 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 2-inch strip of stiff felt around the outside edge. 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 out doors, 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 the Spring of our Eastern climate.

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 cheesecloth. As they increase in size an excellent diet is the paste from boiled oatmeal after straining through muslin or cheesecloth. Powdered shrimp

or codfish as described on page 129 can be added to the oatmeal to advantage.

Whether fed on living or prepared food, young goldfish should be fed very liberally. 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.

As the fry develop in size the more nearly perfect specimens should be selected from the others, given more room and the best of the food. It is much better to concentrate on raising a few fine specimens, and to succeed in this requires plenty of room for each fish. This point cannot be dwelled upon too strongly. 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.

For some unknown reason certain individual fishes grow very much more rapidly than others. These larger ones monopolize the food and sometimes eat the smaller. They should therefore be sorted according to size several times in a season.

WINTERING GOLDFISHES

In outdoor ponds where there are plenty of dead leaves and soft dirt, the hardier varieties of goldfish 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.

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. 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) 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 them swimming bladder trouble.

Chapter Five

Wholesale Breeding

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. Our figure number 49 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 2 or 3 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 them 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 consequently 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

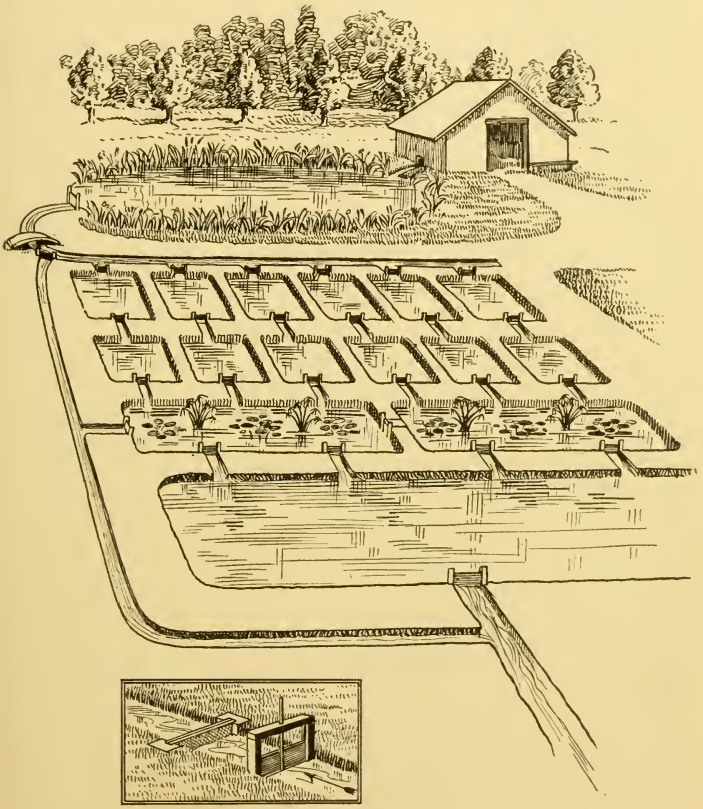


Fig. 49. Farm Breeding Ponds, Showing Detail of Sluice and Guard

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 im-

petus to the production of live fish food. For aesthetic 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 spread 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.

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 extra screened 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 and rat 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. Trees at the right places would be beneficial but this cannot often be arranged. 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 our figure 50, 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 high 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 50, thus making two rows here instead of one. The wooden tanks should be somewhat narrower than the lower concrete pools.

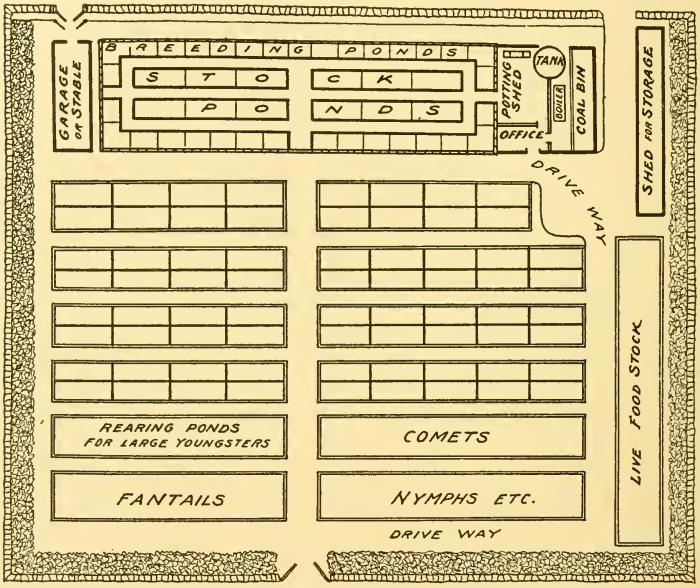


FIG. 50. WHOLESALE BREEDING ESTABLISHMENT, SHOWING GREENHOUSE AND OUTDOOR CONCRETE TANKS

Goldfishes are hatched in the greenhouse from February until April. 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 cir-

culation 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 greenhouse 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, different methods are employed to cut down the light in Summer. 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 vauable 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 down.

A description of methods of building concrete ponds and tanks will be found on page 220.

Commercial Breeding of Tropical Fishes. The detailed descriptions of breeding habits described on pages 92 to 100 will give a practical working basis for anyone wishing to enter this 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 larger 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.

Chapter Six

Some Hardy Native Freshwater Aquarium 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. There are 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 the aquarium hobby.

THE RED-BELLIED DACE

Chrosomus erythrogaster, not exceeding a length of three inches is one of the most satisfactory of hardy aquarium inhabitants. During the breeding season the belly, mouth and base of the dorsal fin of the males

Fig. 51. Red-Bellied Dace (*Life size*)

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 Middle West. They are believed to be community breeders requiring large space. 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, operated by two persons.

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 shown in illustration. This varies in intensity from day to day, and is brightest from February until September. As these fishes dart about the aquarium

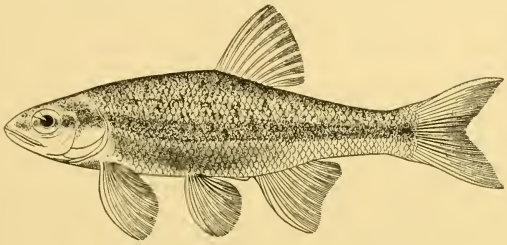


Fig. 52. Rosy-Sided Dace (*Life size*)

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 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 streams of the Delaware Valley, 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, pro-

Fig. 53. Black-Nosed Dace (*Enlarged one-quarter*)

ducing 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 STICKLEBACK

Froebel, the writer of kindergarten fame, in telling the children of the civilized world the life story of the stickleback, has given great promi-

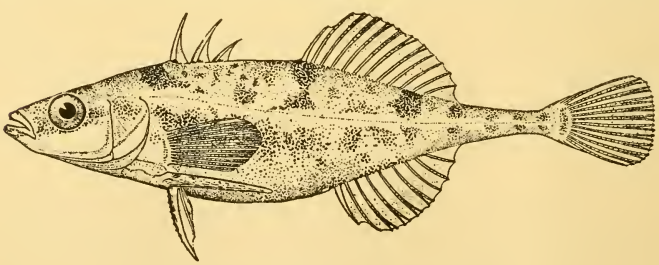


Fig. 54. The Stickleback (*Enlarged twice*)

nence to this interesting little fish. 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 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 daphnia or bits of small worms.

THE CHAETODON

Chaetodons build their nests directly among plants off the bottom. These fish are less of fighters and depend more upon hiding their young

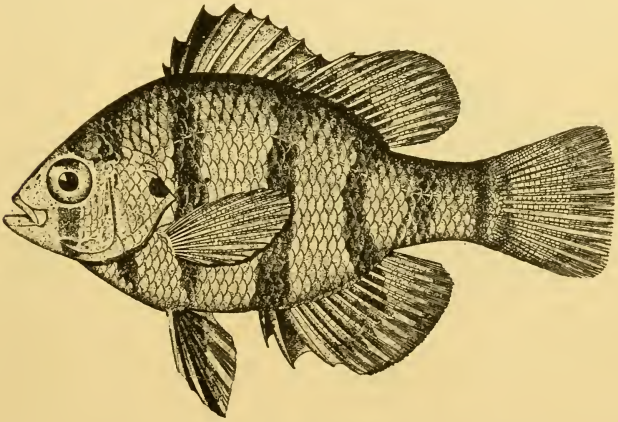


FIG. 55. THE CHAETODON (*Enlarged one-quarter*)

than upon boldly protecting them. The Chadetodon 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 of moving about by

will-power, without physical effort. Chaetodons greatly prefer live daphnia to all other foods. If fed upon them regularly it is difficult to get them to touch anything else, starvation under these circumstances not being uncommon. They do fairly well on dried shrimp once they take it.

THE SUNFISH

The Sunfish is one of the most widely distributed and best known of our freshwater fishes, American boys being well acquainted with them. 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 Chaetodon, or black-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 aqua-

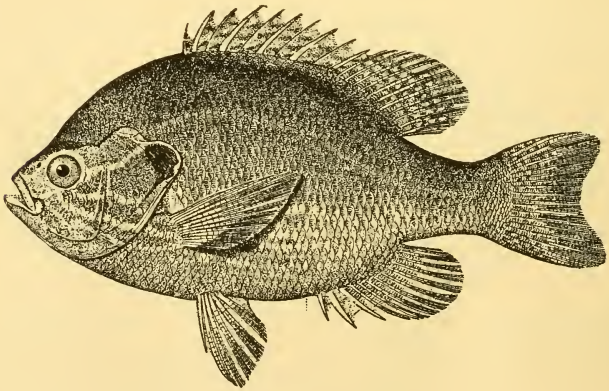


Fig. 56. The Common Sunfish

rium. Sunfishes have a decided carnivorous tendency, much preferring live worms or flies to prepared foods. In winter they will 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.

THE SILVERFIN

Of all the native fishes tried in the aquarium by the writer the Silverfin (*Notropis analostanus*) 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, phosphorescent color from May till September. Darting around in the aquarium, their sleek bodies overcast with a pale steel-blue, and sides laced with black edgings of 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.

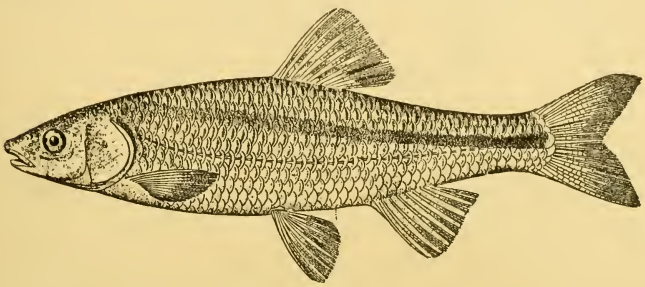


FIG. 57. THE SILVERFIN OR SATINFIN (*Slightly enlarged*)

A 50-gallon aquarium, with plenty of open space, containing about fifteen 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 care should be exercised to cover with a screen to prevent their leaping out.

The Darter

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 object they always succeed in getting what they go after. One would imagine them to have a long tongue like a frog, moving with 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

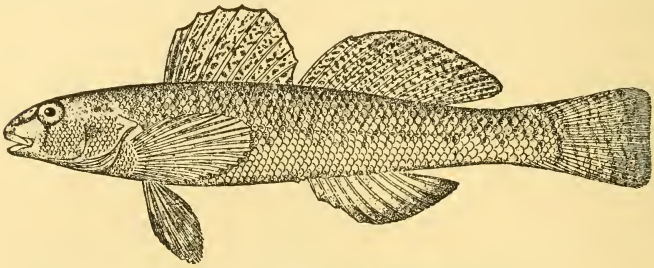


Fig. 58. The Darter *(Enlarged nearly twice)*

known as the Soldier Fish. It occurs in shallow streams of the Middle West. Extremely fond of daphnia or very small worms, but may become educated to taking shreds of raw meat. They can be kept successfully and are well worth the trouble.

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

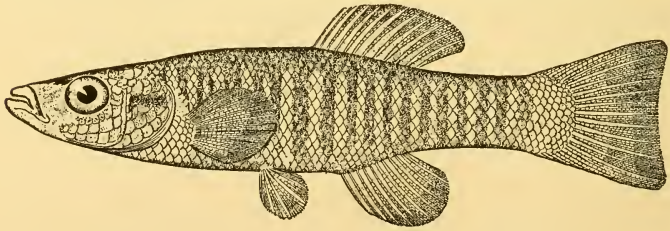


Fig. 59. The Killifish or Bullhead Minnow (*Enlarged one-half*)

very bad treatment before succumbing. The barred sides and fleeting irridescent colors are most attractive, particularly in the saltwater form of *Fundulus diaphanus.* 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 "Mummychug." Size 3 to 4 inches.

THE GOLDEN ORFE OR IDE

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.

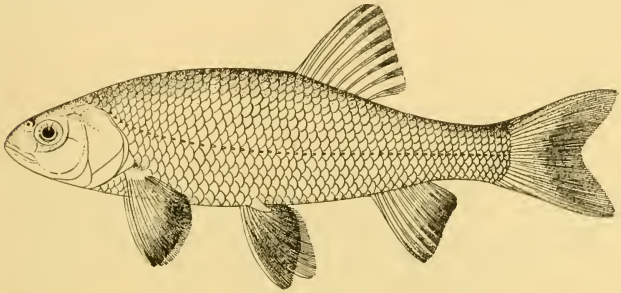


FIG. 60. THE GOLDEN ORFE OR IDE (*Young*)

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 spring or running water and have been successfully bred in the Government fish ponds at Washington.

THE CATFISH

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,

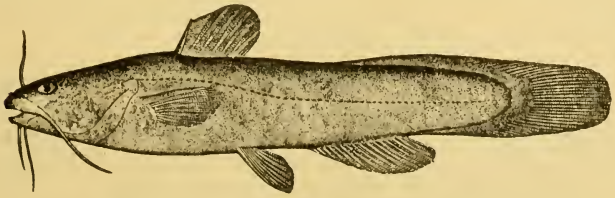


FIG. 61. STONE CATFISH

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.

THE GOLDEN TENCH

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 irridescent

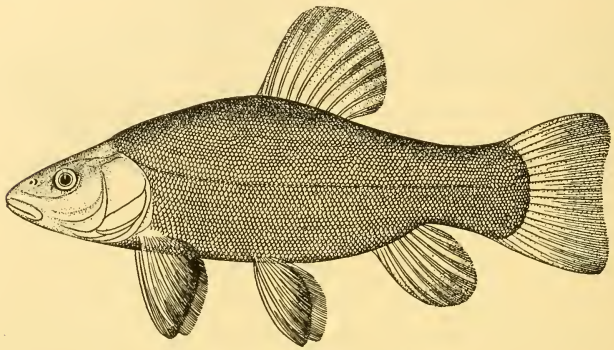


Fig. 62. The Tench (*Young*)

effect, comparable to that of an opal. By transmitted light they are 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."

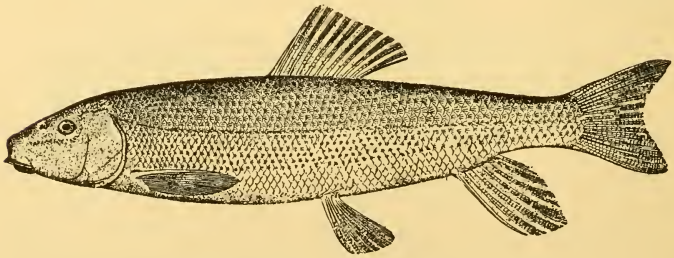


Fig. 63. The Sucker (*Young*)

THE SUCKER

As a novelty the Sucker may be kept in an aquarium. It is by no means a handsome fish, appearing somewhat awkward and clumsy. Preferring vegetable foods, it will also take earthworms. In habits it is perfectly harmless.

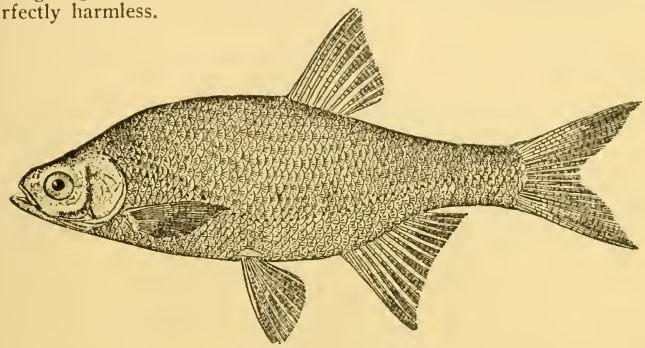


FIG. 64. THE SHINER

THE ROACH, OR SHINER

Here we again have one of the very hardy small aquarium fishes. It is decidedly active, and if kept in a bright light shows its brilliant silvery sides to advantage. The Roach is seldom still and has a stimulating effect upon the more lethargic members of a general collection. It is of a gentle nature and is not at all particular as to what it is fed.

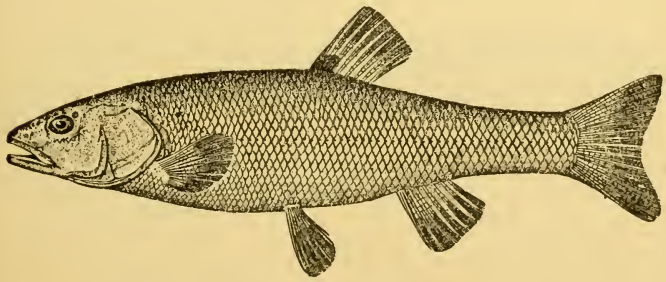


FIG. 65. THE CHUB (*Young*)

THE CHUB

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 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 MULLET

Sometimes known as the Chubsucker, the Mullet in the smaller sizes makes a satisfactory aquarium fish, entirely harmless and of rather

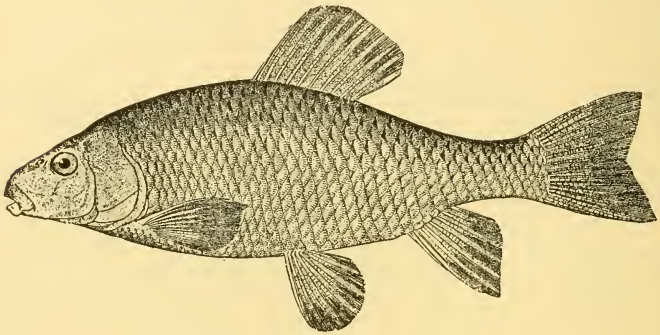


Fig. 66. The Mullet (*Young*)

attractive appearance. The back is green, sides are yellow and abdomen is white. May be fed on ordinary fishfood but has pronounced vegetarian tendencies.

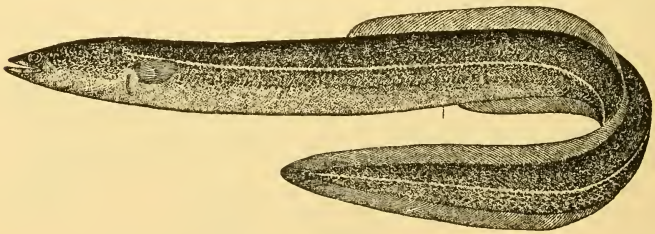


Fig. 67. The Common Eel (*Young*)

THE EEL

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 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 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

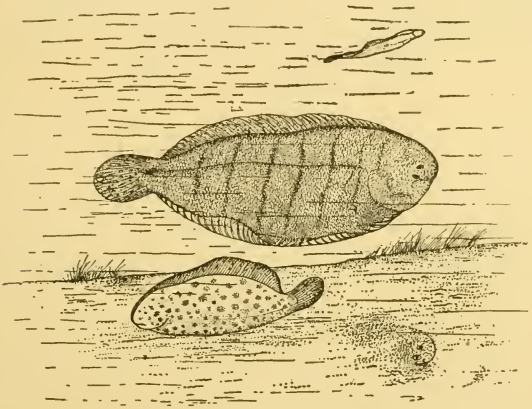


FIG. 68. THE SOLE *(Young)*

the fish, while the lowest pictures the Sole as it lays half concealed in the mud. In the aquarium these fishes frequently fasten themselves flat to the sides of the glass by 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 CARP

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.

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, having blue backs, red sides, white bellies, and with the large irregularly placed scales of the Mirror Carp. It is to be hoped these will be propogated here.

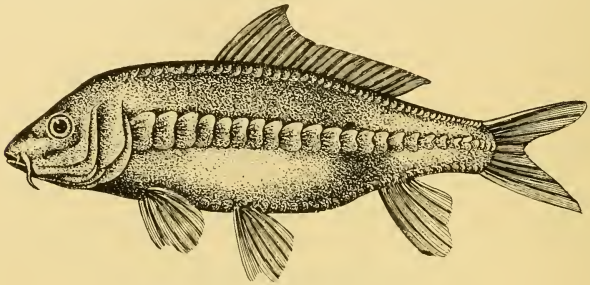


Fig. 69. The Mirror Carp *(Young)*

THE CARNIVOROUS FISHES

The Pike, Bass, Perch and other predaceous fishes are not suited to the household aquarium, although small ones are sometimes kept. If fed upon meat it is important that no uneaten particles be allowed to remain.

COLLECTING IN STREAMS AND PONDS

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 more important 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. Poles are attached to the lower lines containing the sinkers, while the float line is pulled forward by the hand, slightly behind the lower line. They can be operated with great success in any shallow stream where the fish can be manœuvered into a corner for the final sweep. Care should be exercised to put back all fish not actually wanted, and also not to try to carry so many home that they all suffocate before arrival. The landing net is used mainly in streamlets. It is operated by a quick overhead swoop and the net pulled rapidly over the bottom towards the fisherman. The net should be of a depth of about 25 inches and had best be secured to the frame by brass rings of about ⅝ inch diameter, procurable in upholstery stores. These prevent the cutting of the net when dragging over stones. Very little success can be had by scooping upwards.

Chapter Seven

Alphabetical List

of the

Principal Aquarium Fishes

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, see pages 93 to 100.

Scientific Name	Meaning or Popular Name	Home	Length (Inches)	Temperature		Breeding Habits	Food	Nature
				Celsius	Fahr.			
Acanthophthalmus kuhlii	"Kuhl's"	E. India	3″	25	77	B 13	Omnivorous	N 1
Acara bimaculata	"Two-spotted"	Brazil	M. 6″; F. 5″	23	74	B 5	Carnivorous	N 6
Acara coeruleopunctata	"Blue-spotted"	S. America	M. 4″; F. 3½″	25	77	B 5	"	N 6
Acara festiva	"Decorated"	Amazons	3″	23	74	B 5	"	N 6
Acara nassa	"Fish-trap mouth"	Amazons	3½″	25	77	B 5	"	N 6
Acara tetramerus	"Divided in 4"	Amazons	3″	25-30	77-86	B 5	"	N 6
Acara thayeri	"Thayer's"	Amazons	3″	24	75	B 5	"	N 6
Achirus fasciatus	(Sole)	E. Coast Streams	1½″-4″	20	68	B 1	"	N 1
Alestes chaperi	"Chaper's"	Nigeria	2½″	23	74	B 4	Omnivorous	N 3
Ambassis lala	"Worthless"	E. India	1½″	23	74	B 2	Live food	N 6
Ambloplites rupestris	"Rock-dweller"	N. America	4″	20	68	B 2	Carnivorous	N 6
Amblyopsis spelaeus	Blind cave fish	Kentucky	2″	16	61	B 9	Omnivorous	N 1
Ameirus nebulosus	(Catfish)	N. America	24″	20	68	B 13	"	N 6
Anabas africanus	"African"	E. Asia	4″	18-25	64-77	B 7A	"	N 4
Anabas fasciolatus	"Banded"	W. Africa	3½″	18-25	64-77	B 7A	"	N 4
Anabas scandens	"Climber"	India	5″	18-25	64-77	B 7A	"	N 4
Aphredoderus sayanus	Piratefish	N. America	4″	15	55	B 3	"	N 1
Apomotis chaetodon	(see mesogonistius)	E. N. America	3″	22	72	B 2	Live food	N 1
Apomotis cyanellus	(Grassfish)	N. America	8″	20	68	B 2	Omnivorous	N 6
Apomotis obesus	(see Enneacanthus)	N. America	4″	22	72	B 2	"	N 6
Badis badis	"Chestnut brown"	E. India	2″	24	75	B 15	Live food	N 6
Barbus camptocanthus	"with whiskers"	W. Africa	3″	26	79	B 2	Omnivorous	N 1
Barbus chola	"color of galls"	E. India	3″	23	74	B 2	Live food	N 1
Barbus conchonius Barbus pyrrhopterus	"red-finned"	E. India	3″	23	74	B 2	"	N 1
Barbus fasciolatus	"Banded"	W. Africa	M. 2″; F. 3½″	18-25	64-77	B 2	Omnivorous	N 1
Barbus lateristriga	"Side-striped"	E. India	3″	20-24	68-75	B 2	"	N 1

Barbus maculatus	"Spotted"	E. India	3"	18-25	64-77	B 2	"	N 1
Barbus pentazona	"5-belted"	E. India	2½"	25	77	B 2	"	N 1
Barbus phutunio	"Glittering"	E. India	1½"	25	77	B 2	"	N 1
Barbus semi-fasciolatus	"½-banded"	W. Africa	M. 2"; F. 3½"	18-25	64-77	B 2	Omnivorous	N 1
Barbus ticto	(Native name)	E. Asia	2½"	25	77	B 2	"	N 1
Barbus vittatus	"With belt"	E. Asia	2"	25	77	B 2	"	N 1
Barilius neglectus	"Neglected"	E. Asia	3"	23	74	B 2	"	N 1
Belonesox belizanus	(Viviparous Pike)	"From Belize"	M. 3"; F. 3½"	25	77	B 9	Live Fish, &c.	N 2
Betta bellica	"War-like"	Sumatra	4"	25	77	B 7	Omnivorous	N 4
Betta pugnax	"Fighter"	Singapore	3½"	22	72	B 10	"	N 4
Betta rubra	"Red"	Siam	2"	25	77	B 7	"	N 4
Betta splendens	"Splendid"	Siam	2"	25	77	B 7	"	N 4
Boleophthalmus pectinirostris	"Comb on nose"	E. Asia	3½"	25	77	B 6	Live food	N 6
Boleophthalmus viridis	"Green"	E. Asia	3½"	25	77	B 6	"	N 6
Calamichthys calabaricus	(Reed fish)	W. Africa	14"	25	77	B 13	"	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	"Striped"	Brazil	3"	23	74	B 4	Carnivorous	N 3
Centrarchus macropterus	"Big-finned"	S. E. U. S.	5"	22	72	B 1a	"	N 3
Chilodus punctatus	"Dotted"	S. America	3"	22	72	B 4	Omnivorous	N 3
Chirodon arnoldi	"Finger-teeth"	Mexico	2½"	24	75	B 8	"	N 3
Chirodon nattereri	"Natterer's"	S. America	2"	24	75	B 8	"	N 3
Chrosomus oreas	Painted	S. E. U. S. A.	3"	18	64	B 1	"	N 1
Chrosomus erythrogaster	(Red-bellied Dace)	Middle West	3"	20	68	B 1	"	N 1
Cichlasoma aureum	(Golden Cichlasoma)	C. America	3"-4½"	23	74	B 5	Carnivorous	N 6
Cichlasoma bimaculata	(2-Spotted Cichlasoma)		3"-4½"	22	72	B 5	"	N 6
Cichlasoma facetum	(Banded Cichlasoma)	C. America	3"-4½"	22	72	B 5	"	N 6
Cichlasoma fenestratum	(Window-marked)	C. America	3"-4½"	22	72	B 5	"	N 6
Cichlasoma mojarra	(Mojarra Cichlasoma)	Yucatan	3"-5½"	22	72	B 5	"	N 6
Cichlasoma nigrofasciata	(Black-banded Cichlide)	C. A. & S. A.	3"-4½"	22	72	B 5	"	N 6
Cichlasoma salvini	(Salvin's Cichlasoma)	Guatemala	3"-4½"	22	72	B 5	"	N 6
Cichlasoma severum	(Severe Cichlasoma)	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	"From Angola"	W. Africa	6″	23	74	B 13	Carnivorous	N 6
Clarias dumerilii	"Dumeril's"	W. Africa	6″	23	74	B 13	"	N 6
Clarias magur	"From Magur"	E. India	6″	23	74	B 13	Omnivorous	N 6
Cnesterodon decemmaculatus	"Ten-Spotted"	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	"Arnold's"	S. America	2″	23	74	B 12	"	N 3
Copeina callolepsis (see Pyrrhulina nattereri)	"With pretty scales"	S. America	2½″	23	74	B 4	"	N 3
Corydoras macropterus	"big-finned"	S. America	4″	23	74	B 13	"	N 3
Corydoras paleatus	"with neck-lobes"	S. America	3″	23	74	B 13	"	N 3
Corydoras undulatus	"undulated"	S. America	3″	23	74	B 13	"	N 3
Crenicichla lepidota	(Curved-toothed)	Brazil	3″-4½″	26	79	B 5	"	N 6
Crenicichla notopthalmus	"With Eye on back"	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	Bellott's Lebias	La Plata	2½″-3″	20	68	B 8	"	N 3
Cyprinodon dispar	Dissimilar Cyprinodon	Asia Minor	1½″-2″	23	74	B 8	"	N 3
Cyprinodon variegatus	Variegated Cyprinodon	S. E. N. A.	1¾″-2¼″	20	68	B 8	"	N 3
Cyprinus carpio	Mirror carp	N. America	4″	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 Anal Fin	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	(Spotted Dormitator)	C. America	2″-4½″	23	74	B 1	"	N 1
Eleotris lebretonis	"Robber"	W. Africa	2″	24	75	B 6	"	N 3
Eleotris marmoratus	Marbled	E. India	4″	25	71	B 6	Carnivorous	N 4
Enneacanthus gloriosus	(Long-eared Sunfish)	E. U. S. A.	3″	12-22	53-72	B 2	Omnivorous	N 6
Enneacanthus obesus	"Thick"	E. U. S. A.	3″	12-22	53-72	B 4	"	N 6
Epicyrtus microlepsis	"Small-scaled"	S. America	2″	23	74	B 2	"	N 3
Etheostoma coerulea	Soldierfish	N. America	3½″	18	65	B 6	Carnivorous	N 4

Etroplus maculatus	"Spotted"	E. Indies	3"-4"	24	75	B 5	Carnivorous	N 6
Eupomotis gibbosus	(Sunfish)	N. America	4"	10-20	50-68	B 9	"	N 6
Fitzroyia lineata	"With lines"	Argentine	3"	16-22	61-72	B 8	"	N 2
Fundulus arnoldi	"Arnold's"	W. Africa	2"	26	79	B 8	"	N 3
Fundulus bivittatus	"2-bands"	W. Africa	3"	26	79	B 8	"	N 3
Fundulus catenatus	"Chain-marked"	N. America	3"	22	72	B 8	"	N 3
Fundulus chrysotus	"Gilded"	S. N. America	3"	23	74	B 8	"	N 3
Fundulus diaphanus	Translucent	N. America	3"	22	72	B 8	Omnivorous	N 3
Fundulus dispar	"Unequal"	N. America	3"	22	72	B 8	Carnivorous	N 3
Fundulus gularis	"Big-throat"	W. Africa	3½"	25	77	B 8	"	N 3
Fundulus heteroclitus	"Different"	N. America	3½"	22	72	B 8	"	N 3
Fundulus lönnbergi	"Lönnberg's"	W. Africa	3"	25	77	B 8	"	N 3
Fundulus notatus	"Spotted"	W. Africa	3"	25	77	B 8	"	N 3
Fundulus nottii	"Nott's"	Florida	2½"	23	74	B 8	"	N 3
Fundulus pallidus	"Pale"	N. America	3"	22	72	B 8	"	N 3
Fundulus seminolis	"Half-finned"	Louisiana	2"	23	74	B 9	"	N 2
Fundulus sjöstedti	'Sjöstedt's"	W. Africa	3"	25	77	B 8	"	N 3
Gambusia affinis Gambusia holbrooki Gambusia patruelis	Top Minnow	S. U. S. A.	M.1½";F.2½"	23	74	B 9	"	N 2
Gambusia bimaculata	"2-spotted"	C. America	2½"	24	75	B 9	"	N 2
Gambusia episcopi	"Bishop's"	C. America	2"	24	75	B 9	"	N 2
Gambusia nicaraguensis	"From Nicaragua"	C. America	2"	24	75	B 9	"	N 2
Gasteropelecus fasciatus	"Banded Belly"	Brazil	1½"	23	74	B 4	"	N 2
Gasteropelecus stellatus	"Axe-belly"	Brazil	2"	23	74	B 4	Omnivorous	N 2
Gasterosteus aculeatus	(Stickleback)	N. America	2½"	20	68	B 14	"	N 6
Geophagus braziliensis	"From Brazil"	Brazil	3½"	24	75	B 5	Carnivorous	N 6
Geophagus gymnogenis	"Naked cheeks"	Brazil	4"	23	74	B 5	"	N 6
Geophagus jurupari	"From Jurupari"	Brazil	3½"	23	74	B 5	"	N 2
Girardinus caudimaculatus	"With spot on tail"	Brazil	1½"	23	74	B 9	"	N 2
Girardinus decemmaculatus	"10-spotted"	Brazil	1½"	23	74	B 9	"	N 2
Girardinus denticulatus	"Toothed"	C. A. & W. Indies	1½"	23	74	B 9	"	N 2
Girardinus formosus Heterandria formosa	"Beautiful"	Florida and N. Carolina	M. ¾"; F. 1";	23	74	B 9	"	N 2

Scientific Name	Meaning or Popular Name	Home	Length (Inches)	Temperature		Breeding Habits	Food	Nature
				Celsius	Fahr.			
Girardinus guppyi Acanthocephalus r. Lebistes reticulatus	"Guppy's"	N. S. America W. Indies	F. 1½"; M. 1"	23	74	B 9	Omnivorous	N 2
Girardinus reticulatus Phallopticus januarius	"Netted"	Brazil	M. 1"; F. 1½"	23	74	B 9	"	N 2
Glaridodon latidens	"Broad-toothed"	C. America	2"	24	75	B 9	"	N 2
Gobius pleurostigma	Bleeker	Sumatra	2"	22	72	B 6	"	N 4
Gobius xanthozona	Goldband	Borneo	1"	23	74	B 6	Carnivorous	N 4
Haplochilus cameronensis	"From Cameroon"	W. Africa	2"	24	75	B 8	"	N 3
Haplochilus chaperi	"Chaper's"	W. Africa	2"	24	75	B 8	"	N 3
Haplochilus calliurus	"Pretty tail"	W. Africa	1½"	24	75	B 8	"	N 3
Haplochilus fasciolatus	"Narrow banded"	W. Africa	3"	23	74	B 8	"	N 3
Haplochilus grahami	"Graham's"	Africa	2"	23	74	B 8	"	N 3
Haplochilus latipes	"Broad-fin (Medaka)	Japan	1¾"	20	68	B 8	"	N 3
Haplochilus longiventralis	"Long ventral fins"	W. Africa	2"	24	75	B 8	"	N 3
Haplochilus macrostigma	"Big-spots"	Congo	2"	24	75	B 8	"	N 3
Haplochilus celebensis	"From the Celebes"	Celebes, Java, etc.	1¼"	25	77	B 8	"	N 3
Haplochilus panchax	"Worthy of praise"	E. India	2½"	23	74	B 8	"	N 3
Haplochilus rubrostigma	"Red-spotted"	E. India	3"	23	74	B 8	"	N 3
Haplochilus schoelleri	"Schoeller's"	Nile region	2"	22	72	B 8	"	N 3
Haplochilus senegalensis	"From Senegal"	W. Africa	2"	24	75	B 8	"	N 3
Haplochilus sexfasciatus	"Six-striped"	W. Africa	3"	23	74	B 8	"	N 3
Haplochilus spilauchen	"Spotted throat"	W. Africa	2"	24	75	B 8	"	N 3
Haplochromis moffati	"Moffat's"	W. Africa	3"	24	75	B 11	"	N 6
Haplochromis strigigena Paratilapia multicolor	"Striped cheeks"	Africa	2"	23	74	B 11	"	N 6
Hemichromis auratus	"Golden"	Africa		20	68	B 5	"	N 6
Hemichromis bimaculata	"2-spot"	Africa	3½"	23	74	B 5	"	N 6
Hemichromis fasciatus	"Banded"	W. Africa	3"	23	74	B 5	"	N 6
Hemigrammus unilineatus	"1-lined"	S. America	2"	23	74	B 4	Omnivorous	N 2

Hemirhamphus fluviatilis	"Lives in rivers"	Sumatra	2½"	24	75	B 9	"	N 2
Heros facetus	Chanchito	S. America	3-6"	18	65	B 5	Carnivorous	N 6
Heros spurius	Heckel	S. America	3½"	22	72	B 5	"	N 6
Heterandria formosa (see Girardinus formosus)								
Heterogramma agassizi	"Agassiz's"	S. America	2½"	24	75	B 5	"	N 6
Heterogramma corumbae	"From Corumba"	S. America	2½"	24	75	B 5	"	N 6
Heterogramma pleurotaenia	"With side-stripes"	La Plata	2½"	23	74	B 5	"	N 6
Idus idus	Golden orfe	Germany	2-8"	16	61	B 3	Omnivorous	N 1
Iguanodectes rachovii	"Rachow's"	Amazons	2"	25	77	B 4	"	N 2
Jenynsia lineata	"Lined"	S. America	2"	23	74	B 4	"	N 2
Lebias sophiae	"Sophia's"	Persia	2"	23	74	B 8	"	N 3
Lebistes reticulatus	"Net-marked"	Venezuela	M. 1"; F. 1½"	23	74	B 9	"	N 2
Lepomis auritus	"Red"	U. S. A.	5½"	20	68	B 2	"	N 6
Lepomis megalotus	"Long-eared"	U. S. A.	5½"	20	68	B 2	Carnivorous	N 6
Leporinus melanopleura	"Black-sides"	S. America	3"	23	74	B 4	Omnivorous	N 2
Leporinus nattereri	"Natterer's"	S. America	3"	23	74	B 4	"	N 2
Loricaria parva	Guenther	S. America	4"	22	73	B 13	"	N 1
Macrones vittatus	"With bands"	India	3"	23	74	B 13	"	N 6
Macropodus ctenopsoides	"Comb-like"	Hankow	2½"	23	74	B 7	"	N 4
Macropodus cupanus (Polyacanthus)	"From the Cupans"	Farther India	3"	23	74	B 7	"	N 4
Macropodus viridi-auratus	"Paradise fish"	China	3"	23	74	B 7	"	N 4
Malopterurus electricus	"Electric"	W. Africa	4"	23	74	B 13	"	N 6
Mastacembelus argus	Guenther	Siam	4"	23	74	B 13	"	N 1
Mesogonistius chaetodon	"Brush-teeth"	E. U. S. A.	2½"	23	74	B 2	Live food	N 6
Mesonauta insignis	Steindachners	S. America	1½-3½"	25	77	B 5	"	N 6
Metynnis unimaculatus	"1-spot"	S. America	3"	23	74	B 4	Omnivorous	N 6
Mollienisia formosa	Green spreckled	Mexico	1½"	19	67	B 9	"	N 2
Mollienisia latipinna	"Wide-fin"	S. U. S. A.	2½"	23	74	B 9	"	N 2
Mollienisia velifera	"Sail-bearer"	S. U. S. A.	3"	20	68	B 9	"	N 2
Monocirrhus polyacanthus	"Many points"	N. S. America	3"	23	74	B 2	"	N 6
Myletes maculatus	"Spotted"	S. America	3"	23	74	B 4	"	N 6
Nanacara taenia	"Striped"	S. America	2"	23	74	B 5	Carnivorous	N 6

Scientific Name	Meaning or Popular Name	Home	Length (Inches)	Temperature		Breeding Habits	Food	Nature
				Celsius	Fahr.			
Nandus marmoratus	"Marbled"	S. E. Asia	3"	23	74	B 2	Carnivorous	N 6
Neetroplus carpintis	"Carp-like"	C. America	3"	23	74	B 5	Omnivorous	N 6
Nanostomus eques	"Horse-like"	S. America	2½"	23	74	B 4	"	N 3
Neolebias unifasciatus	"1-striped"..	W. Africa	2"	24	75	B 8	"	N 3
Notropis bifrenatus	(Bridled Minnow)	Me. to Va.	2½"	20	68	B 1	"	N 1
Notropis metallicus	"metallic"	S. U. S. A.	3"	20	68	B 1	"	N 1
Nuria danrica	"Flying Barb"	E. Indies	2¼"	23	74	B 1a	"	N 1
Ophiocephalus marmoratus	"Marbled"	Singapore	5"	22	72	B 7a	"	N 4
Ophiocephalus punctatus	"Dotted"	E. Indies	3"	23	74	B 7a	"	N 4
Osphromenus cantoris	"Cantor's"	Singapore	5"	23	74	B 7	"	N 4
Osphromenus trichopterus	"Hair-fin"	E. Indies	3½"	23	74	B 7	"	N 4
Pantodon buchholzi	"Buchholz's"	W. Africa	3½"	23	74	B 7a	Live food	N 1
Paragoniates microlepsis	"Small scaled"	S. America	2½"	23	74	B 4	Omnivorous	N 3
Parosphromenus deissneri	"Deissner's"	E. India	2"	23	74	B 7	"	N 4
Pelmatochromis arnoldi	"Arnold's"	Africa	3"	26	79	B 5	Carnivorous	N 6
Pelmatochromis subocellatus	"Eye-spot below"	Africa	3"	26	79	B 5	"	N 6
Pelmatochromis taeniatus	"Striped"	W. & M. Africa	3"	26	79	B 5	"	N 6
Periophthalmus koelreuteri	"Koelreuter's"	Asia & Africa	4"	23	74	B 6	Live food	N 6
Petalosoma amazonum	"Of the Amazons"	Amazon River	2"	23	74	B 9	Omnivorous	N 2
Petersius spilopterus	"Spotted fin"	W. Africa	3	23	74	B 4	"	N 3
Platypoecilus maculatus	"Spotted"	Mexico	2"	23	74	B 9	"	N 2
Platypoecilus nigra	"Black"	Mexico	2"	23	74	B 9	"	N 2
Platypoecilus pulchra	"Beautiful"	Mexico	2"	23	74	B 9	"	N 2
Platypoecilus rubra	"Red"	Mexico	2"	23	74	B 9	"	N 2
Plecostomus commersoni	"Commerson's"	S. America	4"	23	74	B 13	"	N 6
Poecilia amazonica	"Amazonian"	Amazons	1¼"	24	75	B 9	"	N 2
Poecilia caucana	"From Cauca"	Columbia	1¼"	23	74	B 9	"	N 2
Poecilia dominicensis	"From Dominica"	W. Indies	1½"	23	74	B 9	"	N 2
Poecilia dovii	"Dove's"	W. Indies	1½"	23	74	B 9	"	N 2
Poecilia heteristia	"Changeable"	Brazil	1¼"	23	74	B 9	"	N 2

Poecilia mexicana	"Mexican"	Mexico	1½"	23	74	B 9	"	N 2
Poecilia poecilioides	"Like poecilia"	Barbades	1¼"	23	74	B 9	"	N 2
Poecilia reticulata Peters	"Like a net"	Barbades	1¼"	23	74	B 9	"	N 2
Poecilia sphenops	"Wedge-shaped mouth"	Mexico	2½"	23	74	B 9	"	N 2
Poecilia unimaculata Poecilia vivipara	"One-spotted"	Brazil	2"	23	74	B 9	"	N 2
Poecilobrycon trifasciatus	"3-striped"	S. America	3"	23	74	B 4	"	N 3
Poecilobrycon unifasciatus	"1-stripe"	S. America	3"	23	74	B 4	"	N 3
Polyacanthus dayi	"Day's"	E. Indies	2½"	23	74	B 7	"	N 4
Polycentropsis abbreviata	"Shortened"	W. Africa	2"	26	79	B 7	"	N 6
Polycentrus schomburgki	"Schomburgk's"	S. America	2"	24	75	B 15	Live fish	N 6
Prochilodus binotatus	"2-spot"	S. America	2"	23	74	B 4	Carnivorous	N 1
Prochilodus insignis	Beautifully marked	Brazil	13"	26	79	B 4	Omnivorous	N 3
Pseudocorynopoma	"Doria's"	Brazil	2"	23	74	B 4	"	N 3
Pterophyllum scalare	"Wing-fin"	Amazon River	5"	23	74	B 15	"	N 6
Pyrrhulina australis	"Southern"	Argentina	2"	23	74	B 4	"	N 3
Pyrrhulina guttata	"Spotted"	Brazil	2"	23	74	B 4	"	N 3
Pyrrhulina filamentosa Pyrrhulina nattereri (see	"Thread-like" Copeina)	N. S. America	2"	23	74	B 12	"	N 1
Rasbora cephalotaenia	"Striped head"	E. Indies	3"	23	74	B 1a	"	N 1
Rasbora daniconius	"Daniconius's"	E. Indies	3"	23	74	B 1a	"	N 1
Rasbora elegans	"Elegant"	S. America	4"	23	74	B 4	"	N 3
Rasbora heteromorpha	"Varied colors"	Further India	2"	23	74	B 1a	"	N 1
Rasbora maculata	"Spotted"	Further India		23	74	B 1a	"	N 1
Rhinichthys atronasus	"Black-nosed"	N. America	2½"	18	65	B 1	"	N 1
Rivulus flabellicauda	"Thin"	Mexico	3"	23	74	B 8	"	N 3
Rivulus harti	"Hart's"	Venezuela		23	74	B 8	"	N 3
Rivulus ocellatus	"Eyed"	S. America	3	23	74	B 8	"	N 3
Rivulus poeyi var. rubra	"Red"	Brazil	3"	23	74	B 8	"	N 3
Rivulus strigatus	"Streaked"	Brazil	2"	23	74	B 8	"	N 3
Rivulus urophthalmus Rivulus poeyi	"Eye in tail"	Brazil	3"	23	74	B 8	"	N 3
Saccobranchus fossilis	"Bladder-gilled"	India	8"			B 13	"	N 6

Scientific Name	Meaning or Popular Name	Home	Length (Inches)	Temperature Celsius	Temperature Fahr.	Breeding Habits	Food	Nature
Scatophagus argus	"Many eyed"	E. India		23	74	B 2	Carnivorous	N 6
Stegophilus maculatus	"Spotted"	S. America	12"	22	72	B 13	Omnivorous	N 6
Tetragonopterus aeneus	"Metallic"	C. America	2½"	23	74	B 4	"	N 3
Tetragonopterus ocellifer	"Eye-bearing"	Brazil	3½"	23	74	B 4	"	N 3
Tetragonopterus rubropictus	"Red-painted"	N. S. America	1½"	23	74	B 4	"	N 6
Tetragonopterus rutilus	"Ruddy"	S. Brazil	1½"	22	72	B 4	"	N 3
Tetragonopterus ulreyi	"Ulrey's"	S. Brazil	1½"	23	74	B 4	"	N 3
Tetragonopterus unilineatus	"1-lined"	N. S. A. Trinidad	1½"	23	74	B 5	"	N 6
Tetrodon cutcutia	"4-teeth"	Further India	3"	23	74	B 5	Live snails	N 6
Tetrodon fluviatilis	"River dweller"	Sumatra	3"	26	79	B 8	"	N 3
Tilapia microcephala	"Small head"	W. Africa	5"	23	74	B 5	Carnivorous	N 6
Tilapia nilotica	"From the Nile"	Egypt	4"	23	74	B 5	"	N 6
Tilapia tholloni	"Thollon's"	Congo	4"	23	74	B 5	"	N 6
Tilapia zilli	"Zill's"	Egypt	4"	23	74	B 5	"	N 6
Tinca auratus	Golden Tench	Europe	12"	18	60	B 3	Omnivorous	N 1
Tinca viridis	Green Tench	Europe	12"	18	60	B 3	"	N 1
Trichogaster fasciatus	"Striped"	India	4"	23	74	B 7	"	N 4
Trichogaster labiosus	"Strong lipped"	India	1½"	23	74	B 7	"	N 4
Trichogaster lalius	"Dwarf gurami"	India		23	74	B 7	"	N 4
Trichopodus trichopterus	(See Osphromenus trichopterus).							
Umbra krameri	"Kramer's"	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	"Rachow's"	Mexico	2½"	23	74	B 9	Omnivorous	N 2
Xiphophorus strigatus Xiphophorus helleri	"Striped"	Mexico	3"	23	74	B 9	"	N 2

For detailed description of "B" and "N" columns, see following pages.

DESCRIPTIVE KEY

To 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, full information regarding any of the listed fishes may be had.

EXPLANATION: The letter B stands for "Breeding" and the figure in alphabetical list specifies 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 FAMILY. 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 fish 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 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, action of sunlight, etc. The young fish hang like "commas" against the glass sides of the aquarium in which they hatch (the parent fish having been carefully removed immediately after spawning was completed), and after a couple of days they adopt the position of normal adult fish in the water, 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. As they grow, the larger specimens should be separated from the smaller ones or the latter will be starved. Temperature of the water should be maintained at the MAXIMUM given under temperature herein or slightly higher and so kept until at least two months later before allowing it to drop at all.

B1a GROUP

BARB FAMILY. 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 fertilized externally of the parent fish, deposited in a hollow excavated in a sandy bottom by the adults for this purpose and carefully guarded by the male until they hatch a few days later and also after the young fish first emerge and are defenceless from their enemies. Microscopic live food in the form of Infusoria must be adundantly 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. See page 48.

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 deposit adhesive eggs on stones or, in the aquarium, on the convex side of a large flower-pot, laid on its side. 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 all the time. When the young hatch out, 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—human or aquatic—frequently removing dirt, etc., 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 umbilical 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 cyclops, daphnia, etc., though they will eat dried fish food if finely powdered. Ten days after they begin to feed, the *parents* should be removed, each to a *separate* aquarium. The Cichlids dislike and destroy plants, so none should be provided but they require *clean, pure water,* so some should be changed (siphoning all dirt from the bottom)—daily, replacing it with hydrant water, blended hot and cold to same tempera-

ture as that in the aquarium, which should be of an uniform summer heat. Keep no other fish with Cichlids.

B6 GROUP

THE GOBY GROUP (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. Among the Gobiidæ are our well-known "Darters"—familiar to the country schoolboy—also the "Miller's Thumb," "Tommy Cod" or "Sculpin" (Cottus ictalops, Rafinesque) and the most peculiar "Mud-Springer" (Periopthalmus koelreuteri) from the Tropical Tide-waters of Africa and Asia. Shallow water is a prime requisite for these fish, the last named species requiring stones projecting above the water, sloping up gradually, upon which the fish likes to climb out of water and "bask." 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 the "storage chamber." Most of the Labyrinth fish build "bubble nests", i. e., secrete a "glue" in their mouths, and blow air-bubbles coated with this glue, which float in a mass and 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 36 hours the male fish guards the nest and eggs and re-arranges the eggs 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 out. 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 57. 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 must be fed with finely-strained young cyclops and 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 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 fish to spawn. Care of young fish same as that indicated for the young of Nest-building Labyrinth Fish.

B8 GROUP

TOOTH CARPS (Oviparous or Egg-laying Group)—These include the Haplochilus Group, the Fundulus Group or "Top-Minnows" native to our American streams, Cyprinodons, Lebias, Cynolebias and Rivulus. The Haplochilus mostly spawn at or near the surface on floating bushy plants. So do the 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 these last two species. Others again spawn nearer to the bottom and like Haplochilus and Rivulus, eggs adhere to plants separately.

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 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 Cyclops and Daphnia.

B9 GROUP

LIVE-BEARING TOOTH-CARPS. 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 glass bell jars (8 inch), in about 3 inches of water, 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 jars shown on page 230 do away with the necessity for plants or other shelter for the young.

B10 GROUP

MISCELLANEOUS FISHES. Some species do not come under these classifications and are unknown in respect to their breeding habits.

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° 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 males build nests from bits of plants, glued together. After female deposits eggs he drives her away and assumes entire parental responsibilities. See also page 72.

B15

POLYCENTRUS SCHOMBURKI 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 glass sides or broad-leaved plants, and they do not bury the young, but stick them in different parts of the aquarium for several days. Eggs hatch in 2½ days. Parents should be removed in eight days. To breed these fish requires a well-planted aquarium and plenty of seclusion. Breeders should be well fed up on mosquito larvæ, young tropical fishes or freshwater shrimps. They also eat Water-boatmen. Breeding temperature, from 75° to 80°.

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 has 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 data 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 "N. 1." 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—(this last not a Tooth-Carp)—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. It is not good policy to keep Live-bearers, Egg-droppers (Barbus), Egg-layers (Oviparous Tooth-Carp) and Labyrinth fish all together. Such things *can* be done in very large aquaria but the weaker will soon show signs of persecution.

N3 GROUP

Members of this group are mostly the egg-laying Tooth-Carp, such as Haplochilus, Fundulus and Rivulus. These can be kept in large numbers together, if of same size, but otherwise are best kept in pairs. The larger species such as H. sexfasciatus, Rubrostigma, &c., are best kept only with their own species as their tendency is generally warlike. They eat their own and other smaller species and individuals. Dense vegetation and space are the best remedy.

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 harmony prevails. This refers to the Labyrinth fish or Bubble-nest builders and is noticeably manifest among Paradise fish, Polyacanthus cupanus and dayi, Osphromenus, &c. The Dwarf gourami is remarkable for his peaceable and amiable nature but he is not entitled to undue credit on that account as it is more than likely that his shyness has much to do with his decent behavior. At breeding time he will attack his mate should she approach the nest containing eggs or young—but then she should be taken out anyhow and that rule applies to all Labyrinth fish.

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 voracious species, such as the Cichlids, &c., which should be kept separately, even from their mates, except at breeding time and then large flower pots should be provided for shelter and no plants kept with fish. Large, shallow aquaria and abundant clear water are requisite.

Chapter Eight

Tropical Aquaria

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 92 to 98.

Feeding. The majority of tropical fishes are not heavy feeders like goldfishes and there is not great danger of overfeeding. 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.

The proper types of food are shown on pages 84 to 91. Those indicated as "omniverous" may be fed the same as goldfishes, see page 128. An exclusive diet of dried shrimp agrees with most tropical fishes, but some variation is better. In summer they should have some daphnia, and in winter, enchytrae, see page 136.

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. Forgetfulness of replacing covers has caused the loss of many prized fishes. They will not suffocate if glass is down close.

FIG. 70. *Sphenops vittatus* (Croaking Gourami)

This picture illustrates one phase of the breeding habits of the bubble-nest builders. The males takes entire charge of the nest and young.

Fig. 71. The Chanchito (*Heros facetus*)

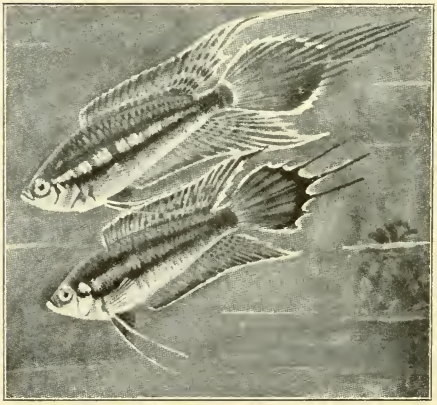


Fig. 72. *Polyacanthus dayi*

Upper Fish, ♂ (Male)
Lower Fish, ♀ (Female)

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. 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

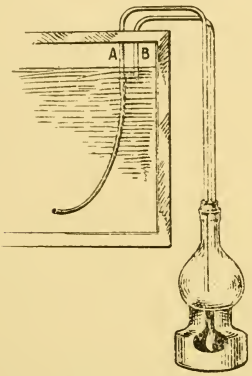


FIG. 73. DIRECT EXTERNAL HEATER

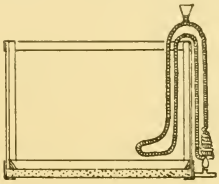


FIG. 74. INDIRECT EXTERNAL HEATER

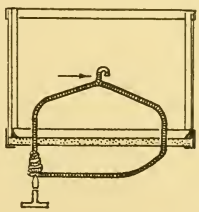
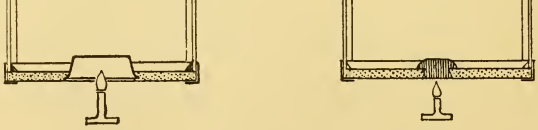


FIG. 75. INDIRECT SYSTEM THROUGH BASE, SHOWING IMPROVED VAPOR EXPANSION HOOK UNDER WATER

pass through. Such an arrangement is shown in Fig. 73. 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 practise. A better arrangement is shown in Fig. 74, 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. This whole arrangement can be hooked over the edge of any aquarium and has the

advantage that the aquarium does not have to be raised 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 it works smoothly and the heat travels past the funnel, 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 nickled after bending into shape, as copper is fatal in the aquarium.

Fig. 75 shows a modification of the same idea with the pipe carried through aquarium base. The little 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 this the system is easily filled. When it is on, the vapor collects in top of hook, 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 hook-on form.



Figs. 76 and 77. Direct Heating Through Pan and Through Metal Disc

For the highest efficiency and greatest all-round satisfaction, note should be taken of Fig. No. 76. This is a 4-inch agate pan set in the cement base described on page 216. When making the aquarium it is no 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. 77 shows a simple and fairly effective ex-

pedient. 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 inventing some defective ones 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. 76.

Heat Control. In a room where there are violent 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 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 may be kept at a satisfactory temperature standing on a hot-water radiator, the heating result not being so extreme as might be supposed.

The most satisfactory means of controlling temperature is to heat by gas and use a gas thermostat to control gas flow. See Fig. 78. 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 the gas supply, 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 instructions regarding regulation, etc. The Arthur H. Thomas Company, of Philadelphia, are specialists in this line. With this equipment in oper-

ation one never need worry about aquarium temperature as long as the wind cannot blow out the small pilot light.

For devices to heat aquaria electrically we recommend the Simplex Electric Co., Cambridge, Mass. They are experts and sell their apparatus at moderate prices.

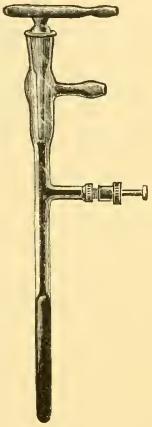


Fig. 78. Gas Thermostat

Chapter Nine

Marine Aquaria

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 Anemonies, 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 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 described on page 10. This will more than compensate for any plant deficiency, especially if the air is liberated in very small bubbles. In the case of large maine aquaria where the water is constantly pumped out, filtered and returned, the oxygenating is accom-

plished 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 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 heavy specific gravity of marine water enables us to break up the air finer than in fresh water.

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. Something less expensive, but quite satisfactory for large work, is wooden pipe. Quantities of this piping are used in the marine division at the Philadelphia Public Aquarium, with perfectly satisfactory results. For the aquarian, 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 offices of the Battery Park Aquarium in New York City, they have in successful operation a number of bell-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 in 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.

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. Mussels will usually clear green freshwater. The author tried a liberal quantity of marine mussels to clear marine water, but three hours of direct sun and five hours of strong diffused light multiplied the green vegetal organisms faster than the mussels could keep pace with. The same aquarium in the same light, when used as a regular goldfish container, never became green.

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 stand the change successfully, 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, 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 men-

tioned, iron is the least injurious and zinc the most, on account of the rapidity of chemical action of salt on this metal. Therefore, galvanized iron is to be particularly avoided, as it is zinc-plated. The author on one occasion could only secure a galvanized pail in which to bring a collection home. As the trip was only three hours and the pail was a well-seasoned one he thought the chances of success were reasonably good. When the can was opened the water showed a slight milkiness and the fishes were nearly dead, although they had not been crowded. On being placed in the aquarium they soon revived. 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 freshwater 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.	8⅗.	2⅗.	18 gr.
Magnesium chloride		3⅗.	5⅗.	13 gr.
Magnesium sulphate		2⅗.	3⅗.	1⅗ 8 gr.
Potassium sulphate			5⅗.	2⅗ 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. 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 229) and after setting, 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. The more pretentious establishments run the water off into deep filter-beds of fine sand, squirting it back into the aquarium under pressure to increase oxygenation. This, next to running seawater, is the ideal arrangement, but is out of reach of the ordinary mortal.

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 82) 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 bucketfull of dead and dying. Unfortunately for those inland there is nobody at the present time in America making a commercial 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, with no seacoast of her own, 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. Most of our tropical specimens are collected at Bermuda and at Key West, Florida. The various kinds of kelp and coral fishes make quarium specimens of such bewitching beauty that any attempted word-description of them would appear extravagant. Anyone wishing to make a collection of them 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 creatures are used to more oxygen in the vast ocean than can be had in a crowded aquarium.

Particular vigilance needs to be exercised when the animals 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 too 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 a propellor-like movement 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.

Sea horses feed upon small marine crustacea about equal in size to daphnia. Some European aquarians 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 induce Sea Horses to modify their ideas on diet, the process taking considerable 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 the Sea Horses usually eat by reaching out for food while attached by their tails to a piece of seaweed, it is necessary to gently circulate the daphnia through the aquarium by the aeration system or other means.

Fig. 79. The Sea Horse (*Life size*)
Hippocampus hudsonius

These strange fishes are of worldwide 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 the Atlantic Coast. This is the one shown in Fig. 79.

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. Uncooked shrimp, shelled and put through the finest meat chopper is excellent and

is particularly valuable, as it can be had all winter in the better fish stores. 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.

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 Ten

Terraria and Aqua-Terraria

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 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 brought to the home rather than into 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 admired.*

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 and 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.

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.

Fig. 80. The Red Triton (*Sperlerpes ruber*)