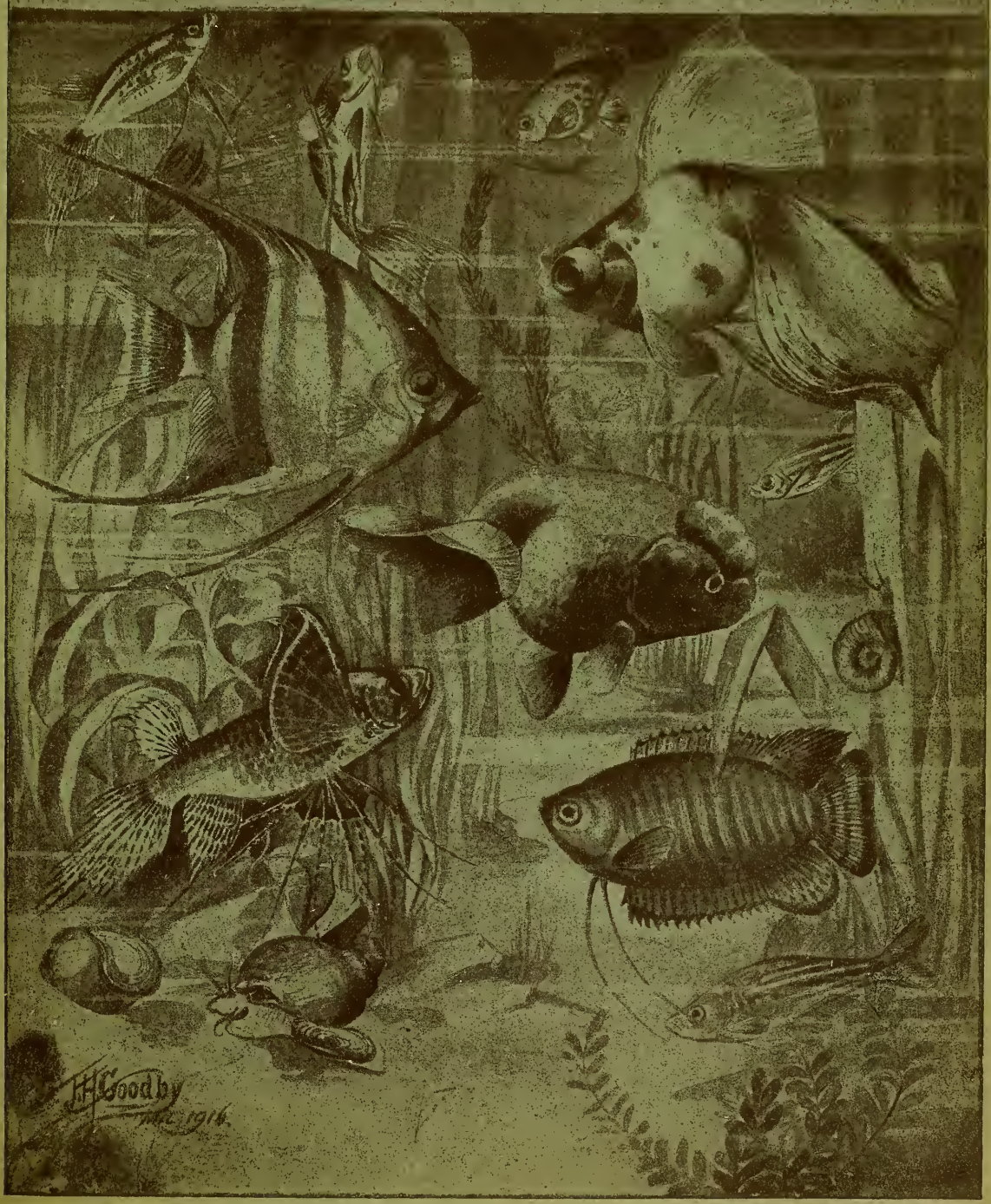
September, 1918 10c Copy

Aquatic Life



THE BLOOD-FIN

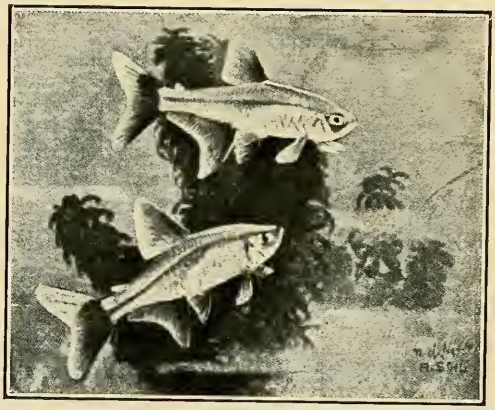
C. J. HEEDE

The blood-fin, *Tetragonopteris rubropictus,* from the Argentine Republic, is a particularly beautiful aquarium fish. Alertness and general good health commend them. When viewed in bright, direct light they shimmer with steel-blue, violet and green, like a newly caught herring, but with all fins except the pectorals and small adipose dorsal colored blood-red with a silvery margin; the red is more intense near the body. Under other conditions the body-color is olive-green above to silvery below, a narrow silvery-gray stripe running from head to tail.

The sexes are quite alike in size (two inches), shape and color except during the breeding season, when the female becomes deeper and heavier incidental to the development of the eggs. At other times the sexes may be distinguished by lifting a pair from the aquarium in a very fine-mesh net, inverting it and allowing both to drop back. The female will fall first. The male possesses some minute appendages, not visible to the naked eye, which catch in the fabric and retard his fall. This test is considered infallible.

To maintain the fish in health the water should be changed at intervals, the new water being of the same temperature. To promote spawning this fresh water, with a very little salt added, is necessary. The average temperature should be from 60 to 70 degrees, Fahrenheit; during breeding activities from 75 to 80, and equally warm for the young.

The tiny white eggs are scattered through the tank amongst the plants and sink to the bottom. From 200 to 500 will be produced at each spawning operation. The parents, like the species of *Danio,* will search for the eggs and devour them as soon as the function is completed. This can be prevented by removing either the parents or the eggs



Tetragonopteris rubropictus

to another tank. Temporary protection will be afforded if the bottom is covered closely by plants, such as *Anacharis* and *Myriophyllum,* keeping them down with small, smooth, not sharp-edged, stones. The best plan is to remove the parent fish. In a high temperature the eggs will hatch in twenty-four hours.

The young lurk among the plants until the yolk-sac has been absorbed, after which they search actively for Infusoria which must be in the tank in abundance to insure success. So long as infusorians suffice their needs, no Daphne should be used, as it is more active than the fish in capturing them. Infusoria can be developed by strewing dried and powdered water plants, especially *Lemna*

or Duckweed, and garden lettuce, on the surface of the water in the rearing tank. Preparations of dried plants for this purpose can be purchased from dealers.

When the youngsters are from ten to fifteen days old they may be given the tiniest Daphne and Cyclops, and a little later some finely scraped beef. At the age of six weeks, if they have been given careful and consistent treatment, they will measure about an inch in length and have the bright red color on their fins.

A number of species of *Tetragonopteris* have been studied by the aquarist, but the blood-fin is most attractive in shape and color.

Those Happy Families

Many times I am asked what fishes can be kept in the same tank. In answer I show two tanks set up six months ago. None of the fishes have died, nor have I discovered any torn fins, which are the usual signs of discord. Of course, the young from the live-bearing species have not survived. A kindergarten in such a tank would be expecting rather too much.

The smaller of the two measures 18 by 12 by 10 inches, and contains the following: 4 *Alfaro cultratum*, 4 *Platypoecilus maculatus rubra*, 4 *Xiphophorus helleri*, 2 hybrids (*X. helleri x P. maculatus rubra*), 4 *Lebistes reticulatus*, 4 *Girardinus reticulatus*, 2 *Haplochromis strigigena*, 2 *Betta rubra*, 6 *Haplochilus chaperi*, 2 *Trichogaster lalius*, 12 *Danio albolineatus*, 12 *Danio rerio*, 2 *Barbus conchonius* and 2 *Barbus semifasciolatus*.

In the tank 42 by 16 by 14 inches I have 40 *Xiphophorus helleri*, 12 *Macropodus viridi-auratus*, 4 *Osphromenus trichopteris*, 12 *Platypoecilus maculatus rubra*, 20 *Barbus conchonius*, 10 *B. vittatus*, 10 *B. semifasciolatus*, 4 *Poecilia vivipara*.

The figures given refer to the individuals; all the species are in pairs.—Hugo C. Nelles.

Mr. William L. Paullin has had all sorts of combinations. In a large tank containing *Pterophyllum scalare* he has a number of broadtail goldfish. These serve as scavengers to consume food dropping to the bottom. There was a little fin-nipping at first, but the novelty soon became common place, and no further notice was taken of the bright co-inhabitants.

Another tank, thickly planted, with a capacity of 125 gallons, contains *Danio albolineatus*, *D. Rerio*, *Barbus* (3 species), *Haplochilus* (several species), *Osphromenus trichopteris*, *Trichogaster fasciatus*, *Betta splendens*, *Polyacanthus dayi*, *Macropodus viridi-auratus*, *Mollienisia latipinna*, *Poecilia sphenops*, *Xiphophorus helleri*, *Platypoecilus maculatus*, *Limia caudofasciata*, *Lebistes reticulatus*, and young examples of *Hemichromis bimaculatus*, *Cichlasoma facetum* and *Haplochromis strigigena*.

In an octagonal aquarium, with an estimated capacity of 15 gallons, Mr. George W. Price has associated *Tetragonopteris guppyi*, *Aphredoderus sayanus*, *Enneacanthus gloriosus*, *Ambloplites rupestris*, *Hemigrammus unilineatus*, *Haplochilus Panchax*, *H. lineatus*, *Trichogaster lalius* and *T. fasciatus*. In another tank, long and narrow but deep, full grown Paradise fish (*Macropodus*) get along well with *Platypoecilus*.

Mr. George Cuthbert reports *Hemichromis bimaculatus*, *Platypoecilus maculatus*, *Xiphophorus helleri*, *Lebistes reticulatus*, *Gambusia holbrooki*, *Polyacanthus opercularis*, *Macropodus viridi-auratus* and *Cichlasoma facetum*, the latter not more than 1½ inches, doing nicely in a fifty gallon aquarium.

Breeding Haplochilus Cameronensis

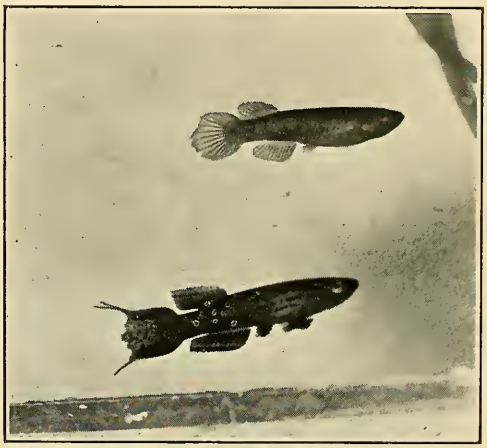
HUGO C. NELLES

President, Ridgewood Aquarium Society

Much is heard of the difficulties and the insignificant results attendant upon attempts to breed *Haplochilus cameronensis,* one of our most beautiful aquarium fishes. The usual procedure in breeding the species of *Haplochilus* is to place floating plants in the tank containing the breeding pair. When eggs are discovered, either the plants to which they are adhering or the adult fish are placed in another receptacle. I followed this plan with poor success, rearing comparatively few young in proportion to the number of eggs secured. This being the usual result with other aquarists, I put on my "thinking cap," deciding to leave the beaten path and follow a new system. That I was successful is proven by 200 fine fish raised from three breeding pairs.

In the early spring I was fortunate in possessing five pairs. From them I selected three well-matched pairs, taking care to avoid direct inbreeding. These were placed in an aquarium holding a gallon, the bottom covered to a depth of 1½ inches with bird gravel and sparsely planted with *Sagittaria subulata.* A bunch of *Utricularia,* the tiny species, floated at the surface covering about half of the area. The temperature was about 80 degrees. Daphne and my "Faultless" food were fed alternately.

On former occasions and when feeding by the old method I had noticed, when the *Utricularia* was removed and placed in a white basin, numerous brownish microscopic animals darting to and fro in the water dripping from the plants. When I examined the water in the breeding tank I now discovered similar creatures. Water from the hydrant after standing for a few days and then examined under the microscope was also found to contain many organisms, not as many as in the aquarium water, but still enough to make me decide to use



Haplochilus cameronensis West Africa

Photograph by Lee S. Crandall

sterilized water in which to develop the eggs. A quantity was therefore boiled and placed aside, well covered, for several days before using.

Eight days after placing the breeding pairs in the aquarium I examined the floating plants for spawn and found some. A quart jar was then filled with the water previously boiled and set aside, this, as should be, was the same temperature as that in the aquarium. The plants were then placed in a basin before a strong light—then the fun started. Holding up piece after piece against the light I carefully picked off the eggs one by one, just 67, dropping them into the jar

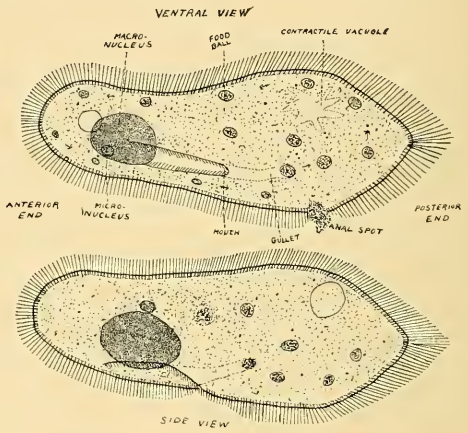
of sterilized water. This accomplished I placed the cover on the jar to keep out the dust, putting it on a high shelf near the window where the sun could not strike it.

The eggs could be plainly seen on the bottom of the jar. On the third day five were observed to have turned white, indicating infertility, and were then removed. The others hatched in exactly ten days. Sixty-two youngsters from 67 eggs!

To test the new method in direct comparison with the old I divided the next spawn, handling half (32 eggs) in the manner described. The balance, about the same number, were placed in a hatching jar with the plants to which they were attached. Result: New method, 29 young; old way, 2. Then again, new way, 46 out of 52 and so on.

During the period of incubation I prepare a rearing tank for the fry. I have had most success with a tank 18 by 12 by 10 inches. This was thoroughly cleaned with salt water and rinsed. The bird gravel for the bottom was scalded with salt water and washed in repeated changes of fresh water until perfectly clean before placing in the tank. Eighteen plants of *Sagittaria subulata* were washed in a solution of permanganate of potassium and rinsed in water previously boiled and cooled. The plants in position I placed the tank in a sunny spot and filled it with sterilized water to within two inches of the top, covering it with a piece of glass. By the time the young hatch the tank is in perfect condition to receive them.

When the eggs hatched I measured the temperatures of the hatching jar and the rearing tank and, finding them to agree, I immediately transferred the fry. Then and every morning thereafter I poured into the tank half a tumblerful of infusoria water, which I had previously cultivated. This was chiefly *Paramecium,* the slipper animalcule. A similar quantity was served during the second week, with the addition of a little powdered "Faultless" food. At the end of two weeks they were able to swallow fine Daphne, and a month from the day they were born the sexes could be distinguished, the fish measuring from one-half to three-quarters of an inch long.



Paramecium (Greatly Enlarged)

Drawing by Perry B. Clark

In several talks I have given on the method I have noticed several listeners wearing a funny smile. When I mentioned boiling the water they probably thought I was poking fun at them. Others has since tried it with good results. He who laughs last laughs best. Try it first and smile afterwards!

(Aquarists will be apt to entertain varied opinions as to the underlying reasons for Mr. Nelles' remarkable success. It may be held that fry hatching from eggs remaining attached to the *Utricularia* would be entrapped in the bladders. Mr. Nelles probably used a very slender species which is common among aquarium keepers. Though small,

(Concluded on Page 14)

THE SPOTTED GOURAMI

DR. L. M. KEARNS

The spotted gourami, *Osphromenus trichopteris,* is a native of the East Indies, being reported from Cochin China, Siam and Java, where it is very abundant. I find it a peaceful, shy and harmless fish except during breeding activities, when the male become quite ferocious while attending the nest and young. It is known to grow as long as six inches, but those bred in captivity seldom get beyond three to four inches.

The body is flat (compressed from side to side), the depth being contained about three times in the length. The general color is dusky silver, darker on the back and light on the sides and belly, crossed by numerous vertical dark lines. In the center of the body is a prominent round black spot and another at the base of the caudal; hence the common name of spotted gourami. The ventral fins are thread-like and often swayed about like the antennae of an insect, making one think they are feeling their way about the aquarium. The anal is large, beginning almost at the ventrals and extending to the tail. Usually the fins are light, almost colorless, but during mating and spawning they become dark with numerous light spots, these in the anal are red, merging into chrome yellow at the margin. The sexes are easily distinguished. In the male the dorsal is pointed and long, extending in old examples well over the caudal fin. The dorsal of the female is small and rounded, the anal smaller. Viewed from above the female is thicker through the chest.

The spotted gourami is a very modest feeder. It will eat almost anything, such as live food, lettuce, crushed worms and the various kinds of prepared foods. Breeding is not difficult, but the aquarium should be of good size, that is, from 17 to 24 inches in length. A particular depth is not essential, as they will breed in water from 4 inches up. I get best results in 10 to 12 inches, as this gives the young plenty of room. The tank

Osphromenus trichopteris
Photograph by Dr. E. Bade

should be an old established one, and well planted to give the young a chance to hide. The male gets vicious during breeding activities, so it is often necessary to remove the female after spawning.

The male builds a bubble nest on the surface, which is not very durable. Then when he succeeds in driving or coaxing his mate under the nest, within a few inches of the top, love-making begins. They swim back and forth rubbing sides until the male wraps his body around the female and squeezes the eggs from her. These rise to the nest, but should any fall, he gathers them in his mouth and expells them into the mass of bubbles. The operation lasts from three to five hours during which from 300 to 600 eggs will be expelled. Now the female

must hunt cover, for as gentle and kind as her mate has been, just so brutal is he now. He will not allow her to come within a foot of the nest; if the tank is small he may kill her. It is best to watch them and remove the female if he gets too ferocious. I have raised three nests of young in the aquarium without removing the female but it is not always advisable.

The eggs will hatch 24 to 72 hours later, according to the temperature, which should be 70 degrees or more. The male takes good care of the eggs and young. It is amusing to watch him gathering youngsters that fall from the nest and putting them back, making bubbles to keep them there. It is advisable to remove him after ten days, as the young can then take care of themselves. At first they should be fed on infusorians, pulverized lettuce leaves, and later on screened Daphne and Cyclops, mosquito larvae, crushed worms and dry prepared foods. Care must be taken not to use any food, either prepared or living, that is too large, for they are gluttons and may choke. The young mature in a year and will often breed before that time.

The Japanese Snail

Molluscs are to me the most interesting inhabitants of the aquarium and deserving of careful observation. The Japanese snail, *Viviparus malleatus,* is well known to all lovers of the aquarium. The shell is short and cone-shaped and olive-green or brown. Very young snails show a dark stripe running along the center of the body whorl. They seem to lose this later, but it is very difficult to determine, for when they grow older they become entirely covered with algae. The head is blunt with long, slender feelers having the eyes at the base. The foot is broad and long, bearing a strong horny plate on the rear, which closes the shell against all but the strongest enemies. The body is a light tan, powdered with golden dots, but in some individuals it is a dirty gray.

The sexes are separate, there being both male and female individuals. On the male the right tentacle or feeler is short and stout, while in the female the feelers are slender and equal in length.

The eggs are not laid immediately after fertilization, but are hatched within the body-cavity of the female. The young when expelled are perfect in form, even to the little shell. It is this manner of reproduction that has given the name "Viviparus." Several young come forth at a time, and for this purpose the female buries herself in the sand. I notice that an individual always selects the same spot.

To the best of my knowledge the young are born covered with a gelatinous substance, which is absorbed before they find their way independently. I have found them in this state, and also a bubble of surplus material.

The Japanese snail will continue to have young for an indefinite period after a single impregnation. I have had two females in an aquarium without a male for more than a year, and they still have young.—Charles H. Boyd.

Reader reports a mouth-breeder, *Haplochromis strigigena,* two inches long, that successfully incubated 80 eggs. This is rather more than the average number for a larger example.

The spotted gourami has been successfully propagated by removing the eggs to another tank. The young faired as well as those of another lot left to the care of the male.

Notes on Aquarium Water and Its Restoration

ADOLPH DORMEIER

The nature as well as the amount of dissolved mineral and chemical substances has a great bearing upon the suitableness of water for the maintenance therein, in a thriving condition, of organic life. There can be no question that the amount and kinds of gases, also dissolved, have a still greater influence upon whatever life it may contain. It is upon the air supply absorbed by the water that most fishes depend for respiration. If this air becomes contaminated by poisonous swamp-gases, which are more greedily absorbed by cool water, the health of these animals will be seriously impaired. Aquarists are apt to lose sight of this fact or else place too little weight upon its importance in successful fish-culture.

The quantity of gases generated by the decay of vegetable, and to some extent, animal matter, that has to be absorbed and then diffused into the atmosphere by densely overgrown bodies of water, is considerable. To illustrate this point: It used to be great fun, when I was a boy, to drill a small hole through the ice cover directly over a pocket of gas in order to watch the characteristic blue flame of the escaping sulphuretted hydrogen (swamp-gas), when ignited. On warm summer nights we listened to the most gruesome tales and speculations concerning will-of-the-wisps. This we now know is simply produced by escaping phosphoretted hydrogen. This product of decay has the singular property of igniting upon mere contact with air, there to burn away slowly with a spookish glow, which often moves about in a breeze and is visible only during dark nights. The water of the pond I have in mind was always crystal-clear, but this one fact alone is never a sure indication that animals of the higher orders can exist therein. In this instance the odor would have condemned the water for aquarium use.

It was probably a similar condition prevailing in the stagnant ponds and roadside ditches of southeastern Asia that necessitated the development of the labyrinth, a supplementary organ of respiration, to enable fishes to survive in them. This organ enables fishes possessing it to take air directly out of the atmosphere and utilize it, thus making them independent of the oxygen content of their own element. Putrefying processes take place within any well planted aquarium, though perhaps in a lesser degree, according to the keeper's sense of neatness. That it does take place under the best of care is attested by the odor, more or less pronounced, of old established tanks containing old water.

The beneficial influence upon fishes in such tanks, to be attained by aerating the water, is too well known to require discussion, but while thorough aeration unquestionably assists in reducing the proportion of the polluting gases to the absorbed air, by inducing the water to absorb more air (ventilating the water, so to speak), how much more rational would it be to eliminate the polluting gases entirely, thus enabling the aquarist to retain his valued old water indefinitely? To point out an efficient method to accomplish this, and more, with very

little additional trouble and without in any way interfering with the contents of an aquarium, is the purpose of this paper.

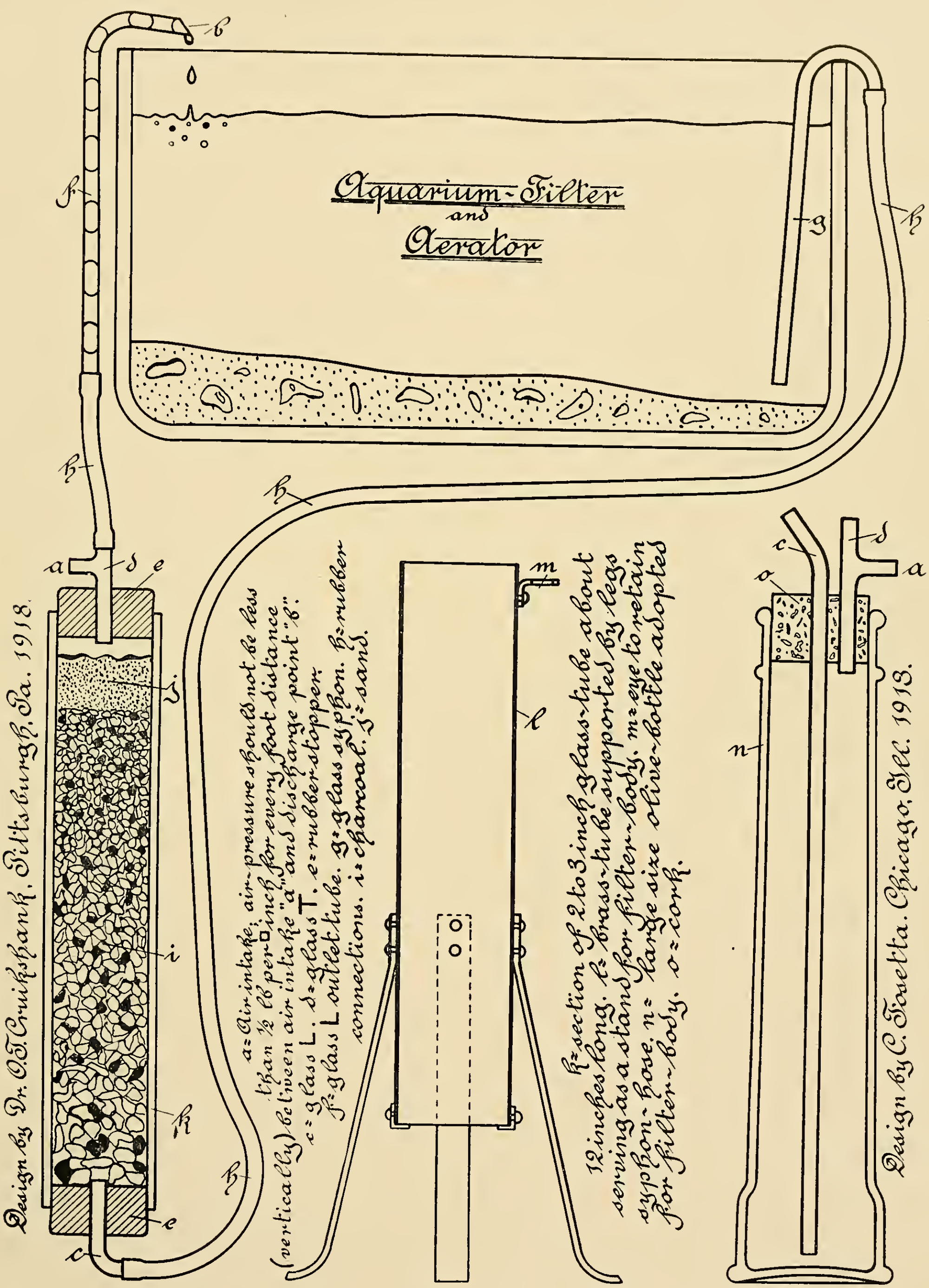
If we have a means to restore stagnating, turbid or discolored water, or such water as is lacking in dissolved oxygen, to a sanitary state, it only remains for us to guard against an unbalanced condition as far as dissolved mineral ingredients are concerned, in order to be able to retain our aquarium water permanently in the best condition for fish and plant life. I mention this last fact because it seems that even experienced aquarists entertain but vague ideas concerning this important point. One had better look to nature to teach us her way of keeping house as regards life in water.

The only supplementary substances that ever enter a body of water, if we let nature have her way, are more water, rain water in fact, either directly or indirectly, and whatever little mineral matter may be dissolved out of the bottom or out of dry earth, this being carried into such bodies of water by springs and surface drainage. The wave motion of the surface does the rest in maintaining favorable conditions for organic life by aerating the water and accelerating the diffusion of foul gases into the atmosphere. The importance of these functions to fishes becomes evident if we prevent them by an impervious film of oil over the water surface.

As to the aquarium we can control the character of the water put into it originally, as far as its mineral content is concerned, by using water of which we are sure. Thereafter its character can be continued nearly unchanged if we replace that lost through evaporation with rain water only. That is important if we expect to retain our aquarium water for a great length of time, for it may be readily seen should we replace such unavoidable loss with water similar to that used at the beginning, and add in the course of time again as much as a certain tank may hold, we have just doubled the amount of solids held in solution. Here I wish to caution against considering newly fallen rain water being harmless; it is not necessarily so. It has been proven by analysis that the water precipitated during the first half-hour of a storm may be charged with as high as 3 per mill of sulphur dioxide, with other equally deleterious substances. This is especially so around industrial centers. One should wait until the atmosphere has been thoroughly washed before collecting rain water, and then it should be collected in the open; if taken from conductor spouts it will contain soot and other materials. The writer has seen rain water collected without these precautions that showed a decided acid reaction.

It may be argued that growing plants extract minerals from the water right along, and there is truth in that, yet, rather than upset the mineral content of the water, it seems to be the better plan, if the plants exhibit signs of lack of nutrition, to periodically inject plant food around the roots. A concoction of dried sheep manure, obtainable from seedsmen, is highly stimulating when used in this way, and a super-abundance is soon counteracted by the incidentally increased microscopic life. On the other hand, the mineral requirements of plants such as are usually found in aquaria are often over-estimated. There is probably always enough such matters dissolved out of the bottom, where sand and stones are used, to satisfy the requirements.

Statements have repeatedly appeared advising the novice, for they must have been aimed at him, to add so and so much salt and so often. In the case of


Aquarium-Filter and Aerator
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Design by Dr. O.T. Cruikshank, Pittsburgh, Pa. 1918.
a= Air-intake; air-pressure should not be less than ½ lb per □ inch for every foot distance (vertically) between air intake "a" and discharge point "b". c= glass L. d= glass T. e= rubber stopper. f= glass L outlet tube. g= glass syphon. h= rubber connections. i= charcoal. j= sand.
k= section of 2 to 3 inch glass-tube about 12 inches long. l= brass-tube supported by legs serving as a stand for filter-body. m= eye to retain syphon-hose. n= large size olive-bottle adopted for filter-body. o= cork.
Design by C. Touetta. Chicago, Ill. 1918.

the aquarist who wants to keep his old water as long as possible, and that means for years, it becomes a matter of plain mathematics to predict when he will have a salt water aquarium. I concede that salt has its place, especially with such of our pets as normally inhabit brakish water, and I can see no particular objection to using a trifle when establishing a tank, but as a rule its usefulness ceases here. The aquarist should have very cogent reasons for adding it periodically, else he may start something he can't stop, short of renewing his water entirely, to the detriment of his fishes.

It is unfortunate that the very things that are most potent in disqualifying water for aquarium purposes happen to be invisible to us when present, though the odor omitted may afford us a clue to the degree of saturation with obnoxious gases. The apparently normal condition of his water, as judged by the eye, may easily lead the aquarist astray in searching for the true cause of the lowered vitality of his more sensitive fishes. Visible derangements of water, though as a rule harmless to aquatic life, are far more apt to be corrected promptly by the caretaker, because these always render aquaria unsightly. Green turbidity, caused by an over-abundance of minute algae, is in itself not nearly as objectionable to fishes as the strong light that developed it, especially if this happened to be a side light. Under natural conditions light falls from above, therefore only reflected light strikes the eyes of fishes. Intense side light on an aquarium should be softened, if for no other reason.

A slightly milky appearance of new water a few days after fishes have begun to live in it, may be taken as proof that it contains no strong acids. The disturbanace is effected by the precipitation of previously soluble calcium salts (hard water), the carbon dioxide exhaled by the fishes acting as the reagent. The water soon becomes clear again. Another sort of discoloration is produced when animal matter, such as unconsumed food, dead fishes, snails, etc., remain in the water for a time. This state of affairs becomes dangerous, the water becoming charged with the products of decomposition, mostly gases again, that are so harmful to all higher forms of life.

Although it is important for the owner of freshwater aquaria to avoid frequent change of water, it is still more so in the case of marine aquaria. Yet all salt-water life, especially the pelagic forms, is exceedingly sensitive to water that has become polluted or unbalanced in mineral composition. Most animals from the Baltic or Mediterranean Seas will quickly succumb when placed in water from the North Sea, yet the difference in salinity between these waters is only about one per centum. To aggravate our difficulties some forms of marine life naturally discharge their feces in the form of a muddy cloud, against which no mud-lever yet designed is of any avail. While a sea water aquarium inland is quite a rarity today, it is perfectly safe to predict that the time is not far off when many of our more experienced friends will try their skill on this interesting subject, and then, if it was never brought home to them before, they will learn to appreciate the importance of keeping aquarium water in a highly sanitary condition, and this without allowing its mineral character and density to change in the least degree.

To purify water that has become polluted, turbid or discolored by any or all of the reasons enumerated, or through any other sources, there is nothing better than charcoal filtration. I have constructed a filter of this kind that is espe-

cially adapted to the needs of the practical aquarist. It was tested under the most severe conditions imaginable. I can justly say it proved to be very efficient, while at the same time it is all that can be desired in convenience of application and economy. As much as I would like to have the credit for originating the system, I must admit that there is nothing new about it except perhaps its use in connection with aquaria.

That charcoal, either of animal or vegetable origin, is an absorbent of gases, odors and colors has been known probably as long as the human race has known fire. The property of "ivory black," simply finely divided charred bone, to extract odor as well as the color of liquids filtering through it, is being made good use of every day in the refining of sugar, for instance; a good deal of brownish, strong scented beet sugar has come out of the other end of a charcoal bed in the form of simon-pure "cane sugar," colorless and odorless. As an absorbent for gases, charcoal has long been used by medical science and in sanitation.

How a filter may be run by discharging compressed air into the outlet pipe was explained by Mr. Carl Fossetta in the November, 1913, number of THE AQUARIUM. This same method has been applied for generations, and is used today by the salt refiners along the Ohio river, where saline water is ejected by air from wells hundreds of feet deep, this way of "pumping" being about 100 per cent. efficient. If it were not for the fact that I wish to emphasize the use of charcoal as a filtering medium instead of sand, I would have little improvement to suggest on the device used by Mr. Fossetta. His sand filter will clarify turbid water and, when used in connection with compressed air, will also thoroughly aerate it, a fact that Mr. Fossetta did not dwell upon in his valuable paper, but which must not be overlooked.

The range of usefulness of such a filter can be increased many times by substituting charcoal for the sand. In conducting tests with this arrangement, water was used containing at the same time clay, milk and red ink, with enough of a saturated solution of sulphuretted hydrogen added to impart a very vile odor. The clay was stirred into the water to simulate the condition caused by fishes disturbing the bottom; milk imitated that turbidity caused by algae or decaying animal matter; red ink furnished a substitute for the dissolved coloring matter sometimes present in aquarium water, while the addition of sulphuretted hydrogen created a condition similar to that obtaining in water in an aggravated state of putrefaction. This liquor, when run through the filter once, came out crystal-clear, and without odor or color. In practice, as applied to the aquarium, filtration is repeated over and over again according to the capacity of the tank and the length of time the device is applied.

The sectional drawings of this apparatus are self-explanatory. It can be constructed in some form and with little expense by almost anyone. The charcoal should be cracked in a mortar, as ground charcoal is apt to pack too tightly. Before charging the filter body it is necessary to stir the charcoal into water, and thereafter to slightly drain it, as dry charcoal repels water and cannot work well in this state. A layer of washed sand placed on top of the filter bed prevents the passage of small particles of charcoal into the outlet pipe.

The only additional requirement is some source of compressed air. In my tests this was supplied by a tire pump in connection with a small air tank. A reservoir 6 inches in diameter by 2 feet high,

carrying 50 pounds pressure, will run the filter during 24 hours, according to the rate of flow desired. A reducing valve on the air tank furnished a constant pressure of about two pounds for the filter nozzle.

Heede on Fish Foods

Many of the prepared fish foods now on the market I have found to be as good, if not better, than any imported foods, but in feeding it must be taken into consideration that they are very rich and concentrated, and that they must be used sparingly. If many large snails are kept with the fishes it will be necessary to allow them some food.

The natural foods, *Daphnia, Cyclops, Cypris, Polyphemus* and worms are, of course, the best, but aside from these, fish eggs, raw or boiled, finely scraped fish flesh of either salt or fresh water species, oysters, clams, shrimp or lobster meat, smoked fish such as herring, whitefish or salmon, can be used with more or less success. After these come warm-blooded animal foods such as beef, veal, lamb or game of any sort, used raw or boiled, but in all cases scraped, or dried and powdered. A good food for fry or small fish that have passed the yolk-sac stage is the yolk of a very hard-boiled egg, fed in a fluid or powdered state.

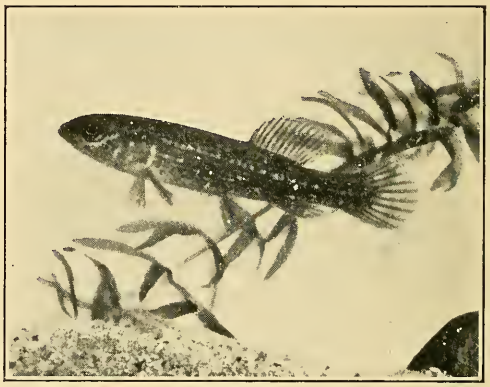
When fishes are fed with meat care must be exercised to have it cut or scraped into minute particles, otherwise fish too eager for it may attempt to swallow pieces too large and choke to death.—C. J. Heede.

It is said that at least 57 brands of prepared foods are on the market. If you are undecided which is best buy all and mix. Variety is the spice of life.

It takes a lot of pluck to pluck the beam from thine own eye.

Breeding Habits of the American Mud Minnow

The earliest investigations of the breeding habits of *Umbra* seem to be those of Carbonnier, who studied the Austrian *Umbra krameri,* publishing results in the Bulletin de la Societe d'Acclimatation (Paris, 1874). Later, in the United States, Dr. Ryder made observations of one of the two American species. He found that their adhesive eggs were laid singly upon the leaves of aquatic



Mud Minnow Umbra pygmaea
Photograph by Charles M. Breder, Jr.

plants and hatched on the sixth day.

It has been discovered that some species of fishes, if removed from their habitat just before or during the early stages of a spawning operation, will continue if placed in a suitable aquarium. Last April, while collecting local fishes, Mr. William L. Paullin discovered *Umbra pygmaea* apparently spawning in a bed of Algae. A pair was soon in his can.

A medium-sized aquarium, containing a rather dense growth of filamentous Algae, was selected. The fish at once proceeded to form a hollow in the mass, the opening being from the side. Soon the eggs were deposited in the hole and the entrance closed. The female then drove off the male and thereafter guard-

ed the nest against intruders. This was the extent of her care.

On the sixth day the eggs hatched, and a like period was spent by the fry in the Algae before reaching the free-swimming stage. On the thirteenth day after the deposition of the eggs the parents were removed. The young grew at a fair rate, reaching a length of 1½ inches in four months. A few eggs were removed from the nest and incubated in another tank, their development and growth approximating those left with the parents.

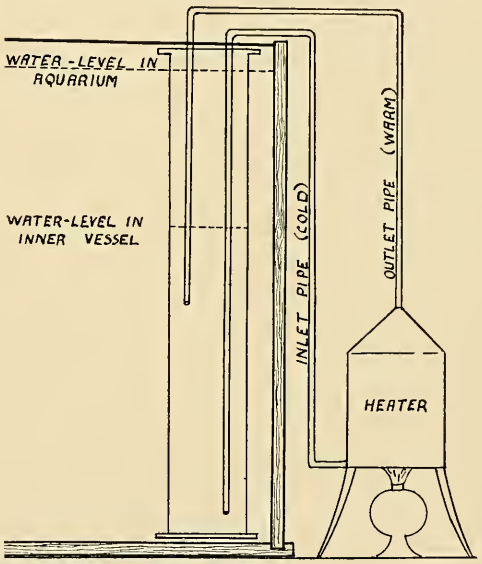
This fish affords a fair reason why the aquarist should use scientific names in preference to common ones. In the genus three species and one subspecies are recognized; the American *U. limi, U. pygmaea* and *U. pygamaea bilineata,* and the Austrian *U. krameri.* To these are applied indescriminately at least five common names: Mudfish, Dogfish, Mud Minnow and Mud Trout. There are several rockfish and several dogfish, and the species are not related to the trouts. Mud minnow is most acceptable.

An Aquarium Heater

HERBERT M. HALE, South Australian Museum

The winter in Australia is generally so mild that many sub-tropical fishes may be kept in open ponds all the year round. Occasionally, however, the temperature even indoors falls below the danger point for some of the more delicate exotics, and a means of heating the aquarium becomes necessary.

The apparatus, which I have used with great success, consists of a small copper heater from the top of which a pipe (the outlet), leads over the edge of the aquarium into the water; another pipe (the inlet), arises from near the bottom of the aquarium and enters the lower part of the heater. By sucking at a rubber tube temporarily attached to the shorter pipe whilst under water the whole apparatus can be filled. The lamp or gas can then be lighted under the heater. Gas, regulated by the thermostat described in *Aquatic Life,* Volume II, Page 11, is quite satisfactory. As the water in the heater becomes warm it is delivered into the aquarium by the outlet pipe, and the colder water from the bottom is drawn into the heater by the inlet pipe to take



its place. If the water in the heater boils it is because no circulation takes place—a condition due to insufficiently filling the apparatus and leaving air in the system. The heater should therefore be of the shape shown, but need not be of large size.

It is not desirable that the aquarium water shall be in contact with metal. The outlet and inlet pipes should accordingly be led into a narrow glass vessel of greater depth than the water in the aquarium. The water in this inner vessel should be kept somewhat below that of the aquarium. Whilst the circulation of the system is thus confined, the heating properties are little diminished. The advantage of this arrangement will be

apparent should the apparatus break at any point, for otherwise the whole of the water may be syphoned out of the aquarium by the longer tube. The vessel and pipes can be effectively hidden by a clump of plants.

If instead of metal, the heater and pipes are constructed of glass, a protecting vessel is not so necessary.

The Hudson Society

The Hudson County Aquarium Society was organized on June 30th, the following officers being elected: *President,* H. A. Van Cott; *Vice-president,* W. J. Wright; *Secretary,* G. C. Albietz; *Treasurer,* F. W. Hedden.

An effort is being made to secure permission from the Jersey City Commission to hold the regular meetings in the Public Library building. Present indications point to a favorable decision. In the interval regular meetings will be held on the fourth Thursday of each month at the home of the treasurer. A public exhibition will be given during September.

The society will be glad to have the aquarists of adjacent towns become members. Communications should be addressed to the writer at 517 Avenue E, Bayonne, N. J.—G. C. Albietz.

While at a large breeding establishment I noticed a little goldfish of strange appearance breathing at the surface. Upon examination I found it to be completely disembowelled. The owner told me that half an hour before he had removed from it a large insect enemy. From the description I imagine it was a "water tiger," the most predaceous of goldfish enemies. I was sorry not to be able to examine the animal, as the "tigers" are only supposed to suck the blood of victims through their hollow mandibles. In any case the surgery must have been neatly performed, for the fish to be living half an hour later. Ordinarily they will succumb to apparently far less serious injury. Of course it could not have existed much longer, so the merciful owner killed it. The fish was about ten weeks old, which emphasizes that we should not relax our vigilance against enemies as soon as the fish develop a little size.—William T. Innes.

(Concluded from Page 4)

it forms quite dense masses and does not possess particularly large bladders. These are not large enough to entrap the comparatively small fry of *Osphromenus trichopteris,* judging from the number the writer has bred in an aquarium in which it nearly covered the surface to a depth of two inches. The late William E. Walp was fond of using it to catch goldfish spawn. A good test of the two methods could be made by using *Myriophyllum* and comparing results. Leaving aside the possibility of the fry being caught in the bladders, the critical period seems to be during incubation. If this is so, the sterilization of the water, which was re-oxygenated in the act of pouring it into the jar, would go far toward eliminating spores of *Saprolegnia* (fungus) and other organisms which might be detrimental.—Editor.)

Recently Putter has maintained that fishes absorb food in solution in the water. He found that a goldfish lived for forty-one days in tap water which contained no organized food and the oxygen consumed substantially accounted for the loss in weight. When organic substances were dissolved in the tap water, the goldfish survived for seventy-eight days, and the oxygen consumed greatly exceeded the amount that would account for the loss in weight.—Eigenmann.

Aquatic Life

An international monthly magazine devoted to the study, care and breeding of native, exotic, gold and domesticated fishes, other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....Editor

JOSEPH E. BAUSMAN.....Publisher

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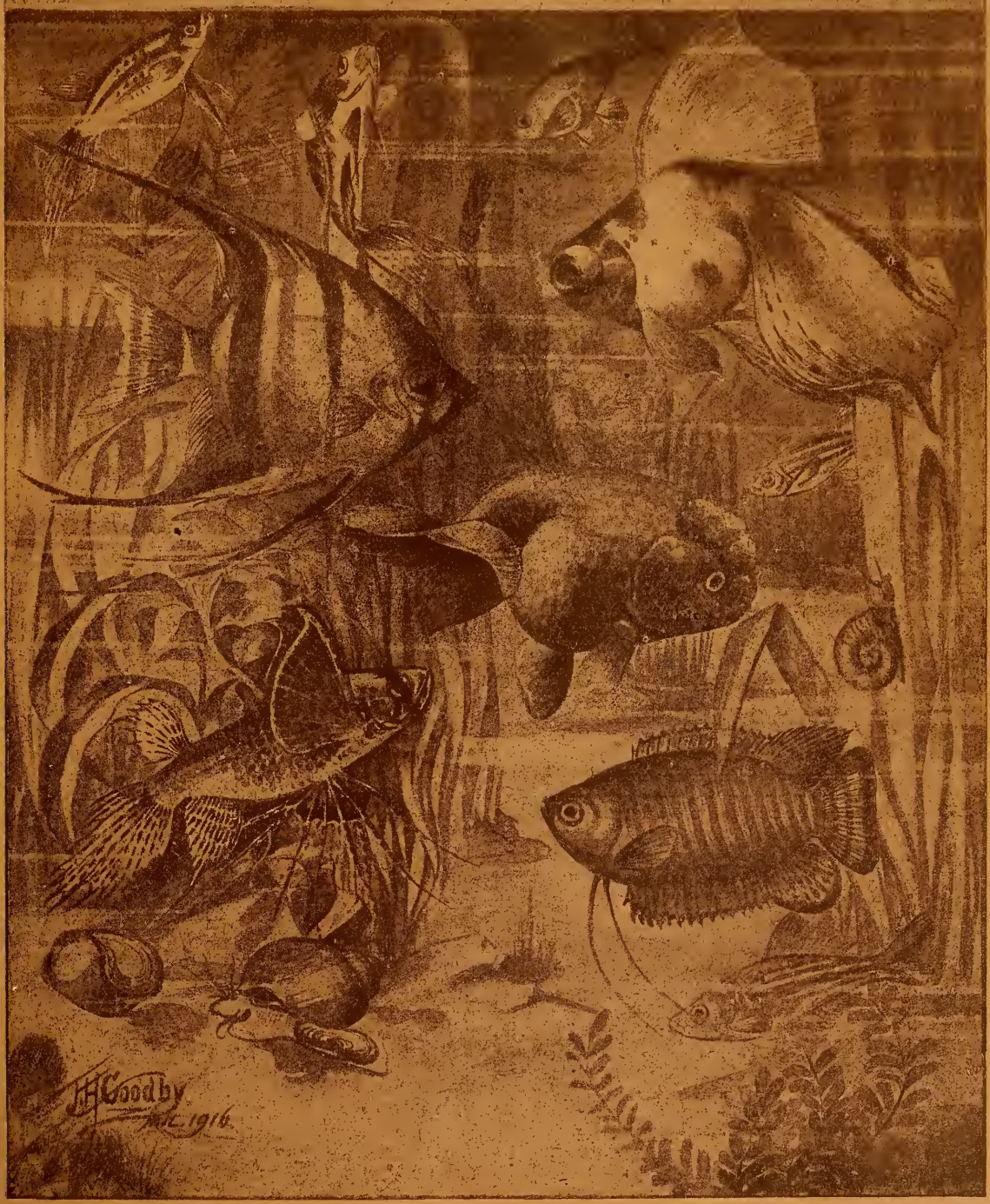
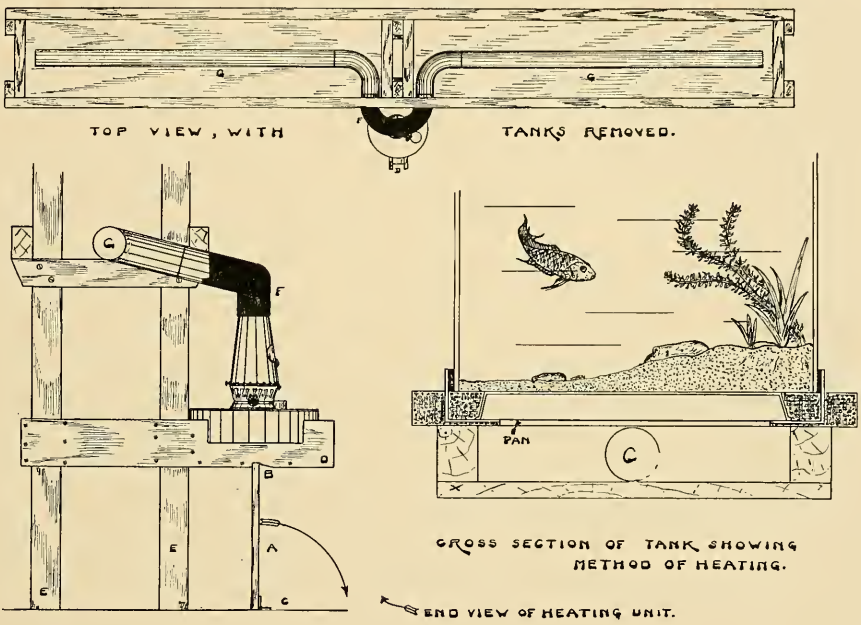


AQUARIUM HEATING

CHARLES M. BREDER, JR.



When creatures of warm countries are removed to cooler climes, past the limit of their adaptability or possible acclimation, it becomes necessary to furnish the temperatures to which they were accustomed in order to meet success in keeping them as pets. With many of our exotic fishes it is necessary to do this in most parts of the United States when winter grips us. From the time when tropical fishes were first introduced for study and investigation into temperate countries, the question of warmth for them has been a leading one, and is still much discussed by aquarists, varying views as to methods being held to a greater or less extent. The types in general use can be briefly classified as follows:

DIRECT HEATING SYSTEMS

1. Gas or oil flame applied direct to metal disc or pan affixed to bottom of the tank.

2. Water from tank circulated through pipes that pass over a flame which heats the water and causes the circulation.

3. Heat source in a cylindrical jar standing or floating in the tank, and extending above waterline (*Aquatic Life*, November, 1915, and September, 1917).

INDIRECT HEATING SYSTEMS

1. System of hot water pipes passing through or near the tank, but not connected with the water in it (*Aquatic Life,* September, 1916).

2. Application of any system to the entire conservatory or room, such as the usual steam or hot air house heater, or a small oil or coal stove.

3. Application of heated air to the tanks by means of pipes running close to them, the heat furnished by any convenient unit.

It is obvious that certain sources of heat are more suited to one than to another of the above methods, and the suitability of the form of heater used is modified by the purpose for which it is intended. For a conservatory a device that heats the entire enclosure is best, while in a room used for other purposes one of the individual tank heaters is preferable. It is the latter which will be discussed in this paper.

It is generally assumed that one of the indirect forms gives a more natural condition. The form described herein allows the plants to attain a beautiful growth, which cannot be said for all devices. It consists of a heating unit, with suitable piping, that conducts the heat to the closed tray below the tanks, proper draft for the flame being considered. In this manner the heat is evenly distributed immediately below the aquaria, and the water therein thus warmed.

The heater used in this particular system is a common incubator lamp. While other units could be used, it is doubtful if they would be as economical in point of cost of operation, a gallon of kerosene lasting for slightly more than a week during the coldest weather. The chimney of the lamp fits close into the pipe that leads to the length under the tanks. Standard two-inch leader pipe was used, with the required elbows. To help conserve the heat the piping exposed to the air was covered with sheet asbestos and then taped.

The rack or stand which holds the aquaria was boarded in with pine, one-half inch thick, and on this rest the pipes. The device would be more efficient if the lamp was placed directly under the rack, as much heat is lost in the double bend, but the space in the present case is occupied by tubs which cannot be placed elsewhere. As it is this lamp heats eight feet of tank space, four on each side. The rack extends upward and holds two more rows of aquaria, but only the bottom row is heated, although general radiation keeps them a little warmer than the average room temperature.

The sketch shows how the lamp is supported, and the provisions made for removing it for cleaning and refilling. The strip A is fastened to the floor by hinge C. The strip is slipped from notch B and dropped to the floor in the direction of the arrow, thus allowing the lamp and its holder D to slide down the legs of the rack E, disengaging the chimney from the pipe F. When in the lower position the lamp may be lifted from its support. The support or holder D is two pieces of wood, separated by blocks the width of the legs E and sliding on them. A suitable recess was cut for the lamp-base.

The short piece of pipe F is fitted into the horizontal part of a T-joint. Four 90-degree elbows are used in making the required turns to connect with the long pipes G running below the aquaria.

Special aquaria were constructed for use in connection with this heating method which added to its efficiency. Large two-inch angle iron was used for the bottom frame, which was embedded

(Concluded on page 18.)

Hemiramphus Fluviatilis

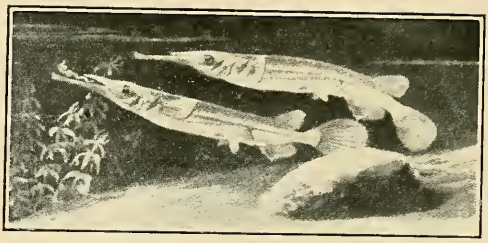
WALTER LANNOY BRIND, F. Z. S.

Regardless of the imposing name, *Hemiramphus fluviatilis,* the half-beak, let not the reader suppose that the fish is striking in appearance so far as color is concerned. Far from it. 'Tis the form, not the color, that is interesting, for the little fellow—an adult female measures about two and one-half to three inches, the male half an inch less—is about as plainly colored as any tropical fish I ever saw.

The color is uniform light olive brown in both sexes, varying in shade, with a white belly. The general shape is similar to a pickerel. The striking characteristic is the short, broad upper jaw, with the lower one narrow and pointed, and twice the length of the upper one. I was much puzzled when I first saw the species, to understand the reason for this peculiar formation, and why both jaws were not alike, but the problem was solved when I saw it eating Daphne. Then I noticed that the Daphne caught in the surface film and unable to descend into the water, were being adroitly taken by the fish with the aid of this broad, circular, or rather semi-oval jaw, which seemed to work more than the lower, contrary to the usual rule. When the "fleas" were swimming below the surface the fish were able to catch them just as well.

The half-beak is also interesting in that it is apparently the only live-bearing or viviparous fish that the Far East has contributed to the aquarium. It is claimed that it invariably gives birth to thirty young at a time, unless immature, in which case none are delivered alive. In 1910, when business took me to Europe, I bought a male and three females, one of the latter being the largest. From her I secured a litter of eighteen as I now remember, but, of course, the remainder of the "invariable thirty" may have been devoured by adults before I discovered them.

I kept these specimens in quite a large all-glass aquarium, and succeeded in



Hemiramphus fluviatilis

breeding them as stated. The tank was well-planted and contained clear old water. This was in contradiction to the opinion then held that a slight proportion of sea water (5 per cent.) was necessary to their health. In nature the fish inhabits Java, Malacca and Singapore in fresh water, but always near the sea. This may have given rise to the suggestion of slightly brackish water for their aquarium.

The half-beak is a quiet and fairly peaceful fish, spending much of the time near the surface of the water.

(The fishes of the family *Hemiramphidae,* speaking generally, inhabit the warm seas and are widely distributed, mostly along shore, though a few are pelagic or deep-water forms. The group

includes both viviparous and oviparous species. Mr. Brind is probably right in asserting that *H. fluviatilis* is the sole viviparous fish thus far brought from the East for our tanks. It is not related to the viviparous killifishes, sub-family *Poeciliinae,* which includes all such fishes studied and bred by the aquarist. Until recently these live-bearing fishes were thought confined to the Americas. Mr. C. Tate Regan, of the British Museum, has described the remarkable *Phallostethus dunckeri,* a new poeciliid and the type of a new sub-family. This fish is from Johore, on the Malay Peninsula. While in all the forms limited to the Americas, it is the anal fin which serves as the so-called intromittent organ, in this new species it is the ventral fins which have become modified into a large muscular appendage to function as the intromittent organ. An interesting paper on viviparous fishes in general will appear in a subsequent number. Mention is made of some quite curious characteristics.—Editor.)

Aquarium Heating

(Concluded from page 16.)

in the concrete base, with ¾-inch projecting above to receive the glass. The other parts of the frame were made of ¾-inch iron. Before pouring the concrete into the mould for the base several inverted pie pans were placed on the bottom angle. Through these pans the heat is transmitted to the water. The pans were, of course, waterproofed before being used.

No vent was made in the tray to allow for draft, the cracks in the joints in the wood tray being found sufficient. If found necessary holes could be bored through the ends. The portions of the pipes shown in black in my sketches indicate those covered with sheet asbestos and taped.

Considerable discussion has been evoked at the meetings of the Aquarium Society of Philadelphia by the important query: "What is the best planting medium in the freshwater aquarium, sand, soil, grit or pebbles?" At first a divergence of opinion was expressed, but later experimentation led to an almost unanimous concurrence in what has since been adopted as the best practice.

Some desirable plants—*Sagittaria, Vallisneria, Anacharis, Cabomba* and *Nitella*—will thrive and exhibit paler green leaves when set directly in the sand; but other plants—*Ludwigia, Potomogeton,* Moneywort and Water-poppy—require soil to continue their growth and to survive under the changed conditions.

The best practice, it has been found, is to place a two to two and one-half inch layer of thoroughly washed bar or beach sand in the aquarium, into which shallow dishes or pots containing clean turf in which the last mentioned are arranged Then those to be planted directly in the sand are introduced, and the whole surface covered with a one-inch layer of small beach pebbles known as grit. A few larger pebbles, or brookworn stones, may be scattered over the surface to produce a natural effect.

Grit permits the finer particles of humus to sift through to the sand layer to serve as nourishment for the plants, presents a neat and tidy appearance, and a firm layer from which to syphon the excess accumulations.—*Aquarium Notes and News.*

Haplochilus lineatus is the proper name for the fish usually called *Haplochilus rubrostigma* by the aquarist. The latter is not a synonym, but the name of another and distinct species with which "our fish" was confused when first imported.

Mollienisia Latipinna

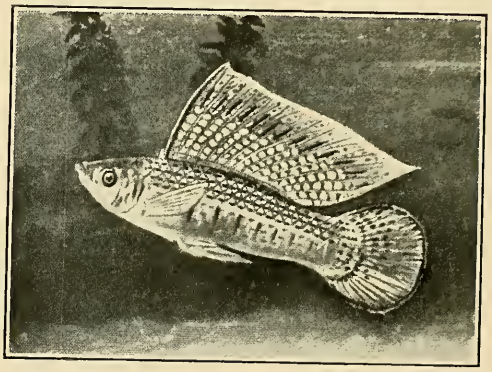
C. J. HEEDE

In habits and actions in the aquarium, though not in color, *Mollienisia latipinna* resembles the female of *Xiphophorus helleri*, but is larger and more stoutly built. While both sexes are attractive, the male is more beautiful, the unusually well-developed dorsal making it a distinctive member of any collection. The body is grayish olive, crossed from head to tail by a series of red or orange dots, which appear as stripes or lines; vertical stripes mark the abdominal region. The gill covers have blue markings, which are also present on the dorsal and caudal fins of the male, the latter fin also marked with red. The caudal fin is rather round, with a stout peduncle. The colors are most intense during the breeding season, at other times, and in young examples, rather less distinct, though the stripes are always present.

This species may be readily propagated in the aquarium if a temperature of 75 to 80 degrees Fahrenheit, is maintained. Preparations should be similar to those used for other live-bearing or viviparous fishes; a well-planted aquarium and prompt removal of the female after the young have been delivered. A considerable quantity of loose *Anacharis* can be grouped on the window or light side of the tank.

The best foods are Daphne, Cyclops, raw scraped beef, clams, etc., but they will do fairly well on prepared foods. They are largely vegetarian, however, and do not need as much animal foods as carnivorous species such as *Gambusia holbrooki*. That they are plant-eating must not be taken to mean that they destroy the higher forms. The reference is to Algæ.

This fish when first imported from the South, unless previously acclimated to the conditions of the aquarium, is rather sensitive to rough treatment in shipping, changes in temperature and transfers



Mollienisia latipinna

from aquarium to aquarium. It is advisable to disturb them as little as possible until they adapt themselves to confinement.

In writing of the abundance of this species, in a past number of AQUATIC LIFE, Major Shufeldt says: "Many years ago I saw thousands of specimens of this species in the very shallow pools connecting with the bayous south of New Orleans, La.; they were mating, and, as the gorgeously colored males chased the females about in the clear water of the pools, a scene was presented that I have never forgotten. To the best of my recollection I would say that some of the old males exhibited markings of a bright

azure blue in addition to the orange ones; but I may be mistaken about this. My Louisiana field notes are not at hand at this writing; but I remember that in them I had drawings of both the male and female of this elegant little butterfly of a fish."

Another fish of the genus, *M. formosa,* from Mexico, is a nice aquarium specimen, but is inferior in color. The body is greenish gray, with yellow cross-stripes; abdominal region, metallic blue; dorsal and caudal fins dull yellow with dark markings. In contrast to *M. latipinna,* the males are smaller than the females. Breeding habits, temperature and food requirements the same.

Nobody Works But Father

Nobody works but father,
He's on guard all day—
Fins in constant motion,
Keeping foes away.

In the black bass family the male selects a nesting place and then seeks and escorts to it a mate. From 3000 to 10,000 eggs are laid, after which the mother bass is driven away, never to return or to know her progeny.

Father bass takes a position immediately over the nest, constantly fanning it with his fins and ever watchful for intruders. This vigil continues for ten days to two weeks, while the eggs are developing and hatching, and for a few days thereafter while the young are getting ready to try their fins. Woe unto the sucker or other enemy which appears too near to the nest! The faithful paternal guardian darts fiercely after it and attempts to rip it open with his dorsal fin. By this means, unless he is attacked by overwhelming numbers of carp or caught by the angler, the father bass is able to hatch his brood and care for them until they scatter for food.

The eggs of the basses cannot be artificially manipulated, and for its supply of such fishes the Conservation Commission must accordingly depend upon the vigilance of father bass. The spawning time of all fishes is governed by water temperature. In normal seasons, in New York waters, the basses do not leave their nests before July 1, and in late seasons the male bass may be seen hovering over his nest until well past the middle of July.

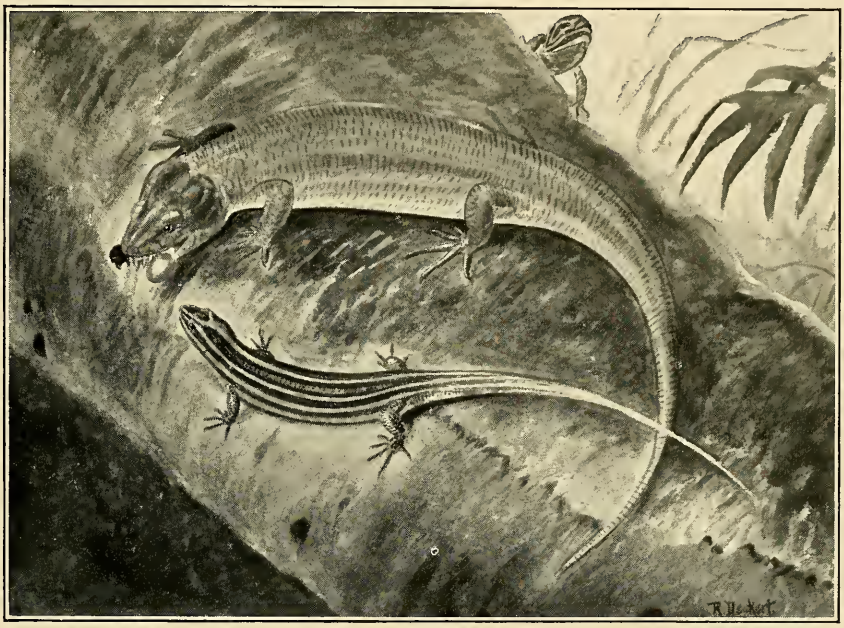
Let us, therefore, give father bass a chance to do his bit in food conservation by working for an extension of the close season until July 1, and let us refrain from fishing over the spawning beds whenever we find him guarding his nest, even if it be during the open season.—New York State Conservation Commission in *American Field.*

I have just read the article on the red bellied newt in the August number. I have had them for years, but they never bred. One pair I have kept with paradise fish, and sometimes with goldfish the latter being nipped and abused should they become inactive or ill. The middle third of my bay window has been cemented and converted into a swamp, with plants, mosses, frogs, turtles and newts. Some time since the ordinary newts crawled out and kept themselves under flower pots or damp moss. A few days ago the red-bellied newts deserted the water almost at once for the more congenial "swamp." It seems therefore that they will stay in a tank only when no more atractive surrounding meets their eye.—*William Leland Stowell, M. D.*

Wired plate glass is better than ordinary plate for the bottoms of small aquaria.

THE BLUE-TAILED SKINK

RICHARD DECKERT
NEW YORK ZOOLOGICAL GARDEN



RED-HEADED AND BLUE-TAILED PHASES OF PLESTIODON FASCIATUS
Painted from life by the author

The lizard known under the above name belongs in the family of Skinks; lizards having smooth scales, a cylindrical body, tail of moderate length and short limbs. The scientific name of the species has been for many years *Eumeces quinque-lineatus*, but in adherence to the rules of priority adopted by the Zoological Congress of Paris, has been changed to *Plestiodon fasciatus*. (*Plestiodon:* pleistos—many, odon—tooth; *fasciatus*—striped.)

Two distinct color phases, with intergrading forms, are met with. When the young lizard emerges from the egg it is shiny black with five pale yellow longitudinal lines on the back and sides, the tail being brilliant blue. Both sexes are alike in this coloring until a length of five inches has been attained, when the male shows reddish tints on the head, which also widens perceptibly at the temporal region in this sex. While the males still retain the brilliant coloring, the females seem to "fade out," that is, the pale stripes become dull, the dark ones paler and the blue of the tail less brilliant, until, at a maximum length of about seven

inches, they are of a light brownish-olive with darker sides and reddish head. The blue of the tail has vanished. The males "fade out" at about six inches in the same manner as the females, until the entire lizard is pale olive-brown with a brilliant vermillion head.

The size of the eggs and young varies with the size and age of the female. I have collected females in Florida that measured but four inches which, after a few days of captivity, deposited from three to eight eggs, each measuring 5-16 of an inch in length. The baby lizards that hatched from these eggs were 1⅛ inches long. The largest female, seven inches long, coiled about seven eggs, each measuring 11-16 inch, or double the length of the preceding, was taken from a hollow log partly filled with pulp and dead leaves, in July, 1912. The lot was taken home, put in a large vivarium in a sunny window, and after about two weeks seven young skinks, 1½ inches long, were darting about among the ferns and moss.

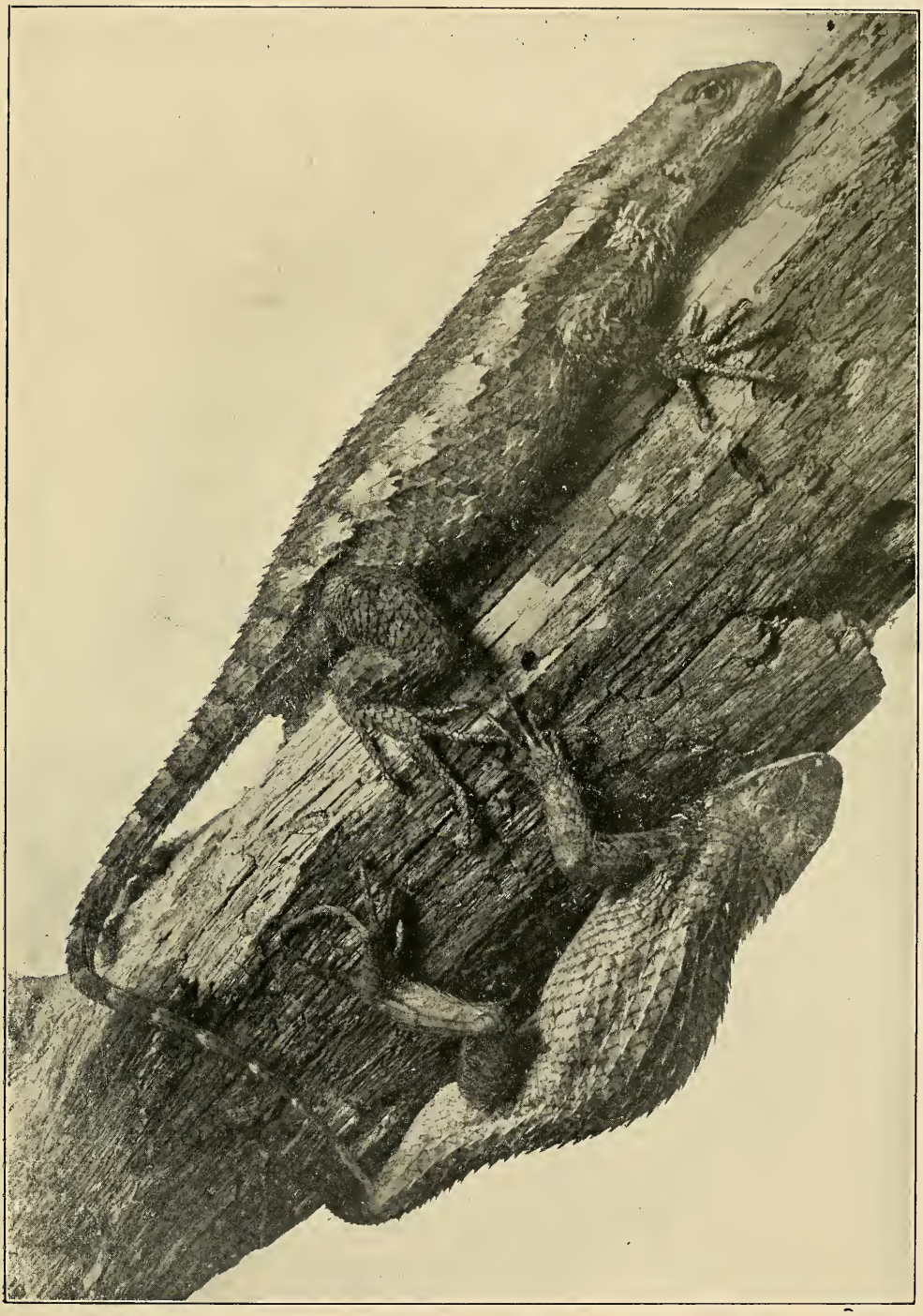
My collecting station was a small shanty near the edge of a bayou or cypress swamp, built on piles about four feet off the ground. A family of "Blue-tails" made their home underneath the flooring, and on days when I did not go collecting, but sat writing or reading, three or four of them would emerge, shy at first, but soon becoming bolder, darting about the floor playing tag and hunting flies. When I looked up from my work, they would stop where they happened to be, instantly on the alert, and if I remained quiet, would soon continue in their activities. A movement of foot or shifting of legs on my part sent the lot scampering for cover. After about a month they became so bold as to run over my feet and climb up on my cot. At first very shy and wild, they soon become so tame in captivity that especially the larger ones will take grasshoppers and beetle larvæ from one's fingers.

They require a fairly large terrarium as they exercise freely, especially on sunny days, and the males often indulge in fights. They rush at one another with mouth wide open, endeavoring to secure a good hold on limb or tail. Their jaws are strong and the grip powerful, so that sometimes a limb and often part of the tail is twisted off in these combats. The loss of limb is, of course, permanent, but the tail is regenerated, though never to its full length and beauty. Otherwise these seemingly frightful injuries do not apparently incommode the victim very much, except to send him hiding for a day or two.

The food consists of insects, their larvæ, small crustaceans, spiders, and, with the big Red-heads, also mice and probably young birds. They certainly are cannibals, as I have seen them devour small specimens of their own kind, and one large male ate a big spiny swift, *Sceloporus undulatus*, fully six inches long. This male was the biggest of his kind I ever saw, measuring 10½ inches in length, the body 1¾ inches in diameter at the thickest part.

The Blue-tailed Skink is never found far from water, usually along the edges of brooks, creeks and bayous, wherever deciduous trees and shrubs abound. Here among vine and creeper-clad stumps, ferns and mosses, he hunts during the cooler hours of daylight, basks in the sun at midday, and retires at dusk to some knothole, usually well up a big Live Oak, Sweet Gum or other such tree.

In winter many specimens can be collected by stripping the bark and digging into the pulpy interior of dead standing timber near water-courses. There the species will be found in all color phases,



A SPINY SWIFT SCELOPORUS SPINOSUS Photograph by MAJOR R. W. SHUFELDT

From the "Guide to Nature"

in company with beetle grubs, scorpions, centipedes, snakes, and sometimes toads, all hibernating until the warm sunshine of spring awakens them to pursue their varied activities. Although of doubtful economic importance, these pretty lizards are harmless, and with their interesting habits, bright, active manners and beautiful coloring, prove an attractive feature of our wild life, and merit our protection. It occurs in the eastern and central United States, and is most numerous in Virginia, North and South Carolina, Georgia and Florida.

As terrarium inmates they make very interesting pets, soon becoming tame enough to feed from one's hand. They are fairly hardy, provided plentiful and varying food is offered, and fresh water sprayed on twigs or plants in their cage. One or two hours of sunshine each day is also necessary for their well-being. Specimens in the collection of the writer have lived thus for more than five years.

(Aquatic Life is indebted to The Agassiz Association, Inc., ArcAdiA, Sound Beach, Connecticut, for the loan of the cut of the spiny swift, which appeared originally in "The Guide to Nature," the organ of the association. The photograph was taken by Major R. W. Shufeldt.)

Concerning the erosion of the shells of snails, I wrote Mr. ——. He tells me it is due to lack of food! This was a stunner to me, as I am always accused of over-feeding. He said four-horned snails must have lettuce or turnip tops all the time. This is probably correct as I find, thought my aquaria are full of plants, that the snails do not molest them, but *all* the species of snails will eat great quantities of lettuce; if this is not supplied they are insufficiently nourished. But if you supply the snails with lettuce and turnip tops the aquarium will smell, so I have taken them out and given them a large tank outdoors. During the winter this tank will be placed in a greenhouse.

For my aquaria I have found a scavenger that beats the snails, which are always dirty. For the past two years I have been using the spotted newt, *Diemyctylus viridescens*, with my paradise fish. The newts are clean and do not bother the fish, in fact, they are the only animals that can be kept with this species. There seems to be a perfect understanding between them and they never fight.—*D. Oscar Mead, M. D.*

Pipe Fish

The pipe fish, a near relative of the sea-horse, might with propriety be called a sea-kangaroo, as it has the distinction of carrying its young in a pouch. This fish, easily distinguishable for its long, slim body, from which it derives its name, is common in British waters, along our Atlantic coast and elsewhere.

The male of the species has a pocket on the underside of its body extending nearly half its length, and is the only part which is unprotected. If a fish is taken from the water and its little ones are shaken out of the pouch into the water, they always seem either unable or disinclined to swim away. If the male is placed in the water again, all the youngsters immediately swim back into the protecting pocket.

These curious creatures have a prehensile tail, which they use to hold on to seaweed to prevent themselves being carried away by the tide.—*Exch.*

It's all right to take time by the forelock, but don't take advantage of your opportunities before they come to you.

Factors Controlling The Development of Tropical Aquarium Fishes

REV. FREDERICK R. WEBBER
Chicago Aquarium Society

When we see a fish small in size, poor in color, scrubby in appearance and deficient in physical vigor, we know at once that something is wrong. What then are the factors that control and influence the proper development of fishes in the aquarium? We will try to mention a few of them, bearing in mind that we speak from the viewpoint of aquarists. A fish in an aquarium is under unnatural conditions, even at best. Certain rules, drawbacks and other unfavorable conditions must be kept in mind. With fishes bred in the aquarium, the factors commonly concerned are these:

Food Supply.—No one will deny that the character of the food has much to do with perfect coloring, and size, too, in our specimens. Authorities who write with conviction tell us that the bright color in fishes is due to deposits of certain light-reflecting spicules, or iridocytes, on the scales. The character of the iridocytes effecting the color. If the spicules are of one type, and present in the deep layers of the skin, the color will be dull. But if these light-reflecting spicules are also present on the scales, their peculiar formation will cause them to act as prisms, breaking the light rays falling on them, and producing iridescent colors. Then we also have the colors due to pigment in the skin. The rapid changes in color in some fishes are due to the contraction and expansion of the pigment cells. It is through this action that certain fishes, the flounders, for example, are enabled to assume a color arrangement simulating the bottom on which they may be resting.

Experiments made in certain European countries have proven beyond doubt that fishes fed on living foods develop these exterior spicules. Daphne, Cyclops and related organisms are rich in the substances producing them. Dr. Francis Ward tells of experiments tried in neighboring fish ponds. In certain ponds the fishes were reared on Daphne and Cyclops; in other ponds prepared foods were used. In every case the "flea-fed" fishes were more brilliiantly colored. *Moral:* Feed "fleas" if you can get them.

Parental Forms.—The coloration and size of the parents has more or less to do with good coloration and size in the offspring. Scrubs usually produce scrubs. While the tendency is not inherited absolutely, a fish born of scrubby parents is predisposed toward that condition. It is therefore well to weed out all the poor, undersized, imperfect specimens.

Temperature. This is an important factor. A fish reared in a small, poorly-heated aquarium will be deficient in size and color. The color-cells of the tropical fish will not develop under sub-normal temperature conditions. According to the evolutionist, a fish should gradually adapt himself to his environment, but this theory is disposed over eons of time, and not merely through one generation or a dozen. We all know what low temperatures will do for our fishes. Tropical specimens have never yet been known to become reconciled to chilly tanks, the temperature less than the average to which they are subjected in their native haunts. If one would have fine, healthy,

beautifully colored specimens, he must keep up the temperature, and keep it as even as possible. Don't keep it so low that you are flirting with disaster.

Unnatural Tank Conditions. The native haunt of the tropical fish differs widely from even the most favorable aquarium conditions, unrestricted movement being in contrast with confinement and monotony. Collectors have noted unusually brilliant colorations in wild specimens, which disappears suddenly, or becomes inferior, under tank conditions. The proverbial "large, roomy, well-planted tank, maintained at an even temperture of 72 degrees Fahrenheit," should be provided. It is better to have three good tanks than thirty small ones.

Size of Aquarium.—It is interesting to take a dozen young fishes, say *Platypoecilus,* and put half of them in a small tank, the other half in a large one, conditions being similar, and note the surprising difference in the result. Not only is growth more rapid, but color likewise is improved by plenty of room. Save in depth alone, a tank cannot be too large for the well-being of the fishes. A Wisconsin friend who boasted of having produced "dwarf Helleri" had yet to learn that the ten-inch jars in which he reared the young were inadequate.

Acidity and Alkalinity.—These important f actors are too little discussed among us. If the gentle (or "savage") reader will evaporate a dozen pails of water drawn from the tap, taking care to use the same pail and retain the sediment, he will be astonished at the "thick soup" which will result. This can be tried on the back of a stove, or on a steam radiator. Aquarium water evaporates rapidly under artificial heat. The average aquarist adds water from the tap. The water continues to evaporate, while the substances in solution and in suspension remain. All water contains such substances. The Shenango River, in Pennsylvania, was called "Red Water" by the Indians because of the substances in suspension, probably from the Pymatuning swamp. In many places the Beaver and Ohio Rivers are acid, and will turn litmus paper red. Northern Wisconsin rivers show strong traces of ore. In other localities salts from the soil, or nitrates from agricultural districts, are to be found in water. Steel mills, iron furnaces, smelter plants, saw mills and paper factories all add foreign substances to the water. Sewage from cities, decaying vegetation, surface drainage, and the character of the stream bed and drainage area play important parts. Water supplied through municipal filtration plants often contains considerable proportions of chlorine and alum. It would be interesting to procure a supply of litmus paper from a dealer in biological supplies, and to make the following experiments: Fill two tanks, equal in size, and similarly equipped, with plants and fishes. For one use tap water and in the other place water from a clear spring or stream. Test occasionally by dipping a small piece of litmus paper in the water, noting whether it turns the paper red, blue or neutral. Compare the effects on fishes, plants and snails.

Selection.—Much has been said about selection. But what, really, is selection? It is the proper combining of desirable characters and the elimination of unfavorable ones. Parental forms, food supply, proper tank conditions, plant life, temperature, etc., all contribute toward selection. Much remains to be done in this respect. The question of inbreeding plays a part here. But this, like Mark Twain's death, has been grossly evaggerated. Inbreeding will in time produce baneful results, but the proper combining

of the above-mentioned conditions will reduce the evils of inbreding to a minimum.

There are other factors which influence the development of our tropical friends. We have noted nothing new. Every fish-fellow should know that the resultant of it all may be summed up in three words: Use common sense!

Snails in Aquaria

ALBERT GALE

I do not know which is the more to be condemned, an aquarium without submerged aqueous foliage or one having no pond snails. It is the combined action of these two accessories that gives health to the fishes. The preservation of health is the most essential factor for the longevity of both the vegetable and animal specimens of an aquarium. Health can only be maintained when the sanitary conditions are fairly perfect. Aids to health must be studied in all details. How the removal of deleterious and decomposing matter is to be accomplished to keep the water free from contamination is as much a nature-study as that of the plant life or of the other inmates of the aquarium.

Nature has provided scavengers in order to keep her many children clean and free from disease germs. The great sanitary scavengers are the too often discarded pond snails. They are very abundant in all water holes and sluggishly flowing rivers. The life history of these molluscs is very intricate, and their method of reproduction is no less so They increase with great rapidity. A half-dozen placed in an aquarium wherein there are only herbivorous fishes will be quickly stocked, though the latter may often prey upon them. The jelly-like masses of spawn will be found deposited on the under surface of any submerged object and on the side walls of a glass aquarium. When thus deposited these jelly-like masses are fairly transparent, and the interesting transformation of the larvæ can be seen with an ordinary hand lens. The first indication of life in the ovum is a small black speck in the centre of the egg sac; when this breaks the young are set free. If some care be not exercised, many will not be suffered to live to maturity. They are tempting morsels for any fish, young or old. If the under sides of the leaves be searched the little jelly-like masses are easily seen, or by passing a blade of *Vallisneria* between the finger and thumb they can be felt. Take these jelly masses that are attached to the leaf and put both eggs and leaf in a bottle of water; put the bottle and its contents in a suitable situation, and they will hatch out by the dozen. Their food will be the decaying leaves on which they were hatched.

Here are interesting phenomena: A little snail will be seen crawling along the water-film, its body suspended underneath; the only fulcrum it has is, apparently, the air above the film, yet he moves as freely as though crawling on a leaf. Suddenly he will lower himself gradually to the bottom and after a time he will as slowly ascend. He appears to have no foothold. This is one of nature's wonders. Here is the explanation of the marvel. These pond snails possess spinnerets, by means of which they spin gelatinous threads; there is a small cavity at the upper end of the thread, almost invisible to the naked eye. These cavities act as small boats, and thus the snails are suspended and enabled to ascend and descend at will.

Always keep snails in aquaria. In addition to their use as scavengers, there many nature studies connected with them.

People can stand a lot of hardship and discomfort if only they are gifted with a sense of humor. The other night a Third avenue car was crowded to the gills, as is usual at the rush hour, and had arrived at the congested condition in which the last arrivals were standing on the bottom step, holding on to the gates. Passengers were wedged like sardines in a can, and in no very good humor about it, either.

At the last stop the conductor decided to add to his load, and a woman climbed aboard carrying a bowl of goldfish and a child. The bowl was half full of water, and a half-dozen fish were swimming about in it, and the woman held on to all this patiently, while she steered the child and wedged into the seething mass of humanity. You wouldn't believe that she could keep the bowl of fish in that jam for two minutes, yet she rode three unruffled miles in great calmness of spirit, without spilling either the fish or the water.

A fat man laughed and squeezed over an inch or two; a workman got off his neighbor's foot and allowed the bank clerk to give up an inch and three-quarters; everybody moved over a bit and grinned, and pretty soon the woman had a clear space around her, she and the goldfish and the child, and everybody was smiling and feeling pretty good about it, too. She hung on to the conductor's cash box with one hand, the goldfish with the other, and the child fed the fish all the way home.

But, of course, nobody could expect the company to furnish a goldfish party every rush hour to take the gloom out of the straphanger's life.—*Seattle Post-Intelligencer.*

A popular globe-trotter; the common goldfish.

Our old friend, Ben Fogel, sends the following set of rules which he thinks seem to govern the deportment of some members of aquarium societies:

1. Don't come to the meetings.
2. But if you do come, come late.
3. If the weather does not suit you, don't think of coming.
4. If you do attend a meeting, find fault with the work of the officers and members.
5. Never accept an office, as it is easier to criticise than to work.
6. Nevertheless, get sore if you are not appointed on a committee, but if you are, do not attend the committee meetings.
7. If asked by the presiding officer to give your opinion regarding some important matter mumble that you have nothing to say. After the meeting tell everybody how it should have been done.
8. Do nothing more than is absolutely necessary, but when other members roll up their sleeves and willingly and unselfishly use their ability to help matters along, howl that the society is run by a clique.
8. Hold back your dues as long as possible, or don't pay at all.
10. Don't bother about getting new members. "Let George do it."

The preferable time to collect wild fishes is during the autumn months. The breeding season has passed and activities principally concern a full stomach. Fishes taken now are more readily accustomed to the conditions of confinement than spring or summer catches. The black-nosed dace and some sunfishes, especially if the last be quite small, are worth a trial in your community aquarium.

The "blue poecilia" of the aquarist is *Limia caudofasciata.* Why not call a spade a spade?

Aquatic Life

An international monthly magazine devoted to the study, care and breeding of native, exotic, gold and domesticated fishes, other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....Editor

JOSEPH E. BAUSMAN.....Publisher

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Aquatic Life

Our American Live-Bearing Tooth-Carps

DR. E. BADE

The last few years have witnessed a tremendous growth of aquarium societies and an augmented interest in keeping and raising fishes in the balanced aquarium at home. The little live-bearing tooth-carps of America have undoubtedly been among the main factors contributing to the advancement. They are easy to keep and readily multiply in captivity.

The male is, as a rule, smaller than the female, and has its anal fin modified into a long intromittent organ. The posterior part of its body has more vertebræ than the female. Several of these are modified to form a support for the mass of muscles involved in the complicated movements of the anal fin during copulation, the muscles being attached directly to the vertebral column by tough ligaments. The shape of the modified anal fin varies in the different species, especially the clasp-like tip, which is probably used for holding or grasping the small projection (papilla urogenitalis) just behind the anus of the female. On the underside of the bone-like ray of the anal fin is a small canal for the sperm. When fertilization is carried on the intromittent organ moves forward with a motion not unlike that of a clasp-knife being opened. Through this motion the canal, which at first lay downward, now faces up. This is characteristic of *Cnesterodon decemmaculatus* and *Glaridichthys januarius*. In what respect some of the other species may differ is at present unknown. *Fitzroyia* and *Anableps* have tube-like intromittent organs, and the sexes are developed into rights and lefts; a "right" male consorts only with a "left" female, and vice versa. Other tooth-carps cannot be classified in this manner.

The eggs are fertilized internally and remain in the ovary during incubation. After one fertilization the female expells

Poecilia vivipara

a number of broods, even though weeks and months may intervene, for only those eggs which are fully mature are fertilized. A receptaculum seminus for storing the sperm is formed by numerous unsymmetrical folds in the lining of the oviduct. Here the spermatozoa are found in great numbers, even after the expulsion of a brood. This is used to fertilize eggs subsequently matured as they come forward. The female constantly endeavors to escape copulation until all the stored sperm has been used.

The period of incubation lasts from four to six weeks, although it may be longer if the water in the aquarium is too cool. The young are expelled when fully developed, the number in a brood varying considerably. Premature births are

not unknown among these fishes, but the progeny invariably die. It must not be forgotten that the adults, in the aquarium, are generally cannibalistc, though seldom perhaps in nature. Therefore, for breeding in confinement, the older fish must be separated from their young or a densely planted aquarium provided for the operation. Among dense masses of plants the young will find a comparatively safe and sheltered retreat. Conscientious aquarists place the female, just prior to an expected delivery, in small boxes or glass tanks placed partly into

Pseudoxiphophorus bimaculatus

the water of the aquarium. These tanks have holes or slits in the bottom just large enough to permit the young to drop through freely, the adult being retained. If this plan is not followed, place the aquarium near a window, massing the plants toward the light. The young when born seek the light, penetrating the plants out of reach of the parent.

The young are easy to raise. Their first food consists of infusoria and algæ, which is present in all aquaria that have been standing for a number of months; after a few days Daphne and Cyclops may be given. During the winter months the tooth-carps should have a *minimum* temperature ranging between 60 and 70 degrees, Fahrenheit, according to the species, but in the summer months they may be kept out-of-doors without danger.

Under some circumstances females apparently about to expel a brood fail to do so. This is a so-called mis-fertilization. The female, after a few hours of agitated swimming, gradually becomes slimmer, and on the surface of the water appear a number of bright, round spots resembling the "eyes" on bouillon. These persist on the water for several days, and, though the microscope will not solve the riddle, it is known that these "eyes" are over-ripe and dissolved eggs. They consist of a gelatine-like substance that does not subsequently develop.

It is very probable that many of these viviparous fishes, which are more or less closely related, interbred in their natural habitat as well as in the aquarium. The majority of these hybrids are no doubt capable of developing progeny. Such an interbreeding between *Xiphophorus helleri* and *Platypoecilus maculatus rubra* was brought to a successful conclusion by rearing the sexes separately and later placing them together in an aquarium. The resulting hybrids in turn reproduced, the second hybrid generation retaining the characteristics of the first cross. Segregation of the sexes is necessary to induce cross-breeding, as females after having lived with males of their species will repel the advances of others.

The tooth-carps are natives of Southern United States, Central and South America, and are found in great abundance, both in numbers and in species, in the small streams, brooks and ditches, which they frequent.

Advertising of character and dignity has much to do with success.

Fool friends are worse than wise enemies.

AQUARIUM NOTES

ERNEST LEITHOLF

The Aquarium Original in Oil by the Author

The meaning of the word aquarium has, in the course of time, been subjected to change. In England, years ago, cellars used for storing liquid medicines, and basins in conservatories utilized for growing aquatic plants, were known as aquariums. Later, when tanks of varied construction came into use for the observation and study of aquatic life, it was some time before a permanent name was adopted. The name vivarium soon gave way to aqua-vivarium, this subsequently being superceded by the word aquarium.

Of the various types of aquaria, the rectangular, with an iron frame, is unquestionably the best. In durability and merit it far surpasses any other form. Some styles should never be used for large or active fishes—the goldfish globe and "miniature" aquaria. Most fishes, with the possible exception of the smaller "labyrinth" and the tiny viviparous species, when confined in these "prison cells" soon succumb, the water space and oxygen being entirely inadequate to sustain them.

The fad of decorating the exterior of an aquarium with painted scrolls and flowers is reprehensible. It is not only an ornamental failure, but a decided detriment, inasmuch as it prevents free observation and, moreover, destroys any possible internal effect with plants and fishes.

Exact workmanship is an important factor in the appearance of all aquaria. The painting of the frame should be neatly executed; the glass free from smears. A subdued shade of green is the most desirable color. It harmonizes with the plants and brings the bottom into good relief. Avoid "loud" and striking colors, as these detract from the contents of the aquarium.

For the practical fish breeder, the disposition of stones and plants in his tanks most primarily conform to the requirements of the species to be bred, to facilitate the observation of spawn and fry, and when necessary, their removal to other vessels. However, in all exhibition and room aquaria of principally ornamental character, an artistic arrangement, "Composition," is essential.

In creating these we should as near as possible imitate nature in her various moods. They can in a general way be classified as sand, gravel, stone and swamp or mud bottom effects. The latter is not practicable for room aquaria, unless for a display of plants alone, with a possible association of snails and insects. Fishes keep a bottom of this nature continually stirred up.

While some aquarians prefer to use white sand, favoring contrasty effects, the majority use the common river variety. Many fishes become pale in color when placed in a tank with a white sand bottom, furthermore strong light on it causes a reflection which is an irritant to some and a tendency to shyness develops.

Avoid regularity in arranging an aquarium; also indifferent scattering of stones and plants. The first will result in a mechanical effect, while the latter will be void of interest. I have found it most satisfactory to have a single effect in an aquarium—sand in one, a stone in another, etc. In this way one creates an added interest in the various aquaria independent of their respective inmates. Of course, a certain amount of sand may be used in all tanks to give the bottoms some slant. By this, all excrement will accumulate at one place, facilitating its removal.

A very simple and effective composition can be evolved by placing a large mass of stones and plants near one end, with a considerably smaller group near the opposite end, just large enough to give balance to the first. This arrangement assures plenty of space for active fishes.

If but one aquarium is to be set up, various plants can be used to a good effect. With a large number of aquaria I prefer to use only one or two species of plants in each, making it possible with the variety of plants available to create different plant effects in quite a number of tanks. These in association with varied bottom arrangements will give each aquarium a distinct character and interest which will be further amplified by the introduction of different fishes.

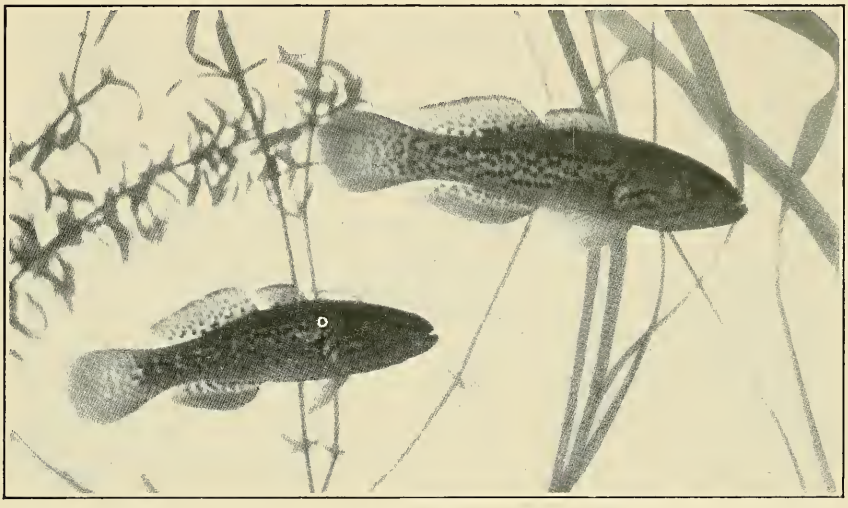
Fascinating interiors may be constructed with tuffstone. However, its numerous cracks and openings make inaccessible pockets for the accumulation of filth, and the aquarium soon becomes unsanitary; hence it had better be avoided for permanent display. This also applies to the use of sea shells.

The plants should be placed either direct in the sand bottom or in irregular shaped vessels made of Portland cement If these are not available, small pots of symmetrical design may be used, but should be completely concealed among the stones. It is a mistake to try to embellish an aquarium by introducing artificial objects such as stone statues, floating swans, etc. These only depreciate

(Concluded on page 34.)

Notes on Krefftius adspersus

ERWIN O. FREUND



Krefftius adspersus Purple-striped Gudgeon Photograph by H. E. Finckh

About ten months ago I arrived at the conclusion that if my aquaria were to continue to hold the interest for me which they should, I would have to secure some fishes that would be unique in these parts. I had seen the collections of practically all my fellow-members of the Chicago Aquarium Society, and all contained the usual run of aquarium pets. To be sure, some of these collections are splendid, but, taken on broad lines, they are much the same. Nothing new has been introduced for a long time, except the poeciliid hybrid. I wanted something which hadn't been seen here before, a fish which I could study in my pseudo-scientific way, discovering if possible its peculiarities and breeding habits. For various reasons my thoughts turned to Australia and New Zealand, and I later discovered that this was fertile territory from my viewpoint, as none of the fishes of that far-off corner of the globe had been brought to the United States. With this object in view I consulted the editor of AQUATIC LIFE, whose advice and assistance made the venture a success.

It was first necessary to find a devotee in Australia to co-operate with me, and a very capable and enthusiastic one was found in Mr. H. E. Finckh, of the Royal Zoological Society. Mr. Finckh succeeded in getting to me a number of native Australian species and, I am glad to add, has received from me a number of our American warm water fishes. In

addition it was necessary to secure the services of a reliable man on board ship, and also an aquarist in San Francisco to receive them. Both were found. Mr. R. Borden, of Oakland, voluntered to handle the fishes on arrival, and a very efficient party was found on one of the ships. This man was experienced in transporting birds, reptiles and small mammals, and soon learned to care for fish.

During the middle of May the first shipment arrived in San Francisco. Mr. Borden placed them in his tanks, where under his careful treatment they eventually recovered from the hardships of their three-weeks' ocean journey. It was not, however, until the end of July that Mr. Borden was successful in sending any on to me. The lot was well worth waiting for, and consisted of eleven specimens of *Krefftius adspersus*, from two to two and one-half inches long. This fish has been fully described in past numbers of Aquatic Life, but the descriptions are not glowing enough. It is a beautiful little fish, of exceptionally favorable appearance. While there is no real similarity, it reminds me of one of our own trout in miniature.

On August 19th one of the females appeared heavy with roe, and a male was in particularly bright dress. That evening the pair were removed from the others. The following morning they spawned, the eggs and nest appearing exactly as described by Mr. Gale in his article in the July number. The temperature of the water was 80 degrees Fahrenheit. The male continually agitated the eggs with his fins and, not satisfied with merely keeping fresh water circulating about them, he disturbed and shook them frequently. The eggs developed rapidly and became elongated. On the 22d, eyes were plainly visible and the embryos occasionally squirmed; on the 25th they became detached from the egg-capsules and were free swimming.

When first liberated the fry are very small, not much larger than those of the Paradise fish. I have fed them freely on infusoria and very green water, and they are doing well. The brood numbers about a hundred, and today (September 4th) averages about one-quarter inch long. The parents spawned again in another aquarium on August 26th, this time on a clump of algæ instead of on the side of the aquarium. This spawning was in a very obscure place, and impossible to observe. The eggs have since disappeared, but I have not noticed any fry.

Aquarium Notes

(Concluded from page 32.)

its quality and bring it down to the level of a cheap toy. We must bear in mind that if we desire to reproduce nature in our tanks we must eliminate all artificial makeshifts.

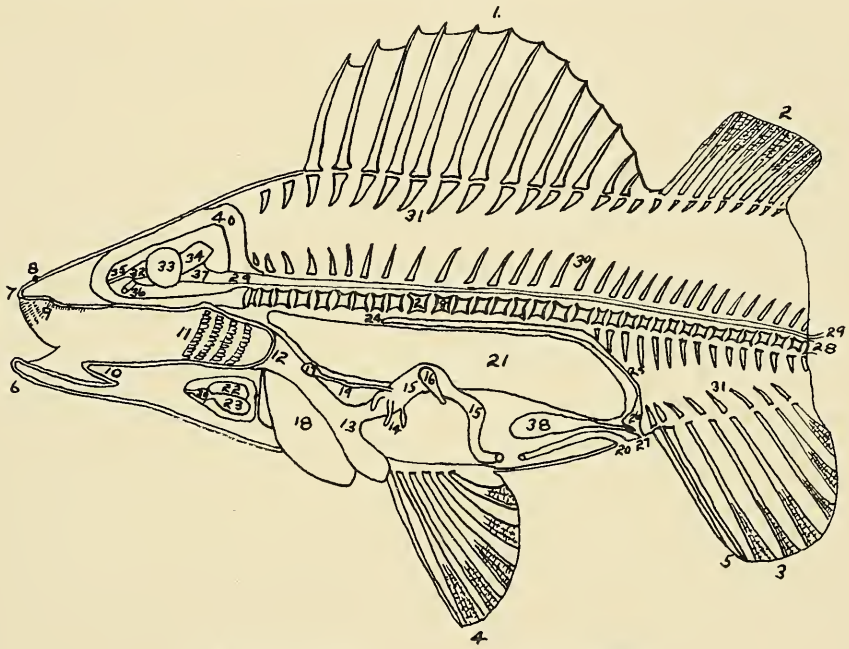
While some aquarists are opposed to direct sunlight for aquaria on the theory that it causes an excessive growth of algæ, and this in turn green water, years of experience have taught me that a daily exposure of no more than two hours is positively beneficial, the plants and fishes displaying more vitality. I have had an aquarium in an eastern window for over eight years, and the water always remains clear.

Goldfish and those species of the temperate zones can be held in ordinary room temperatures, but those from the tropic require a temperature, varying with the species, from 68 to 80 degrees Fahrenheit. To insure this it is necessary to install some system for heating the aquarium.

The problem of artificial aeration enters generally with the keeping of some fishes, especially those frequenting shallow and rapidly moving streams, and for overstocked and unbalanced aquaria that lack a sufficient number of growing plants to produce the needed oxygen for the inmates.

The Anatomy of the Fish

PERRY BRUCE CLARK



The Yellow Perch — Perca flavescens

1, Dorsal fin—spinous portion; 2, dorsal fin—soft portion; 3, anal fin—soft portion; 5, anal fin—spinous portion; 4, ventral fin; 6, mandible; 7, maxilla; 8, nostril; 9, teeth; 10, tongue; 11, gills; 12, oesophagus; 13, stomach; 14, pyloric coeca; 15, intestine; 16, spleen; 17, gall bladder; 18, liver; 19, bile duct; 20, anal orifice; 21, air or swim-bladder; 22, auricle of heart; 23, ventricle of heart; 24, kidney; 25, ureter; 26, urinary bladder; 27, uro-genital orifice; 28, spinal column; 29, spinal cord; 30, ribs; 31, interspinals; 32, cerebrum; 33, optic lobe; 34, cerebellum; 35, olfactory nerve; 36, optic nerve; 37, medulla oblongata; 38, ovary; 39, aorta; 40, skull or cranium. (Drawing by the author, after Linville and Kelly.)

In the study of any one animal a knowledge of other animals is of great help, therefore it may be worth while to briefly review the lower animals in the order of their complexity, from their simplest beginning, that of the single cell, up to and including our present subject, the fish. This review being somewhat evolutionary in character, it might be added that in trying to follow the course of evolution, we know very little or nothing at all of many links in the chain, as great numbers of them are now extinct (many more than are living today) of which no geological record has been found. We can, therefore, only guess

from the evidence at hand approximately what these links were.

After the formation of the earth, when the crust had cooled sufficiently to allow the vapors in the air to condense upon it, so forming the oceans, it is supposed that the first forms of life which appeared were unicellular in character, that is, composed of single cells—the lowest form in which life can exist. It has been assumed that of the two kingdoms, plant and animal, the former was the first to appear as plants are able to live at higher temperatures and can subsist upon an entirely inorganic diet; animals, on the other hand, require an organic source of food supply. It is reasonable then to suppose that the plant kingdom was the forerunner of the animal kingdom.

When animal life first appeared the simplest forms prevailed, namely, the Protozoa or single-celled animals. These varied in complexity from the very simple *Amoeba* to the more organized *Infusoria* and highest of all Protozoa, the *Tentaculifera*. During the subsequent ages the forms of life gradually increased in complexity by very slow steps from the single cells, of which there were almost countless numbers of species, to the sponge group which is the link from the highest Protozoa to forms like the hydra and the sea-anemone, which are among the first animals to possess a digestive cavity. All animals so far were composed of only two elementary layers of tissue; an outer layer or ectoderm and an inner layer or endoderm. The next highest existing group is the first to possess a third elementary layer of tissue, this being a middle layer or mesoderm. An example of this group is the planarian worm, which is about one quarter to three-eighths of an inch long, resembling very much in outward appearance a small leech and generally found around decaying vegetable matter in ponds. Up to this stage all the existing animals are invertebrates, or, in other words, do not possess a backbone. A vertebrate is an animal with a backbone or spinal column, having a spinal cord or great nerve lying above it. It is to this group that man and all the higher animals belong. One of the first animals which shows a tendency toward vertebrate structure is the lancelet. This is not a true vertebrate, but forms one of the very few connecting links existing today between vertebrates and invertebrate. This fishlike animal, about two inches in length, lives almost completely imbedded in the sand on the sea bottom. Along its back passes a notocord or primitive backbone, and above this lies the spinal cord. The notocord is soft, but sufficiently strong to act as a support for the body. This brings us to the fish proper.

One of the most representative of the fishes is the perch, consequently a great deal of the following description relates to it primarily, but may also be applied to a great many other species. We will first consider the external appearance. The body is elongated, compressed from side to side, and tapers at both ends. It is divided into three parts, the head, trunk and tail. One of the first things that strikes our eye as we look at a fish are its fins. These are generally five in number; three unpaired and two paired ones. The unpaired ones are the dorsal, caudal and anal fins; the paired ones the ventral or pelvic and the pectoral fins. There is present in some fishes another, called the adipose fin, situated on the dorsal surface between the dorsal and caudal fins. It is usually small. The dorsal (1 and 2) and anal (3 and 5) fins are divided into two parts, the spinous (1 and 5) and the soft (2 and 3) portions. These two parts are supported

by two kinds of fin-rays; the spinous portions by hard, unsegmented and unbranched rays or spines; the other by soft, segmented and branched rays. The other fins are of the branched form. The caudal fin or tail is the one generally used for propulsion. A movement of the caudal to the right will bring the fish forward and to the left, a movement to the left brings it forward and to the right; by means of two strokes in quick succession, one to the right and one to the left, the side motion is counteracted and the fish moves forward in a straight line. The other fins are generally used in steering and in maintaining an equilibrium. Along the side of the body, generally half way between the dorsal and ventral surfaces, is what is called the lateral line. Along this line the scales are somewhat modified, and beneath them are situated sense organs that respond to very low frequency vibrations, it being supposed that these organs stand between those of true hearing and those of touch.

Protective coloration, which nearly all fishes possess in greater or less degree, is fairly well developed in the perch. The dorsal surface is of a rather dark shade to correspond with the dark bottom of most lakes and streams when the fish is viewed from above. The ventral surface is of a very light color to correspond with the light of the surface when the fish is viewed from below. And lastly the sides are more or less mottled, which makes the fish much less conspicuous in his surroundings of vari-colored roots, plants and rocks. The mouth consists of two portions; the lower moveable jaw or mandible (6) and the stationary upper jaw or maxilla (7). On the snout, a short distance above the mouth, are situated two small projections, which are the nostrils (8). They are peculiar in the fishes, as contrasted with other animals, in that they are not connected with the respiratory apparatus. The eyes are moveable, but have no eyelids. Behind the eye, on each side of the head, is situated an opercle or gill covering. These opercles protect the delicate gills, and if necessary may be clamped down with surprising strength.

It has been said that there are only two things worth while to a perch, and these are "To eat and not to be eaten." We have already seen how the perch avoids being eaten by his powers of locomotion and somewhat protective coloration. We will now see how he eats.

Most fish have teeth, the most primitive of which are small papillæ or rough elevated spots. The two kinds most generally found, however, are more pronounced in form and are the moveable teeth and the firm or fixed teeth. They may be situated on the lower jaw or mandible only or on both the mandible and maxilla or upper jaw, depending upon the species. The moveable teeth are merely imbedded in the skin of the mouth, and generally indicate that the fish possessing them subsists mainly on a herbivorous diet. The fixed teeth are larger and stronger than the moveable ones, and are firmly set in the bone beneath the skin. This form is generally possessed by the carnivorous fishes, and helps them in holding fast their prey. In some fish a few of the teeth in the front of the mouth are enlarged and are called incisors, being used for cracking snail and crab shells. In the sharks the teeth are being continually formed on the inner margins of the jaw and the old ones pushed out over the edge. On the ventral surface of the mouth is a fleshy, generally immoveable tongue (10), which varies in size in the different genera. Back of the tongue is the pharynx, with gill slits on both sides, which allow the

water to pass out over the gills (11), thus aeriating the blood passing through them. From the pharynx a short œsophagus (12) leads to the stomach (13), which is a blind tube with the intestine (15) leading out from it a little below the centre. A short distance from the stomach, along the intestine are several pyloric coeca (14), which correspond to some of the digestive glands in the higher animals. These coeca empty digestive fluids into the intestines. Below the beginning of the intestine is the liver (18) with its gall bladder (17) and a bile duct (19) through which the bile flows into the intestines. Another small organ along the alimentary canal, but not connected with it, is the spleen (16). The function of this organ is still a mystery, it being supposed, but not proven, that it assists in the production of blood. In passing it might be mentioned that herbivorous species generally have a very long intestine, which in some fish is coiled around the air bladder, while in the carnivorous fishes the intestine is relatively short. Finally the intestine ends at the anal orifice (20), which is situated a short distance in front of the anal fin.

The air bladder (21), or swim bladder, as it is sometimes called, is a comparatively large membranous sac, filled with air, and generally reaching the length of the body cavity. By means of muscular movement it is contracted or expanded accordingly as the fish wishes to sink or rise. This contraction or expansion increases or decreases the density of the fish, thereby making it heavier or lighter than water. Some fish that spend their lives on the bottom have little or no swim bladder, and are therefore unable to rise or sink without the use of the fins.

The gills (11) are eight in number, four on each side. Each consists of a bony arch, which supports the delicate gill filaments. The blood passing through the fine capillaries in the gills gives off its carbon dioxide from the body and takes up a fresh supply of oxygen from the water passing over the gills. Extending into the pharynx from the gill arches are a number of bones arranged like the teeth in a comb these are called gill-rakers and are supposed to act as strainers.

The heart is fairly simple, possessing only one auricle (22) and one ventricle (23); in the higher animals there are two of each. It is placed in a rather large cavity called the pericardial cavity, the posterior or rear wall forming a thin membrane between the pericardial and the digestive or body cavity. The blood coming from the body is received by the auricle, which is a large, thin-walled chamber, it then enters the ventricle, a smaller, thick, muscular-walled chamber, which it is pumped by a muscular contraction through an artery called the aorta (39) to the gills, where it is aeriated. After aeriation the blood is collected by an artery called the dorsal artery, through which it is distributed to the various organs. In the fine capillaries of the organs the blood gives up the supply of oxygen it is carrying and collects carbon dioxide and other waste products. It then flows back to the auricle of the heart through the veins, thus completing the circle. There is also a lymphatic system, which acts in a supplementary capacity to the blood. The fluid which circulates in the lymphatic system is a milky fluid called lymph, which helps to distribute food throughout the system, and also, to a certain extent, to pick up waste matter.

The principal organs of excretion are the kidneys (24). These in the perch are long, thin bodies, which extend along the upper surface of the air bladder,

just under the spine. There is a tube called the ureter (25), leading from each kidney. The ureters join and then empty into the urinary bladder (26), which in turn empties into the uro-genital opening (27), situated directly behind the anal aperture. The kidneys filter all waste matter out of the blood as it passes through them; this waste matter is eliminated in solution in the form of urine.

The skeleton is formed of bones composed largely of calcium phosphate. Extending from the head to the tail is the vertebral column or backbone (28). This is composed of a number of separate bones, each being called a vertebra. Along the dorsal surface of this spinal column is a groove, in which rests the spinal cord (29). To the backbone the skull or cranium (40) is attached, and along its length a number of ribs (30) project and serve as a protection and support to the body cavity. A small row of bones called the interspinals (31) support the unpaired fins. The pectoral and ventral fins are each supported by a framework of bones called the shoulder girdle and the hip girdle respectively.

The brain is divided into four principal parts; the cerebrum (32), the two optic lobes (33) (only one being shown), the cerebellum (34) and the medulla oblongata (37), which is extended to form the spinal cord. The cord, as has already been mentioned, lies in a groove in the vertebral column, and from this branch most all the main nerves of the body except some of the sensory nerves. Extending forward from the cerebrum is the olfactory nerve (35) which connects the nostrils. The organs of hearing in the perch are very peculiar, being simple in comparison with the ears of the higher animals. They consist of a closed cavity on each side of the head. Contained in each of these cavities is a small concretion or stone, made of calcium carbonate and called an otolith or ear-stone, besides the capacity for hearing they are supposed to be of service to the fish in maintaining an equilibrium. These otoliths are also found in some of the lower animals, such as the jelly-fishes and some medusæ. The sense of taste is not greatly developed. The vision is fairly clear, though at short distances only.

The muscles of the fish differ from those of the higher, warm-blooded animals in that they are generally white in color and are composed of large flakes. The largest of all the muscles is the great lateral one, reaching the whole length of the body on both sides and controlling its movements. There are also other smaller muscles which control the jaw, eyes, fins, etc. In some fishes, such as the salmon and herring, the muscles are orange or red, but this color is due to the presence of certain oils and not to blood, as in the higher animals.

The reproductive organs consist of the ovary (38) in the female and the spermaries or testes in the male. These extend forward from the uro-genital opening and are connected with it by the oviduct in the female and the vas deferens in the male. It will not be necessary to go into details regarding reproduction, as every aquarist is familiar with both the oviparous and viviparous forms. The process of fertilization of the egg and the development of the embryo is a very interesting study, but space will not permit its discussion at this time.

"I wonder if the little goldfish feels that he is penned up?"

"I doubt it. Take my own case. Theoretically I could go anywhere in the world. Practically I merely swim around in a circle like that fish."—*Kansas City Journal.*

Breeding Habits of The Burmese Eel

This eel (*Amphipurus cuchia*), which is brought at times to us from China, is well known to many of us, and for eight years I have had three of them in a rather large tank. On the 7th of January I noticed that some eggs had just been laid, giving me the opportunity of studying the behavior of the adult fish towards the eggs.

Many of you know how the Paradise Fish (*Macropodus*) breeds, and have watched the construction of the nest and the method of depositing the eggs. The fish makes a nest of air-bells by inhaling air from the surface, holding it in the mouth for a short time, and then letting it escape mixed with saliva. A mass of coherent air-bells, two to three inches in circumference, is thus formed, and the eggs which have been laid are gathered by the male fish in his mouth and placed amongst the air bubbles. He watches over the eggs until hatched, and the young until old enough to take care of themselves.

The Burmese eel acts in a very similar manner. Always the one eel gathers the eggs and places them in the air-bubble nest, watching them unremittingly until hatched. The eggs are fairly heavy and readily sink from the nest when the tank is tapped or the water disturbed; but the fish replaces them immediately. I have seen the eel gather as many as eight eggs in his mouth at once, and then put them back in the nest. He pokes his head right through the nest and endeavors to place the eggs on top of the mass of bubbles.

In about eight days the young are plainly visible, wriggling about in the egg. The eggs, being on top of the nest, and in some cases quite half an inch above water-level, are fairly dry, and the embryo eels become very active when the eggs are moistened by sprinkling with water.

The eggs hatch in twelve days, and the young remain in the nest for quite a week. A couple of weeks after the eggs were laid I found one of the adults at the bottom of the tank. Perhaps it had been trying to get at the young and had paid the penalty.—H. E. Finckh, in *The Australian Naturalist.*

The Name "Water-flea"

The origin of "water-flea" as a common name for *Daphnia*, which are not insects, is explained in the following excerpt from the chapter on the Cladocera by Birge, in Fresh Water Biology:

"When men began to study nature by the aid of the microscope in the seventh century the "insects" were among the first objects to be examined. In 1669 the Dutch physician, Swammerdam, described in his history of insects the '*pulex aquaticus arborescens*'—the water-flea with branching arms. This was one of the Cladocera, still called *Daphnia pulex*, the commonest species in shallow pools. These creatures he described and figured, giving an account of their structure and habits and speaking of their sudden appearance in enormous numbers, and their equally sudden disappearance.

For nearly a century little was added to the knowledge of the group. In 1755, the German, Schaeffer, gave the first really good account of their strucutre. In 1785, O. F. Mueller, the Danish naturalist, issued the first general systematic work upon Entomostraca. This described many of the species as we now know them, and gave a firm scientific basis for further knowledge of the Cladocera. In the rapid advance of science during the latter half of the nineteenth century the systematic work of the group was sub-

stantially done, the Norwegian, G. O. Sars, having contributed more than any other one man. This work showed that the Cladocera constitute the largest group of fresh-water crustacea in number of species; the most diversified in size, in structure, and in habits."

A Bloated Axolotl

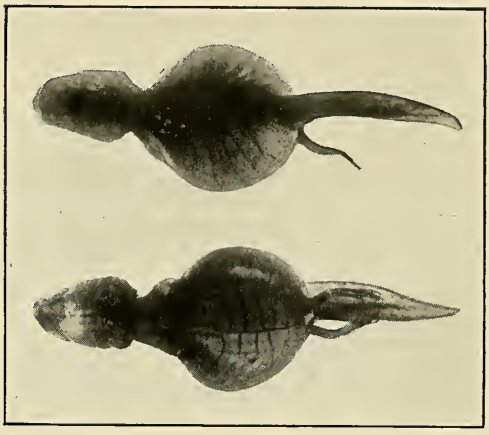
EDGAR R. WAITE, F. L. S.

It is within the experience of most breeders of these remarkable amphibians that, out of every hatching, one or more larvæ may be expected to, unintentionally, of course, become like the frog that wished to be as big as an ox.

In his article on these batracians (Aquatic Life, Vol. I, p. 130) Mr. W. L. Brind states that the "bloating disease" is a result of too frequent feeding; a friend of mine in Sydney maintains that it is the result of starvation, but neither explanation is satisfactory. It is not, however, my present object to consider causes, but merely to record an interesting experience.

Though I have seen quite small larvæ with the disease, I am here writing of one in which the malady did not become manifest until the larva was fully four inches in length. The swelling took place somewhat rapidly, for within three months, when the creature had grown another inch, it was unable to descend, but remained at the surface, belly upwards; it was still able and willing to feed if a worm were offered to it. When held to a strong light its body was seen to be transparent, and its weight, when in the air, suggested that it was distended, not with air but with water.

Having reached a stage when it was neither useful nor ornamental, and doubtless a burden to itself, I decided to perform a slight operation: reducing and rounding one end of a 3-16-inch glass tube, I inserted the nozzle thus formed, into the vent, catheter-wise, being careful not to damage the delicate membranes. As soon as I judged the tube had passed the cloaca, a stream of clear liquid, apparently pure water, issued from the tube with considerable force, induced by the tension of the distended body. When the



Upper and Lower Views of the Bloated Axolotl

liquid ceased to flow, the body of the poor creature was nothing but skin and backbone. Next day it recommenced to feed, and soon became a respectable member of axolotl society. I regret to say, however, that the operation proved a palliative only, for before long the animal again began to swell, and in a few weeks regained its former bloated condition.

I noticed that it now floated with part of its head and chest out of water, and as it could scarcely be supposed to be enjoying its amphibious existence, I decided to put an end to it; its death, however, occurred in a manner I had not anticipated or intended.

Wishing to preserve a memento of this peculiar condition I took two photographs (here reproduced) by transmitted

light and was in the act of returning the animal to the water when it slipped out of my hand and fell to the floor, flop!—and burst!

An interesting fact now became revealed: the axolotl, being unable to keep its head under water, had been breathing atmospheric air, and the most noticeable objects exposed as a result of the catastrophe were a pair of well-developed lungs. I also noticed that the gills had greatly diminished; the larva was, in fact, becoming a Amblystome, though surely an abnormal one. (The Amblystome is the adult stage, wherein the animal lives on land and breathes by means of lungs.)

The Hudson County Aquarium Society, of Jersey City, New Jersey, held its first annual exhibition in the Museum of the Jersey City Public Library on the afternoons and evenings of October 5th and 6th.

The display of goldfish attracted considerable attention, due to the large variety and perfection of the specimens. Here were the "old timers" in little groups, heads together and mumbling in low tones, with their eyes focused on certain tanks. There were forty tanks, each containing from four to twenty fish.

The section for tropical fishes was well patronized, and justly, too, for here was displayed the largest collection, both as to species and number of specimens, that has been brought together in this vicinity for quite some time. Some almost forgotten fishes were in evidence.

The exhibitors and those who otherwise contributed to the success of the exhibition were: Messrs. Wright, Fidell, Kissel, Fanning, Amelung, Albietz, Sidell, Smith, Renken, Koenig, Savage, Obermiller, Smail, Heath, Shaw, Hedden, Pyle, Krebs, Elliott and Warn.—*Abridged from the report of G. C. Albietz, secretary of the society.*

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912, of Aquatic Life, published monthly at Philadelphia, Pennsylvania, for October 1, 1918.

State of Pennsylvania } ss:
County of Philadelphia }

Before me, a notary public in and for the State and County aforesaid, personally appeared W. A. Poyser, who, having been duly sworn according to law, deposes and says that he is the editor of Aquatic Life, and that the following is, to the best of his knowledge and lief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, to wit:

That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Joseph E. Bausman, 542 East Girard Avenue, Philadelphia, Pa.

Editor—W. A. Poyser, 207 South 37th Street, Philadelphia, Pa.

Managing Editor—None.

Business Managers—None.

That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

—*Owners*—Joseph E. Bausman, 542 East Girard Avenue, Philadelphia, Pa.; W. A. Poyser, 207 South 37th Street, Philadelphia, Pa.

That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of the total amount of bonds, mortgages, or other securities are: *None.*

W. A. POYSER, *Editor.*

Sworn to and subscribed before me this 26th day of September, 1918.

(Seal) Josephine V. Yeager.

(My commission expires at the end of the next session of the Senate.)

During the winter ascertain how warm—not how cold—you can keep your tropical fishes. Cold is a big factor in retarded growth.

Aquatic Life

An international monthly magazine devoted to the study, care and breeding of native, exotic, gold and domesticated fishes, other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....Editor

JOSEPH E. BAUSMAN.....Publisher

542 E. Girard Avenue, Philadelphia.

Entered as second-class matter, September 2, 1915, at the Post Office, Philadelphia, Pa., under Act of March 3, 1879.

Practical articles and notes on topics pertaining to the aquarium and terrarium are always wanted for Aquatic Life. Readers of the magazine are invited to join in making it a medium of mutual help, and to contribute to it any ideas that may occur to them. The pages are always open for anyone who has anything helpful and practical to say. Manuscripts, books for review and general correspondence should be addressed to the editor.

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Vol. IV. November, 1918 No. 3

Important!

With the number for January, 1919, the subscription price of AQUATIC LIFE will be advanced to $1.25. Single copies, fifteen cents.

To conform to the regulations of the War Industries Board, unsold copies of periodicals cannot be returned for credit by newsdealers and other wholesale agents. Readers who purchase copies from these sources are urged to place a definite order in advance. The pet shops throughout the country, which are agents for AQUATIC LIFE, will receive and forward subscriptions. This is perhaps the best way to insure against missing a number.

JOSEPH E. BAUSMAN,
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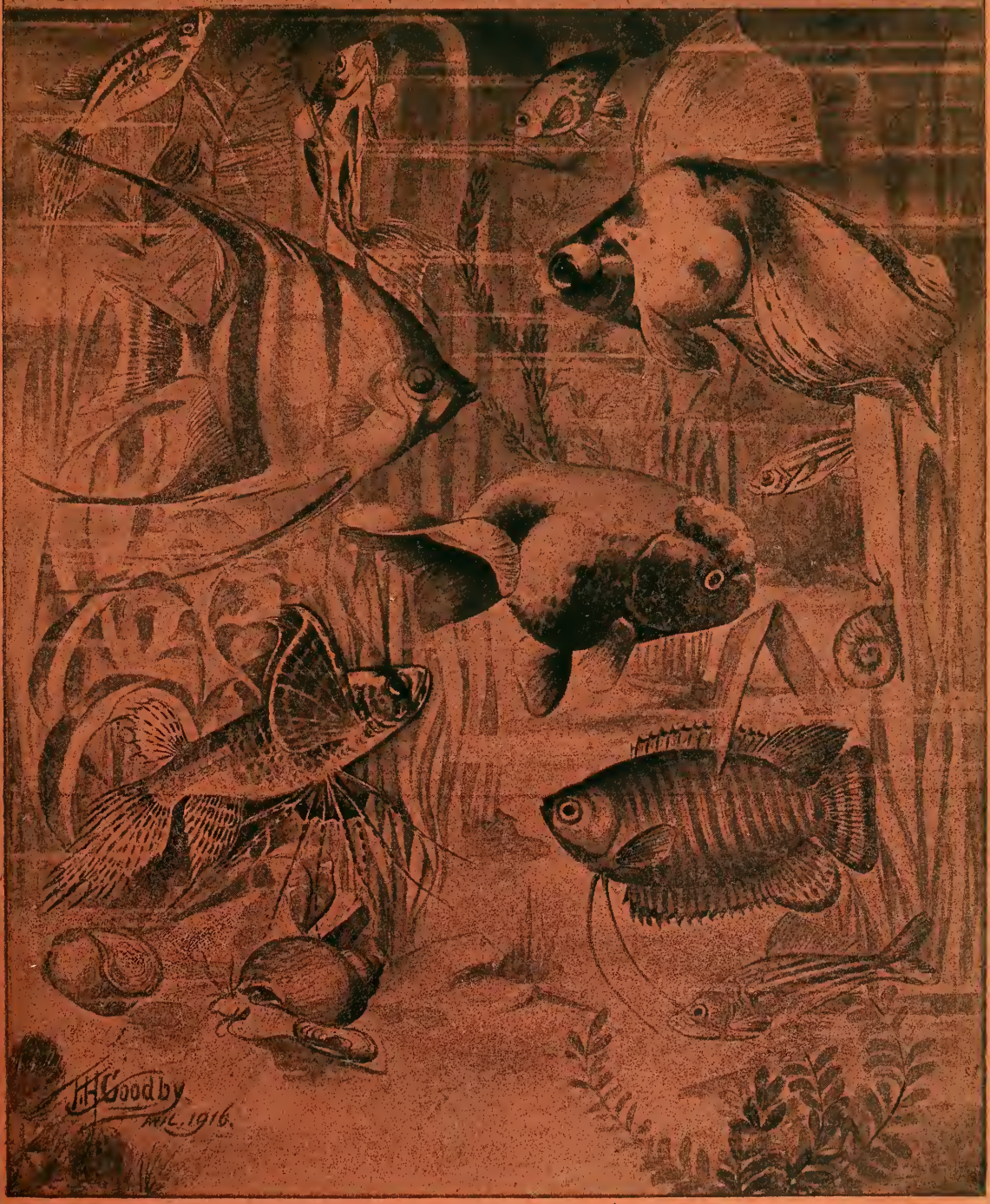
December 1918 10c Copy

Aquatic Life



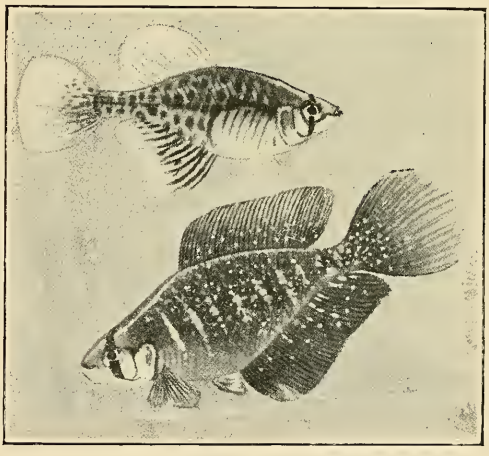
Cynolebias Bellottii

WALTER LANNOY BRIND, F. Z. S.

As far as our collections of fishes in America are concerned, *Cynolebias bellottii* is an exceedingly rare fish, in fact, I don't believe a specimen still persists alive. To the best of my knowledge the fish has only appeared in collections in and about New York City, and that some time since. Mr. J. Arthur Osborn, one of the "old-timers" of the Aquarium Society, New York City, was one of the proud owners, and it was in his home that I had the pleasure of seeing the species for the first time. He didn't succeed in breeding it, nor did others here, but "overseas" the aquarists were more fortunate.

The male is a beautiful shade of indigo or sea blue, darker on the back. Over this ground color are numberless sky-blue or pearly gray spots; a vertical black stripe runs from the top of the head downward through the eye to a point below. Dorsal fin, dark blue; anal, metallic blue-green. Vertical stripes of dark gray cross the body, with spots of same color on the dorsal and anal fins. The female is garbed in modest grayish-brown, shading to white beneath. The anal and dorsal fins are much smaller.

Instead of depositing its eggs on water plants, as in the case of its allies in the genera *Rivulus* and *Fundulus,* this fish buries the eggs separately in the sand, the male standing on its head and boring the holes in the bottom with his snout! The female approaches, with trembling and fluttering movements on the part of both sexes, and protrudes her oviduct, or egg-depositing tube, whereupon both dart upward through the water and down again to the hole, wherein the female deposits a single egg. This the male promptly fertilizes and then covers with sand. From fifteen to twenty eggs are thus stowed away daily, with intervals of eight to fifteen minutes, for perhaps eight to ten consecutive days. If the adults are well nourished a similar period



Cynolebias bellottii

of sexual activity will commence a week hence. Thereafter a temperature of 75 to 80 degrees Fahrenheit should be maintained; other than for the fry and during breeding activities, 70 degrees will be sufficient.

Schneising, who bred the species, claimed that it took six months for the eggs to hatch, but that is most unlikely. He doubtless figured from the time his first eggs were deposited, and they may have been infertile. The concensus of opinion places the period of incubation at from seven to eight weeks, with a

slight variability according to the water temperature. There is much still to be discovered concerning the proper treatment of the eggs during the hatching period.

This Cynolebias is a native of the Argentine Republic, being found especially in the La Plata River. It is said to inhabit cool, clear waters which contain a small percentage of nitrate of potash, the mineral salt commonly known as saltpeter. A certain amount is considered essential to the welfare of the fish when kept in the aquarium. Specimens have been imported that measured from three to four inches long, but at half this length have been found sexually mature and have bred in aquaria. It is a fish well worth while.

Miscellaneous Notes

NICHOLAS NACKS

A male of *Danio albolineatus* has been found sexually mature when four months old. A male of that age bred by the editor was used with an older female by George W. Price.

Hybrids derived from the following combinations have been reported: *Heterandria formosa x Lebistes reticulatus, Phalloptychus januarius x Lebistes reticulatus, Xiphophorus helleri x Limia caudofasciata.*

In the spawning operation of *Haplochromis strigigena,* the common mouth-breeder, according to a recent observer, the eggs are gathered by the female as soon as fertilized, without waiting for the extrusion of the full complement.

Speaking generally the species of *Xiphophorus* kept by aquarists do not agree in color patterns with the species of similar names as described in systematic works. This is probably the result of indiscriminate cross-breeding. Pure species have apparently not been imported for several years.

Boxes of soil used for the propagation of the white worm, *Enchytraeus albidus,* soon become populated with a variety of forms of life—larvae of various insects, mites, common earthworms, etc., none of which seems to be detrimental. The mites are not relished by the fishes, probably because of the bitter taste incidental to the presence of formic acid. In one box podurids made their appearance in great numbers, and proved a good food.

During the winter meal worms, the larvae of certain bettles, are splendid food for the larger, "strong-jawed" fishes. In the fall of the year any wholesale grocer, and some smaller fellows, can supply "wormy meal," in fact, they'll be glad to have you carry it away.

Away off in Australia the aquarists have a number of exotic fishes which would be highly prized in America today, among them *Barbus phutunio* and *Rasbora cephalotaenia.* Some of the native Australian fishes are mighty interesting, and could be carried through our winters at ordinary house temperature.

The hornwort, *Ceratophyllum demersum,* is a peculiar plant in several particulars. It is one of the few species in which fertilization is effected under water. The plant floats freely in the water; when found attached the condition is purely accidental, as it possesses no roots. The embryo develops a single rootlet, but this soon disappears, and none are subsequently formed. The functions of life are performed indiscriminately by all parts of the plant-body.

Mr. William Guild, 33 Main street, Winter Hill Postal District, Boston, Massachusetts, desires to enter into correspondence with aquarists interested in snails and willing to exchange specimens.

Tillaea Recurva and Other Notes

H. E. FINCKH

Royal Zoological Society of New South Wales

In *Tillaea recurva,* a species peculiar to Australia, I have found a satisfactory aquarium plant. It occurs in various localities around Sydney, in pools, from which it creeps onto swampy banks and even to dry situations beyond. I have met it growing, much stunted to be sure, in perfectly dry places, which, however, are covered with water at times.

As an aquarium plant it is useful as well as ornamental. It is graceful, grows freely, and forms dense masses of a pleasing light green. Contrary to expectations (being semi-aquatic), it is always submerged in a tank eight inches deep; in shallow tanks but a few inches deep it will, when it becomes dense, appear above the surface. Roots form on the stems, but generally where branches occur; when a stem lies horizontally roots will appear throughout its length. A small piece pinched off and placed in the sand takes root rapidly.

In a poorly lighted aquarium it will not do well, and is apt to break up and float near the top, where all the small pieces will develop rootlets. In this condition it will not protrude above the surface.

In my aquaria and ponds it shows no change during the winter, when the temperature may drop to 40 degrees Fahrenheit. How it will do under colder conditions I do not know.

For two years I have had a small tank, holding six gallons, at a window in our sitting room. The position must be admirable. From the first the water has been crystal-clear, not even has the glass been cleaned.

A month ago our piano was tuned and cleaned, naphthaline being employed to destroy any moths. Two days later the water in the tank turned milky. I left it thus for fourteen days, and then

Tillaea recurva

changed the water. Again it turned milky, the odor of the napthaline still persisting in the room. Since I have moved the tank to another room and again changed the water the milky condition has not returned. The fishes, *Gambusia* and *Oryzias* (Medaka), were not affected.

In my early fish days I was ever at a loss how to keep the inside of the glass

of my tanks bright and clean. I employed scrapers, pads, brushes and goodness knows what not; all more or less unsatisfactory. One day I picked up a piece of cuttlebone at the seashore, took it home and found it to work wonders. There is nothing equal to it; appears to polish as well as clean the glass. Its use in this connection is mentioned in one of the earlier numbers of Aquatic Life, but only quite incidentally. As A. L. has many new subscribers now, it may be well to mention the use of cuttlebone in a more prominent way. No matter how hard the coating, the bone removes it with the greatest ease.

(*Tillaea* is a genus in *Crassulacaea*, the orpine family—stonecrops, houseleeks, etc. *Tillaea aquatica* is an allied American species, and has been recorded from some New England States, eastern Pennsylvania, Delaware and probably elsewhere. The Australian species bears some resemblance to *Anacharis* in general aspect, but is rather brittle and seems to branch more freely.—*Editor.*)

Another Tank Heater

ARTHUR KUHN

Mr. H. M. Hale's description of an aquarium heater (Aquatic Life, September, 1918) prompts me to describe an arrangement which I have used during two winters with success. It may appeal to aquarists who do not care to use gas or oil for the purpose.

The heater consists of a narrow, cylindrical flower-holder of glass and an electric bulb of a size to be slipped into the holder, with necessary wiring, socket and plug. The flower-holder, which is greater in depth than the water in the aquarium, rests on the bottom, small lead shot being used to sink it. The electric bulb is placed in the holder and connection made to the nearest electric fixture.

Aquaria holding from eight to twelve gallons have been kept sufficiently warm by this scheme. The temperature may be regulated by raising or lowering the lamp, or by floating it in water placed in the holder, the proper depth being determined by experiment.

To conserve the heat, and also to prevent fishes leaping into the heater, some sort of a lid should be placed on the holder. Products of combustion being absent, no consideration need be given to draft.

Heating vessels of transparent glass have the advantage that, even in corners not receiving proper natural light, the plants will grow splendidly, while the fishes do not seem to be annoyed by the artificial illumination. Instead of flower-holders, any other vessel of suitable shape and material may be used. The vessel used by Mr. Hale is very similar to mine, which I bought in a "10-cent store."

I prefer the old-fashioned carbon filament lamps, as more heat is generated than by the modern tungsten bulb, even though the current consumption of the latter is smaller. The glare of the light can be softened by grouping plants about it.

(By using an outside or waterproof porcelain socket and carefully sealing it with a good elastic aquarium cement placed around the base of the lamp and in the holes through which the wires run, the lamp may be safely immersed in the water of the aquarium without the protecting jar.—*Ed.*)

Perhaps the chief concern of all organisms is to provide material for carrying on the complicated chemical processes that are going on within—that is, to get food and oxygen.—*H. S. Jennings.*

Aquarist versus Aquarian

IDA M. MELLEN

Secretary, New York Public Aquarium

What is the correct title for a person who understands the management of aquaria? For some years this has been a vexed question. *Aquarian, Aquarium-keeper, Aquarist,* and other names have been given. A similar difficulty accompanied the selection of a word to describe a receptacle or building containing live aquatic plants and animals, *aquavivarium* and other names having been used before *aquarium* was finally settled upon.

The euphonius and unique name of "Aquarial Garden" was bestowed upon an aquarium opened in Boston in 1860. Professor E. S. Morse, President of the Boston Society of Natural History, thinks it may have been suggested by Agassiz, who was greatly interested in the institution. The *Leisure Hour* of 1864 states that Agassiz "may frequently be seen walking towards the Boston Aquarial Gardens." As the histories and guide-books of Boston covering that period tell very little about the opening of the Aquarial Garden, it is interesting to learn from Professor Morse that the exhibition consisted of "individual aquaria round the hall, and in the centre a huge tank, in which seals, a shark and other animals were displayed. Afterwards a group of Africans, Zulus, Hottentots and other negroes danced and sang on the stage."

Such awkward words as *aquavivarium* and *aquarium-keeper* are not likely to become popular. A book in our Aquarium library, published sixty years ago in London, is entitled *The Aquarian Naturalist.* This is typically English. From old American dictionaries we learn that Aquarians were members of an heretical Christian sect that flourished about the middle of the eighteenth century and were so called because they used only water at the Lord's Supper. Murray's *English Dictionary,* at present the standard dictionary in England, gives this definition, and also defines *Aquarian* as "One who keeps an aquarium." It also states that the word has been used, though rarely, as an adjective, an article in the *Intellectual Observer* for 1865 being entitled "Aquarian Principles."

The word *Aquarist* was adopted some years ago by the New York Aquarium. In perfectly correct form, probably, it should be *Aquariist;* but the contraction is preferable. The publishers of the *Century Encyclopedia,* conferring with the officers of the Aquarium on the subject several years ago, stated that in view of our adoption of the word, its usage would be regarded as established, and they purposed inserting it in the next issue of their encyclopedia. This has not yet been printed.

Mr. W. A. Poyser, editor of AQUATIC LIFE, revived the word *Aquarian* in 1916, and has since used it in his magazine, though he also uses *Aquarist.*

Mr. Poyser advised the writer last summer that he had received intelligence of the formation of an astrological society in Boston for the purpose of studying mental, moral and physical effects of planets on human beings. As the world was passing through the portion of the universe dominated by the sign Aquarius,

the society was named *The Boston Aquarian Society,* its members being known as Aquarians. Mr. Poyser's informant expressed a humorous fear lest a confusion of the titles *Aquarian* and *Aquarist* lead to the latter being accused of star-gazing. But however that might be, aquarium lovers may take assurance from the moral in the old story about the little boy who, being a star-gazer, finally fell into a pond while looking skyward—which only shows that he was obliged to direct his attention to aquatic life sooner or later.

It is true that the word *Aquarian* has proved most versatile, having found a place successively in the realms of religion, pisciculture and astrology; but *Aquarist,* being capable of but a single construction, seems to hold the advantage.—Reprinted by permission from the *Zoological Society Bulletin,* New York.

Photosynthesis

When it was first discovered that green plants take in carbon dioxide and give out oxygen, it was natural to suppose that this gas exchange represented the respiration of plants. Since the gas exchange in the respiration of animals is just the reverse, the opinion became current that plants and animals differ in their "breathing." Since this impression is still current, its correction should be emphasized. It is clear that photosynthesis has nothing to do with respiration, for respiration is associated with what may be called the act of living, and therefore is carried on by every living thing all of the time. If respiration stops, the plant or animal is dead; in fact, we use respiration as a sign of life. Therefore plants and animals "breathe" alike, both taking in oxygen and giving out carbon dioxide; but green plants carry on the process of photosynthesis also, in connection with which carbon dioxide is taken in and oxygen is given out. The confusion arose from the fact that during the day, when photosynthesis is going on, the amount of gas exchange involved in the manufacture of carbohydrates is so much greater than the amount involved in respiration, that the latter was not noticed. If the observation had been extended into the night, however, it would have been discovered that only the gas exchange of respiration was being carried on.

Carbohydrates are by no means the only foods that plants make, and therefore photosynthesis is not their only process of food manufacture. Another conspicuous group of foods is the group of proteins, which may be regarded as foods in the most advanced stage as living photoplasm is largely composed of proteins. Carbohydrates, therefore, may be thought of as the first stage of food, and protein as the last stage. It is known that neither light nor chlorophyll is required for the manufacture of protein, for the process goes on in living cells removed from light, and in plants containing no chlorophyll. It is known, however, that carbohydrates are used, and that to the carbon, hydrogen, and oxygen supplied by them, the elements nitrogen, sulphur, and often phosphorus are added, and these elements are obtained from their combinations in the salts of the soil.

The role of green plants in the world, therefore, is evident. It is only by them that food can be made from that which is not food. For this reason they are the only independent organisms, that is, independent of the work of other organisms. When we see the phrase "nothing but leaves," with its implication of failure, we must realize that leaves stand for the most fundamental of all the work of the earth, without which there would be no world of living beings.—*American Museum Journal.*

The Emotions of Fishes

ALBERT GALE

Royal Zoological Society of New South Wales

Have fishes sensibilities akin to those of warm-blooded animals? We know they have the natural feelings of love, courtship and matrimony. If we watch fish that are under the confinement of an aquarium during the connubial season we see they are actuated in precisely the same way as are warm-blooded animals. Each sex has its rivals in greater or less degree, and the period of courtship varies; sometimes it is lengthened into days, at other times it is "love at first sight." When there are several fish of one variety in the tank, and the sexes are not equal numerically, some are left unpaired, and the unfortunate ones are very soon worried and bitten to death. This is a trait with paradise fish. As a rule these are monogamous, although on one occasion I saw a case of polygamy. Where fish live solitary lives their matrimonial traits differ from those of gregarious fish. Gold and other carp are communal. Two male zebra fish (*Cichlasoma facetum*), when separated one from the other by a sheet of glass only, will for days be striving for a combat. By their pugnacious characteristics we know they have the capacity of hatred and malice. Should they by any chance get together, then begins a struggle for the mastery. First they view each other from a distance with every sign of enmity and rancour, approaching each other with open mouths. They soon become interlocked, the one is held by the upper and the other by the lower jaw; it then becomes a tug-of-war to the finish, unless there be a means of escape. That they are sympathetic with their own young there is ample proof. When in captivity they are timid and fearful, even when generation after generation have been reared in captivity. We have seen them, when disturbed by a sudden noise, remain for a moment or so motionless, tremble, then sink to the bottom, gasp for breath, and with fins quivering literally die of fright.

In an aquarium the most interesting functions of fish life are lost to view if the law to "replenish the earth" be neglected. For without the patient investigation of the laws relating to procreation and the perpetuation of species, all written language relating thereto fails to enlighten the observer of nature's most interesting processes, how she works out her hidden secrets and at the same time reveals to the student how she "replenishes the earth."

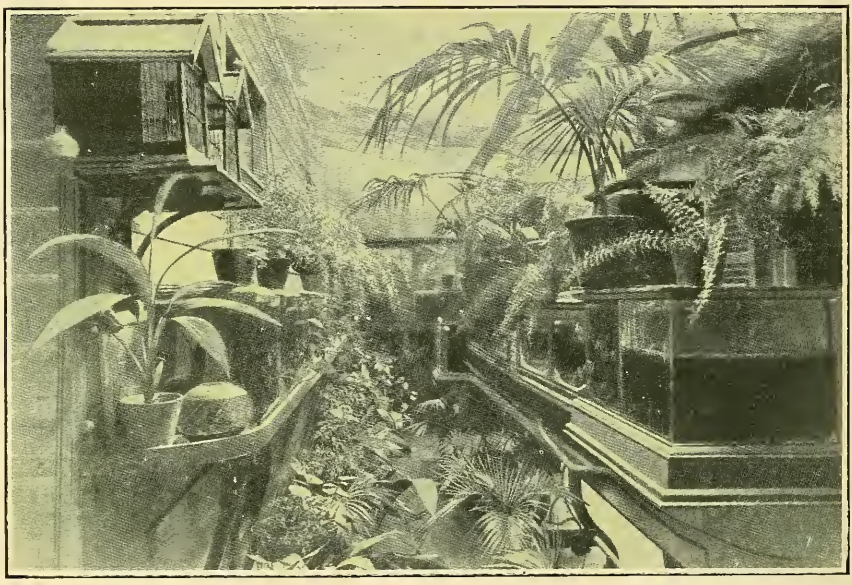
Discrepancies exist between what is written and what is seen. Darwin, in his work, "The Descent of Man," says "carp (*Cyprinidae*) appear regularly to follow the practice, rare in the animal kingdom, of polyandry—when a female carp comes amongst the males she is immediately pressed closely by a male on each side, and when they have been in that position for some time are superseded by two other males."

Carp are gregarious, and their courtship and marriage are carried on under communistic conditions. Darwin observed their gregarious habit only, but did not attempt to verify the necessity or otherwise of a male fish on each side of

the female and their replacement by other two.

In the fructification of the ova, as in the case with most oviparous fishes where they are gregarious and marriages communistic, the female discharges the germs of matter (ova) and the male the germs of life (sperm), scattering them at random among the most suitable weeds that are on the surface of the water, the males always intermixing with the females. When these germs or cells of matter are once freed from the ovary, the male at once discharges the sperms or cells of life, which are microscopic. The cells of the ova and the cells of the sperm are rapidly churned up by the quick movements of the excited fish. This prevents them from at once adhering to the weeds (the eggs are glutinous). Each ovum receives one germ cell of life from the sperms through the little gateway, the micropyle, and that must take place before the ovum has found a lodgment on the weeds or elsewhere; therefore, there is no necessity for the females to be pressed by the males.

Among the gregarious fish the males have no clasping fins, as is the case with some of the monogamous, or with some that are monogamous for one season only, especially those that are viviparous, such as *Gambusia affinis*.



The Author's Conservatory

The males of the carp referred to by Darwin, as the breeding season approaches, develop excrescences on the gill-covers and pectoral fins. The function of these excrescences is wholly independent of the extrusion of the germ-cells, but serves a purpose that leads up to the maturity of the ova. That it is essential for two or more males to accompany a female to aid her to discharge her ova is not exactly the law of reproduc-

tion with other animals. If we test Darwin's written language with the facts as seen with this class of fish when confined in an aquarium, we note as the season of procreation approaches that it is far from being so essential as he supposes, to have two males one on each side of a female. If an aquarium has all the healthy conditions necessary for the purpose of breeding goldfish, a single pair is as certain of reproducing the species as a dozen of the two sexes intermixed would be.

The writer successfully tested this by practical proofs, selecting an aquarium containing all the health conditions necessary, and setting it apart for the purpose of observation. Choosing a mature male, *i. e.*, one showing the excrescences of maturity, also taking a female showing signs of reproduction, and placing them in company in the same aquarium, he observed that, as soon as the two fish saw each other, there was indicated love at first sight. On the morrow it was evident by their movements there was courtship in full swing, and an engagement soon followed. Two days later there was a clear understanding that maternity would follow. The two fish had taken to hide and seek among the *Vallisneria* and *Nitella* growing on the surface of the water. Knowing the glutinous nature of the ova of these fish the writer placed a sheet of glass under the water plants to intercept the eggs in their transit downward. The plan was successful. In the evening the two fish were returned from whence they came. Removing the sheet of glass (scores of eggs were adhering thereto) and placing it erect about one-fourth of an inch from the glass front of the tank, it became evident there were only a very few infertile eggs (infertile eggs are whitish). The experiment resulted as anticipated. From the position of the ova on the sheet of glass, every change in the eggs could be seen with an ordinary lens. In eight days the young hatched out healthy and strong. The length of time differs according to conditions. And now, fourteen months afterwards, I have the young, and they are healthy and strong, and have grown to about two inches long.

Uses for Fishes' Scales

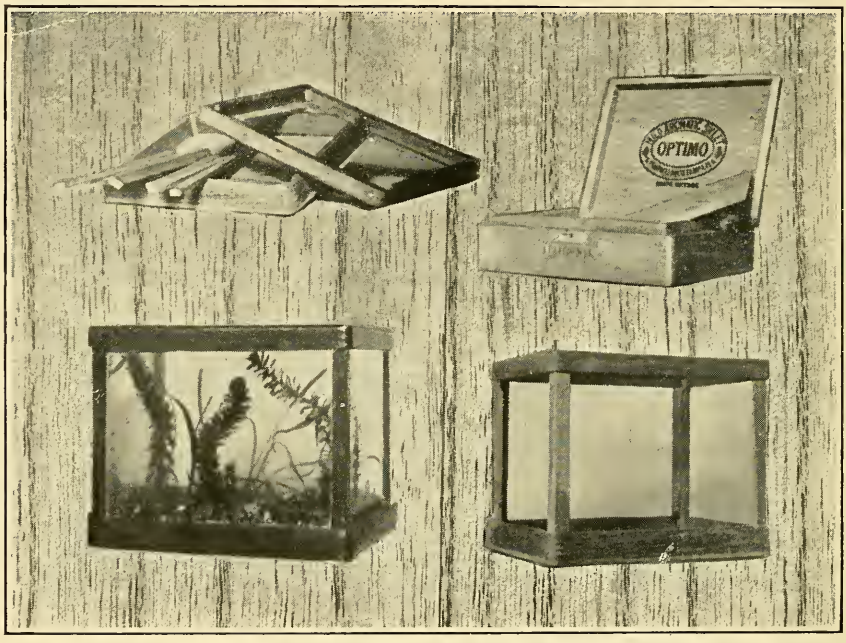
The scales of fishes are used to some extent in the manufacture of glue, and also (recently) in the preparation of gelatine. They are also used for the purposes of ornamentation and for the manufacture of artificial flowers. In 1875 the Royal University of Norway sent to the Smithsonian Institute, Washington, a diadem made from fish-scales and eyes. Ornaments for ladies, made from fish scales, were at one time largely sold at the Crystal Palace, London. The Chinese are said to have a mode of grinding up fish scales and using the powder as a dry pigment, to give brilliancy to parts of pictures. In some parts of the world the scales of large fishes—such as the Tarpon of America—are treated in such a way as to make them appear like mother-o'-pearl. They are then worked up into artificial flowers, marquetry articles and other fancy works, and in some cases little scenes are painted on them.—*David G. Stead.*

Herpestis amplexicaulis, often erroneously called *Bacopa*, assumes quite a changed appearance when permitted to grow above the surface. The tiny hairs with which the stem is thickly covered become silvery white, the aerial leaves a dull red, with a waxy lustre.

Silence may be golden, but withholding facts is robbery.

A "Cigar Box" Aquarium

A. MODESTO



The Evolution of the Cigar Box

During the winter months, when the evenings are long, the making of various articles out of material that is usually thrown away will generally prove a pleasant diversion. Any number of useful and ornamental things, for instance, can be made from the ordinary "Boite Nature," or natural wood cigar box; a well-made package with dove-tailed corners, hinges and lock.

Perhaps you would like to know how to make a very attractive and serviceable small aquarium out of one of them, the only tools necessary being a pocket knife, a ten-cent glass-cutter and some sandpaper. A small plane, a saw and a square are also handy, and will save much time and labor, but are not at all essential. If you will follow me through the various steps you will see how easy it is to build such a tank.

Take a cigar box, such as is shown in the illustration, and remove the cover and fittings, and slip out the inside lining pieces. As the box is a trifle too high, draw a line around the outside, about an inch and a quarter from the bottom. Trim the box down to this line. If the brand marks are not thereby removed, either plane or sandpaper them out, or else

make strips from the thin top-board, which is usually found in these boxes, and glue them over the markings so as to make a pleasing panel effect.

On the cover fill the depressions left by the hinges and lock with pieces of scrap of the same thickness, or glue strips from the top-board on the side and underneath, which g ves an attractive finish.

Take the long inside lining pieces, and from them cut four strips to finish about seven-sixteenths of an inch wide. In making these strips a small plane is very handy, and they can be made smooth and uniform without trouble. Cut them to such a length as will make the tank of the desired height, care being taken to make them all of exactly the same length. For convenience, number them 1, 2, 3 and 4.

On the ends of the bottom lay off, on the inside, the width of the strips, selecting one for each corner as a gauge, and mark the corner with the number corresponding to that on the strip used. Do the same with the cover, using the other ends of the strips. Then with a knife cut out these places, so that the strips fit flush into them.

Both on the inside and outside of the cover top, draw a line around the edge about three-quarters of an inch in, and cut along this line from both sides, to avoid splintering the wood. After the centre of the cover is thus removed the edges should be sandpapered or filed smooth and straight. The tank is now ready for assembling.

Cover one end of each strip on one side, both edges and the bottom, with glue, and put each piece in its corresponding slot. Great care must be taken at this point to set these upright pieces perfectly square in both directions. For this purpose I use an ordinary drawing board triangle, but if not available the cover of a box can be used. See that the ends of the strips are down against the bottom board. The work must now be allowed to stand until the glue is hard, after which put glue on the other ends of the strips and fit the top in place.

From the other lining pieces cut four strips three-sixteenths of an inch wider than those already used. If precaution has been taken not to make the space between the top and the bottom too great, the short lining pieces can be used, otherwise additional material will have to be obtained. Cut these strips to fit between the top and bottom on the sides, and glue in place with the edge flush with the outside of the adjoining strip. After the glue has set it is advisable to reinforce eac hcorner with three or four small nails Driven at an angle through the inside edge of the strips last placed, and into the top and bottom, they will also materially strengthen the corners.

The frame is now completed and should be thoroughly sandpapered and then coated all over with varnish or any color paint desired. I prefer either three or four coats of waterproof varnish or a good quality of white enamel.

If there is a photographer handy, particularly one who uses X-ray plates, there should be no trouble securing all the glass needed, and of a quality far better than can usually be purchased. Failing in this the usual paint and glass dealer must be patronized.

Cut a piece to fit the bottom and drop it temporarily into place, then cut the pieces for the two sides—the ends should be left until later. The next step is to cement the glass in place. For this purpose get some aquarium cement, which can be bought from any aquarium supply house. If this is inconvenient, a mixture of Stockholm tar and red lead will an-

Aquatic Life

An international monthly magazine devoted to the study, care and breeding of native, exotic, gold and domesticated fishes, other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....Editor
JOSEPH E. BAUSMAN.....Publisher
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swer, but is very sticky and very messy to handle.

Put a thin layer of the cement around the edge at the bottom and press the bottom glass firmly in position, working it down as flat as possible; then do the same with the sides. Cut the glass for the ends and set them in a similar manner. Either with sticks or by filling the tank with sand a considerable pressure can be maintained against the glass until the cement has hardened. Guard against too much strain on the glass as it is then liable to crack. Remove the cement that will be squeezed out on the edges and along the joints of the glass on the inside. When the cement has hardened the glass should be properly cleaned on both sides. Cement may be run along the joints on the inside, but if the glass is properly set it will be unnecessary, though it is an additional safeguard against leakage. The tank is now completed and ready for use.

Florida Notes

S. D. CARLTON

Last spring while wandering through southern Florida I came across a number of fishes that I think would be suitable for the aquarium. One closely resembles *Fundulus chrysotus* in shape and size (2 to 5 inches). The ground color of yellowish green is thickly covered with metallic gold spots about the size of a pinhead, and numerous wine-colored spots of the same size extend from below the dorsal to the end of the caudal fin. It is oviparous and evidently of bottom habits. Those I caught were lurking in a dense growth of plants; none were seen in open water. They are very active, and must be kept in a deep vessel with plenty of plants.

Another species resembled in shape and size the hybrid, *Xiphophorus helleri x Platypoecilus maculatus* Var. The body was greenish yellow, covered with black blotches, interspersed with tiny metallic gold spots. This, too, was caught amongst dense masses of plants, but in very foul and stagnant water. Altogether it is one

of the most beautiful fishes I have seen.

A live-bearing species was taken that I first thought was *Gambusia holbrooki,* but the anal fin was entirely different.

In an entirely different class is a fish called the rainbow minnow by the natives. It was present in thousands. Evidently it is very tender, as it invariably died before I could carry it half a mile. The fish is very slender, and reaches a length of four inches; all the colors of the rainbow, with a metallic lustre. Found in running water, and is fond of skipping along the surface.

Mollienisia latipinna is found by the million all over the State in fresh, brackish and salt water. I caught one covered with chrome green spots, but did not succeed in getting it home alive.

I saw many beautiful sunfishes, some bottle-green, covered with gold spots; others brown and gold. None were found more than three inches long, hence would be very desirable for the aquarium.

Plant life of the sorts used in the aquarium was plentiful. Beautiful *Ludwigia* could be obtained in the running streams. Acres of ponds are covered by *Azolla caroliniana,* some bright green and others rusty brown. Entire ponds are covered with *Cabomba* in flower. Frog-bit is plentiful about Jacksonville. Then there was water lettuce and duckweed, and *salvinia* and water hyacinth were all over the state.

(Identifying fishes by mere color descriptions is hazardous. The one described as resembling *Fundulus chrysotus* seems to be that species. Specimens so called by aquarists have at times been *F. cingulatus.* The remaining fishes may be *Jordanella floridae, Heterandria formosa* and *Labidesthes sicculus.* If the last named is correct, then Mr. Carlton's attention is directed to Wolf Lake, Indiana, where it is abundant. Specimens collected there did well in a cool aquarium.—*Ed.*)

Society News

A fine blue calico telescope entered by Mr. Michael J. Moylan carried off the silver cup at the November meeting of the West Philadelphia Goldfish Fanciers' Association. The specimen scored 82 points. Ribbons were awarded to fishes shown by Messrs. Weinreich, Bell, Moylan and Armbruster. The entries were judged by Messrs. Pfeffer, Scheibel and Bausman.

At the November meeting of The Aquarium Society, Philadelphia, Mr. Henry W. Fowler, of the Academy of Natural Sciences, gave an interesting talk on the anatomy of the fish, laying emphasis on the characters used in the identification of species. In his demonstration Mr. Fowler used fresh specimens of the Glut Herring (*Pomolobus cyanonoton*) and Yellow Perch (*Perca flavescens*). It was interesting to be told that the black peritoneum—the membrane lining the abdominal cavity—of the Glut Herring distinguishes it at once, regardless of other characters, from its two very similar local relatives, *P. mediocris* and P. *pseudoharengus.* In the latter the membrane is pale. The writer is sure Mr. Fowler greatly appreciated the assistance of Mr. Innes, who provided an old hand towel and a pair of rusty scissors, which the lecturer had forgotten to include in his dissecting kit.

As an aftermath, Dr. Van Deusen, of the Philadelphia Public Aquarium, entertained with a glowing description of the delights of fly fishing for black bass—way down Jersey, not at the Aquarium. Several members have since been observed varnishing rods, oiling ancient reels, inquiring as to the cost of flies, etc.

The inference to be taken is that Dr. Van Deusen is expected to arrange a little party for next summer.

A public aquarium under the auspices of The Madison Zoological and Aquarium Society has been established in the gardens in Henry Vilas Park, Madison, Wisconsin. The collection contains both native species and the hardy and interesting tropical fishes. This is the only permanent exhibition in the State, in fact, in all the Middle States, excepting Detroit. There seems to be no real reason why every town boasting of a zoological garden should not have a collection of fishes. A separate building would not be necessary. The tanks could be disposed through the various buildings, the temperature factor being overcome by placing the tanks of tropical fishes in the houses given to animals of that zone.

The South Australian Aquarium Society was organized with twenty foundation members, a remarkably good "start." The program for the initial year included sundry papers, collecting excursions and visits to the private aquaria of members.

A number of years ago an aquarium society flourished in Sydney, Australia. Later, finding its work to somewhat coincide with that of The Naturalists' Club of New South Wales, it merged with it. This proved mutually valuable and brought together specialists in the various departments of nature-study.

A recent announcement of a meeting of the Chicago Aquarium Society starts off with:

> Little Guppies have little fleas
> Upon their backs to bite them,
> And these, again, have smaller fleas,
> and so ad infinitum.

And this without apology to Dean Swift, or whoever started the *"ad infinitum* business" a few hundred years ago. The parody was not without appropriateness as Dr. George R. La Rue, of the University of Michigan, who has made a study of the parasites of fishes, was present to tell of his researches. And there also was Dr. H. B. Ward, of the University of Illinois, and so *ad infinitum!*

The Chicago Aquarium Society leaves no stone unturned to do its bit to maintain the prestige of the city slogan—*I will.* President Orsinger and his fellows will do it if it can be done. Something going on all the time, with Keedy as punchologist thrown in for good measure, which makes us wonder what sort of a substitute Keedy will pull off six months hence.

The second annual exhibition of the Aquatic Association of Maryland was held in the Hotel Sherwood, Baltimore, on December 3d. The affair was a combined social gathering and competition. The exhibition room and tanks had been tastefully arranged by the president of the association, Mr. Ernest Gill, and Mr. J. Shelton Hill. Mr. and Mrs. Gill received the guests.

After calling the meeting to order President Gill explained the purpose of the exhibition, and appointed Messrs. George A. Wieman, W. J. Smith and J. Shelton Hill as judges. This being the first competition for fish raised by members, it was announced that no attempt would be made to segregate the breeds, but that the awards would be made to the best specimens regardless of type. After a careful examination the three winners were determined and placed in a tank together.

The first prize, a cup offered by the president, was awarded to Mr. H. A. Altpeter for a fine calico telescope; second, to Mr. W. H. Cassell on a Jap fringe-tail; third, a calico telescope entered by Mr. Louis Hens.

It was estimated that at least 150 visitors were present during the meeting.

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Aquatic Life

Aquatic Life

An international monthly magazine devoted to the study, care and breeding of native, exotic, gold and domesticated fishes, other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....Editor

JOSEPH E. BAUSMAN.....Publisher

542 E. Girard Avenue, Philadelphia.

Entered as second-class matter, September 2, 1915, at the Post Office, Philadelphia, Pa., under Act of March 3, 1879.

Practical articles and notes on topics pertaining to the aquarium and terrarium are always wanted for Aquatic Life. Readers of the magazine are invited to join in making it a medium of mutual help, and to contribute to it any ideas that may occur to them. The pages are always open for anyone who has anything helpful and practical to say. Manuscripts, books for review and general correspondence should be addressed to the editor.

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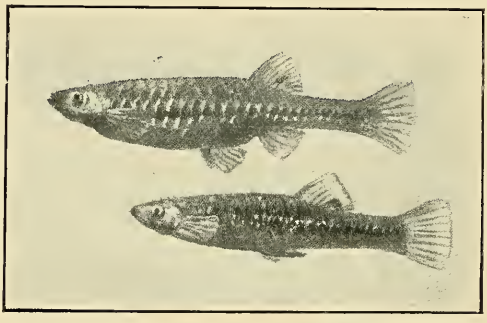
Vol. IV. January, 1919 No. 5

Limia Caudofasciata

ERNEST LEITHOLF

Perhaps in no other class of fishes do we find such variations in individual species as in the cyprinodonts, and particularly in the viviparous ones. Fossil remains of both the oviparous and viviparous forms have been found in the tertiary deposits of Aix and Bonn, France, and at Frankfort, Germany. This suggests that the tooth-carps are of recent origin. Moreover, the many transitory varieties in present species in the genera *Haplochilus* and *Fundulus* bear out this theory. Hence it is quite probable (as some ichthyologists aver) that species are in process of formation today. While in nature this may require many years, the aquarist has, to a certain extent, within a few generations, developed constant color varieties. Thus four color forms of *Platypoecilus maculatus* have been evolved, the most aberrant being that known as rubra. Even in nature this genus is notable for its variable species. The variability in coloration shown in a single brood of young is well known, but is notable in the subject of this article, the so-called "blue Poecilia" of the aquarist, which has lately been identified by Dr. Carl H. Figenmann as *Limia caudofasciata* Regan.

This Limia makes a rather attractive addition to a collection of exotic fishes. The back or dorsal region of the female is a greenish olive, the scales of the sides and abdomen having a transparent quality, varying with the light from olive to a shade cast with pink or violet underneath, the surface with a bluish sheen. The scales along the sides are edged with iridescent light blue, some individuals having a broken black lateral streak, with occasional vertical bars, though this is more pronounced and characteristic of the male. The base of the dorsal fin is light amber with a dusky spot or several dashes, these, however, may be absent.



Limia caudofasciata
Original in Oil by the Author

The caudal fin is yellowish with a transparent margin.

The colors of the male are more intense. The dorsal and caudal fins may be yellowish orange, the former with the characteristic dark blotch at the base. A few individuals have been favored with a flush of orange over the breast and abdomen, which, with the complimentary blue of the sides, are exceptionally attractive.

For several years we have had a form identical with the one described other than that it is more humble in coloration. It has the olive back and blue sides, but lacks the glistening light blue spots and the yellow fins and breast.

The breeding habits do not differ from other live-bearing poeciliids. Pregnant females soon give evidence of the im-

pending increase by the greatly distended abdomen. When this stage has been reached the female should be placed alone in a small aquarium containing quite a mass of plants, which should be grouped at the bright or window-side. The tank should be frequently examined, and when the young have been expelled the parent should be removed. Daphnia and the foods usually supplied tropical fishes should be used. The temperature should average from 70 to 75 degrees.

Classification of Fishes

DAVID G. STEAD, F. L. S.

For purposes of reference, fishes—which belong to a *class* called by Naturalists *Pisces*—are separated into two main *sub-classes* known as *Elasmobranchii* and the *Teleostomi;* with a third and smaller one called *Dipneusti* or *Dipnoi;* the latter including the remarkable lung-fishes. These sub-classes are again divided into *orders, sub-orders* and many *families;* the families themselves being split up into *genera* and *species;* the *genus* and *species* forming what is called the scientific name. For instance, in the case of the Nannygai, the scientific name is *Beryx affinis;* the former being the genus, and the latter the species. Fishes having certain slight affinities with one another are grouped together under the main divisions, while those showing a greater and still greater natural relationship to one another are placed in the more restricted groups. Generally speaking, this is the plan followed by all Zoologists and Botanists in classifying animals and plants; the idea being to make the system of classification as natural as possible, and as far as possible obviating the formation of artificial divisions. Unfortunately, however ardently a person may desire it, the latter cannot always be carried out in practice; in many cases, through our imperfect knowledge of the groups that we are dealing with. This being so, scientific nomenclature is likely to, and does, change in accordance with the state of our knowledge.

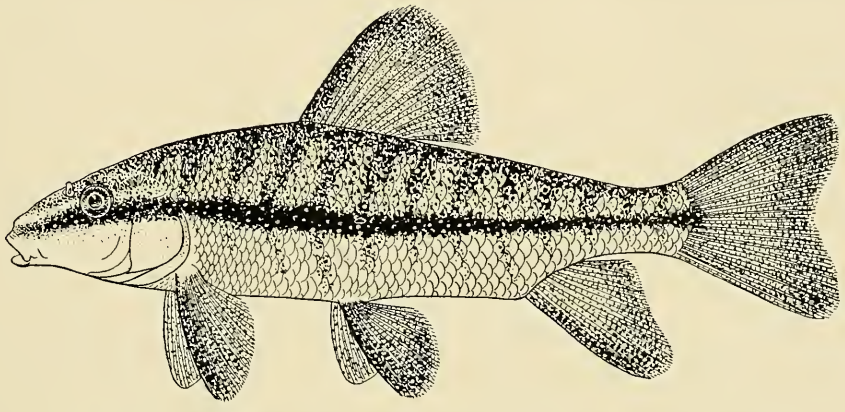
Incidentally, I might here mention, that a great many people find it difficult to understand the utility of technical names for animals and plants; and I here take an opportunity of giving a suitable answer. In doing so, I cannot do better than quote the words of Professor Huxley, who, in his work on "The Crayfish," says: "Many people imagine that scientific terminology is a needless burden imposed upon the novice, and ask us why we cannot be content with plain English. In reply I would suggest to such an objector to open a conversation about his own business with a carpenter, or an engineer, or, still better, with a sailor, and try how far plain English will go. The interview will not have lasted long before he will find himself lost in a maze of unintelligible technicalities. Every calling has its technical terminology; and every artisan uses terms of art, which sound like gibberish to those who know nothing of the art, but are exceedingly convenient to those who practice it.

"In fact, every art is full of conceptions which are special to itself; and, as the use of language is to convey our conceptions to one another, language must supply signs for those conceptions. There are two ways of doing this; either existing signs may be combined in loose and cumbrous periphrases, or new signs, having a well-understood and definite signification, may be invented. The practice of sensible people shows the advantage of the latter course; and here, as elsewhere, science has simply followed and improved upon common sense."

Color Changes of the Chub-sucker*

CARL L. HUBBS

Field Museum and Chicago Aquarium Society



Young Chub-sucker (Erimyzon sucetta), showing full complement of color markings

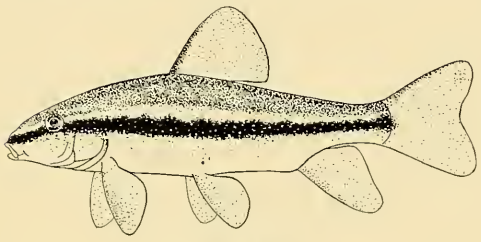
A well-known ichthyologist tells of an interesting experience which once befell him while collecting fishes on the reefs of Panama. Among numerous other gaudily marked little fishes he obtained one which he wished to observe further. This fish he placed in a brightly tinned pail. Returning an hour or so later, he was surprised to find what appeared to be a different fish, pale and plain in color. Leaning over to obtain a closer view he chanced to touch the edge of the pail; in an instant the whole color pattern of the little fish was displayed in all its former conspicuousness. I have had somewhat similar experiences on the reefs of California. Certain sculpins, caught there in the deeper algae-filled tide-pools, were found to be almost uniform blackish in color; when placed in a light sandy pool or held in my hand they brought out on their bodies, before my astonished gaze, a pattern of black and white almost as contrasting as the ink and paper on this page.

Anyone favored with a normally curious frame of mind, upon seeing such color changes exhibited by fishes, would inquire into the significance and the causes of the phenomena. A search through fish literature reveals quite a number of articles dealing with this subject. Would it not, however, prove far more entertaining and instructive to study the problem independently, by direct observation of the changing coloration of some suitable aquarium fish, and then compare our results with those that others have obtained and written of?

For a few weeks past I have kept a young chub-sucker (*Erimyzon sucetta*), a neat little fish of our own creeks, in a

* With five original drawings from nature by Leon L. Pray, Field Museum of Natural History.

medium-sized all-glass aquarium on the top of my desk. From day to day or from hour to hour I have watched it change its color-pattern back and forth, from one type or phase to another, each appearing like the marks of a distinct species. When kept in the dark, either dur-



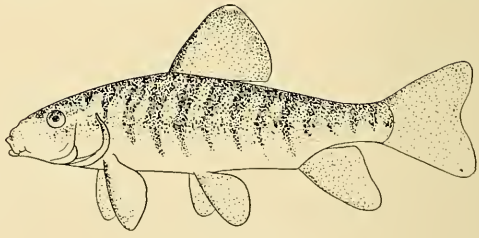
Striped Phase

ing the night or during the day (by covering the sides and top of the aquarium with pasteboard), the whole complement of dark colors is brought out, as shown in the figure at the head of this article: a black lateral streak, extending from the tip of the snout to the base of the caudal fin, is crossed by about thirteen dark bars; the fins, too, are largely blackish. The darkest color and most extensive pattern, it thus appears, are displayed in a similarly dark environment. The darkening of the fish by darkening the tank in the daytime would seem to indicate that light, rather than temperature, influenced the change.

In the morning hours the little sucker actively swims about in the increasingly bright light of the aquarium, usually in clear water away from weeds and stones. The vertical bars now more or less gradually fade out, leaving the back a nearly uniform dark shade, separated by a bright streak from the black lateral band or stripe, which thus by contrast is rendered very inconspicuous. Can this pattern tend to conceal the fish in open water? Though we cannot be certain in our answer, it appears probable that this black stripe enters the classification of "ruptive" markings, that is, those that conceal an animal or other object by breaking its outline in two, making it appear what it is not. To produce analagous results, a camouflage artist paints a black streak, or several of them, across a field gun. Though *conspicuous* in itself, the marking is *concealing* in reference to the fish—or to the gun, depending on whether Nature or Man is the artist.

Under certain conditions the chub-sucker loses the black longitudinal stripe, but gains in its stead a series of vertical bars. It is hard to believe that this barred fish is the same individual as the streaked one observed before. But it really is the self-same fish, exhibiting another and distinct color pattern. By combining the bars and stripes, the chub-sucker develops the complete color pattern illustrated at the head of this article.

We have not yet exhausted the color phases which the young sucker is able to display at appropriate times. Often when browsing over a gravelly bottom it takes on a blotched appearance. This blotched phase, it appears on a moment's analy-



Barred Phase

sis, combines features of both the barred and striped phases. As the blotches render the fish extremely inconspicuous (under natural top light) against the gravel background, it is obvious that we are dealing here with a typical example of concealing coloration.

Thus we discover that the young chub-

Concluded on page 62.

Neetroplus Carpintis

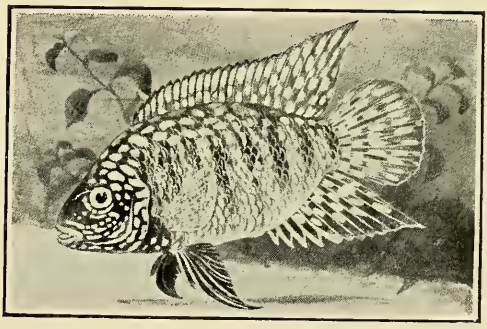
WALTER LANNOY BRIND, F. Z. S.

The illustration gives a good general idea of the appearance of *Neetroplus carpintis;* it is easily recognizable as a cichlid and somewhat like *Cichlasoma nigrofasciatum.* In fact the genus Neetroplus occupies a doubtful position. Its claim as a valid genus, distinct from *Cichlasoma*, rests upon certain incisor-like teeth. Dr. Seth Eugene Meek, who had opportunities to examine numerous specimens, found that these teeth were not always evident. So it will not be surprising if we find the next ichthyologist who works over the cichlids placing *carpintis* in *Cichlasoma.*

From a standpoint of appearance, which is of prime interest to the aquarist, this cichlid is not unattractive. The large, distinct pearly scales are scattered sufficiently apart on the yellowish-olive or bluish-olive ground color to make them stand out in bold contrast. Younger fish show dark vertical bars which disappear with advancing age. These, however, as in all fishes of the family, are more or less evanescent all the time. A dark spot at the base of the tail, and another on the body, are somewhat more persistent. Sexual distinctions are much as in others of this group. The males are angular, with coarse mouths, and acute dorsal and anal fins. The females are more rotund, with fins blunt. During the breeding season the males are much brighter in color.

If at any time you become the possessor of a pair of *Neetroplus,* don't waste plants in the aquarium. Like our boys of the Tank Corps, their slogan, as far as perfectly good plants are concerned, is to "treat 'em rough." They will assiduously uproot every shoot. This, of course, is incidental to clearing up preparatory to breeding.

This cichlid is a large fish, reaching a length in nature of twelve inches, though in the aquarium one-half this size will be a big one. It follows that a large,



Neetroplus carpintis

shallow tank should be supplied for breeding. In it should be placed several large stones or a flower pot laid on the side. On either, according to the desires of the pair, the adhesive eggs will be laid in a cluster and carefully guarded until they hatch. This being successfully consummated, the fry will be removed to a hole previously excavated in the sand, where they will be kept clean and free from debris by the parents, who carefully keep the water in circulation about them by means of the constantly-moving pectoral fins. With the absorption of the yolk-sac the fry reach the free-swimming stage, and move about in a shoal, guarded by the parents, in search of microscopic live food. During breeding activities, and for the young for some time there-

after, the temperature should be maintained at about 80 degrees; at other times 75 degrees will be sufficient.

This fish is decidedly carnivorous, hence should be fed Daphnia, worms, larvae of aquatic insects, meal worms, shreds of raw beef and similar materials. The young should, of course, be supplied with Daphnia until large enough to take the food of adults.

Our knowledge of aquatic life has long been accumulating. Those who have contributed have been of very diverse training and equipment and have employed very different methods. Fishermen and whalers, collectors and naturalists, zoologists and botanists, with specialists in many groups; water analysts and sanitarians, navigators and surveyors, planktologists and bacteriologists, and biologists of many names and sorts and degrees, all have had a share. For the water has held something of interest for every one.

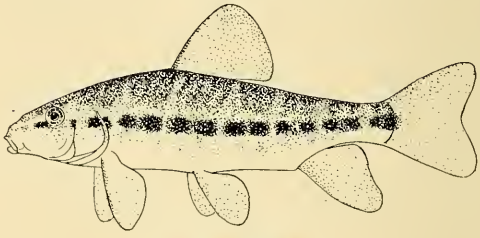
Fishing is one of the most ancient of human occupations, and doubtless the beginning of this science was made by simple fisher-folk. Not all fishing is, or ever has been, the catching of fish. The observant fisherman has ever wished to know more of the ways of nature, and science takes its origin in the fulfillment of this desire.

The largest and smallest of organisms live in the water, and no one was ever equipped, or will ever be equipped, to study any considerable part of them.—*Life of Inland Waters.*

The life of daphne and fish buckets will be lengthened materially if given several coats of asphaltum varnish. After each coat has hardened, bake overnight in a very slow oven.

Concluded from page 60.

sucker, like most other fishes of temperate waters, is protectively colored. In this case, as is many others, which we learn about in our reading, the fish has several color patterns with which to ren-



Blotched Phase

der itself inconspicuous—and thus often to save itself from its enemies—in the different and changing types of environment through which it passes in the course of its hourly and daily wanderings.

Plans are under way for the construction of an aquarium on Santa Catalina Island. Novel features are promised. It is proposed to insert great pieces of plate glass in the rocks near Sugar Loaf, through which the fishes will be viewed in their haunts. Food will be supplied regularly to attract the fishes to the desired location.

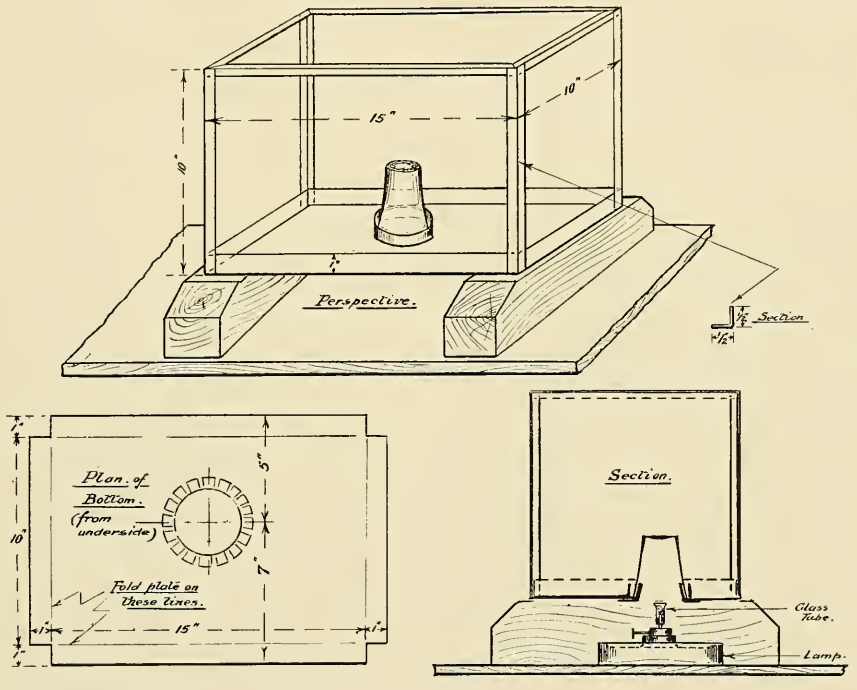
Doing business without advertising is like winking at a girl in the dark. You know what you are doing but nobody else does. So why not come out into the open, in *Aquatic Life*, where all the world's aquarists may see? Then if you have something good, aquarists will "beat a path to your door even though you live in the backwoods." Without advertising you have about as much chance of coming through as a man with a wooden leg in a forest fire.

There can be no better way to employ one's leisure hours than by scientific work, or even by scientific play.—*Stokes.*

A Simple Heated Aquarium

H. E. FINCKH

Royal Zoological Society of New South Wales



Even in aquarian nature-study the war has taught us to rely upon our own resources, and this in my case has proven an advantage. I have in my collection a number of species of the smaller fishes which I keep in separate tanks, each heated individually. Until last year I have used the "Thermocon," a blown-glass tank with a glass bulb in the centre of the bottom, which answers very well. Requiring additional tanks, and the one mentioned being no longer obtainable, I decided to make some on the same principle. As others may feel disposed to follow my example, in addition to a description, I present a drawing giving construction details and a photograph showing how inconspicuous the "heating glass" appears when the tank is equipped.

My tanks measure 15 by 10, by 10 inches, and are constructed of galvanized sheet iron. This is a handy size, and best suited to my needs, but can be varied as desired.

The "heating glass" is an ordinary drinking glass, measuring two and three-fourths inches in diameter and three and one-half high.

Now for the frame, bottom first. Cut a piece of the sheet metal 17 by 12 inches, draw lines an inch from the edge on all sides, snip the square inch from each

corner and then fold the edges, thus forming a tray one inch deep. Then a round hole in the centre, one-fourth inch less in diameter than the glass, is cut with a one-fourth inch chisel and a hammer. Lay the tray on a solid piece of wood and the work can be done so neatly that filing will not be necessary. The position of the circle should be marked with a pair of dividers.

Next cut a strip of metal one-inch wide and as long as the circumference of the hole. Draw a line lengthwise in the

centre and, with tinners' shears, make cuts half an inch apart from one edge to this line. Bend the sections thus formed at right angles, fit the collar into the hole from below, and solder into place. Make another collar one-half inch wide and sufficiently large to slip over the first collar and still leave sufficient space for the glass between both. Solder this second collar to the bottom. The glass should fit loosely between the collars, and will be cemented in place later.

For the balance of the frame cut strips one inch wide; 4 pieces 10 inches long for the corner uprights, 2 pieces 10 inches long and 2 pieces 15 inches long for the top frame. Bend the strips lengthwise to form angles with each face one-half inch. One by one solder the corner uprights to the corners of the tray or bottom, and then the strips forming the top. Make certain, as you proceed, that each is square, otherwise there will be trouble in fitting the glass. Paint the inside of the frame, not the bottom, and, after it has dried, cement the glass in place. Ordinary window glass will do for a tank of this size, but it should average one-eighth inch thick. Hold the glass in position while the cement is setting by means of strips of wood wedged from side to side and from end to end. Now lay a little cement in each corner, from top to bottom, and let the tank stand for a day to dry.

Fill the groove formed by the two collars with cement, then press the glass firmly in place, trimming away the surplus cement.

In an ordinary tank made after the plan described, I also cement a sheet of glass over the bottom to prevent the water coming in contact with the metal. In the present case this is not possible, so I melt marine glue (a sort of pitch) and pour it over the bottom while hot. In this proceeding the bottom should be kept warm, as the glue sets quickly

Any small kerosene lamp can be used, but it should be as short and compact as possible, as the aquarium must be raised to permit it being placed underneath. Glass-bodied lamps are to be preferred as one can see at a glance the amount of oil still unconsumed at any time. I clean the wicks and remove the charred portion every other day.

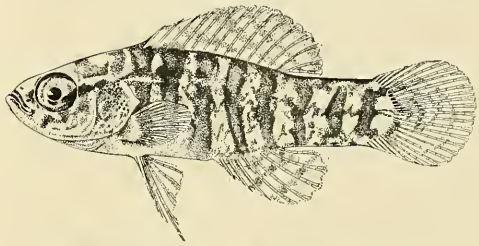
In rare cases the male of *Xiphophorus helleri* will not develop the sword-like extension of the tail until nearly a year old. This usually means a fine big specimen. When the sword reaches its maximum length body-growth has ceased; hence precocious tendencies in this direction indicate the "runts."

Notes on the Breeding Habits of The Pigmy Sunfish

W. A. POYSER

More than a year ago, through the courtesy of the United States Bureau of Fisheries, the writer received a number of specimens of the pigmy sunfish, *Elassoma zonatum,* collected at Mound, Louisiana. These, barring two or three which have died in the interval, have been under close observation to determine, if possible, the breeding habits. Nothing has heretofore been published in this connection, in fact the species has received little attention save at the hands of the systematic ichthyologist. The examples when received were about half-grown, measuring from one-half to three-fourths of an inch long. Today, fourteen months later, the average maximum of one and one-fourth to one and one-third inches has been reached.

Suitable food enters largely into the problem of maintaining this species in the aquarium. Dry prepared foods of the usual sorts and ground dried shrimp will at times be taken while falling, but very little and without avidity, particles reaching the bottom being left unnoticed. Shredded fresh fish flesh and raw scraped beef did not seem much more desirable. Its predilection for entomostracans and the larvae of mosquitoes has been recorded by Dr. Robert E. Coker. In the absence of the mosquitoes the writer had recourse to the white annelid worm, *Enchytraeus albidus,* with an occasional lot of *Daphnia pulex.* While the fish were small it was necessary to use only the tiniest enchytraeids, lest larger ones be tackled with disastrous effects. To this end a small mass would be placed in a shallow, flat-bottomed glass dish, with dark cardboard beneath to bring the worms into relief, and quickly teased apart, the larger being removed with slender dissecting forceps. These worms are obviously preferred, a reasonable number being consumed in a short time, whereas an equal bulk of Daphnia will persist through several days. Though

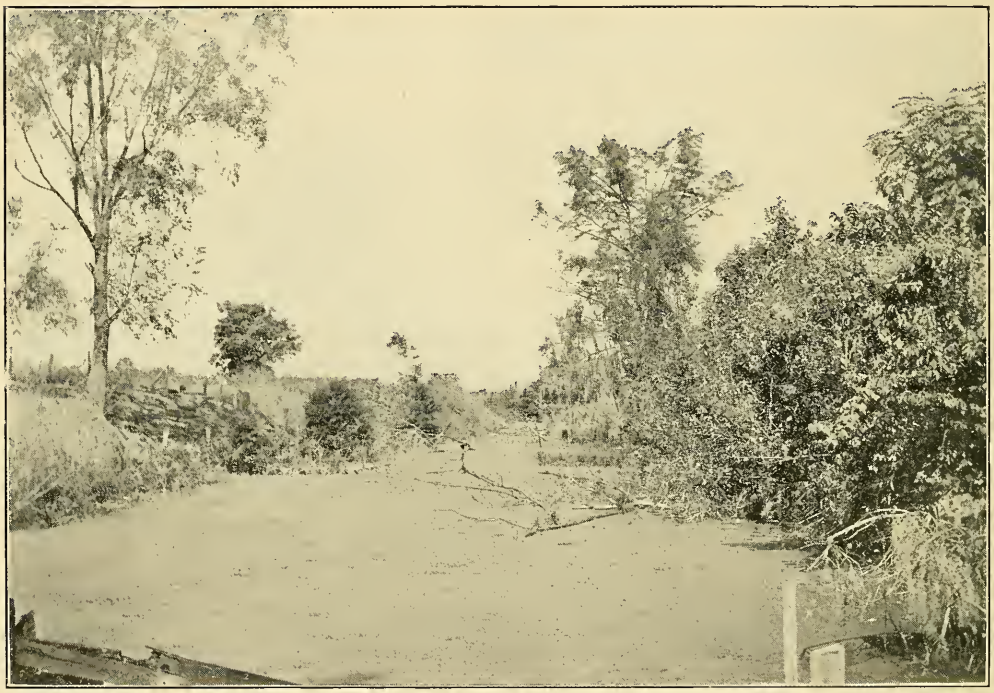


Pigmy Sunfish Elassoma zonatum

I have used enchytraeids extensively for quite a number of species of fishes, only in the pigmy have I seen it penetrate through the gills and wriggle free. This, however, rarely occurred, and only when a particularly greedy fish would seize several large ones. Beyond a few spasmodic jerks, the affair did not seem a matter of much moment. The pigmy takes its food with a peculiar little sidewise snap quite unlike other fishes.

Several color descriptions would be necessary to describe this fish in its varied moods, I say moods because the changes do not altogether seem in the nature of protection, and because the greatest extremes, in both sexes, are incidental to sexual activity, and in the male to combat. Usually the basal color is given as olive-green, which, taking fishes as a whole, is an "elastic" color, to be used when we cannot be more definite. The sides are marked by ten

to twelve vertical bars, with pale interspaces. Technical descriptions give the bars and interspaces as equal in width, and somewhat less in width than the diameter of the eye. In this my specimens disagree. The interspaces are quite uniform, but the bars just behind the head are three times this width, decreasing gradually backwards until at the caudal they do equal the interspaces. variation, almost instantaneous, both in mere intensity and in the appearance and disappearance of the vertical bars. At times a fish may be quite pale, so much so that it appears nearly uniform in color, or it may be dotted or mottled; again the bars may be either faint or prominent. Among a number all phases will be apparent under identical conditions, but the most intense display is reserved



Habitat of the Pigmy Sunfish, Elassoma zonatnm, at Mound, Louisiana

When the coloring is deep they are much more sharply defined than in the illustration. On the sides, just below the forward portion of the dorsal, appears a large, more or less evanescent black spot, most pronounced in the male, with another spot at the base of the caudal. In the absence of bars numerous fine spots, becoming confluent at times and forming light blotches, cover the body. Similar but larger dots are disposed in more or less regular rows on the fins.

The coloration is subject to wide

for the male. In breeding dress he is altogether a handsome little fellow. The head and the bars become intense black, the interspaces dusky, the forward spaces flashing with yellowish metallic green, with deeper spots on the gill-covers. The fins, all save the pectorals, heretofore pale and transparent become decided blue-black, just short of being opaque, with the numerous spots quite prominent. When the color recedes, which it will do momentarily to return as quickly, the fading becomes noticeable

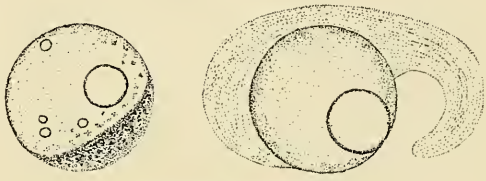
in the greater transparency of the fins, and in the tendency of the interspaces to become yellowish.

Breeding females are consistently pallid, a pale dirty straw, showing, if at all, but mere traces of bars. Even the tiny dots may be scarcely discernible. The abdominal wall appears salmon-pink, the color extending from the gills to the vent. When the eggs have been expelled the color has vanished, indicating that it was incidental to fertility. In spent females there is a slight deepening of color, the dots appearing and becoming confluent. Females are uniformly more chunky than the males. The wide divergence in the colors of the sexes (dimorphism) while breeding is in marked contrast to the sunfishes proper (Centrarchidae), which develop little if any differences in coloration at any season.

Last summer a pair was segregated in a tank that had been allowed to become messy, and intentionally so. The usual rubbish accumulated, Algae flourished, but the water remained sweet and was probably more pure than that in the stagnant ponds frequented by the pigmy in nature. At times the male was highly colored, while the female waxed fat and grew lean, but nothing eventuated. The others, placed elsewhere, fared likewise.

During September a 20-gallon tank was released by the removal of its fishes to other quarters, so it became the habitat of the pigmies. This aquarium has been standing for a long time, more than a year, and as a result is rather unsightly. Perhaps a dozen plants of *Cryptocoryne griffithsi* are surrounded by thickets of *Sagittaria,* with here and there a little *Nitella, Tillaea, Elodea* and some other things, with a luxuriant growth of filamentous Algae (Vaucheria, etc.) betwixt all. Strewn over the sand is considerable debris, mostly decaying and dying leaves, for the plants show lack of nourishment. But altogether the conditions probably simulate closely those to which Elassoma is accustomed.

Until the middle of December nothing unusual was noted. About this time two males took up stations at remote ends and were in rather good color. A number of females were obviously gravid. As by common consent the spots selected for nests were avoided by the others, including the females, in fact it was rather unwise to approach. If an intruder did appear, it was greeted by a



Eggs of E. zonatum

courageous little warrior with color flashing, and one short dash was sufficient. One of the sites was amid a dense growth of Algae and nothing could be observed other than that the male was constantly there; certainly there was no attempt to form a nest. This instance leads me to believe that under certain unfavorable bottom conditions no attempt may be made to clear a space, if indeed this is not the normal method. The other nest was more in the open. This was a space two inches in diameter and surrounded by plants of S. subulata; the observer's side was fairly free from Algae. While I did not see the operation, the rubbish was cleared and heaped about the periphery, but not with the nicety of *Eupomotis gibbosus*, as much flocculent matter was allowed to remain. This stage reached, the male at various times was observed making obvious efforts to attract a female, indulging in most amusing gyrations for such a "stiff" and usually sedate fish. During these plays the body assumed the most intense col-

oring. The movements were sinuous, but quick, possibly to be described as resembling peristalsis—not unlike the motions of *Betta* or *Polyacanthus* when two "measure up to one another" side by side. The dorsal was flabby but erect, waving with the movement, while the action of the caudal fin was quickened. A peculiar and conspicuous feature of the play was the rapid, rythmic, alternate backward and forward "clicking" of the ventrals, a feature I have not noticed in any other mating fish.

This remained the extent of my studies up to December 22d. That day, being Sunday, I was prepared to spend more than the usual time in observation. The result was the discovery of fry in the free-swimming stage. Twenty were counted, some near the nest and others elsewhere. To these the male gave not the slightest attention and, I am glad to add, neither did the others—at that time. Within a week all but one had disappeared. The fry were quite transparent, with pigmented eyes, and approximately three-sixteenths of an inch long. A few days later a single fry, much smaller and with yolk-sac still unobsorbed, evidently from another brood, was noted trying to rise from the bottom.

On December 27th it was my good fortune to observe the spawning operation. I had paused before the tank attracted by the antics of the male in the nest best visible, when a female approached quite unostentiously and without the slightest hesitation. When the two met, the play of the male gave way to rapid trembling on the part of both, the male taking a position immediately below the female, his mouth snapping not unlike a person with a chill. Extrusion and fertilization took place immediately over the nest, the non-adhesive eggs falling to the bottom seven inches below. So little were they dispersed in the effort that a half dollar would have covered all. The number was small, probably not more than fifty. Though the female did not seem to be spent, she was quite exhausted, sinking to a decumbent leaf close by, where she rested for more than an hour. The male assumed his position "on guard" and ere long was indulging in another love-play, but spawning was not repeated. From this I am inclined to think polygamy may be practiced in event of more than one gravid female being present. Should this subsequently prove true, we have in the pigmy a most adaptable species as far as matrimonial affairs are concerned, monogamy, polygamy and polyandry being practiced. This spawning occurred at 9.30 A. M., with the water at 72 degrees, Fahrenheit; weather cloudy.

On the 31st another spawning was witnessed. This took place on the edge of the nest just below the surface of the water (depth, 11 inches). I was too late for the preliminaries arriving in time to see the legitimate male and an intruder take a position, side by side, just below the female. The orgasm lasted a number of seconds, the eggs being ejected continuously. The female seemed completely spent and immediately swam from view among the plants. Both males guarded the nest and maintained sort of an armed neutrality for several hours, until one none too gently persuaded the other to depart. But this was decidedly under protest, as it loitered about the outskirts, making an occasional foray into the nest. Time 8 A. M., weather clear and sunny; temperature 71.

The endeavors of the male do not seem to extend beyond guarding the site of the nest. At no time, not even when the eggs were entangled among the Algae in plain view, did he evince the slightest in-

terest. His usual station is five or six inches above the nest or immediately by. Occasionally he has dashed quickly to the bottom, which merely seemed to stir up the humus. The infrequency of these dashes inclines me to regard them as caused by the fancied presence of an enemy in the nest.

From the last spawning I was able to remove a small number of the eggs which were entangled in the Algae Drawings are given made one hour and twelve hours after fertilization. At thirty-six hours all the remaining eggs had been destroyed by fungus. I am unable to explain the pecular process shown encircleing the eggs at the first period. Six were examined and it was present on all; at the second period it had disappeared. The loss of the eggs effectually precluded the possibility of determining the period of incubation. The eggs are very transparent and measure approximately one millimeter.

Kichigoro Akiyama

Last month, figuratively speaking, we visited Australia and looked with wonder at the beautiful aquarian conservatory of Mr. Albert Gale, wherein plants and and birds vie with fishes, for Mr. Gale finds everything in nature worth while and interesting. Homeward bound we will visit the Orient and become acquainted with Mr. Kichigora Akiyama,

The Goldfish Breeding Plant of Kichigoro Akiyama

the largest goldfish breeder in Japan. Perhaps this qualification is inapt. What we really mean is that Mr. Akiyama has the largest breeding establishment in Japan, both in area and in number of fishes bred. More than 25 acres of ponds are in service, all devoted to the fancy or toy breeds, so we may further say that this is the largest fancy goldfish hatchery in the world. It is to be regretted that a single photograph cannot show all the interesting features of the farm. Some of the devices in use are quite primitive. A well-sweep will be noted

where an occidental would use a windlass, not to mention an up-to-date pump. We are indebted to Mr. Eiichiro Nakashima, who took the photograph, for thoughtfully posing Mr. Akiyama before the portal of one of his sorting and equipment houses. Several other views are in hand, including a series showing the various implements used by Japanese breeders.

The annual meeting of The Reading Aquarium Association was held on Tuesday evening, December 17, 1918, in the store of Mr. George S. Breneiser. The work of the past year was reviewed and plans formulated for 1919. According to the report of the secretary the organization has forty-three members, most of whom are active, in whose collections may be found "anything" from common goldfish to lionheads, and wild fishes from native minnows to the regal *Pterophyllum scalare*. The financial condition is sound.

The following were elected to office: *President,* John Kershner; *vice-president,* T. Ralph Wilson; *secretary* and *treasurer,* S. D. Mellert; *assistant secretary,* Oscar A. Becker; *official judge,* George S. Breneiser.

It was decided to continue awarding ribbons at the monthly competitions, with a special prize to the member who captures the greatest number of firsts during the year. A dinner was served at the conclusion of the meeting.—Oscar A. Becker, *Assistant Secretary.*

The inaugural meeting of the South Australian Aquarium Society was held last March, the formation of which was suggested partly by the interest taken in aquaria, established in the South Australian Museum. The society was established "with the object of promoting the study of aquaria and aquatic life by the association of its members and others who may be interested." During the past eight months excursions and meetings have been held, including visits to various aquaria, and the reading of papers by members. On Tuesday evening, November 5, 1918, the first annual meeting was held at the residence of Mr. J. W. Hosking, Norwood. The balance sheet and report, read by Mr. H. M. Hale, secretary, indicated that the inaugural period had been eminently successful, and that the organization was justified in continuing and extending its operations. The following were re-elected to their respective officers: *President,* Edgar R. Waite, F. L. S.; *vice-president,* J. W. Hosking; *committee,* C. G. Pilkington, R. Rash and L. R. Catt; *auditors,* A. E. Wadey and B. B. Beck; *honorary secretary and treasurer,* H. M. Hale. A syllabus of meetings and outings was arranged for the coming year.

Of all the fins of a fish the pectorals are the most transparent and usually so devoid of color as to escape ordinary attention. This, to originate an expression, is "protective absence of color." The pectorals are in constant motion even when the individual is still. If they were colored it is obvious that the eye of a passing enemy or prey would at once be arrested. This was shown in an interesting way by a poeciliid hybrid in the collection of George W. Price. The fish was one of the "darks" or dominants of the cross, deep orange and black. One pectoral was deep velvet black, while the other was normal (transparent). When viewed with head or tail toward the observer the effect of the waving black fin was startling.

You think your job is the hardest in the world, but it's soft compared to the one your mother had raising you.

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Aquatic Life

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W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
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Polycentropsis Abbreviata

WALTER LANNOY BRIND, F. Z. S.

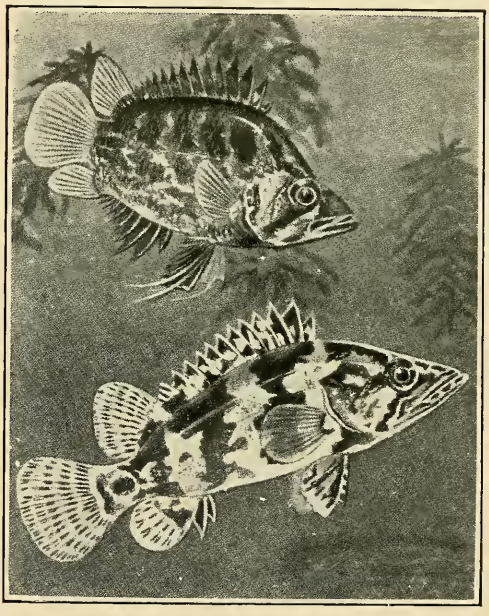
Here indeed is a rare fish, and I have seen it alive but once. The name signifies a fish with many spines and abbreviated tail. It is not a large species, a mature specimen averaging between two and two and one-half inches long, but it is a voracious rascal, and must therefore be kept alone. The illustration shows this species with *Nandus marmoratus* below, a whim of the artist bringing the two forms together, though it would not be advisable to associate these species in an aquarium.

In color our subject is warm brown with dark mottlings. The eye is reddish chestnut; mouth very large. The caudal fin and the extremities of the soft dorsal and anal fins are transparent and nearly invisible, thus adding to the foreshortened appearance of the fish.

Sexual differences are difficult to determine. During breeding activities a short ovipositor protrudes from the vent of the female, the abdominal line being convex, due to the distended ovaries; in the male the abdominal contour is quite straight.

The breeding habits are interesting. The male constructs a nest of bubbles under floating leaves. After close contact between the sexes the female assumes a position under the nest, back downwards, thrusts her ovipositor into the nest, and therein deposits the eggs singly. In the aquarium, with this accomplished, she should be removed. The eggs number about one hundred, and hatch in five or six days. The tank should contain not more than three inches of water, and be maintained at a temperature between 80 and 85 degrees; 75 degrees will be an agreeable temperature at other times for older fish.

The water should be well aerated and contain abundant microscopic life to support the growing fry. Tiny daphne



should follow, and then the live foods usually provided for carnivorous fishes—mosquito larvæ, small mealworms, fry of live-bearing fishes and similar materials.

The species is a native of tropical West Africa, and was first discovered by Dr. W. J. Ansorge, in 1900, in the Niger delta. It is described as rare, and when found occurs in brooks, rivers and ponds.

Polycentropsis and *Nandus* are members of the group of fishes called Nandidæ, which has representatives in Southeast Asia and South America as well as in Africa.

Reactions of Fishes to Habit-forming Drugs

The reactions of goldfish to certain habit-forming drugs is the subject of an article in the Journal of the American Pharmaceutical Association, by Prof. Victor E. Shelford, of the University of Illinois. The craving engendered by the use of habit-forming drugs is not understood. Most of the pharmacologic studies in this connection have been made on mammals (a few have been on frogs), but almost none on the lower vertebrates. By chance Professor Shelford discovered that fishes are peculiarly affected by numerous organic substances in aqueous solution when put under special experimental conditions. The conditions are established in a tank approximately 48 inches long, 5 inches deep and 6 inches wide, in which water containing a drug flows into one end and out at both top and bottom, at the middle, while water which contains none of the drug flows into the other end at the same rate. The two flows meet at the middle and with most substances there is a mixture of the two kinds of water which occupies the centre third of the tank. In this mixture a fish moving from the pure water end toward the drug-containing end encounters a gradual rise in concentration of the drug. This region of change of concentration is called the gradient. The character of the gradient in these tanks has been fully determined by taking samples, by measuring and by the use of colored water. If a fish encounters no change in water, it moves freely back and forth without showing preference for either end of the tank. If it encounters water containing an excess of carbon dioxide, it backs away and starts again, often repeating the operation before going forward. It gives other evidence of stimulation. The opercles are lifted, the lower jaw protruded, or the mouth moved in a yawning, coughing or gulping motion. When a fish enters a solution containing ethyl-alcohol, cocaine, morphine or any one of several other substances tried, there is no apparent rejection of the drug, but, on the contrary, after a time the fish is found to have a preference for the drug-containing end of the tank. With cocaine the fishes, after a short exposure, refused to leave the drug solution, soon became intoxicated and died. With ethyl-alcohol the fishes reacted more and more positively as the concentration increased up to 10 per cent. The experiment was discontinued because the subjects became semi-intoxicated. In 20 per cent. ethyl-alcohol the fishes avoided the full strength, but still reacted positively. With morphine no preference is shown in concentrations of 0.15 g. per litre. In 1 g. per litre positive preference was shown by one individual, but not by another. Some individuals avoided the strongest solutions of morphine. With naphthalene in half-saturated and saturated solutions, the fishes reacted postively, although they died after a time. Some species of minnows were less sensitive to ethyl-alcohol than goldfish.

The goldfish is becoming a great pest. It has multiplied in the River Murray to such an extent that a frayed rope-end let down into the water will in a few days be a mass of goldfish spawn. These wild goldfish grow up to two or three pounds in weight, many of the largest being red. —Herbert M. Hale, *Australia.*

We recently heard of a house that found a tenant solely because it happened to have a glass-enclosed sleeping porch. To aquarists, nuf sed; to property owners, a hint of a desirable improvement.

Chologaster cornutus
The Fish of the Dismal Swamp

W. W. WELSH, United States Bureau of Fisheries

The first recorded description of this curious and little-known fish was published by the elder Agassiz in the *American Journal of Science and Arts,* in 1854. The fish then described was taken in ditches in the rice fields of South Carolina. In 1853, on his return from a tour through the Southern and Western States, Professor Agassiz gave a summary of some of his ichthyological discoveries in a letter to Professor J. B. Dana. In this letter are the following remarks:

"I would mention foremost a new genus which I shall call *Chologaster*, very similar in general appearance to the blind fish of the Mammoth Cave, though provided with eyes; it has, like Amblyopsis, the anal aperture far advanced under the throat, but is entirely deprived of ventral fins; a very strange and unexpected combination of characters. I know but one species, *Ch. cornutus* Ag. It is a small fish, scarcely three inches long, living in the ditches of the rice fields in South Carolina. I derive its specific name from the singular form of the snout, which has two horn-like projections above."

Since the discovery of this species by Prof. Agassiz, two other species of *Chologaster* have been described, both being found in subterranean streams and caves.

The family to which *Chologaster cornutus* is assigned, together with the so-called blind-fishes, is the Amblyopsidæ, composed of small, ovoviviparous fishes living in caves, swamps and ditches of Southern and South Central States. In this family the body is elongate, compressed posteriorly, the head long and flat, with projecting under jaw. Superficially there is a strong resemblance to the Poeciliidæ, or Top Minnows, but the mouth is smaller, the scales finer, the ventral fins are absent or rudimentary, and the vent is placed far forward. Of the four or five known genera, the genus Chologaster is the only one that has functional eyes and a pigmented skin, all the others having skin-covered eyes and colorless body.

In *Chologaster cornutus* the ventral fins are absent, and the vent is placed forward of the pectoral fins. The body and head are dark brown above, white below, with three narrow longitudinal black stripes on the sides, the middle one extending through the eye and snout. In some examples the belly and sides of the trunk are flushed with red of various shades. The dorsal fin is white with dark spots. There is a black blotch at the base of the tail, beyond which is a white area or bar; remainder of caudal dusky. The length does not exceed two and one-half inches.

Cholgaster cornutus is found from Virginia to Georgia, in swamps, ditches, and backwater of small rivers. It appears to be solitary in habit, but is locally abundant. In April, 1916, the writer obtained six examples in the Little Peedee River, all being captured in drifts of dead leaves at the foot of sand-bars, and in shallow indentations of the river bank. Associated with them in such places were

numerous larval salamanders, and the resemblance of the two in shape, color and movement, was striking. Four males and two females were secured at this time, the latter containing large yellow eggs, 1 to 1½ mm. in diameter.

This species appears to be nocturnal in habit, invariably attempting to hide in the daytime, and when disturbed moving from hiding place to hiding place in short, wriggling dashes of astonishing rapidity. One example, taken in the Peedee River, survived a trying journey to Washington, where it lived in a small aquarium for several months. Although supplied with a variety of live food, it was never observed to feed in the daytime.

Considering the apparent hardiness of this species, and the character of the waters it inhabits, it would appear to be well suited for observation in the aquarium, which might throw some light on its habits and life-history.

A Wood Aquarium

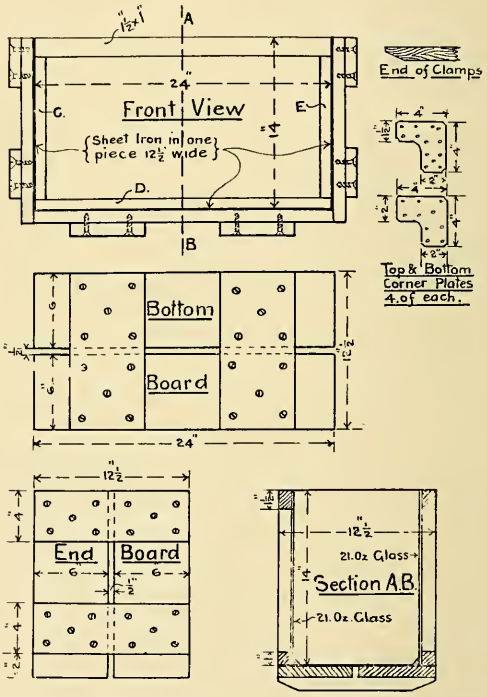
C. G. PILKINGTON

At the present time, in Australia, it is difficult to secure all-glass aquaria. Inasmuch as not all aquarists are sufficiently adept with tools to make tanks of metal, with reinforced concrete base, the following specifications for a tank with ends and bottom of wood, one of which I have had in use for fifteen years, may make an appeal:

All wood one-inch red pine, dressed (cypress or first-grade white pine may be substituted in America). Screws (60) where shown in sketch; all other parts nailed, including top and bottom corner plates, which are cut out of thin sheet iron.

Give all woodwork three coats of paint, and the piece of iron, which covers the bottom and two ends three coats of white bath enamel after it has been bent to fit.

The pieces of timber marked C, D and E are nailed through the sheet iron to the bottom and end boards. It is most important to see that all parts are marked out accurately with a square, and that bottom and end boards are square before nailing together; also square everything before nailing on the top and bottom corner plates. If the clamps are beveled off



at the ends as shown the appearance is lighter.

Any good aquarium cement will answer for fixing the glass. That used on this tank was composed of equal parts of fine sand, cement, white zinc and rosin mixed with boiled linseed oil.

In making a number of aquaria the height should be uniform, as a miscellaneous collection is difficult to arrange.

You cannot run away from a weakness; you must some time fight it out or perish. And if that be so, why not now and where you stand?—*Robert Louis Stevenson.*

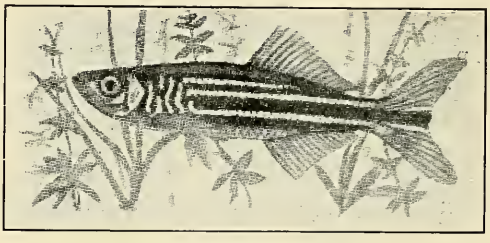
Danio Malabaricus

ERNEST LEITHOLF

In the Madras Journal of Literature and Science, for 1849, Jerdon describes *Perilampus malabaricus, canarensis* and *mysoricus;* Bleeker, in 1864, describes *Danio micronema* and *lineolatus* from Ceylon; Day, 1869, describes *Paradanio aurolineatus.* All were merely variants of one species, the fish we now know as *Danio malabaricus,* and as synonyms are handled by Day in his larger and later work on the fishes of India.

In color it is one of the most beautiful of the genus. The back is gray-green; abdomen silvery; the sides with three sapphire-blue bands, the central one somewhat wider at its base gradually tapers toward the caudal. Between these are two luminous golden lines, with another line about three-fourths of an inch long, sometimes very broken and irregular, and seemingly a continuation of a number of irregular golden streaks and dashes directly behind the gills, extends partly through the centre of the central band. The ventrals, anal and abdomen are tinged with reddish salmon. Extending through the caudal fin are three or four dusky rays. Some writers maintain that these rays, in the female, incline toward the upper lobe, and that the irregular marks behind the gills are more numerous, but I have not found these details very convincing guides. The number of irregular marks varies considerably, a particular male may have more than the average, and a certain female less. Before maturity it is practically impossible to distinguish the sexes, but when fully developed the coloration of the male is more intense and the body more slender and graceful.

In proportions the length of the head is contained four or five times in the length of the body—two and one-half to three and one-half times its height. The dorsal contains from 12 to 15, anal 15



Danio malabaricus (Male)

to 19, pectorals 8 and the ventrals 15 rays. Lateral line with 35 to 37 scales, transversely 7 to 8. Of the four barbels the two lower ones are very minute and rudimentary, often entirely absent; the upper pair correspond in length to one-half the diameter of the eye, and may also be absent.

The breeding of this Danio in confinement has not met with any great degree of success, and as none have been imported since 1914, the species at this writing is nearly extinct in our collections. We secured our stock at the time mentioned, and since then the original pairs and later their offspring have frequently spawned in our tanks. Fortunately some of the fry always survived to maturity, though each succeeding year marked a decrease in number until, in 1918, only three were found, and these succumbed

when about an inch long. Inability to infuse new blood undoubtedly has been the main factor in this decline.

For breeding purposes a large tank should be used. The vegetation should be arranged in one dense group at one side or in a corner, as this affords protection for the spawn, and gives ample swimming space for the fish; moreover it facilitates locating and removing the eggs, which can be accomplished with a glass dip-tube or a rubber hose. In our tanks the species has never spawned more than three or four times during a summer. The operation takes place while the fish force their way through the densely planted section of the aquarium.

After incubation, which requires from two to five days, the fry can be seen suspended from the plants, stones or sides of the aquarium. They will cling to the same spot for hours, only changing their positions when disturbed. This inactivity, broken only by an occasional effort to swim, continues from one to two days, the yolk-sac supplying nutrition during this time. When able to swim about, and supplied with an abundance of infusoria, and later daphne, small mosquito larvæ, etc., their growth is remarkable, individuals attaining a length of three-fourths to one inch in less than four weeks. This seems to be the most critical period. The majority, if an apparently healthy lot of fry, will in a few days' time be transformed into a sickly lot, with arched backs, shrunken abdomens and contracted fins. This has frequently happened in tanks that were painstakingly maintained in the best of condition, and so far we have been unable to determine the cause.

Our experiences lead us to conclude that in order to raise this species in large numbers, an exceedingly large tank, or, better still a pond or basin in a conservatory, must be employed, with artificial aeration if available.

Mr. W. H. Cassell, of The Aquatic Association of Maryland, is very much exercised over the following note, which appeared in the Baltimore Sun. W. H. C. is anxious to know if fishes hatched by this method develop feathers or fins. Seems to us that the problem should be solved in Baltimore. The clipping specifically states that hens' eggs were used, so the question is referred to the treasurer of the Aquatic Association, Mr. Louis Hens. The clipping:

"The Chinese have a novel way of propagating fish. The spawn is carefully collected from the surface of the water, and when a sufficient quantity has been obtained they take a number of hens' eggs, the contents of which have been carefully emptied through a small aperture, and refill the shells with spawn. The holes are sealed up and the eggs put under broody hens. The hens are allowed to incubate the eggs for a certain number of days, when the eggs are again broken and their contents put into water that has been previously warmed by the sun. In a very short time the spawn hatches, and the young fry are then kept in pure, fresh water until a sufficient size to be put into the ponds. At one time a considerable business was done in this style of spawn hatching."

The West Philadelphia Goldfish Fanciers' Association met on Thursday evening, January 2d, in their new quarters, Hamilton Hall, 5236 Market street. The competition was for blue ribbon winners. Awards were made as follows:

Scaleless Telescopes—Silver cup to Michael Moylan; blue and yellow ribbons, Howard E. Demuth; red ribbon, E. Weinreich. *Scaled Telescope*—Blue ribbon, E. Weinreich. *Lionhead*—Blue to Michael Moylan. *Scaled Jap*—Blue to Frank Merges.—Earle W. Roak, *Secretary*.

Notes on Native Fishes in Aquaria

LEON L. PRAY

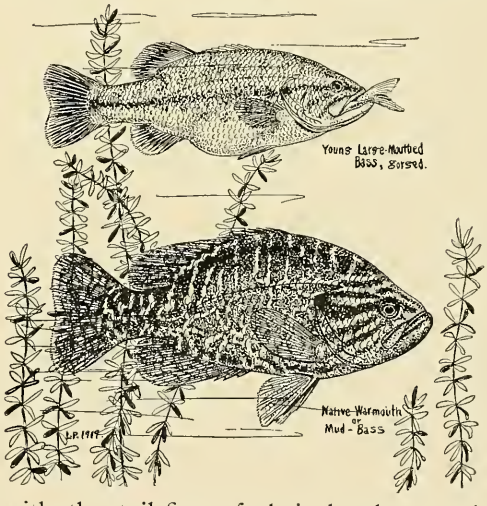
Field Museum of Natural History

For a number of years I have maintained a small aquarium or two on the back of a table at my place of employment. A few seasons ago, in June, I netted some fishes from a body of water adjacent to the building. With the rubble brought by the net from the bottom of the pool were pieces of mussel shell and pebbles, which I kept to add to the collection at the bottom of my aquarium.

Large-mouth black bass were nestling along the shore of the pool, but I didn't suspect I had taken eggs until several days later, when I noticed half a dozen newly-hatched babies moving uncertainly about over the bottom. They were too small to identify, but I suspected immediately that they were bass. Each consisted principally of a pair of goggle eyes, a stomach attached below and a little to the rear, and a pointed, apparently finless tail. The tail was held curved around at one side, except when the owner wanted to get somewhere, when it was energetically flipped backward to produce forward motion.

At this time there were countless minute, whitish creatures dodging about over the bottom and through the plants. To these the baby fish turned their attention, seeming to depend upon them for food at this stage of their career. In a few days the little fish, which at first were scarcely more than one-sixteenth of an inch in length, began to straighten their oddly-curved tails. During the same time the yolk-sac was absorbed, their mouths became larger and the fins began to take shape and become visible. After three weeks they exhibited the form and markings of the species, though they were not more than a fourth of an inch long.

Soon a rather surprising thing happened. The baby bass turned cannibals. The larger and stronger ones quickly swallowed the smaller, afterward going slowly about, rolling their eyes wisely,



with the tail-fins of their brothers and sisters protruding from their mouths. In a few days but two remained. There was but slight difference in size. When I came in one morning one was gone. Carefully I watched the survivor and, sure enough, there was the bulging belly and the tell-tale caudal fin sticking out of his mouth. In outline he resembled a mature bass. He was paunchy and full-throated, just like many an old "crab-cracker" that has fallen to my rod. It was laughable. There swam the lordly little savage, sole proprietor and tenant of the tank, ruthless destroyer of his kin

that he might live.

After this I caught a swarm of minnow fry and turned them in with the little bass for company and for food. Until his appetite prodded he ignored them, but when the spirit moved he gave them unswerving attention. Then he would slide up through the water toward the glinting drove, all of which were longer than himself, and aim his baleful eyes and bulldog nose at the one he intended to kill. Time and again I watched him make his selection. They were in limited space, and he could be deliberate. The minnow chosen seemed to know that ill was brewing and would rush alone from the throng, wildly seeking an escape. A wire screen covering the tank prevented an aerial egress.

The little bass fed twice daily, as regular as a clock, in mid-forenoon and mid-afternoon. He rarely missed his first strike, usually catching his prey by the middle, then quickly and deftly shifting his hold to the head, and swallowing with a quick gulp and a wriggle of his body. Nearly always the tail of the minnow protruded from his mouth for two or three hours after. A few times I saw him snatch a frantic minnow by the tail and try to swallow him that way. Usually the vibrating tail of the victim would work out through his gills, when he would shake it free and then take head first. When he struck he sped in a slight arc, so fast that he resembled a silvery dart thrown with incredible speed from a sling. If he missed he became angry and the speed of his next seemed doubled, if indeed greater speed be possible. There was no perceptible "open mouth effect" when striking; he snapped as his snout met the minnow, its scales flying in a shimmery shower.

The other minnows would soon be playing and feeding again, not showing any particular alarm, even when the gorged bass would lazily swim among them. I kept this interesting little fellow three months. In that time he consumed 160 minnows, including his own relatives. He grew about an inch a month, and was slightly under three inches in length on the first of September.

Among the many other fascinating little native fishes which I have kept was a young Warmouth or Mud bass. This fellow was even more bulldog-like in appearance than the black bass, but was fairly gentle and as proud as a peacock. He would change his colors and dark mottling into several beautiful combinations in less time than it takes to tell it. Once I put a piece of mirror behind his tank. Whether this delighted or incensed him I could never make out. Before it he would bristle and strut with mouth agap, his colors blazing and gills expanded until they resembled a rosy blossom. With all fins spread, he would wriggle about, rolling his fiery eyes at his reflection. A dog would have laughed at his antics.

He would eat almost anything, and was altogether a very satisfactory aquarium pet. Goldfish shared his tank, and to them he made love. This he did in the most ardent and mirth-provoking style, until the goldfish in consternation would flee into the weeds.

Last summer I had a mud minnow and two young bluegill sunfish. The two species engaged in a feud which ended in disaster. Not a day passed but the three staged a battle or two, in which the mud minnow nearly always bested his two doughty antagonists. The longer they lived together the more savage the fights became. The minnow usually started hostilities by sliding out from his weedy retreat with his head twisted sidewise, fins spread and undulating with nervous energy. Slowly he approached the hid-

ing sunfish. Then with a motion exactly like the swing of a pugilist's fist, he would strike so fast that one could see him only as a blurred, brown arc. Bing! When his tough little "mug" hit a sunfish, and he never missed, that sunny went sailing like a flat stone. But the sunnies came back every time, game as bantam cocks. Then it would be bing! biff! bang! for a few seconds, until the combatants retired to the weeds to glare and bristle and accumulate energy and courage for the next round.

It came to an end one Sunday when I was not on hand to witness the final scrap. I wish I had seen it. On Monday morning the sunfish were swimming around with an air of triumph. The mud minnow floated dead at the surface of the water, with his snout bruised and swollen, his sides gouged and half the scales stripped from his body. It must have been *some* scrap!

With the end of the war the interest of the members of the Essex County Aquarium is reviving, and prospects look bright for the future. The following officers have been elected for the current year:

President, Rev. B. Coltarti; *vice-president*, F. Hoernig; *treasurer*, Dr. William Bachmann; *recording secretary*, C. M. Breder, Jr.; *financial secretary*, C. F. Hermes.

Membership, exhibition, entertainment and publicity committees have been appointed—the machinery has been set in motion for a big and prosperous year.

The members were glad to welcome back to the fold the Hoernig boys, who have been wandering in other fields for more than a year. They have plans for a fine goldfish hatchery in the nearby country, so New Jersey is now to have a real fish establishment near her metropolis.—C. M. Breder, Jr., *Recording Secretary*.

One reason why consumers have confidence in advertised wares and buy them freely is that an advertisement constitutes a reliable record of the terms upon which the seller offers his goods to the buyer.

The personal salesman may or may not truthfully represent the quality of the product he urges upon his customer. If he misrepresents it, and afterwards repudiates his description of it, or his promises in its behalf, there is no come-back for the purchaser. An oral statement is unsubstantial. It is not a matter of record.

The magazine advertisement is a protection to the buyer. It is always available for reference; it is first-class evidence.

Buyers and sellers alike recognize the advantage of the printed word as a promoter of square dealing and clear understanding. The aquarist who commits himself to print in the magazine advertisement is fully accountable, and is therefore a safe man to deal with.

Blood circulation in the frog is readily observed by placing the web of a hind foot under a moderate-powered microscope.

A chanchito with a shoal of fry is about as busy as a cross-eyed boy at a three-ring circus.

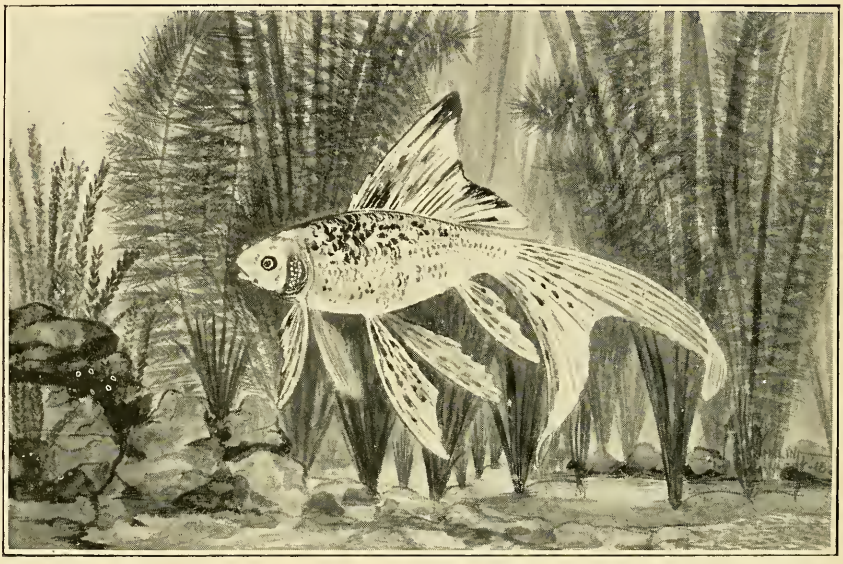
Some men are like musical glasses—to produce their finest tone you must keep them wet.—*Coleridge.*

Even the things we get for nothing may cost an effort.

Don't brag about your goldfish; let them do the talking.

MANAGING THE AQUARIUM

WILLIAM T. INNES



Blue Calico Comet **Original Water Color by Franklin Barrett**

There is one question which the beginner always asks of the experienced aquarist—"How often should I change the water?" The answer: Except under unusual circumstances, not at all. This is sure to bring forth expressions of surprise and wonderment, and a demand to know how in this way one may avoid having the water become stagnant and ill-smelling. As a matter of fact, a properly conditioned aquarium only needs water added to make up for evaporation, while a general house-cleaning and replanting may be desirable (but not necessary) from one to three years apart.

The governing principles are so simple that it is surprising to find the general public ignorant of them. The big fact is that the fish exhale carbon dioxide, which the plants need in food-making, the plants breaking up the combination, retaining the carbon and returning the oxygen to the water, to again be used by the fishes in respiration. The answer, in a general way, then, is to have enough plants to handle the products of the breathing of the fishes. This arrangement makes what is known as a "balanced aquarium," which is capable of remaining undisturbed for years. The writer has an aquarium which has not been drained for five years.

The proper conditions naturally group themselves into five considerations—plants, light, number of fishes, feeding and temperature. The general principle

regarding the benefits exchanged between plants and fishes has already been stated, but the plants in order to do their part of the work must have light—not too little nor too much. They give off oxygen only under the influence of light, but most aquarium plants will be "burned" if exposed to too much direct sunlight. A strong north or other diffused light is generally successful. An hour or two a day of direct sunlight is beneficial, but more than this is not recommended, particularly as it is apt to turn the water green by promoting a rapid growth of minute algæ.

Some plants are better oxygenators than others. Three of the best are giant *Anacharis*, *Vallisneria*, the Italian or diminutive form, and *Sagittaria*. The latter two are probably the most satisfactory of all aquarium plants. The Washington Grass, *Cabomba caroliniana*, frequently sold by dealers, is not recommended. It breaks up easily, and unless the conditions are just right it soon looks shabby. There cannot be too many plants as long as the fishes have room to swim. The surplus oxygen passes off into the atmosphere.

For the bottom of the aquarium use washed, coarse sand, or sand and gravel. Do not use fine ocean sand. If the plants have roots, spread them well. From one to two inches of sand will be found sufficient.

The next important subject is the number of fishes which may be placed in the aquarium. In spite of advice to the contrary, the beginner insists on overcrowding, and only learns by repeated failures. As a large fish consumes more oxygen than a small one, there can be no satisfactory rule as to the number of fish used, but there *is* a very good rule which it will be well to remember—one inch of fish to the gallon of water. This is not counting the tail. That is to say, a five-gallon aquarium will properly maintain either one five-inch or five one-inch or ten half-inch fish.

To calculate the capacity of an aquarium in gallons, if it be rectangular, multiply the depth, length and width of the water measurement in inches, and divide the total by 231.

Avoid globes where possible, but if they must be used, do not fill more than two-thirds full. This gives more air surface than when they are filled to the top. The greater the air surface the better, and this applies to any aquarium. Therefore a broad, flat shape is better than a deep, narrow one. Fish undoubtedly do better in rectangular aquaria than in globes, and they can be seen to much better advantage.

An aquarium of less than five-gallons capacity is not very satisfactory for goldfish. A ten-gallon size is a good one to start with. For many of the tropical fishes it is possible to use quite small aquaria, even down to quart jars.

Many persons kill their fishes by kindness. They overfeed them. Fish in the confinement of an aquarium should not be fed more than will be entirely consumed in a few minutes. In moderate and warm weather they may be fed once daily; if the water is cool (50 to 60 deg. F.) every other day is sufficient. If below this, once a week. The white rice wafer, the food generally used by the inexperienced, is the least desirable. Nearly all dealers sell a better food in granular form, composed of dried insects, egg and farinaceous substances.

The best temperature for goldfish is from 65 to 70 degrees F. They can maintain life down to the freezing point, but under artificial conditions necessarily pertaining in an aquarium this is to be avoided. Higher than 80 degrees is also

dangerous.

A ten-gallon aquarium should be provided with about half a dozen snails such as dealers sell. They will keep down the green growth on the glass and also consume particles of food which the fishes may have overlooked. For the latter purpose some aquarists use tadpoles. The writer does not care for them, as they keep the water and sand stirred up too much. The snails should be watched and dead ones promptly removed. A mussel helps to keep the water clear, and is a desirable addition, but should not be used unless one is willing to frequently observe whether it is alive. When dead their decomposition is rapid and very offensive.

Once in a while, when the sediment in an aquarium becomes unsightly, siphon it off with a rubber tube of from one-fourth to one-half inch in diameter and about three to four feet long. Fill the tube with water, holding one end closed while the other is quickly placed in the aquarium. Hold the closed end as far down as possible below the aquarium and then open into a suitable receptacle. The water will run out as long as the discharging end of the tube is lower than the surface of the water in the aquarium. Move the end of the tube about in the water just above accumulations of dirt, which will be rapidly sucked up. Care must be taken not to draw in small fish and snails.

If the time can be taken, let the drawn-off water settle somewhat and filter the clear portion through fine muslin back into the aquarium. This is better than new water if the aquarium is right. If new water is used, see that it is of nearly the same temperature as the old. This is important. Violent changes in temperature produce contagious diseases known as "white fungus" and "tail rot." At the first sign of a whitish coating on a fish, or a general splitting of the fins, separate it from the others and place in salt water until improvement is distinct. This may take from one day to a week. The water should be salt enough to be just noticeable to the taste. Salt water should be changed daily. Feed sparingly. Sometimes this treatment is beneficial to fish which are generally run down, but show no external signs of disease. It is believed that sea water, properly diluted, is more effective than common cooking salt. Do not use advertised brands of non-caking table salt, as some contain chemicals injurious to fish.

On cloudy days, even in a properly conditioned aquarium, fishes will come to the surface of the water to breathe, but if they do this in clear weather, it is a sure sign that something is wrong. It may be from too high a temperature, too few plants, decomposition of snails, mussels or unconsumed food, but in all cases it is from overcrowding. Whatever the cause, it must be found and quickly remedied. To delay is to invite disaster.

I should like to express my great appreciation of Aquatic Life, and wish it the very best of succes, which it greatly deserves. It has given me many hours of pleasure and instruction.—A. E. Atkins, England.

Let our object be our country, our whole country, and nothing but our country.

Let us then stand by the constitution as it is, and by our country as it is, one, united, and entire; let it be a truth engraven on our hearts; let it be borne on the flag under which we rally in every exigency, that we may have one country, one constitution, one destiny.—*Daniel Webster.*

Nature yields only to work.

The Boston Show

WALTER N. CHUTE

The third annual exhibition of the Boston Aquarium Society was held in the Mechanics' Building, January 14th to 19th inclusive, in conjunction with the Boston Poultry and Pet Stock Show. Five hundred fishes were shown in 73 tanks, 23 of which were "balanced."

More than a hundred goldfish were entered in the sixteen classes. In the tropical section twenty-nine species were shown, together with two hundred native fishes, representing fourteen species. The tropical were shown in electrically heated cases, the heat being applied to the air and not to the water direct. One member showed a beautiful community tank, heated by an oil lamp. This worked admirably, maintaining a temperature of 75 degrees, while the hall temperature dropped as low as 50, until some curious individual in the absence of the attendant, turned up the flame to see how it worked —and forgot to turn it down again! After that the aquarium was maintained at 120 degrees, presenting its unfortunate owner with an entirely unexpected fish chowder the following morning. This is mentioned as a warning. If exhibition tanks must be heated, heat the air, not the water, and by all means have an attendant present at all times, even if you have to hire one.

The End of a Perfect Day– Members of The Chicago Society Aquatic Life at the Daph Pond

The greatest interest centered in the special awards. Mr. F. S. Blodgett carried off the honors for the best fish shown with a big black. A younger black, entered by W. N. Chute, was awarded second, while F. A. Packard's blue was third. In the class for balanced aquaria the 50-gallon tank entered by C. L. Hauthaway was far and away the best. The writer took first in the "under five-gallon" class. Mr. Hauthaway also carried off the honors for the largest collec-

tion of plants, the most species of tropical fishes and the largest number of native fishes, and also received first prize for the number of classes entered, showing fishes in 45 classes against 32 entered by his nearest competitor.

No record was kept of the attendance, but 900 copies of a little pamphlet called "The Daphnian" were distributed.

A True Fish Story

Professor Roy L. Moodie, of the University of Kansas, related a good fish story in the American Naturalist for March, 1909. He said that cattle in Nebraska were seriously infested by the Texas horn fly, *Haematobia serrata,* a pest that had been introduced from Europe. These flies "literally swarmed around the cattle, and since the majority of the stock was dehorned, the insects would settle all over the backs and sides of the animals, although they were in some cases observed to cluster around the horn bases."

"At Harris' ford, where the collecting parties crossed Running Water, several hundred cattle watered all summer. . . .

"The cattle would almost always enter the stream at the shallow part of the ford and gradually wade up stream, drinking as they went, until they came to the deep place near the fence where the water reached well up on their bellies. The chubs, *Semotilus atromaculatus,* seemed to be unusually numerous at the ford, and we often wondered at the great numbers of the little fishes which we could see in schools in the clear water. Their presence was soon explained. As soon as the cattle entered the stream at the shallow place in the ford the chubs would come out from their cool and shady retreats under the grasses along the sides of the bank and hasten to meet the cattle at the shallows. Often we saw as many as a dozen or more chubs following a single cow. As soon as the water came near the bellies of the animals the chubs would leap out of the water and catch the horn flies from the sides of the cattle. Often we saw them leap as much as half their length out of the water to secure a fly which was high up on the animal's side. These observations were made on several consecutive days, and on the last day but one I was so fortunate as to secure a photograph of a chub in the act of catching a fly from the side of a cow, and the photograph is published herewith.

"That the fishes actually learned that the dark spots on the sides of the cattle made good food there can be no doubt. Just how they first learned it we may not know. The chubs had further learned that the coming of the cattle meant food for them, hence they would meet the cattle in the shallows and follow them to deeper water."

Dr. Moodie proves his story with a good photograph.

Scientific education is necessary with practical education, for if we raise the standards of work we must also raise the standards of knowledge in our nation.

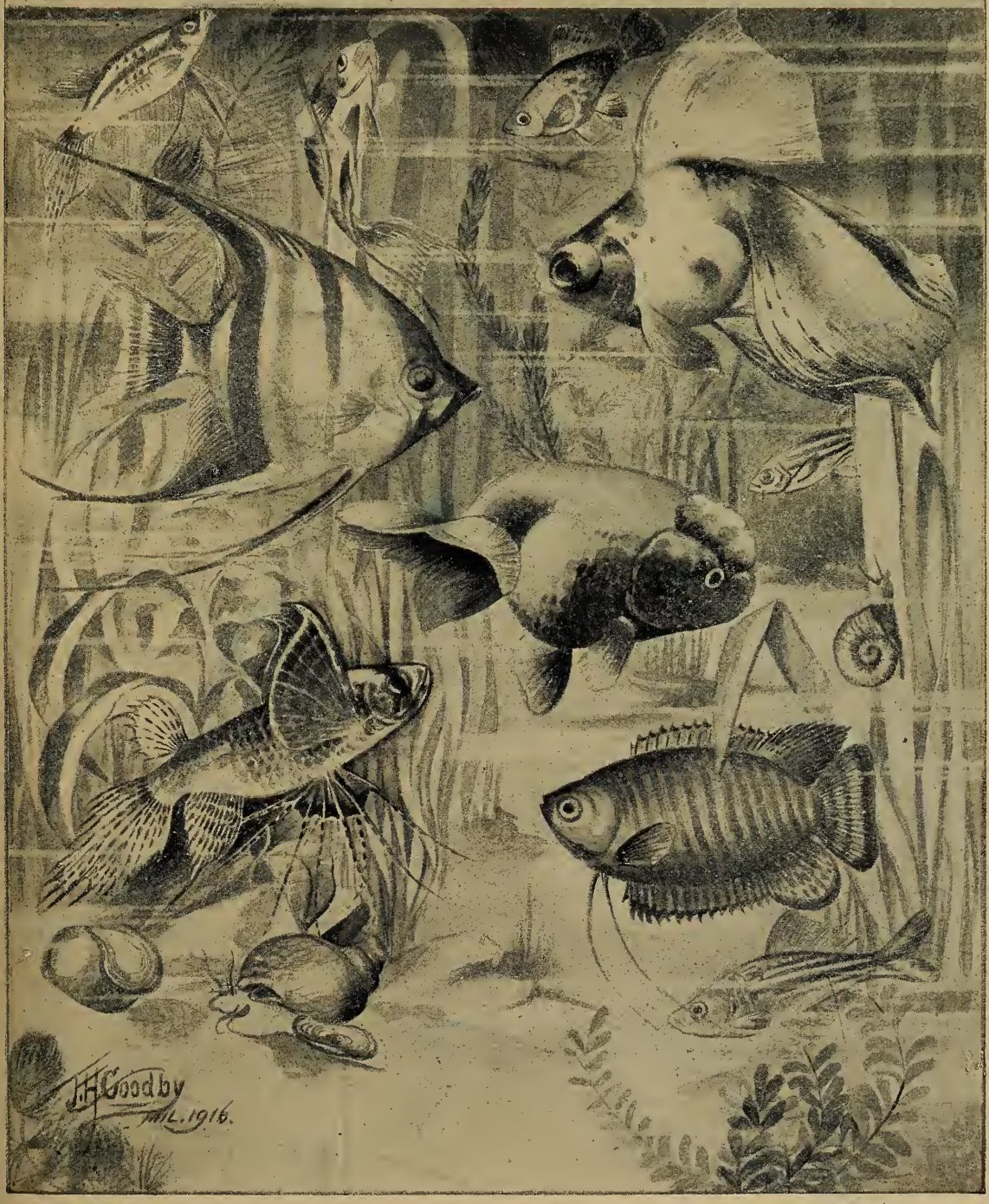
You can gauge an aquarist by the contents of his bookcase. Are you preserving for reference every available scrap of literature?

If you think you have troubles, just watch a fat man trying to catch a swordtail in a 75-gallon aquarium—with a 3-inch net!

Keep a note book near your aquaria and jot in it every little observation of interest. Don't trust to memory. The best of us err at times.

March, 1919 15c Copy

Aquatic Life



Aquatic Life

Vol. IV. March, 1919 No. 7

An international monthly magazine devoted to the study, care and breeding of fishes and other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
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Popular and scientific artic'es and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

"Aquatic Life" has the largest circulation of any magazine in the world devoted to aquatic nature-study. It offers to advertisers a market that can be reached through no other medium. Rates made known on application.

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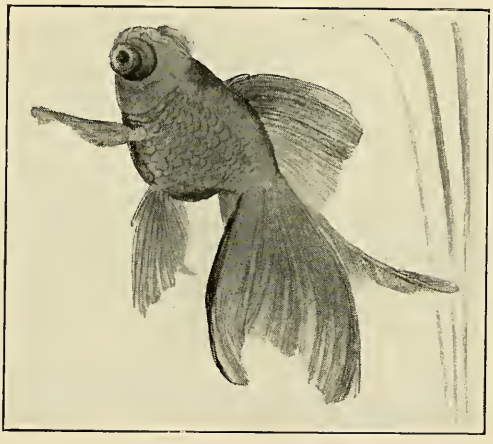
BREEDING THE GOLDFISH

DR. FRANK B. HANNA

The goldfish is at once the most interesting and the most exasperating of the fishes commonly cultivated; the most easily bred and the hardest to develop to the degree of perfection necessary to a place among the winners at a big show. The problem of selection while the fish are quite small, to eliminate the undesirables, is really the important feature and, judging from average results, the least practiced.

How to breed goldfish is a common question. The answer is that the fish will breed whether you want it to or not, using the term breeding to concern the deposition of eggs, allowance being made for individual barrenness. The controlling factors, assuming the fish are properly "housed," are foods and temperature. Spawn will be developed during any part of the year if living foods, such as Daphne and mosquito larvæ, are provided and the water temperature consistently maintained above 60 degrees. Thus sexual activity is not difficult to influence, and this flexibility proves the pitfall of many. It is not uncommon to hear an aquarist gloating over a spawn in January, thinking an advantage is secured over his fellows. Here we wish to emphasize why rearing is more important than mere breeding. The early fry appear when weather conditions are far from favorable, Daphne scarce and the water cool and uncertain in temperature, not to mention its variable condition as to soluble contents due to natural spring thaws. Fry reared under such conditions are outstripped by those hatched three months later. Therefore happy is the man, and fortunate, who holds back his fish until April at the earliest, even though he possesses a conservatory.

For spawning and rearing no receptacle excels the common, 24-inch wood or composition washtub. Of course, when a new one is brought into service it must be properly seasoned. Fill with water and furnish a generous mass of *Myriophyllum,* which the writer much prefers



Black Telescope Goldfish

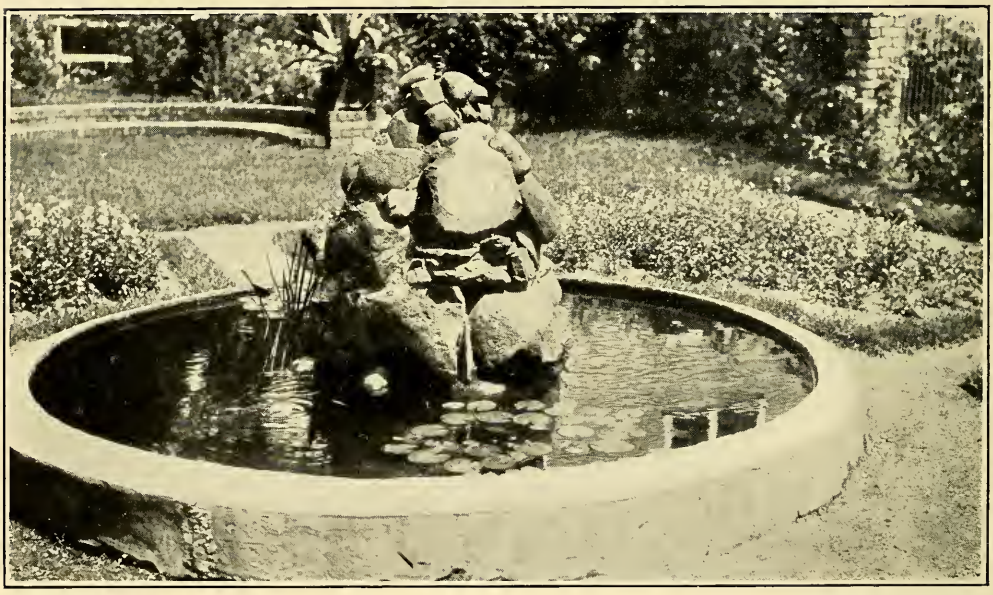
Original Water Color by Franklin Barrett

to water hyacinth All dealers catering to aquarists carry this "spawning grass" during the spring and summer months. Place in the tub a trio of breeding fish, two males to one female being a good general combination, though often one vigorous male will be sufficient, especially if he is the larger of the two. More than two males may be used if much smaller than the female, it being believed that fewer infertile eggs will result.

In the parlance of the fancier the prenuptial play of the goldfish is called

"driving." To the uninitiated one fish seems to be chasing and annoying the other. The pursuer is the male, to be further distinguished, on close examination, by the presence of more or less prominent excrescences (white spots) on the gill-covers and along the first rays of the pectoral fins. The object of his attentions, especially when viewed from above, will appear broader across the back at the rear, one side perhaps more distended than the other, making the fish lop-sided, this being due to the unequal development of the roes. When the attentions of the male become so constant as to make it appear that the female is being harassed, then spawning may be expected soon. The desired individuals should be placed in the tub previously prepared, if not already transferred before this stage has been reached.

The climax is reached during the early hours of the morning, and is usually finished by noon, the period being determined by the size and vigor of the participants. It is well to terminate the orgasm by removing and separating the fish should either show signs of exhaustion. While it is commonly said that the male assists in the extrusion of the eggs by bringing his body into more or less violent contact with the female, I am inclined to voice dissent. His movements solely concern the ejection of the sperm and his desire to eject it where it will soonest meet the falling ova. In the absence of a male, a female is well able and does rid herself of ripe ova. Many a fancier has had this experience with a choice fish, to his sorrow. The eggs are expelled during the spasmodic rushes through the plants and adhere to them. When the action becomes desultory, the fish apparently nearing exhaustion, remove the sexes to separate tanks to recuperate.



Goldfish and Lilies in the Garden of Miss J. L. Cornwall

Within about twenty-four hours the unfertilized eggs will be attached by fungus and appear as tiny, white, fuzzy balls. Remove them with forceps, lest the infection spread to the fertile ones.

(Continued on Page 96.)

Observations on the Chelonians of North America. I.

DR. R. W. SHUFELDT, C. M. Z. S.

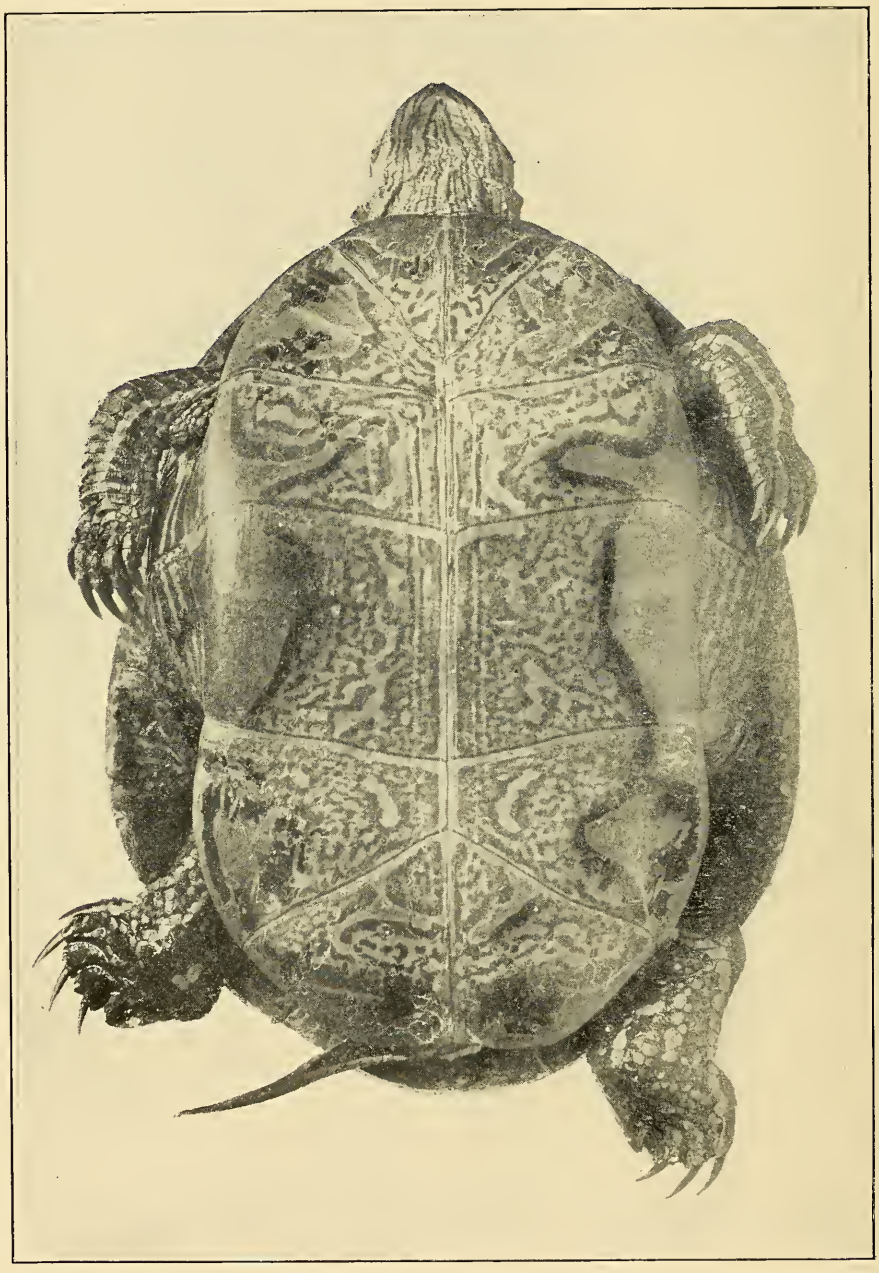
As in most other countries of the world, all the various forms of terrapins, turtles and tortoises are well represented here in the United States, and when taken as a group of the *Vertebrata*, these represent the *Chelonia* of North America. Our tortoises are wholly terrestrial forms and so will not concern us in the present connection (*Terepene*, the "Wood Terrapin," and *Testudo*); possibly the large marine species (*Sphargis*, *Thalassochelys*, and *Chelonia*) may be referred to further on, while it is my intention, in this series of articles, to devote the space to brief, illustrated descriptions of our turtles and terrapins, as these, at various ages, are kept in aquaria everywhere.

Strictly speaking, the true turtles are the big marine species; though in various parts of the country nearly all of the smaller fresh water species are called turtles—the edible ones sold in the markets are usually known as terrapins. Frequently we find these two vernaculars applied indiscriminately. The name terrapin is very generally given to the famous "Diamond-back" (*Malacoclemmys palustris*); next to it the pond turtles of the genus *Chrysemys*, while the snappers and soft-shell species are almost without exception referred to as turtles.

Our largest genus of pond or river turtles is the genus *Chrysemys*, and it contains quite a long list of species that occur in suitable localities all over North America, the West Indies, and parts of South America. This great host of forms has been but partly worked up. As they doubtless hybridize in many districts where the limitations of range of various species and sub-species are defined, and, further, as shape, size and coloration varies immensely within the species and subspecies for every known one of these in the list, the problem of exact identification is still further complicated by such sexual variations as may be present in the case of any species of the genus.

Our eastern form has a distribution over all eastern Northern America, where, among those who have studied these animals, it is known as the Eastern Painted Turtle or Terrapin (*C. picta*). I have examined and compared a great many hundreds of them, and expect to study others in the future. Typical individuals of this species are not difficult to identify. As we know, the *shell* of a turtle is divided into an arched upper part or *carapace*, and a lower, ventral, or flat part, called the *plastron*. These are generally overlaid with shields of various sizes and contours, and in the main they have a pretty definite pattern for any particular species. The outer, terminal row on the border of the carapace are called the *marginal scutes*, or *shields*.

C. picta rarely exceeds eight inches in length, and its markings usually fade in old age. A typical specimen of five inches in length has the entire plastron of a rich immaculate yellow; there are rather broad, brilliantly red emarginations to the marginal scutes above and below. The stripings on the head and limbs are of a fine Naples yellow, with the tail lined longitudinally in a similar manner. Above, the carapace is smooth and com-



Bell's Terrapin **Chrysemys belli**

Venteral view of adult male. Natural size

pressed, being of a rich olive when wet, and the borders of the scutes deeply emarginated with pale yellow. Border of carapace sharp, and of even, unnotched contour. Claws sharp, sometimes long, and black.

In the Western Painted Terrapin (*C. marginata*), the yellow surface of the plastron has a median, elongate, blackish area that varies in intensity, length and width. The carapacial emarginations are much narrower than in *C. picta*. This terrapin is found in ponds, lakes and similar places throughout the Central States southward to Louisiana. It ranges eastward to Western New York, westward to Iowa. In general form it in no way departs from its eastern relative in the same genus.

Recently I have been much indebted to Mr. Edward S. Schmid, of 712 Twelfth street, Washington, D. C., for a superb series of Bell's Terrapin (*Chrysemys belli*)—more than twenty of them, and all from central Illinois. This form comes nearer to *C. marginata* than to *C. Picta,* for the reason that it is not so large a species (six inches), and it has markings *on its plastron.* These markings vary for the individual in many particulars, and *never* agree in pattern. They may be nearly symmetrical, or quite the reverse—in any event they are responsible for making this terrapin easily the handsomest species in the United States chelonian fauna. The ground color of the plastron in Bell's terrapin is a deep yellow, while the variegated, watered pattern of the plastron, here well shown in the cut for one individual, is black, brilliant red and yellow—the latter being the ground color—overlaid with the black and red of the pattern. The black bounds the figure as a rule, as well as the emargination of the *interior* pattern.

There are also, as in the cut, black dots and scraggly markings throughout the general pattern. The stripings on the head, limbs and tail are of a bright yellow —lemon yellow. Compared with *C. picta,* the red of the marginal scutes is not nearly so brilliant. The pale scutal marginings of the carapace may be absent, or, at the most, very narrow.

Other species of aquatic chelonians will be described later on.

Lucania Ommata

W. W. WELSH

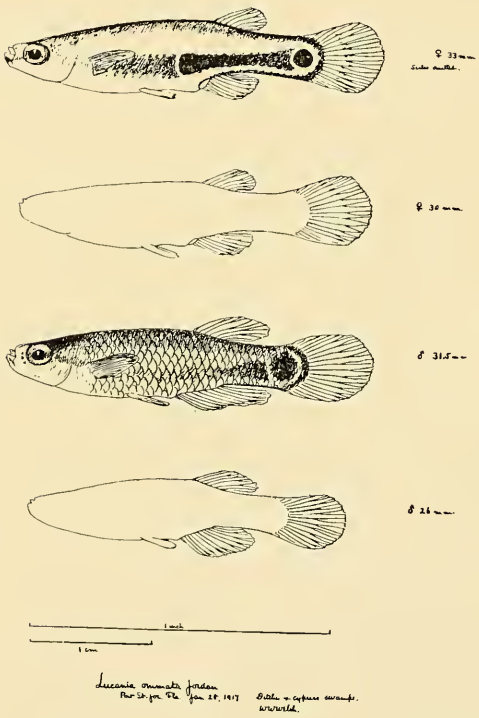
This little-known fish is one of the smallest species of the Top Minnow family, and not the least attractive of the many beautiful forms included in this group. It grows to a length of about 1¼ inches. The sexes differ in coloration, and in the length of the dorsal and anal fins, but do not differ much in size, the male being only slightly smaller than the female. The female is more brilliantly colored and more strikingly marked than the male, which is unusual.

The male of this species is almost uniform brown, somewhat lighter beneath, with a darker longitudinal band along the side, and in small examples traces of dark vertical bars on the after portion of the body. At the base of the caudal fin there is a large black ocellated spot. The back of the female is brownish, the rest of the body being straw color to yellow, and the brown lateral band is more intense and much more sharply marked off than in the male. In addition to the caudal ocellus there is a black ocellated spot in the lateral above the vent, sharply defined forward, but grading into the lateral band behind.

As far as known, this species has been reported only from Florida, where it is found among the vegetation in shallow water along the edge of cypress swamps and in ditches leading to them. It ap-

pears to be locally abundant, 14 examples being taken within a few feet at the edge of a cypress swamp at Port St. Joe, Fla., in January, 1917.

There is no reason to believe that this species would not thrive in the aquarium, to which it should prove a very attractive addition. Nothing is recorded concerning its habits.



(Aquatic Life is fortunate in being able to present in connection with Mr. Welsh's article the first published illustrations of *Lucania ommata*. The sketches were made by Mr. Welsh for the files of the Bureau of Fisheries, to whom we are indebted for permission to publish. Aquarists having connections in Florida should make a special effort to secure specimens.—*Editor.*)

Don't sit back and wax envious of the city having an aquarium society—get busy and organize one in your town.

In order to be a success, the position of an aquarium is important. Water-plants cannot grow nor can fishes live very long without sunlight, and in this connection the term *sunlight* much not be confused with *sunshine*.

As most aquariums are placed near a window, direct sunshine, by raising the temperature of the water, robs the latter of its oxygen, and it is conducive to the growth of conferva, which soon coats the tank and plants with green, slimy vegetation, and the water becomes turbid, and objectionable to the fishes, plants and the owner.

A window facing the north is best, but any position will do if the aquarium does not receive direct sunshine.

In London and other large towns many houses are constructed with basements and narrow areas. An aquarium under a basement window in such circumstances is usually a real success, particularly when nearly all the sunlight which reaches the tank is more or less "top light" and approaches natural conditions of lighting.

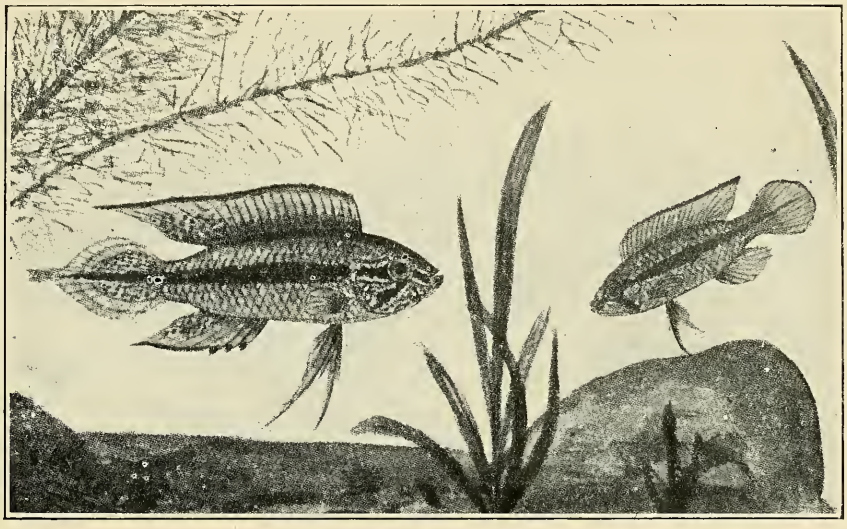
An eastern position is by no means bad if care is taken to shade the early morning sunshine in the summer time.

Any other aspect requires a little management, and it is highly important that a suitable and effective screen or shade be provided against strong sunshine during the hottest hours of the day.—*Fishing Gazette.*

At the annual meeting of The Aquarium Society, New York City, the following officers were elected for the current year: *President*, Richard Dorn; *Vice President*, Henry Kissel, Jr.; *Treasurer*, J. P. Lowel; *Secretary*, C. B. Rush; *Assistant Secretary*, William Pelzer; *Librarian*, William Pukall; *Assistant Librarian*, J. T. Dye.—C. B. Rush, *Secretary*.

Apistogramma Agassizi

C. J. HEEDE



Apistogramma agassizi **The Amazon**

In South America the cichlids, in untold numbers of species, are analogous to the sunfishes of the northern continent and in general surpass them in those features dear to the aquarist—interesting breeding habits and attractive colors. Not the least is *Apistogramma agassizi* (syn. *Heterogramma agassizi*) of the Amazon. Here is a gorgeously colored fish which possesses the added attractions of small size (about 2 inches) and the characteristic breeding habits of the family.

With any species of fish it is of prime importance to the aquarist to know the distinguishing features of the sexes. In this connection our subject is eminently satisfactory. The male averages larger than his consort, is much more brightly colored and, above all, bears a tail fin differing in contour. The central rays are prolonged after the manner of *Polyacanthus cupanus,* whereas in the female the rays are alike in length, giving the fin an unbroken outline.

The color pattern is quite complex, and is persistent and not merely donned during the nuptial season. From the head to the tip of the caudal rays runs a black-brown stripe. Posteriorly this is bordered by scales of bright blue, while forward and above appears yellow. From the eyes extend lines of blue. The black is dark violet and the abdomen light rose. The dorsal fin is violet and bluish white

with a dark seam; spinous rays yellow with web bright red; rear or soft portion, spotted; anal similar. The ventrals are light blue, the first ray orange. The female is less prominently marked, with a yellow cast over all.

In breeding habits the species of *Apistogramma* do not differ from others of the family observed in the aquarium. The eggs will be deposited on a smooth stone, or on a flower pot if one is provided, and assiduously guarded and kept free from silt until hatched. When the babies appear they are moved into a nest, a mere hole in the sandy bottom, being carried in the mouths of the parents, this moving process being repeated at intervals. When about ten days old the young will be swimming free, clustered in a school, and still under the watchful care of the adults. In another ten days it will be well to remove them to another tank.

The spawning tank should be well provided with infusoria, as also the tank to which they are removed for rearing. The smallest Daphne, separated from the larger by sifting, or rotifers if obtainable, should follow when the fry attain the size necessary to master these larger foods. Finely ground artificial food may also be used. Larger fish may be given enchytræids (white worms).

For the welfare of *Apistogramma* it should have an old established aquarium, with clear water and a temperature from 75 to 80 degrees. Plant life will not be disturbed by the fish, even during nesting operations, so a luxuriant growth should be present.

The related species, *A. corumbae, pleurotaenia* and *pertense,* are similar in habits and require the same treatment.

The Water Fleas

C. H. TOMPKINS

There are many water fleas, the species being widely distributed over the world. Some will be found in almost any ditch or pond, no matter how shallow, and with little regard for purity of the water. The true water-flea (*Daphnia*) is oval in appearance and may be distinguished by the two arm-like swimming organs (the antennæ) with which it jerks itself along. The rest of the limbs and the whole body are enclosed in a saddle-shaped, bivalved shell; the legs bear the gills. Daphnia is so transparent that by the aid of a microscope all the internal organs and the action of the heart may be seen. The eggs are laid and pass into a brood pouch situated between the back and the shell. The species are remarkably prolific, reproducing their kind in remarkable numbers. During the spring and summer months, in stagnant pools free from fishes, they become so numerous as to color the water reddish-brown. Such a situation is sure to be the mecca of local aquarists.

With gatherings of water-fleas one often takes *Cyclops*. This averages much smaller and has a segmented, pear-shaped body, with two pairs of long antennæ and five pairs of swimming legs. While constant motion characterizes the true water-fleas, *Cyclops* spends much of the time at rest. On the front of the head is a single central eye, from which its name is derived. The females may generally be seen carrying two comparatively large bags of eggs. The young differ from the adult form, and are known as "nauplius" larvæ.

Crawling and swimming about near the bottom of pools one often meets the common ostracod, *Cypris*. These are little brownish or greenish animals, more fond of running about on the mud than *Daphnia*, and when swimming the motion is steady and direct, not jerky. The body is enclosed in a bivalved shell, between the valves of which some appendages may be partially extended when the animal is in motion. There are seven pairs of limbs, but only the last two pairs are used as legs. The antennæ are used for swimming. Cypris is not much relished by fishes, but at least does do harm.

Viviparous Fishes - in - General

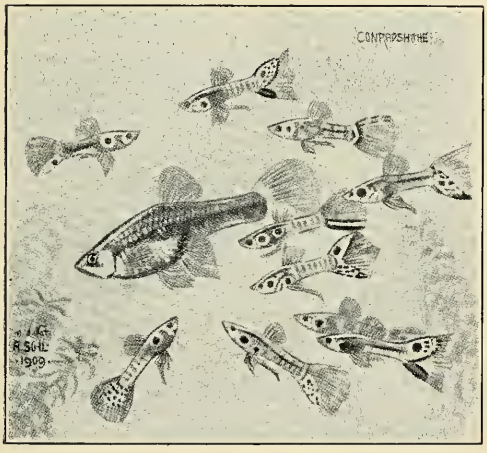
DAVID G. STEAD, F. L. S.

Naturalist to Board of Fisheries, N. S. W.

The reproduction of fishes in general may be carried out in one of two ways:

1. By the production of living young.
2. By means of eggs.

Those species which produce living young (and which are, consequently, called viviparous), are in the minority, and are principally confined to the Elasmobranchs (sharks, rays, etc.) At the same time there are many viviparous



Lebistes reticulatus

Teleosteans or "bony-fishes." Some of these produce young which are fully developed and practically exact counterparts of the parent fish. This condition of things reaches its greatest development, perhaps in the *Embiotocidae,* a family of fishes inhabiting the waters of California and Japan. They are small or moderate-sized fishes, chiefly marine, though one species has been taken from fresh waters. At birth the young are relatively large and similar in form to the adult fish. Most of the species of these Embiotocids are to be found in the vicinity of the surf on sea beaches, from which habit they are often known as "surf-fishes."

Another family of teleosteans that must be mentioned as containing many viviparous species is that of the *Poeciliidae,* known in America as "killifishes." The species of this family are usually of small size, inhabit fresh waters and principally abound in America. Some are egg-producing, or oviparous, while others, as pointed out, are viviparous. In the oviparous species the males and females are very nearly alike, both in point of size and in color, but in many of the viviparous forms there is a great difference between the sexes. This shows itself particularly in the form of the body which, in the male, is only about half the length of that of the female, and in which also the anal fin is placed far forward. It will be of interest here to note that these viviparous killifishes include amongst their number those highly remarkable forms known as the "four-eyed fishes" (*Anableps*), which inhabit Central America. In these the integuments of each eye are divided into an upper and lower portion by a dark-colored transverse band, the pupil becoming incompletely divided into separate lobes. These "four-eyed" fishes swim at the surface of the water, with the upper half of the eye (which projects above the upper surface of the head) out of the water, this enabling them to clearly distinguish objects, both above and below the water, at the same time.

Other families of teleostean fishes

which contain amongst their numbers certain viviparous forms are the *Scorpaenidae*—a familiar member of which is the common Red Rock cod, *Scorpaena cruenta,* though itself not viviparous—and the *Scombresocidae* or Garfishes. In the latter the viviparous members are restricted to fresh water. The family of Blennies (*Blenniidae*) also contributes its quota to the fishes showing viviparity, and a number of remarkable instances have been at times brought forward.

As far as our present knowledge carries us, viviparous forms of fish life do

Limia ornata

not appear to be abundant in the waters of Australia, but at the same time there are some rather striking examples, prominent among which are the "Crested Weed-fishes" of the genus *Cristiceps.* These are usually rock-frequenting fishes of a conformation and color to suit their weedy surroundings. The young are very small at birth.

A highly interesting viviparous fish is that known as *Comephorus.* It occurs in the great depths of Lake Baikal, and is remarkable because of the fact that it dies after having given birth to its young. This fish, like many bathybial forms, is practically colorless, and is provided with very large eyes. The skeleton, also, is very thin and papery.

Amongst viviparous teleostean fishes inhabiting great ocean depths should be mentioned the curious forms known under the generic names of *Saccogaster, Diplacanthopoma* and *Hephthocara,* the last two of which have been taken in the Indian Ocean at a depth of about 1000 fathoms. In another member of the same family, known as *Cataetyx messieri,* a most remarkable state of affairs has recently been disclosed by Dr. Gilchrist, Marine Biologist at the Cape of Good Hope. The fish referred to, which is a native of the deep seas in the neighborhood of South Africa, produces well developed young which are most pronounced cannibals, eating each other while still unborn. Though this reads like a fairy story, it is founded on very positive, indisputable evidence. All of these, here mentioned, are closely allied to the family *Ophidiidae,* of which our Australian Rockling (*Genypterus blacodes*) is a familiar member. We are not yet acquainted with the mode of reproduction of the latter.

As I before mentioned, most of the sharks and rays are viviparous. Amongst familiar instances of species which occur on the New South Wales coast may be mentioned the large predaceous sharks, such as the "Grey Nurse" (*Odontaspis taurus*), the "Tiger" (*Galeocerdo rayneri*), and the "whaler" (*Carcharias brachyurus*). These produce relatively large, well-developed young. The various Sting-lays (*Dasyatis*) also may be cited as belonging to this group.

In regard to the fecundity of viviparous fishes, it may be taken as a rule that they produce comparatively few within one breeding season as compared with the bulk of the oviparous species. But then, as will readily be seen, the risk of destruction is more and more lessened, in accordance with the degree of advancement reached by the embryo, before birth

(Concluded on Page 98.)

BREEDING THE STRIPED GOURAMI

D. A. SIMPSON

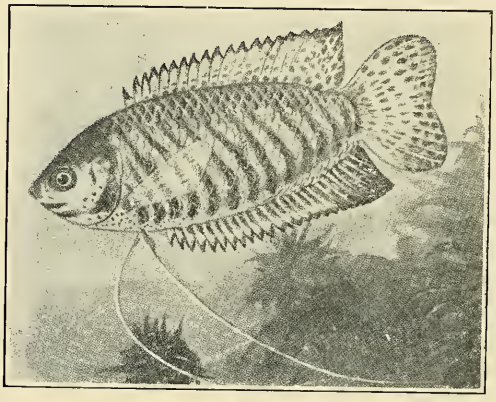
The striped gourami, a shy member of the Labyrinthici from India, is a particularly beautiful fish. Larger than its brother, the dwarf gourami, it is equally interesting and pretty, though not so intensely colored. A nature aquarium-grown specimen is about three inches long, though in the wild state it reaches a length of five inches.

The male is more brilliant in color than the female, and has the characteristic pointed dorsal fin. His "feelers," the very much elongated ventral fins, show a more decided orange than his mate, while the pale, vertical fins are bordered by dark reddish orange. The body exhibits vertical bluish stripes on a grayish silver background.

To breed this fish successfully you must have a fairly large aquarium, one 30 by 15 by 10 inches being a nice size. The tank should be allowed to stand for a long time without fishes, over winter if possible, to promote a good growth of algæ and abundant infusoria for the prospective young. Provide a goodly number of plants, not forgetting the small floating species, which are used in the construction of the nest. The water should be clear and old, and about five inches deep.

After the familiar bubble nest has been built, the male coaxes the female beneath it, and there fertilization takes place with the characteristic entwining of bodies. After the eggs have been extruded from the female in this manner, fertilized and placed in the nest by the male, he drives her from the vicinity, sometimes killing her in his frenzied zeal to guard the spawn from harm. It is best to remove the female immediately after the spawning process, though if the tank is large enough she may not be harmed, provided, of course, she does not interfere.

Incubation generally takes from 36 to 72 hours, depending on the temperature of the water. During the time preceding,



Striped Gourami Trichogaster fasciatus

and for about three days after hatching, at which time the youngsters begin to leave it, the industrious male guards the nest, replacing the eggs should they fall, adding more bubbles when needed, and returning the fry to the nest in his mouth should they attempt to depart prematurely.

When the fry begin to leave the nest in numbers, the male should be removed. His usefulness is then at an end and, with the usual cannibalistic tendencies, he will proceed to devour the young. In no case should the young be removed from the tank in which they were hatched until they are plainly recognizable as young of the species, at which time they are generally about one-fourth of an inch long.

Breeding the Goldfish

(Continued from Page 86.)

The good eggs are somewhat transparent, with a slight tinge of yellow, and are very evident to the naked eye. The time of hatching is governed by the temperature of the water; at 70 to 75 degrees the fry may be expected in 5 or 6 days. Daily examinations with a compound microscope will be both interesting and instructive. Cool water during incubation, with slow development of the embryo, and high temperature and rapid development, are equally undesirable.

The first food of the fry, after the absorption of the yolk-sac, consists of the minute forms of animal life collectively called infusoria by the aquarist, though other forms are taken, including the rotifers, a higher group of animals. These organisms are present in all water, but not ordinarily in sufficient numbers to meet the needs of our ravenous fry, as we may have from several hundred to several thousand. To this end several tubs should have been previously prepared—about two to three weeks. Any method by which water is made stagnant will answer. A little sheep manure, a wisp of hay and a handful of dried leaves of water plants or lettuce, placed in the tub of water will cause a condition favorable to the rapid development of infusoria. Preparations are now sold for this purpose, which need only be added to the water. The "infusoria tub" should be kept with that containing fry, that the temperature of both may be alike. When the fry are three to four days old, depending upon the degree to which the yolk-sac has been absorbed, remove several quarts of water from the tub and replace with an equal quantity of "infusoria water." This can be made a mere exchange, and should be repeated daily until the fry reach a size sufficient to warrant supplying the tiniest Daphne. Meanwhile, powdered shrimp and prepared foods, ground to the fineness of flour, may be used sparingly. Spread a pinch on a piece of cardboard with a knife blade, incline the card and a whiff of the breath will distribute the powder evenly over the surface of the water. If sprinkled from the fingers it will invariably fall in clusters, and the tendency will be to use too much. The yolk of a 30-minute boiled egg, diluted with water to the consistency of cream, can also be used. This is best squeezed through a cheesecloth bag, to eliminate lumps. This is more apt to pollute the water than the prepared food or shrimp.

In stagnant ponds it is sometimes possible to collect rotifers in quantity, skimming them from the surface, where they may collect in such numbers as to give the water a decided reddish color. These should follow the infusoria. Change to Daphne as soon as the young are able to take the smallest, and from this point on use it persistently as long as obtainable.

To rear fine fish the aquarist must be absolutely ruthless. Just as soon as the fish reach a size sufficient to permit the detection of single-tails and cripples—spiked dorsals, twisted tails and all malformations—destroy them. They consume valuable food and occupy the even more valuable water space to the detriment of the better specimens. If the parents are transparent-scaled, also eliminate all opaque-scaled young, unless you have bred from a combination designed to produce some black telescopes. In sorting give preference to dark colored youngsters, though others light in color may later develop attractive hues and markings. In thus proceeding the beginner will undoubtedly throw away some good fish, but until the knowledge in this connection that only experience and study

can give is acquired, this cannot be prevented. In other words, the beginner should retain only those which seem desirable to him. The fewer the fish retained for rearing, the better they will be individually, in point of size and vigor.

In the process of eliminating the "unfit" the survivors enjoy more room, and the more room you give them, coupled with proper food, the faster they will grow, and we all like good big fish—any one can raise runts. "Spread 'em out" is the slogan of the successful. You may have a hundred fish an inch long, body included, in the tub described, but when the body alone is this length, let the number be half or less. This presupposes that the tub has a water connection and overflow pipe, and that a trickle, perhaps the diameter of a soda straw, runs into it continually. This is the prevailing method, and is in a great measure responsible for the great size attained in a few months by fishes so treated. Such rearing tanks contain no plants, and are kept rather scrupulously clear and free from sediment and dead, unconsumed Daphne by frequent syphoning. If the old still water method is followed, plants in pots should be used and more water allowed per fish.

It may seem heartless to advocate a radical destruction of imperfect fish, but only by so doing can really desirable specimens be reared. Most fanciers have a sufficient number of breeding fish to provide them with ten times as many fry as they can handle to an age of a few weeks. This is an advantage. The best practice is to handle a great many spawns and to early get rid of all but the best. The percentage of good fish varies. Sometimes it may run high, and again be not more than one in five hundred. The others grade from good to those "not worth a plugged nickel."

In rearing goldfish a lily pond of "home size" can be used to an advantage, not to mention it as a beautiful feature of the garden. It is possible to raise a few youngsters by merely placing therein the breeding adults, but this is the wasteful way, as but a small percentage will survive. Better results are obtained by spawning the fish in tubs and later placing the well-grown young in the pond. Such fish grow surprisingly fast, even if the food question is left to nature. The disadvantage of the pond lies in its luxuriant growth of plants, which conceal the bottom and render the detection of enemies very difficult. A few dragonfly larvæ will work havoc, not to mention numerous other insects. The larger the young when placed in the pond the better the chances of survival, though quite large fish may be attached. But all in all the pond is well worth while, especially as our interest may not entirely be centered in the fish.

Moral: To raise good fish, raise few fish.

To get proper food and oxygen; to find or construct a proper place to dwell; to arrange for the production and growth of the young; to protect one's self and one's progeny from enemies and from the forces of nature—these, and the activities growing out of them, form the groundwork of life in the lowest as well as the highest creatures.—*H. S. Jennings.*

Inclinations differ. Some folks are fond of raising "Cain;" others prefer the quiet pastime of raising fishes.

Love making, even among fishes, may not be "real work," but surely it can't be classed with non-essential occupations."

Never cry over spilled milk. There is enough water in it already.

Viviparous Fishes

(Concluded from Page 94.)

or liberation from the egg. (Similarly, the production of large eggs carries with it fewer numbers, and generally an advanced state of development of the ambryo, the latter being usually more and more like the parents as the eggs are larger. From relatively tiny eggs, such as the majority of pelagic ones, are hatched highly undeveloped larval fishes, totally unlike the species which produce them.)—Abstract from a paper read before the *New South Wales Naturalists' Club.*

(The familiar "guppy," *Lebistes reticulatus,* one of the killifishes, presents the best known example of sex dimorphism—dissimilarity of sexes—among fishes.—*Editor.*)

The common or popular names of these fishes are even more mixed up and poorly applied than usual. *Cynoscion nobilis,* the "sea bass," is not a bass, and *Seriphus,* sometimes called the herring, does not even remotely resemble the herring. The young "sea bass" is known as "sea trout." No possible stretch of the imagination could make it suggest a trout, and, having wrongly called its parent a bass, to call it a trout is a very good commentary on how loosely common names are used. *Genyonemus,* the fish that is usually known as the kingfish, is sometimes called "tomcod" on the southern California coast. It resembles a tomcod as little as *Seriphus,* the queenfish, resembles a herring. When *Genyonemus,* the kingfish, is called "tomcod" the name kingfish is transferred to *Seriphus,* the queenfish, or white croaker. *Cynoscion parvipinnis,* a close relative of the "sea bass," is sometimes called "bluefish," though it has nothing whatever in common with the famous bluefish of the Atlantic. The names croaker, roncador, and corvina are not at all consistently applied, but are shuffled back and forth between various of these fishes.

Hence in the use of vernacular names among these or any other fishes the reader is again cautioned that there is no constancy nor rule for their application, and he can only be sure of definitely indicating a given fish by using its scientific name. Though such names will probably never be used by people at large, and certainly not by unlettered fishermen, the scientific name is nevertheless the one true name for a species, and a name that will be recognized by scientific men in all countries the world over.—*Edwin Chapin Starks in "California Fish and Game."*

There is a type of fish fancier who derives more pleasure from pulling down than in building up; in saying the unkind thing, rather than the kind; the sort of a man who goes gladly forty miles out of his way if he thinks he can "put one over." It takes a peculiar mental construction to gloat in "knocking"—a sort of self-hypnosis, which makes the knocker think he is doing himself good by doing another fellow harm. The knocker believes that others take his story at its face value. But note the consistent knocker. He is seldom a successful aquarist. When he gets a fish he can't hold it; when he has a friend, he loses him. He has to buy for cash, for the knocker has no credit. Nobody trusts him, nobody believes him. The knocker does a lot of harm, but in the long run it is only to himself. The man who knocks is always among the down-and-outs, the has-beens, the never-to-bes. The successful aquarist ignores the knocker. He is too busy studying his fishes. The discreet man, if he can't say a good word, says nothing!

Important!

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Aquatic Life

Aquatic Life

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Popular and scientific articles and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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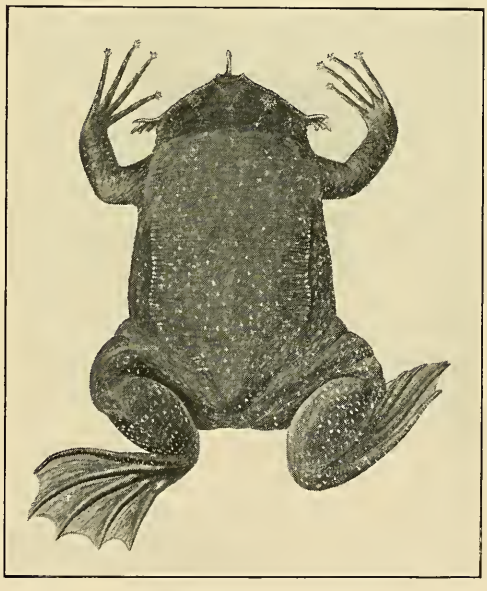
The SURINAM TOAD

RICHARD DECKERT
New York Zoological Society

The Surinam Toad, *Pipa americana,* belongs in the sub-order Aglossa (meaning without tongue), of the order Salientia, the frog-like amphibians. It is a large aquatic toad, living in the creeks and back-waters of rivers and in the larger ponds, in the forests of the Guianas, Venezuela and, as rediscovered by R. R. Mole, on Trinidad, off the Venezuelan coast.

In spite of its ungainly shape the Surinam toad is a powerful swimmer, moving along in its native element with slow strokes like the measured wing-beats of a gull, and covering as much as three feet with two strokes of its immensely webbed feet. In captivity it is fairly hardy, provided the aquarium is large, the temperature maintained at 70 to 80 degrees, and food offered freely. According to Mr. Mole, the latter should consist of small frogs, preferably newly metamorphosed Leopard frogs (*Rana pipiens*), Pond frogs (*R. clamitans*) and Bull frogs (*R. catesbiana*). With the writer it refuses all small fishes, worms and insects, though Sclater and Bartlett, of the London Zoological Gardens, were successful in inducing it to take these articles of ordinary frog-diet.

The females are remarkable in their nursing habits. During oviposition the oviduct is protruded to a length of several inches, and shoved up on the female's back, where it discharges the spawn, which is absorbed into enlarged pores, each egg occupying a separate pore or cell. The eggs number from 40 to 120. The skin becomes very much swollen and almost half an inch thick, appearing like a cushion. After about 80 days the young begin to emerge, some as perfect little toads, though the majority still possess the tadpole tail. By rubbing against rough objects, the female then rids herself of the now useless epidermis or outer skin. These observations were made on captive specimens for the first time by Sclater, in 1895, in the London Zoological Gardens, and a year later by Bartlett in the same place.



Pipa americana
By the Author from Life

The "Pipa" is large for a toad, the males measuring six inches and the females up to eight inches from snout to vent. The shape is bluntly oblong, with a limb at each "corner." The head is triangular, very thin and flat, with fleshy appendages at the tip of the nose and at the mouth-angles. A fringe of fine, white

papillæ surrounds the eyes, which are exceedingly small. Teeth are absent. The skin above is finely shagreened, while below it is smooth and of a silky texture. The "arms" and "hands" are slender, with long, delicate fingers, each of which is tipped with a star-shaped appendage. The legs are long, thick and very muscular. The long toes are webbed to the pointed tips, and when the web is spread the toes curve inward, the foot thus somewhat resembling an open umbrella.

The aquatic life of this creature has resulted in a peculiar specialization of structure, which is evidenced by the very much flattened body, loss of tongue, eyelids and teeth, uniting of the eustachian tubes of the ear into a single opening in the rear of the mouth, and eyes looking up instead of to each side. The skeleton is also peculiar in being composed of only seven vertebræ. The diapophyses or "wings" of the sacral vertebræ are broadened enormously, serving to prevent any sidewise movement of the backbone, and thus stiffening the whole body.

The color above is a dirty sepia brown or dark gray, without markings. Below it is dirty white, often with a black cross, the long arms of which extend the length of the body, and the short ones across the chest. There may be numerous brown spots on the belly, and the males are usually iron-gray underneath, with large whitish patches, but without the cross.

These toads, when lifted from the water, emit a loud, deep moan. When coming to the surface voluntarily they protrude their head entirely, breathe long and deep, and sink to the bottom again with a sighing sound. These sounds, in addition to a peculiar ticking noise which the males often make under water at night, are all I have observed in this species.

I don't believe the Surinam toad ever leaves the water voluntarily, though it may burrow under mud and debris on the bottoms of ponds and creeks which sometimes dry up completely. This it does in order to æstivate, a summer rest period which corresponds to the hibernation, or winter rest, of our local species.

Father Explodes a Theory

Did I tell you about Mother and the goldfish? Well, you see, in December, when it became a little cool, Mother contracted a bad cold, and so Father bundled her off to Florida with Betty and Mary, and they did not come back until the end of last month. Just about a month before they went away Mother, who is very fond of pets, had bought some goldfish, and it was her delight to watch them. And every morning and evening they would come swimming up to the top of the bowl, searching for the food which she scattered on the water's surface for them. While Mother and the daughters were away the little fish all died, but Father was not to be conquered by that, and so the day before the family's return he hied him downtown and bought a whole new set of fish.

Well, Mother had scarcely been home more than an hour before she wanted to see her dear little fishies. Upstairs they all trooped and Mother gazed lovingly at the fish, and as the glinting little things swam up to the top she smiled tenderly, and, turning to Father, murmured, "See, see; they know me, dear."—*Nancy Wynne*, in the Philadelphia Evening Ledger.

The point of view depends upon which is you your side of the fence.

What a delightful world this would be if it were possible to size a man up by his opinion of himself.

Cichlasoma Nigrofasciatum

WALTER LANNOY BRIND, F. Z. S.

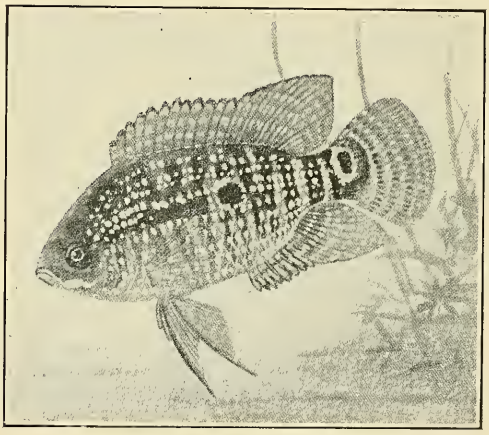
In the spring of 1904, a Mr. Umlauff, who had a pet shop in Hamburg, imported a few specimens of a new species of cichlid from Brazil. Later a Mr. Engmann, of Berlin, wrote an account of his experiences with the fish, and how the male of his pair jumped out of the aquarium and "dried up." He bewails the loss and mentions that it cost him thirty marks to replace.

Engman's weeping reminds me of an experience I had with a Brooklyn aquarist, back in the days when the Guppy (*Lebistes reticulatus*) was new and novel. He lamented the fact that I charged him $2.00 for a pair. I could have told him that I paid Paul Matte $2.50 for my first pair, in Berlin, in 1910. But I did not feel that I was "held up." I merely looked upon it as an indication of the value of a species soon after first importation, and while it was comparatively scarce. What a fish will fetch is a matter of agreement between buyer and seller at the time. The selling price is not staple, as it is for a commodity like sugar, for instance.

Through ignorance of the requirements of *Cichlasoma nigrofasciatum*, which the new cichlid proved to be, all of the first importation died from cold, save the pair owned by Engmann, which he then wisely turned over to Paul Schame, the Dresden fish culturist, as he possessed considerable knowledge of this class, and the necessary facilities for breeding them .

During November the pair bred, and Mr. Schame succeeded in raising thirty-eight youngsters. From this stock was derived all the fish of the species raised in Germany in 1905. In later years many more were imported, so that new blood was infused.

In the United States, Gustave Sebille, of New York City, can claim the distinction of having first brought this fish to this country direct from its native waters, together with *C. mojarra* and *C. steindachneri,* in the summer of 1912. The



Cichlasoma nigrofasciatum

specimens averaged about three inches long. This does not take into consideration any possible importations from Germany, such as used to occur frequently with tropical fishes generally before the war.

Owing to the general unpopularity of the cichlids, among aquarists, both here and in Europe, no special efforts have been made to breed this species of late years, and in consequence it is well-nigh extinct in the United States, though isolated pairs still persist. Last year it was reported that a Pittsburgh man had bred it. It is plentiful enough in its native habitat.

Owing to the difficulty in distinguishing the sexes, and the ferocity of the species, most aquarists have "passed it up." The handsomest male I ever saw, and the largest, was long in the possession of Dr. Frederick Schneider, of Brooklyn. But he could never find a female sufficiently large and self-assertive to mate with this seven-inch warrior. Franklin Barrett, of Philadelphia, has long had a big one, whose disposition earned for itself the name of "Relentless Rudolph."

The coloration of the species, like all cichlids, is extremely evanescent. The male during breeding periods is truly a handsome fish. The entire ground color becomes velvet black, speckled with large, metallic, turquoise-blue scales, while the outer margins of the fins, except the pectorals, are scarlet-red. The abdominal region is dirty white. In body contour the female is more rotund than the male. In the male the fins are prolonged into points, while those of the female are rounded. Her general color is dusky olive.

In breeding time, when the water becomes warm enough in their native haunts, the cichlids-in-general seek clear, shallow places, depositing their eggs on the surfaces of flat stones. These are fanned zealously with the pectoral fins, and are thus kept clean until they hatch. As with our North American sunfishes, all intruders are driven none too gently from the vicinity. Within three or four days the fry appear, helpless and very unlike the parents. The family is then moved to a nest, a mere hole in the sand, a proceeding oft repeated during the days following, until the yolk-sac is absorbed and the fry become able to swim freely. Then the babies rise in a shoal, guarded by the parents as they prey upon the minute life of the water, passing as they grow from the infusorians to the more satisfying and growth-promoting Daphne. For about two months the old fish guard their swarm against all comers. After this time the parents should be removed and separated from each other.

Few cichlids are "better scrappers" than *nigrofasciatum*, and the aquarist who elects to try them should provide himself with a ten-inch globe for every adult. For breeding activities a wide, shallow tank, free from plant-life, will be needed. This should be as large as possible, and certainly not less than three feet long.

Brooklyn Society

A very successful meeting of the Brooklyn Aquarium Society was held on Thursday evening, March 11th, at the Bedford Branch of the Public Library. An exhibition of tropical fishes was on, and seventy-five enthusiastic aquarists were there. Mr. Hugo C. Nelles, President of the Ridgewood Society, spoke of the growth of the organization, and emphasized the need of closer fellowship, harmony and co-operation.

The exhibition was competitive, awards being made by Judges Heede and Moody as follows:

Best display (*P. scalare*), silver cup to F. B. Johonnot; greatest variety, cup to R. D. Bright.

Diplomas were the high awards in the following classes: *Barbus*—first, Johonnot; second, Bright. *Haplochilus cameronensis*—first, Bright; second, Shenk. *Platypoecilus maculatus rubra*—first, Johonnot; second, Donovan; third, Miss Bright. *Dania rerio*—first, Shenk; second, Hoare. *Xiphophorus helleri*—first, Johonnot. Labyrinth fishes—first, Shenk (*Trichogaster lalius*); second, Shenk (*Macropodus opercularis*). Poeciliid hybrids—first, Johannot; second, Hoare. Balanced aquaria—first, Mrs. Post.—J. H. Shenk, *Corresponding Secretary.*

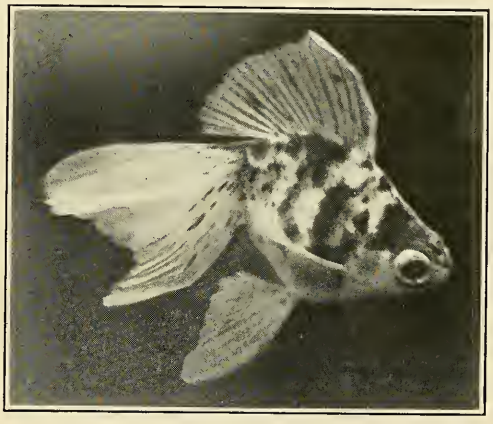
KEEPING LIVING FOOD ALIVE

WILLIAM T. INNES

No fish culturist ever seems to have as much storage space for living foods as he would like. The best practice, therefore, is to utilize available space to the utmost advantage. This is not always done, as is shown by the fact that many breeders gather live food daily, even in cool weather, when it keeps well if given half a chance.

To a great extent the keeping of *Daphnia* and of fishes works on the same general principles. Both breathe the free oxygen in the water. This is renewed by absorption from the atmosphere, and by aquatic plants. For Daphnia it is not practicable to replenish the oxygen by plants, because they would be disturbed too often; hence we must depend upon absorption from the air. The tanks need not be deep—three inches of water is plenty. The writer uses two inches with good success. However, as large a surface area as possible should be provided. The amateur is often quite limited as to space, but as a rule he could use what he has to a better advantage. For instance: If a space will permit the use of a tank measuring three by four feet, the usual plan is to have it about sixteen to eighteen inches deep. Far more efficiency could be had by using several trays four inches deep, stacked in a pile and separated by about seven inches. According to the observations of the writer, *Daphnia* survive better in shallow than deep water. Many are slightly injured in catching and are unable to swim near the surface. These sink to the bottom, where the increased water pressure lessens their chances of survival.

Another important point is to keep all living food cool, especially *Daphnia*. Cool water holds more oxygen than warm, and it also slows down the life actions of the animals, which then make less demand on the available supply of oxygen. Methods of keeping the water cool can be best decided in individual cases, but it is certain that direct sunshine should be entirely excluded in warm weather, and also



Calico Telescope Goldfish

Photo by F. Schaefer

that a draft should be maintained over the water's surface.

Owing to their small size, it is difficult to supply *Daphnia* with running water, as they would be carried away in any ordinary overflow. Several large wicks of thick felt carried over the edge of the tank, and allowed to hang outside to a length of several inches will carry away enough water to allow a constant drip from a faucet to strike on the water surface.

An important point is to remove at once all insect enemies that have unavoidably been taken when catching the *Daphnia* in the pond. These feed raven-

ously on *Daphnia* and mosquito larvæ, and materially deplete the supply if permitted to remain. Most enemies can be sifted out under water through a tea strainer or flour sieve.

A consideration is usually overlooked that is probably worth thought. That is, the water in which the *Daphnia* are kept. The common practice is to place them in clean, fresh water. This would seem to be a mistake unless they are intended for immediate use. The water of the ponds in which they occur naturally is well charged with the food they require. To rob them of this entirely is to weaken them and shorten their lives. It is better to use the same water, but dilute it. If green aquarium water can be had it is better than clear water, the microscopic vegetal organisms being perfectly good for Daphnia. This can be well demonstrated by removing fishes from a green-water aquarium and introducing a supply of *Daphnia*. In a few days the water will be crystal clear, and many young Daphnia will be observed.

Cypris or "hard-shell daphnia" are not quite such good food, but make an acceptable second choice. They are extremely hardy, and may be bred in large numbers by supplying them with decaying leaves, etc. They will stand heat and extreme crowding.

Mosquito larvæ, on the other hand, should not be allowed to feed. In clear water their development is retarded, particularly if kept cool. However, when they have developed to a good size it is impossible to prevent their turning into fully developed mosquitoes. A good plan to prevent the escape of mature individuals is to keep the larval stock in a large bottle, partially filled with water, inverting it to pour out larvæ desired for feeding. After the bottle is emptied, the hatched mosquitoes may be drowned by filling the bottle with water, pouring it through mosquito netting fastened over the mouth.

Scrimshaw Working a Florida Pond

Beware the Dragonfly

HARRY S. GORDON

The dragonflies form possibly the most conspicuous feature of the insect fauna in the neighborhod of a pond—barring personal familiarity of mosquitoes. But the mature form is not nearly such a matter for serious consideration on the part of the aquarist as the result thereof; popular fables to the contrary notwithstanding.

The females of the species deposit the eggs on water plants, just below the water's surface. From these hatch the larvæ—the bane of the fish culturist. These infantile insects are provided with a peculiar elbow-jointed jaw, which at rest is retracted and hidden; but if prey comes within reach it is quickly thrust out, the jaws at the end gripping the victim and drawing it to the larva's mouth. Little imagination is required to picture the havoc it will wreak when it happens to find a home in the aquarist's rearing tank. Its appetite seems insatiable, and killing a pleasure. In a garden pond, with plants affording it protection, it is fully capable of getting away with hundreds of fry before it reaches maturity or is discovered and destroyed. This illustrates why it is possible to rear a greater proportion of fish in the small portable wood tank, free from plants; the bottom is clear and may be examined frequently.

The Larva of a Dragonfly

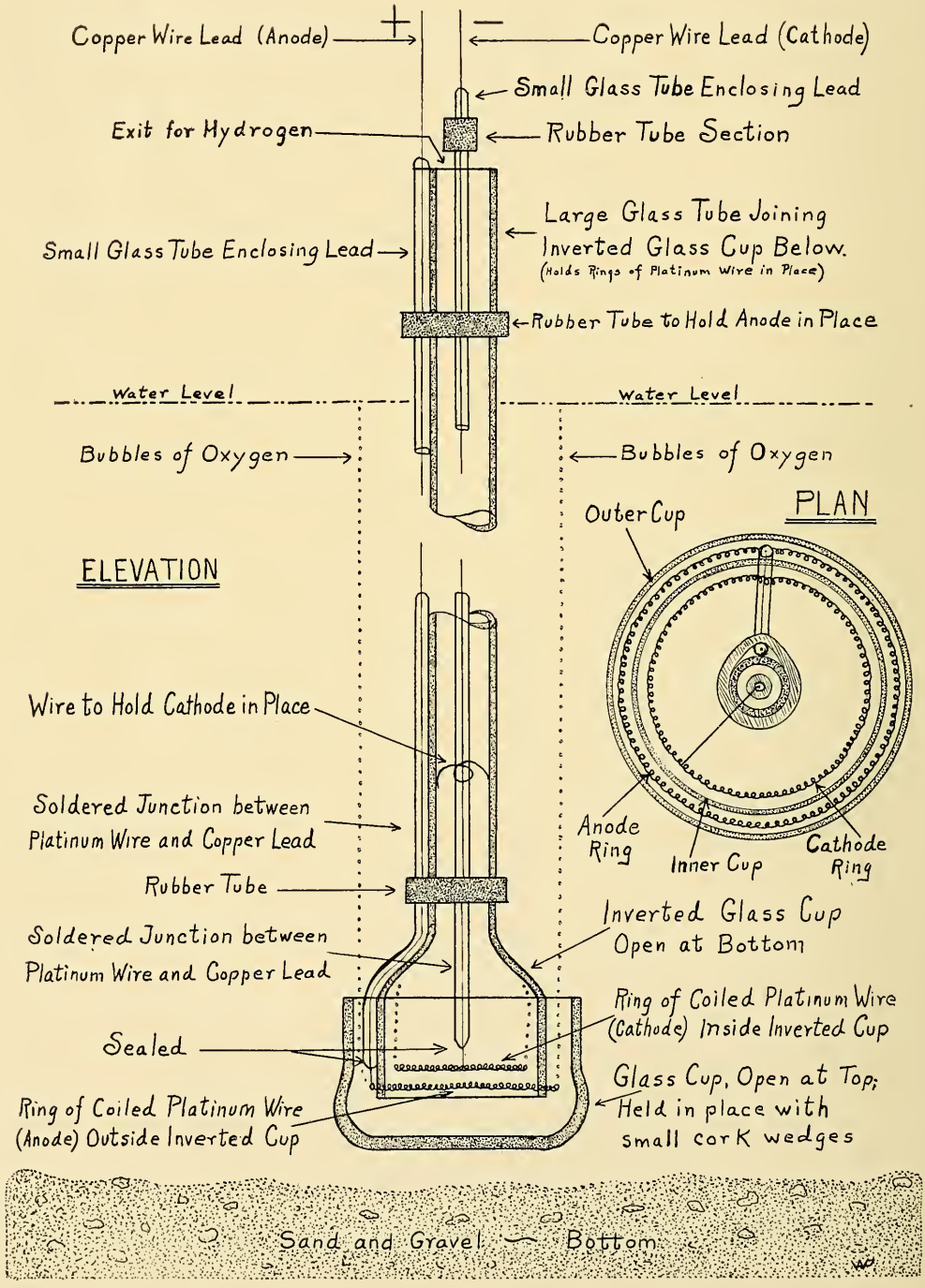
After casting its skin several times the larva becomes full-grown, the wing-cases become conspicuous, and the body shorter and thicker. Though now in the pupal stage the larva continues active. Eventually it ascends some convenient reed or stick, and remains at rest above the water, and in due time the perfect dragonfly emerges through a split along the thorax of the pupal skin.

West Philadelphia Society

The West Philadelphia Goldfish Fanciers' Association met on Thursday, April 3d, at Hamilton Hall, 5236 Market street. The competition was for broad-tail Japs bred last year, the best fish to receive a silver cup presented by Dr. Clark, of the Board of Governors. Mr. Gustav Armbruster achieved a unique distinction by winning all prizes, being awarded the cup, blue, red and yellow ribbons.—Earle W. Roak, *Secretary.*

To the series of handbooks published by the American Museum of Natural History, New York City, has been added the *Fishes of the Vicinity of New York City*, by John Treadwell Nichols, Assistant Curator of Recent Fishes in the Museum. The volume contains 122 pages, with 60 illustrations, and a frontispiece in color. It may be obtained from the Museum, in paper cover, for 50 cents; cloth bound, 75 cents. It is a popular account of the fishes of the region indicated by the title, though it is serviceable over a much greater area. A detailed list is given of the fishes known to occur within fifty miles of the city, with a key for identifying them. The introduction, by Dr. William K. Gregory, treats of the structure of fishes and their adaptations for an aquatic life. The book is well worth a place in every aquarian library.

With the number for January, 1919, The American Museum Journal becomes *"Natural History,"* a much more appropriate title.



Putnam: An Electrolytic Aerator

AN ELECTROLYTIC AERATOR

JOHN P. PUTNAM

Massachusetts Institute of Technology

To those over-zealous aquarists who are wont to overstock their tanks, I submit a device which I believe may be of use. Nature's method of providing oxygen for the inhabitants of water cannot be improved, but Nature never intended large numbers of fishes to live in small receptacles. We cannot, therefore, expect her to produce a plant that will compete quantitatively with the oxygen generator. Commercially the purest oxygen is generated by electrolysis. I have accordingly applied this method of production to the problem of aeration.

Electrolysis is in effect the interchange of ions brought about by the passage of an electric current through a liquid. Or, looking at it from another point of view, these ions carry minute charges of electricity. Chemically pure water is but slightly ionized, and therefore does not conduct electricity appreciably. Tap water, however, contains salts which are ionized, and is, in a limited extent, a conductor or electrolyte.

Water is composed of two gases—hydrogen and oxygen—in the proportion, by volume, of two to one. Hydrogen is an inert gas. I believe it has no physiological effect other than that of "blanketing" the oxygen, as does the nitrogen of the air. When a current of electricity is passed through water it is split up into its chemical constituents, hydrogen and oxygen. It is the latter gas which is of use in aeration, so the former may be discarded.

During electrolysis the ionized salts dissolved in the water are also split up; thus acid is formed at the positive pole or anode, while alkali appears at the cathode. If the acid and alkali are allowed to mix they will recombine to form the same salts originally present in the water. This must be accomplished if the chemical constituency of the water is not to be altered.

The device I have mentioned consists of a glass tube about one centimeter in diameter, expanding below into an inverted cup, which is open at the bottom. This cup fits down into another glass cup, open at the top, leaving a clearance between the two of about two or three millimeters. The two are held together with wedges of cork. The oxygen is generated at a ring of coiled platinum wire encircling the inverted cup just above its rim. Bubbles of this gas rise up between the two cups, through the water of the aquarium, to the surface. The hydrogen, evolved from a similar ring just inside the inverted cup, passes up the glass tube and escapes. The electricity reaches these rings along copper wire leads, sealed in small glass tubes. It passes from the outside ring under the rim of the inverted cup to the inner one. The acid and alkali become thoroughly mixed in the bottom of the outside cup. This cup also prevents the fishes from coming in contact with the electrodes.

As electrolysis procedes the water within the glass tube becomes slightly alkaline and, in consequence, the water outside of the tube becomes correspondingly acid. For this reason, when the apparatus is first set up, it is best to put one drop of caustic soda into the glass tube. This should be done but once.

I have figured that with electrical en-

ergy for sale at eleven cents a kilowatt hour this device, using one-tenth of an ampere, will produce half a liter of oxygen gas in one day for three cents, using four-fifths of a cubic centimeter of water in so doing.

The apparatus must be used on direct current, and the anode must be connected to the positive pole. The proper pole may be ascertained as follows: Take an old carbon electric light bulb and knock the tip off under water, allowing it to fill up. Put in a drop or two of phenolphthalein. Connect to socket. A pink stream will be seen issuing from the broken end of the negative wire inside the bulb.

The glass tube should be placed vertically in the aquarium, so that the glass cup just clears the bottom. It may be conveniently supported by an iron-ring stand and clamp.

On one occasion I kept thirty-two fishes, averaging two inches in length—goldfish, dace and shiners—in a three-gallon tank for three weeks without changing the water. At the end of this time a chemical analysis of the water was made for oxygen. The result, 8.95 parts per million (by weight) of dissolved oxygen, showed the water to be in a state of 3 per cent. super-saturation.

Beef vs. Liver

An interesting experiment has just been undertaken at the Wytheville (Va.) station in the feeding of beef liver and beef heart to young rainbow trout. In each of two 14-foot troughs 10,000 fish just ready to take food were placed. The water temperature for the first 30-day period was approximately 55 degrees F., and a flow of about seven gallons per minute was maintained. All the fish included in the experiment were selected from the same lot, and their treatment in the troughs was identical in every way, with the exception that those in one trough were fed on heart and those in the other trough on liver. The results were as follows:

Fed on beef heart:
Weight at beginning.....5 oz. per 1000 fish
Weight after 30 days....10¼ oz. per 1000 fish
Fish lost during period..... 156
Fed on beef liver:
Weight at beginning.....5 oz. per 1000 fish
Weight after 30 days.....10 oz. per 1000 fish
Fish lost during period..... 275

From this it will be seen that the rainbow trout fed on beef heart suffer less mortality and also gain slightly in weight as compared with those fed on beef liver. With the continuance of the experiment the results may be more striking. Much discussion has been carried on at the various stations as to the relative merits of heart and liver as food for fish, and it is thought this experiment if extended and confirmed, may be of practical value. —*Fisheries Service Bulletin.*

During April

How foolish 'tis to sit and sigh, how needless is the pain; thinking every cloud in the sky means bucketsful of rain.

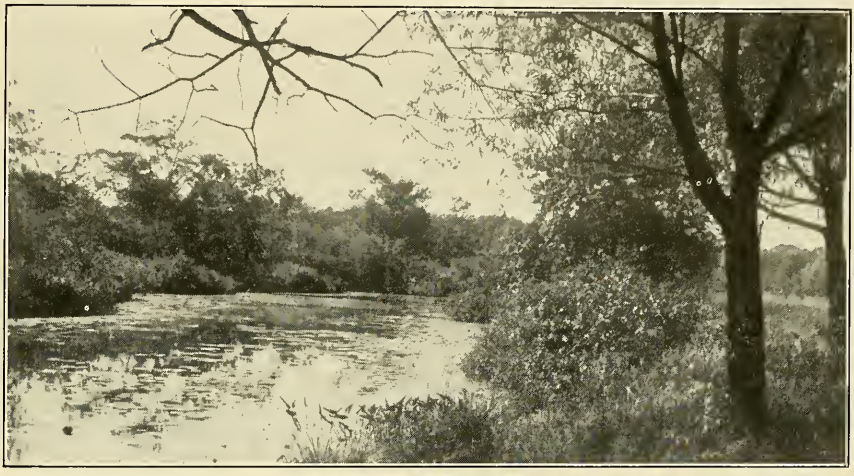
To derive the maximum enjoyment from aquarian nature-study one should possess and learn how to use a microscope. Avoid instruments for which extravagant powers are claimed, especially when the price is ridiculously low. Such usually lack the name of the maker. The maker of a good stand has reason to be proud of his work, and therefore places his name upon it. The cost of a microscope sufficient for the needs of the aquarist, made by a reputable firm, need not be great.

For "pep and punch" does any other fish beat the Chanchito?

WATER LILIES

Some Historical and Cultural Notes

G. H. PRING, :: Missouri Botanical Gardens



Nature's Lily Pond

The cultivation of water lilies is one of the most fascinating branches of horticulture. This is undoubtedly enhanced by their exquisite flowers and the important feature of water in beautifying the landscape. Water gardening holds an important place in our parks and private estates. Unfortunately, however, a fallacy prevails in supposing that water lilies in general demand large bodies of water, combined with expert knowledge of cultivation. On the contrary, an ordinary half-barrel is large enough to grow a representative of certain varieties. The cultivation is an easy matter, providing a few rules are followed, which will be discussed later.

The history of water lilies dates from the ancient Egyptians, who held the so-called Egyptian Lotus as a sacred flower. It was also deemed sacred by the natives of India, China and Japan, being to a greater extent still employed in religious invocations and ceremonies.

Beauty of flower was not the only quality possessed by the Nelumbium which compelled the admiration and veneration of the ancients, for the plant had utilitarian properties that appealed to them, rendering it of considerable economic importance. The root stocks and seeds were prepared and eaten as food by the inhabitants of China, India and Australia. In Cary's translation of Herodotus, it is recorded as follows: "But to obtain food more easily, they have the following inventions: When the river is full, and has made the plains like a sea, great numbers of lilies, which the Egyptians call Lotus, spring up in the water; these they gather and dry in the sun; then, having pounded the middle of the Lotus, which resembles a poppy, they make bread of it and bake it. The root

also is fit for food, and is tolerably sweet, and is round and of the size of an apple. There are also other lilies, like roses, that grow in the river, the fruit of which is contained in a separate pod that springs up from the root, in the form very like a wasp's nest, in this there are many berries fit to be eaten, of the size of an olive stone."

It is believed that from this statement of Herodotus the popular error has risen that the Lotus was a native Egyptian plant, although he made no reference to the subject of Egyptian ornament, and that Nelumblun speciosum was the typical sacred plant of Egypt.

The introduction of this pink Nelumbium or Nelumbo into the United States dates from about 1840, when Thomas Hogg, an oriental traveler, sent plants from Japan to Isaac Buchanan, of New York, but these unfortunately perished. At a subsequent date plants were again sent to Mr. Henshaw, a well-known landscape gardener of New York, and they grew and flourished. Mr. Henshaw's success with these and other aquatics led him to introduce other water lilies into various landscape designs carried out by him, having first become acquainted with the merits of the water lilies at the famous Chatsworth aquatic collection of England.

The cultivation of the Nelumbo as a commercial plant in this country was first engaged in by E. D. Sturtevant, who received tubers from Kew Gardens, England, at about the same time that Mr. Henshaw received his. These were planted in a sheltered mill pond in shallow water, where their hardiness was fully demonstrated, stock obtained from them being distributed to all parts of the country.

The introduction of the giant water lily, *Victoria regia,* dedicated to Queen Victoria by Dr. Lindley, did more for popularizing aquatics than any previous introduction. Regarding the introduction, I will quote Smith's records of the Kew Botanic Gardens:

"In August, 1846, seeds of this remarkable water plant were first sent by Thomas Bridges, a plant collector, who discovered it in Bolivia. Part of these seeds were purchased for Mr. Kew, two of which vegetated and formed leaves about an inch across, but, on account of their having sprouted late in the season, and our not being then acquainted with the true nature of the plant, they both died in the dull weather of November of the same year.

"From that time several attempts were made to introduce it, both by roots and seeds, but these arrived dead. In February, 1849, seeds were received, sent in a phial of water from Demerara by Dr. Boughton, which vegetated, and in March six plants had become fully established. A tank was made, 25 feet in diameter, and in August soil was placed in the center, and a plant was planted, which grew rapidly, flowering for the first time under cultivation during November of the same year."

From these plants seeds were distributed throughout Europe and this country. Caleb Cope, of Philadelphia, having the distinction of being the first successfully to flower this variety, on August 21, 1851. The leaves of this giant are commonly called water platters, the terms water maize or water corn are also used. The last two are very appropriate, as the seeds are gathered and eaten by the natives of South America. The leaves will readily support the weight of a person of 200 pounds, providing it is equaled over the leaf surface.

Prior to the introduction of *Victoria regia, Euryale ferox* was considered the largest lily. This plant, however, is not as handsome as its Amazonian neighbor.

It does not possess the large, white, fragrant flowers, or the platter-like leaves. However, it is a good substitute, the leaves measuring four feet to five feet across, lying perfectly flat upon the water. The flowers, which are small and insignificant, have a deep purple color. This is an excellent variety for the amateur, because when once planted in the pond it will reseed itself annually. The plant is indigenous to India, where the edible seeds are gathered, baked and eaten by the natives.

A Lily Pond of Man **Photo by H. E. Demuth**

We will now discuss the smaller varieties, which are grown for their ornamental flowers. There are two main groups to the genus, nocturnal and diurnal, or night-blooming and day-blooming.

The tropical species contain both types. The night bloomers include many hybrids, all of which are from the two original species *Nymphaea lotus* and *Nymphaea rubra*. *N. devoniensis* has the distinction of being the first garden hybrid raised from these species. It was raised at the famous aquatic gardens at Chatsworth, England. This work has since been carried out more extensively in this country, where climatic conditions (especially in the Western States) are more favorable.

This group has tuberous roots, which may be dried up during the winter period. During March these small tubers should be planted in good sod soil and placed in tanks of water in the greenhouse. The temperature of the water should be 65 deg. to 70 deg. F.; this is easily maintained if the tanks are placed over the steam pipes, and where the full benefit of the sun is obtained. During the

middle of May these young plants may be planted in the outside ponds, leaving a space six feet to eight feet in diameter for development. The flowers of this group open at sunset and close about 9 A. M. the next morning. The tropical day-blooming lilies produce smaller flowers, and usually open when the sun appears, the opposite of the previous group. We also find among these the additional colors of blue and yellow, besides the white, pink and dark pink. These types readily intercross through insect agency, so much so that all colors will appear from the same seed pod.

The winter treatment of this group is different from that given the night bloomers. It is not possible to dry the old plants, which have been lifted from the outside ponds, in the same manner as the night bloomers are handled. To keep them over winter it is necessary to keep them in tanks of water at low temperature. A more practical method is to raise fresh plants from seed every year. The seeds are rather small, and soon lose their vitality; therefore it is advisable to sow out as soon after collection as possible. The seeds should be sown on the surface of finely sifted soil and covered with a thin layer of fine sand. Half barrels are very convenient for this purpose, filling about half full of soil and the remainder with water. The seedling may be transplanted directly to the open ponds in spring, or may be potted up early and grown in separate tanks. The seedling should have at least four floating leaves at the time of transplanting to the outside ponds during May; by July it will be sufficiently developed to flower.

The hardy lilies are the most familiar, being native of North America and Europe. The best hybrids have originated chiefly through the influence of the American species *Nymphaea odorata* (white), *tuberosa* (white, also pink), and *flava* (yellow).

This yellow variety attracted the French hybridist Latour Marliac in 1886. He crossed the two species tuberosa and flava and obtained the hybrid *Marliacea cromatella.* This yellow variety may be traced in all the present-day, yellow-flowered hybrids. Marliac also used the rose-colored European species in crossing with the American species and the hybrid *Marliacea rosea,* in 1887, was the first hybrid of rose color among the hardy group. Marliac never revealed the parentage of his hybrids, chiefly for trade reasons. But the expert can readily recognize them in the progeny.

The hardy lilies are mainly represented in our public parks and private estates. They are rank growers and when once planted do not demand the attention and cultivation that the tropical representatives do. They spread rapidly by their continuous rhizomes, which subdivide, it becoming necessary, therefore, to keep them within bounds. These hardy lilies flower in the late spring until August; the hot weather at that time usually retards the production of flowers. The hardy type should form the nucleus of all aquatic collections.—An address delivered at the annual meeting of the *Missouri State Horticultural Society.*

With preparations sold to create a condition favorable to the multiplication of protozoans (infusoria, etc.) it is no longer necessary or desirable to allow a tank to stand over winter without fishes in order to condition it for breeding labyrinth fishes. In such a tank the maximum protozoan content was reached and passed long before it was used for breeding.

Books, good reliable books, as well as tanks, plants and fishes, are necessary to a successful nature-student.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912, of Aquatic Life, published monthly at Philadelphia, Pennsylvania, for April 1st, 1919:

State of Pennsylvania, } ss:
County of Philadelphia. }

Before me, a notary public in and for the State and County aforesaid, personally appeared W. A. Poyser, who, having been duly sworn according to law, deposes and says that he is the editor of AQUATIC LIFE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., or the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, to wit:

That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Joseph E. Bausman, 542 East Girard Avenue, Philadelphia, Pa.

Editor—W A. Poyser, 207 South 37th Street, Philade'phia, Pa.

Managing Editor—None.

Business Manager—None.

That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock.)

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That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of the total amount of bonds, mortgages, or other securities are: *None.*

W. A. POYSER, *Editor.*

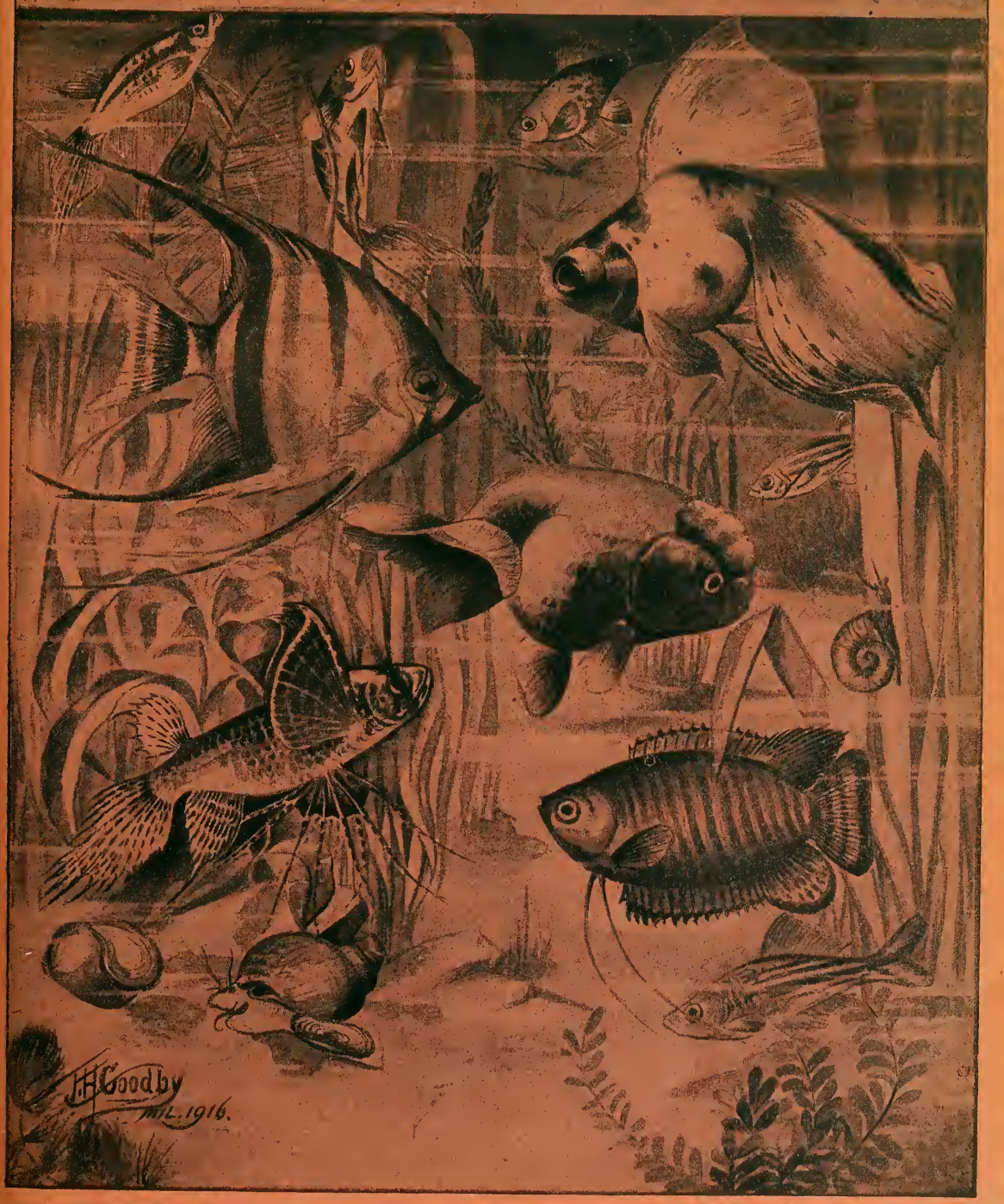
Sworn to and subscribed before me this 27th day of March, 1919.

(Seal) JOSEPHINE V. YEAGER.

(My commission expires at the end of the next session of the Senate.)

May, 1919 15c Copy

Aquatic Life



Aquatic Life

Vol. IV. May, 1919 No. 9

An international monthly magazine devoted to the study, care and breeding of fishes and other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
542 East Girard Avenue ..... Philadelphia

Entered as second-class matter, September 2d, 1915, at the Post Office, Philadelphia, Pa., under Act of March 3d, 1879.

Popular and scientific artic'es and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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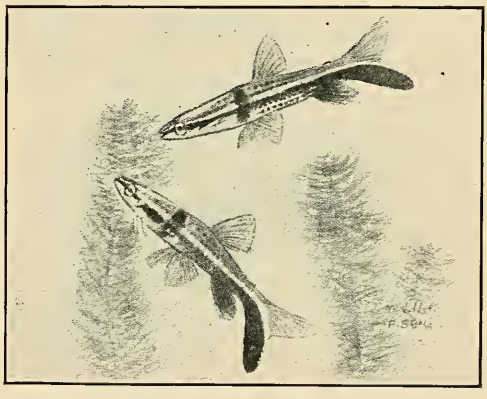
NANOSTOMUS EQUES

WALTER LANNOY BRIND, F. Z. S.

About nine years ago, *Nanostomus eques*—call it *Poecilobrycon marginatus* if you prefer the latest dictum of the systematic ichthyologist—was brought to the attention of aquarists in four small specimens, an inch long, taken in the Amazon. These were thus half-grown, the maximum size being usually recorded as two inches. It is one of the characins, the dominating group of fishes in South America.

The sexes seem quite alike, though there is some difference in the anal fins. A dark red stripe runs from the snout back through the eye to the caudal fin, there meeting the same color in the lower lobe; this is bordered above with a golden band. On the sides are two broad, dark, vertical bands, one just in front of the dorsal and the other behind; the latter sometimes almost invisible. The anal and tail fins are carmine, which is particularly evident when the fish is viewed by artificial light. The intensity of the colors is subject to variation, being influenced by light, temperature and other conditions. The back is grayish-brown, the abdominal regions white. On the back, between the dorsal and caudal fins, is situated the adipose dorsal or fat-fin characteristic of the family.

Nanostomus has not been bred in confinement. Eventually it should be accomplished. Should it breed like its relatives the eggs will be placed on finely divided leaves of water plants, or their rootlets, adhering singly as in the case of the familiar goldfish. A large, sunny aquarium, well planted with *Myriophyllum*, but with a clear space for play and prenuptial addresses, and clear, pure water, would be most apt to induce spawning, provided the temperature is maintained around 80 degrees and ample live food, such as Daphne, is given consistently. When commerce with South America becomes normal, we should be able to secure this fish from Brazil, and, if some one is fortunate in having it spawn, it will be well to immediately remove the parents to another tank, rather than transfer the plants with the adhering eggs, thus saving all.



Nanostomus eques

This species is peculiar in possessing a habit of "standing" stationary in a corner of the aquarium with its body pointing upwards at an angle of forty-five degrees. This probably concerns its feeding habits.

Many a man pins his faith to a star, only to discover that it is a firefly.

Some people are born lucky. It isn't every fellow who can fall in love and land on his feet.

The Water Horse-tail

J. CHARLES WOBLER

During the Carboniferous Age, ferns and allied plants were the dominant features of the landscape. The giant calamite, now known solely from its fossil remains, grew as large as our present-day forest trees, and is the prototype of our scouring rushes or horse-tails—the EQUISETACEAE. These vary in height from a few inches to thirty feet, and are seldom greater than two inches in diameter. The average American species is but a few feet high, and as thick as a lead pencil, often less. About twenty species are known, mostly from the temperate zones, North America containing more than half of the species in the world. The name *Equisetum* is from two Latin words meaning "horse" and "bristle." While its application is not always apparent, some kinds have many slender branches that render the plant not unlike the tail of a horse.

The Water Horse-tail, *Equisetum fluviatile,* in North America extends from Virginia northward and westward; occurring in Europe and Asia, it belts the earth in a zone perhaps a thousand miles wide. As its name implies, it prefers the water, growing in the sand and mud of shallow ponds and ditches. With its root-stock protected by the unfrozen mud, it early feels the vernal impulse and shoots its stems upward.

The root-stock and stems are made up of sections or joints quite unlike any other plant. One writer likens them to a line of drain pipe, each section of which fits into the flaring end of the one below. Growth consists merely of the lengthening of the sections or internodes. The flaring top of each section is composed of a circle of teeth that are said to be the remains of leaves which were present in an ancestral form. Existing species bear no leaves, the stems and branches performing the necessary functions. The stems are produced from the nodes of the creeping root-stock.

Spores are born in cone-like spikes or catkins, at the tips of the stems. Not all stems are fertile, but end in a whip-like prolongation. Each spore has two hair-like appendages attached by the middle. When moist they coil around the spore. As the catkin matures and dries, the elators uncoil and assist the spores to float about in the air. Too, they are equally important in entangling two or more spores together, as the development of two spores in close proximity is necessary to reproduction. The actions of the elators may readily be observed with a magnifying glass.

The Water Horse-tail might be grown in a pan or box in a breeding tank. In winter it should require no attention if the water does not freeze solid. If this is apt to happen, place the pan in a *cold* cellar, keeping it moist.

The "Guppy" in Golf

It was the office of the great sporting newspaper. The golf editor was home, sick. The baseball editor was doing the golf stuff.

"Which is the better course," wrote in a Constant Reader, "to fuzzle one's putt or to fetter on the tee?"

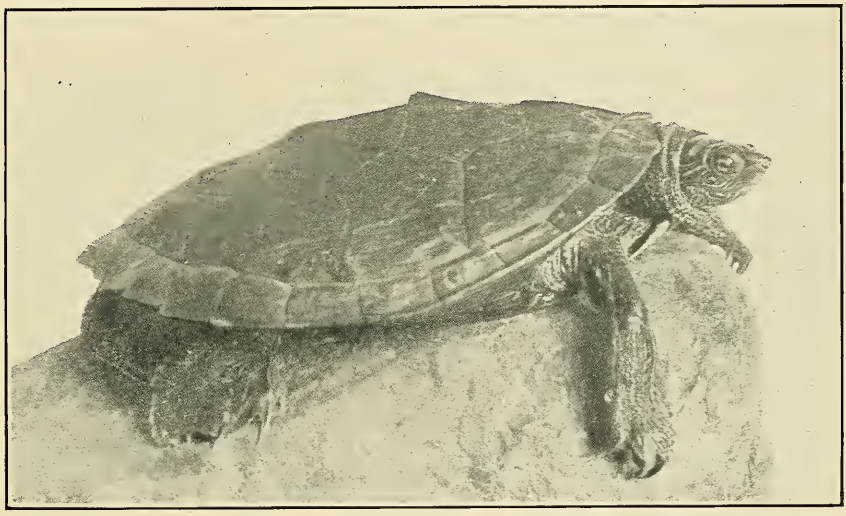
The b. b. ed. tilted back in his chair, smoked a cigarette and wrote:

"Should a player snaggle his iron, it is permissible for him to fuzzle his putt; but a better plan would be to drop his guppy into the pringle and snoodle it out with a niblick."—*The Guide to Nature.*

At the twenty-eighth meeting of the Aquarium Society of Washington, held in the Zoological Laboratory of the George Washington University, May 10th, Dr. R. W. Shufeldt read a paper on the Basses of the waters of the District of Columbia.

Observations on the Chelonians of North America. II.

DR. R. W. SHUFELDT, C. M. Z. S.



Right Lateral View of Lesueur's Terrapin

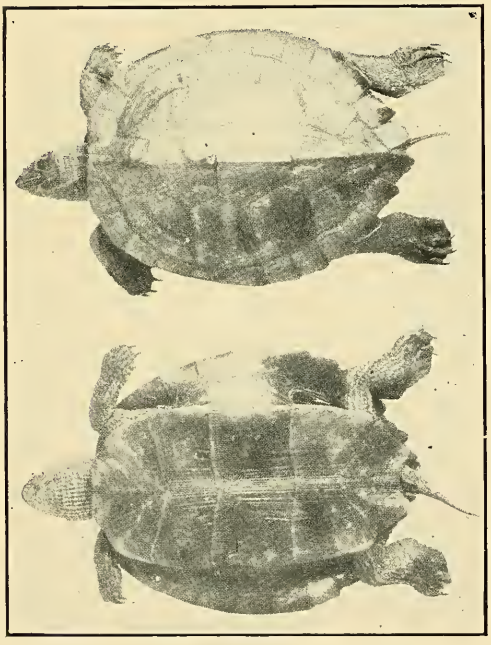
In my first article of this series of brief contributions on our native chelonians, a short account was presented of Bell's Terrapin of the genus *Chrysemys*. This group will be taken up again later, as it embraces many interesting species of wide distribution; for the present they are passed by, in that a more or less nearly related genus may be touched upon. This is the genus *Malacoclemmys*, which up to date is said to comprise some half a dozen species. Generally they are of good size, the largest forms attaining a length of a foot or more. Besides the famous and very widely known Diamond-backed Terrapin (*M. palustris*), we have in this interesting assemblage such elegant types as the Geographic Terrapin (*M. geographica*); Kohn's Terrapin (*M. kohnii*); Maur's Terrapin (*M. pulchra*); Lesueur's Terrapin (*M. lesu urii*), and the Ocellated Terrapin (*M. oculifera*).

While these six species differ considerably, in some instances, do not depart so very much from certain species of the genera *Chrysemys*. Popularly, as in the case of the latter, they are known as "sliders," and they are sold in many of our markets under that name, a prominent contradistinction being seen in the "Diamond-back," large examples of which often sell at the stalls for no less than eight dollars.

One of the species of this genus is but rarely seen away from its range, and that is Lesueur's Terrapin, listed above. Recently Mr. Edward S. Schmid has received a large consignment of these from

Illinois, where they are abundant, and he has favored me with both living and dead specimens of several sizes. Of the former I have made a number of photographs, a very good one of which is here reproduced in Figure 1. It is natural size, and was a most difficult subject to photograph—that is, with its head, limbs and tail in full sight. This achievement cost me nearly six hours spent in consecutive trials.

The dorsal and ventral views (Figs. 2 and 3) are from a specimen that had been



Superior and Ventral Views of Lesueur's Terrapin

dead but a few hours previous to my photographing it. These cuts present many of the specific, as well as generic characters of this form, and special attention is invited to the large feet and long tail, as well as the tuberculated ridge down the median line of the carapace seen on side view in Figure 1.

In several specimens before me at this writing I find the color of the carapace to be of a deep olive brown, varying somewhat in different individuals. Blackish-brown splotches, one on each shield, are more or less distinctly seen. In some cases they are very well marked, but they unfortunately do not come out in these photographs. Below, the plastron is of a grayish yellow, and sometimes presents a deeper marbling near the margins of the scutes (Fig. 3). The head, limbs and tail are of a deep brownish olive, figured in various ways by *fine lines* of yellow, with a sharply defined small area of the same color on either side of the head—back of and above either eye. A median stripe of yellow runs the length of the tail, one above and one below.

The median length of the carapace in this species may sometimes be found to measure nearly ten inches and its width over seven.

Lesueur's Terrapin is an abundant species throughout the valley of the Mississippi, and may be found as far to the eastward as Ohio; it is sold in numbers in the Chicago markets. It is a delicate form by nature and does not bear captivity well. Its habits are much the same as those of any of the ordinary fresh-water terrapins of its own size, and occurring in the same locality. As a rule, in the species of this genus the females are larger than the males—markedly so in some examples, while the long tails are very conspicuous, this latter character being particularly noticeable in the males. Lesueur's Terrapin feeds largely upon fresh-water snails and other small mollusca, and such food they can easily crush through the use of the broad, hard surface just within the margin of the mandible on either side, as well as in similar localities, and opposite them, in the upper jaw. These gringing surfaces are accurately opposed to each other—that is, the pair above and the pair below; so that adult individuals of this terrapin are, through their use, quite capable of crushing the shells of ordinary snails and other small molluscs.

I Became a Fancier

EDITH PROCTOR

To plan and lay out a garden, build a fountain, and thereafter indulge in the delights of raising water lilies and other aquatic plants had long been a smoldering ambition. Some time ago I purchased a property which, while not large, proved well adapted to fulfil my desires. Within a week the ground was broken for a pond twelve feet in diameter. In its construction two inlets were provided for fresh water, with an adequate outlet, while an additional line of pipe ran to the centre to supply the fountain. The pond was of concrete.

Now my attention turned to the selection of water lilies. Large white, pink, red and yellow ones were chosen and set in boxes under eighteen inches of water. Four weeks later I was rewarded with three beautiful blooms and, though I have since had as many as twenty-five in a single day, none have seemed as wonderful as that first success.

But, beautiful though water lilies may be, one needs other plants, and our native species are not to be despised. About five miles from town I discovered a large pond. I will never forget my delight as I came upon this spot, so wild and almost unknown to man. I have visited famous gardens from coast to coast, and not even Santa Catalina, with its wonderful marine gardens, could vie with this little inland pool. The surface was covered by lilies, with Arrowheads, Anacharis, Hornwort, Starwort and mosses in profusion, each seeming to strive to excel the others in daintiness and beauty. Saucy green frogs blinked from the lily pads, seemingly proud of the hundreds of tadpoles basking in the warm June sunshine. As I stood there, lost in profound admiration, the opening lines of *Thanatopsis* flashed through my mind: "To him who in the love of Nature holds communion with her visible forms, she speaks a various language."

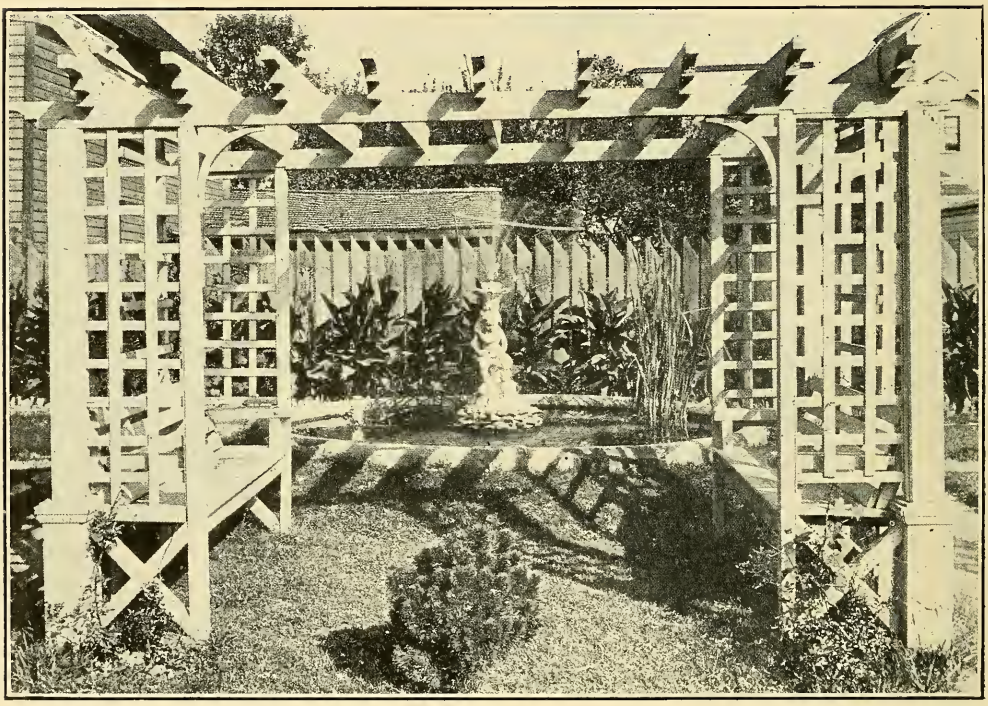
Water Lily (Nymphaea)
From Bisset's "Water Gardening"

Many times I visited the pond, and thus the pool in the city grew more lovely. The snails multiplied and strange insects began to inhabit the water. A little turtle appeared and, later in the season, as unceremoniously disappeared. Then came a frog and still another, and again six baby frogs. With these we parted as soon as possible. Four sprightly goldfish com-

pleted the ensemble.

One morning I was startled to hear a shout from my little son, "Mother! Come see the funny little things in the water. They look like fish." And, sure enough, there were hundreds of baby goldfish. Let me say, for the benefit of the inexperienced, that I had never before seen a young goldfish. In planning the life for the pond I had endeavored to reproduce natural conditions. The result was a rank growth of submerged plants, lilies and cat-tails, among which the young fish had hidden and found protection. The babies were all of six weeks old, and had subsisted entirely on the foods naturally found in the water. About four hundred were successfully reared.

That was the beginning of four successful years. A market was found and the demand now exceeds the supply. But this has not been without ups and downs, for I have battled congestion, fungus and other ills and natural enemies, but there is not a sick fish among the hundreds I have at present. The secret is to simulate nature. The same principles have been applied to a larger pool, fifty feet long and four feet wide, constructed when the original pool became too small to handle the number of fishes needed.



The Author's Garden Pool

They were looking at the kangaroo at the "zoo," says the *Boston Transcript,* when an Irishman asked his neighbor in the group: "Beg pardon, sor; can you tell me phwat kind of a crature is that?"

"That," said the man, "is a native of Australia."

"Good hivins!" exclaimed Pat. "And me sister Julia married wan o' thim."—*The Youths' Companion.*

Those who boast that they never take water may find themselves between the devil and the deep sea.

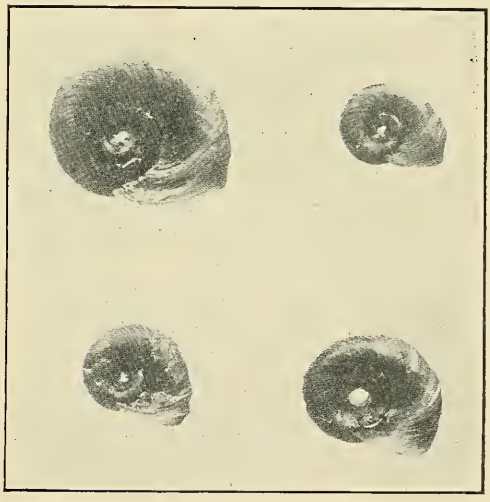
A Peculiar Planorbis

CHARLES M. BREDER, JR

A tank containing among other things a number of local pond snails (*Planorbis Sp.*) of rather small size, was taken by the writer as a prize, during December, 1917, at a drawing held by the Essex County Aquarium Society. These molluscs were very prolific, the aquarium soon becoming the home of numerous offspring. But having on hand more atractive species with which to grace this tank, they were pooled with some Jap snails, *Viviparus malleatus,* in a large aquarium used for rearing young exotic fishes, and no notice was taken of them for more than a year.

Recently one rather odd individual drew attention. Apparently the common condition that is responsible for the erosion of the shells of snails had eaten a hole completely through the centre of the shell, and the animal was still alive and in good health. Further examination disclosed that half of the individuals of the species were in the same condition; literally living doughnuts! The perforations varied from pinholes to ones making the animal suggest the mentioned pastry.

It is reasonable to believe that as the snails grow and the shells increase in size, the water becomes deficient in lime. Coincidentally the water dissolves parts of the shells previously built up, usually the oldest portion—the spire—which for some reason is less resistant to its action than the more recently formed body whorl. It should follow that the greater the number of snails to a given body of water, the greater the degree of erosion. From the observations of the writer this is generally substantiated. Be the cause what it may, there is evident weakness or lack of resistance at the apex of the shell, and this has been noted in a large number of species. Such snails have invariably died when the etching perforated the shell and thus exposed the body of the animal, this being especially the case with the red variety of *Planorbis corneus.* The unusual feature of the eroded local *Planorbis* is that the animals live and appear



to enjoy perfect health. Can it be that a race of snails is thus developing with power to render innocuous this ordinarily fatal condition? Experiments in artificial selection along this line would be interesting, and some sort of result could be expected when it is considered how readily these univalves adapt themselves to changed conditions.

The following experiment will serve to show the effect of environment on a pond snail. Eggs of *Physa heterostropha* were allowed to hatch and develop in a small,

tightly sealed jar, which contained a body of water an inch and a half deep and two inches in diameter. Six were thus grown, and in due time reached maturity and spawned, though measuring but a sixteenth of an inch across the widest part. One deposit contained five ova, and to remove it the jar was opened for the first time. The eggs were hatched in a much larger vessel and eventually the resulting animals grew to the normal size for the species. Later, when placed with other and normal specimens, they could not be distinguished.

It must be mentioned that the annular *Planorbis* grew in company with normal Jap snails, as well as with the ever-present *Physa,* neither of which exhibited any departure from the type. Lime in the form of plaster of paris had been added from time to time for the benefit of the desired Japs, and, of course, the others likewise profited. From this fact it is evident that there must have been a weakness of shell peculiar to the Planorbis.

Biologists have conducted experiments similar to that with *Physa,* and the results with other organisms have been similar. Bearing this fact in mind, the aquarist with a limited purse should not hesitate to purchase small specimens for breeding if the stunting has been brought about by small quarters. Succeeding generations need not inherit the dwarfish size, and dealers naturally will not charge as much for such small individuals.

The Bladderworts

We have in England two varieties of water-plants known as bladderworts, both of them veritable death-traps. Fortunately for tiny fish fry and other minute aquatic animals, they are somewhat rare and local. On the other hand, as they inhabit ponds and gentle streams, they are particularly well placed to do the maximum amount of mischief.

Attached to the plants are many small bladders of a purple tint. These bladders serve two purposes—as buoys to the leaves and as traps for small aquatic animals.

The trap is formed in such a manner that an entrance is particularly easy; not so the way out. No eel trap is more cunningly devised.

An eel-trap is a human contrivance devoid of life and power to assist in effecting a capture. The bladderwort is a thing possessing vitality and cunning.

There are many traps on each plant, and if an examination be made it will be found that all or nearly all contain a victim. The plant never lacks for food.

Many long and careful investigations have been made respecting the harmfulness of the bladderworts, and in some cases every trap contained a little fish.—*Fishing Gazette.*

Trainer Simpkins was telling some admiring ladies how he first discovered that Teddy, the famous Mack Sennett dog, has brains. "I had an armchair in which I always liked to sit," he said, "but Teddy, even as a pup, also showed a fondness for it, and it became a habit that I had to drive him from the chair in order that I might sit down. One day I had a bright hunch, so, stepping to the window, and, peering out intently, I cried out, 'Cats! cats!' Teddy made a bound for the window and I grabbed the chair. A few days later came the sequel. I was in the chair reading a book when Teddy strolled into the room. He looked at me, and then ambled over to the window. Suddenly his fur ruffled up stiff and he began to growl. I tossed my book aside and dashed to the window, and, will you believe it, that dog made one leap and landed in my chair."

Too many men are measured by the size of their bank accounts.

Association and Color Discrimination in Mudminnows and Sticklebacks

GERTRUDE M. WHITE, Ph. D.

Observations were made on the activities of the mudminnow, *Umbra limi,* and the stickleback, *Eucalia inconstans,* with special reference to the acuteness of their sense organs, their ability to form associations and to discriminate colors and patterns. The experiments were carried on in the Zoological Laboratories of the University of Wisconsin.

In these fishes the senses of sight and smell are most used in seeking food. The Stickleback displays more alertness in using both senses, and a much higher degree of acuteness of the sense of smell. This was tested as follows: Cloth packets one of which contained meat and the other cotton, were suspended at opposite ends of the aquarium. The mudminnows did not show that they perceived either packet though they swam in close proximity to both.

The sticklebacks behaved differently since the appearance of the packets attracted them at once. Those fishes which went towards the packet containing meat darted furiously upon it, and pulled at it with great excitement, but those which swam in the direction of the packet of cotton stopped about 4 cm. away, and turned off in another direction. Only once or twice did they actually snap at the cotton packet. Then, perceiving the struggles of the rest of the fishes with the other packet, they swam over and joined them.

In the use of the sense of sight the mudminnow compares more favorably with the Stickleback, though the latter reacts more quickly. Both pursue moving objects without odor, such as bits of paper, or objects above the surface of the water; both are stimulated by shadows or an increase in the amount of illumination.

A series of experiments were carried on to discover whether these fishes possess color vision. The general problem presented to them was that of learning to associate food with a certain color, and at the same time associate unpalatable substances, such as paper, with another color. In order that there might be no chance to smell the food, the bait was not dropped into the water, but the fishes were taught to leap out of water and take it from forceps. Repeated trials determined that the fishes were not able to distinguish between the imitation baits and the food when both were offered out of water under the same conditions.

In the first set of experiments colored papers were used. Discs cut 7.3 cm. in diameter and stiffened with cardboard. An aperture was cut in the centre of each large enough to allow the discs to be slipped down over the ends of the forceps from which the fishes were fed. After a mudminnow had been given food in this way for some time, the appearance of a colored disc became a signal for the fish to dart to the surface and spring out of water after food. When this association with one color seemed to be thoroughly established, a disc of another color was substituted, with paper closely resembling the food in color and appearance in the forceps. The fish first snapped at the paper, but soon came to avoid it, and refused to snap at paper or food under the disc with which it had come to associate unpalatable substances, though it

continued to take food under the colored disc beneath which it had first been fed. In this way red and blue, and red and violet papers were distinguished.

Since colored papers are never spectrally pure, monochromatic lights were used in order to make more accurate tests. The following lights were discriminated by mudminnows, as was shown by associations formed with them: Red and green, red and blue, yellow and green. Varying the intensity of the red and green lights did not affect such discrimination, indicating that the reactions of the fishes were to color rather than to intensity. Sticklebacks also disinguished between red and green lights forming associations of food and paper with them.

An interesting piece of evidence was obtained from an aquarium containing fourteen Sticklebacks. These fishes were kept under observation for several months, during which they were regularly fed, and became very tame. Calves' liver was given to them nearly every day from forceps. It was very amusing to see all fourteen of them dart to the top at a slight movement of any one near them and begin sticking their noses out of the water in anticipation of food. When food was held a slight distance out of the water, they would with one accord leap out after it, and at times hang on so tightly that they could be lifted several inches out of water before letting go their hold. On one occasion, after the Sticklebacks had been given a small piece of calves' liver, the forceps were held out to them empty. None of the fishes approached the forceps, but the merest bit of dark red liver was sufficient to attract them. Small pieces of bright red and dark red paper rolled into balls and substituted for the food were at once attacked; lavender which had a pinkish tinge was snapped at twice, while tan yellow, yellow, dark blue, gray and green elicited no positive response. This experiment indicates that the color of the food which Sticklebacks take habitually makes an impression difficult to eradicate.

Since the theory has been proposed that fishes see colors as shades of gray, as a totally color-blind human being perceives them, further experiments were performed. If the fishes were reacting to intensity rather than to color in the experiments described above, they ought to be able to form associations of food and unpalatable substances with gray lights as they had done with the colored lights. Accordingly photographic plates were "fogged" to different shades of gray and food offered on the appearance of one shade and paper on another. No associations were formed by the fishes, since they attempted in the same manner to take whatever was offered with both plates, which supports the conclusion that the discriminations in the experiments cited were due to the wave length of the light.

Only negative results were obtained in experiments to test the perception of differences in background by mudminnows and sticklebacks, suggesting that such discrimination does not have a very important function in their search for food. The perception of color and movement seems to be of the most importance.—Author's abstract of paper in the February, 1919, number of *The Journal of Experimental Zoology*.

The "one-time" advertiser abandons the field right after sowing, and the weeds of public forgetfulness grow over his immature plant. To be sure, there are exceptions to this rule. Some "one-time" advertisements are highly productive, just as some seeds grow into fine plants with practically no care or attention after the planting. However, these only prove the rule.

The HAY INFUSION MICROCOSM

LORANDE LOSS WOODRUFF
Professor of Biology in Yale University

Since the days of Leeuwenhoek and Joblot hay infusions have been a prolific source of material for amateur and professional microscopists, but there has been relatively little scientific study of the sequence and interrelations of the various organisms which abound in them. As a matter of fact there is probably no better introduction to microscopic organisms in general, or indeed to general biology, than a careful study day by day of the kaleidoscopic series of changes which an infusion presents from its inception until it reaches a stage of sterility or, in the presence of sunlight, of practically stable equilibrium in which animals and green plants become so adjusted that a veritable microcosm exists.

Hay, tap water and air are all sources of the life of an infusion, but in order to get a representative series of forms for study it is better to "seed" the material with a small amount of debris and water from the superficial slime of a pond. Divide the infusion into several equal parts and put each into a large battery jar, weighting the hay down so that it does not float. Cover the jars loosely with glass plates and stand them near a window where they will get but little direct sunlight.

When hay and water are combined a complex series of physical, chemical and biological phenomena are initiated. The liquid rapidly becomes straw colored, and within a few days, depending largely on temperature, bubbles of gas rise to the surface. Gradually the liquid appears darker, until a brownish color is assumed. The lighter and darker shades are due respectively to relatively high and low acidity.

When infusions are first made up the liquid, though slightly colored, is transparent, but within a day or so it becomes markedly turbid, due to the development of countless bacteria. The bacteria at first are about equally distributed throughout the medium, but soon a scum appears on the surface, and gradually increases in amount until it finally falls to the bottom and another is formed. In some cases, however, after reaching its maximum thickness, it merely thins out and disappears. The hay and smaller amount of oxygen at the bottom and the more abundant supply of oxygen at the top, offer attractions for different forms of bacteria, with the result that approximately the same number are to be found in each region. After the surface scum has fallen or disappeared the centre of bacterial life is at the bottom amongst the remnants of disintegrating hay.

As soon as the bacteria have become numerous, there occurs the great growth of Protozoa—saprophytic, herbivorous, carnivorous and omnivorous forms rapidly succeeding each other in dominance, and illustrating within the confines of a drop that struggle for existence which is one of the fundamental facts of biology. It is this phase of the life of the infusion which we shall emphasize.

After the period of greatest protozoan fauna has passed, rotifers become numerous, and as the diatoms, desmids and filamentous blue-green and green algæ flourish under proper conditions of illumination, various species of aquatic worms,

crustacea, etc., are more or less abundant. This condition of the fauna and flora merges imperceptibly into a condition of nearly stable equilibrium, in which green plants and animals, under optimum conditions of light and temperature, are so adjusted that for a considerable period a practically self-supporting microcosm exists—but with the balance of nature established neither Protozoa nor Bacteria can ever again attain their maximum abundance.

Turning now to the protozoan fauna of the infusion. No one, of course, can predict just what forms or what the sequence of forms will be in any given infusion, since both are the result of so many variables. But if several infusions are studied which have been "seeded" with representative material from a number of sources, the general results can be foretold with reasonable accuracy.

The variety of species of Protozoa which appear in such infusions is so great that it is necessary, at first at least, to concentrate attention on a few typical forms, and neglect the many transient species which appear apparently at random. The groups or genera to be considered first are Monads, or simple flagellates, *Colpidum* and *Colpoda*, *Oxytricha* and various closely related hypotrichous forms, *Paramecium*, *Vorticella* and *Amoeba*, because all these organisms are present in practically every infusion.

These forms ordinarily succeed each other in maximum numbers at the surface of infusions in the order in which they are named above. That is, first there is a great growth of monads, rising to a sharp maximum and then declining as *Colpidum* and *Colpoda* gradually assume the ascendancy. Then creeping ciliates, like *Oxytricha* and *Stylonychia*, devour the *Colpidia* and flourish. *Paramecium*, which feeds chiefly on bacteria, comes next—and so the series proceeds.

Although there is this fairly definite sequence of typical protozoan forms at the surface of infusions, the data at hand does not indicate any definite sequence in the middle or bottom regions. The middle seems to be more or less neutral territory, which is encroached upon by animals from the top and bottom regions. The bottom protozoan fauna is also, until late in the life of the infusion, relatively meagre; the main types emphasized above, with the exception of certain Amoebæ being essentially surface dwellers, and seldom resorting to bottom, except during or after a period of great development at the top. However, there is no invariable correlation between a fall in numbers at the top and a rise in numbers of the same organism at the bottom, and it seems clear that, in the majority of cases, when a form declines in one region, most of the animals encyst or die. The latter is certainly true for *Paramecium*, because many hundreds of passive and dying individuals, affording a feast for *Coleps*, sometimes may be seen at the bottom among the debris. Again, myriads of cysts of hypotrichous forms are frequently found at the bottom as the surface decline proceeds. Amoebæ among the general types mentioned give some evidence of migrating from the surface to the bottom, which is their chief abode. On the whole, the bottom dwellers are largely independent of those at the surface, though it is usually possible to find there a few struggling individuals which have survived from an earlier prosperous surface population.

It is impossible to discuss briefly the factors determining the relative number and sequence of the Protozoa. Chief among these are, however, food conditions, chemical changes due to bacteria, the excretions of the Protozoa themselves, and the relative reproductive powers of the different forms. The compe-

tition between the various organisms is so keen and the cycle is so rapid that even daily observations are hardly sufficient to study the factors involved; though now and then some prominent case of competition, such as between *Paramecium* and *Didinium* is forced upon the attention and the reason for the extinction of one form is clear! The premature elimination of *Paramecium* obviously may disturb thereafter the "normal" cycle of such infusion.

But enough has been said to indicate the possibilities which hay infusions offer for becoming acquainted with many of the fresh water Protozoa. And by becoming acquainted, I do not mean learning their names, but rather, getting an inside glance, as it were, at the daily life and strife in the "world of the infinitely little"—a world beyond the ken of unaided vision but within that of any one with a compound microscope at his disposal.—By permission, with courtesy of illustration, from *The Guide to Nature*, organ of the Agassiz Association.

(In the language of the aquarian the hay infusion microcosm becomes the "infusoria tank," the source of food for newly hatched fishes.—*Ed.*)

The South Side Aquarium Club was organized on March 16th, at a meeting called for the purpose at the home of the writer, 6711 Parnell avenue. Fifteen aquarists were present, the following officers were elected for the initial year: President, M. Stubbs; secretary and treasurer, A. A. Maina; importation committee, Carson, Zemke and Maina. Aquatic Life becomes the official organ of the club. Meetings will be held regularly on the first Thursday of each month. The secretary will be glad to furnish information to aquarists desiring to become affiliated.—A. A. Maina, *Secretary*.

Didinium **Paramecium** **Vorticella** **Amoeba**

Photograph of Vorticella by Philip O. Gravelle; others at Yale University

You wouldn't know many a fellow was making an ass of himself if he didn't bray so much about it. Likewise many a fellow would be credited with knowing a lot more about fishes if he didn't talk so much on "meetin' night."

A "get together" dinner was given on April 22d by the Chicago Aquarium Society, Anglers' Casting Club, Chicago Fly and Bait Casting Club, and the Lincoln Park Casting at the Hotel Breevoort. According to reliable reports, in the battle, the fish culturists cleaned the boards under the leadership of Fred Orsinger. For an unbiased account of the affair see Jamison, the bait man.—*Communicated.*

Max G. Hammerschlag, of the Essex County Aquarium Society, says Newark, New Jersey, is far and away in the lead of all cities. The slogan of the city is "Newark Knows How." To substantiate the assertion Mr. Hammerschlag sends the program of a local theatre, which announces that the orchestra will play *"Excerpts from Xiphophorus Helleri"* and *"Gems from Platypoecilus Rubra."* Colorful music.

Mr. William T. Innes, Twelfth and Cherry streets, Philadelphia, is one of those fortunate individuals who seldom have sick goldfish. This places him in a quandary. To continue his researches into the causes and cures of the diseases of goldfish he must have patients. To this end he will be glad to have Philadelphia aquarists turn over to him all their sick goldfish, except those suffering from constipation, and is especially interested in cases of dropsy. Fishes restored to health will be returned to owners.

Visitor—"Why don't you advertise?" Town Storekeeper—"No, siree; I did once, and it pretty near ruined me." Visitor—"How so?" Town Storekeeper—"Why, people come in and bought durn near all the stuff I had."—*Judge.*

Instead of running away from your work, try to find a more efficient way of doing it. That is the secret of success.

I would like a little information concerning red snails. I have found that many have white spots on different parts of the shell and, in a great many instances, it is eaten through. I was told that it was due to a lack of lime in the water, but under a microscope I find a small white organism, which is apparently responsible for the condition. Can any one tell me how to prevent or kill this parasite?—*F. S. Boston.*

(Referred to readers.—*Ed.*)

"Love is like a dear little kitten," gurgled the sweet young thing of 45. "It is born blind." "But it takes a kitten only nine days to get its eyes open," replied the masculine brute.

"There are some queer ways about building operations." "How do you mean?" "When a man wants to expand his building for business reasons he calls in a contractor."—*Baltimore American.*

Blobbs—"Doolittle is a miserable specimen of humanity, and yet he is forever boasting of his ancestry." Slobbs—"Oh, many a man is completely cast in the shade by his family tree."

If you want to kill an aquarium society let a member monopolize the floor, meeting after meeting, with a lot of "small talk," but remotely connected with the study of fishes.

We are often asked how much does so-and-so fish cost a pair. Don't know in many cases. It depends upon the general supply and demand, and how anxious you are to possess it.

"What is the connecting link between the animal and vegetable kingdoms?" asked the teacher.

"Hash!" yelled the class with one voice.

Aquatic Life

1918—1919

SEPTEMBER, 1918. The Blood-fin (*Heede*); Breeding Haplochilus cameronensis (*Nelles*); The Spotted Gourami (*Kearns*); Japanese Snail (*Boyd*); Aquarium Water and Its Restoration (*Dormeier*); Aquarium Heater (*Hale*); Fish Foods (*Heede*); Happy Families, Breeding Habits of Mud-minnow, notes and news.

OCTOBER. Aquarium Heating (*Breder*); Hemiramphus fluviatilis (*Brind*); Mollienisia latipinna (*Heede*); Blue-tailed Skink (*Deckert*); Factors Controlling the Development of Tropical Aquarium Fishes (*Webber*); Snails in Aquaria (*Gale*); Habits of Black Bass, The Pipe-fish, notes, etc.

NOVEMBER. American Live-bearing Toothcarps (*Bade*); Aquarium Notes (*Leitholf*); Notes on Krefftius adspersus (*Freund*); The Anatomy of the Fish (*Clark*); Breeding Habits of Burmese Eel (*Finckh*); A Bloated Axolotl (*Waite*); The Name "Water Flea," notes and news.

DECEMBER. Cynolebias bellottii (*Brind*); Tillaea recurva and Other Notes (*Finckh*); Another Tank Heater (*Kuhn*); Aquarist vs. Aquarian (*Mellen*); Emotions of Fishes (*Gale*); A Cigar Box Aquarium (*Modesto*); Florida Notes (*Carlton*); Photosynthesis, Miscellaneous notes, news, etc.

JANUARY, 1919. Limia caudofasciata (*Leitholf*); Classification of Fishes (*Stead*); Color Changes of the Chub-sucker (*Hubbs*); *Neetroplus carpintis* (*Brind*); A Simple Heated Aquarium (*Finckh*); Notes on the Breeding Habits of the Pigmy Sunfish (*Poyser*); Goldfish Farm of Kichigoro Akiyama, notes and news.

FEBRUARY. Polycentropsis abbreviata (*Brind*); Cho'ogaster cornutus, the Fish of the Dismal Swamp (*Welsh*); A Wood Aquarium (*Pilkington*); Danio malabaricus (*Leitholf*); Notes on Native Fishes (*Pray*); Managing the Aquarium (*Innes*); Reactions of Fishes to Habit-forming Drugs, The Boston Show, A True Fish Story, notes and news.

MARCH. Breeding the Goldfish (*Hanna*); Observations on the Chelonians of North America, Part I (*Shufeldt*); Lucania ommata (*Welsh*); Apistogramma agassizi (*Heede*); The Water-fleas (*Tompkins*); Viviparous Fishes-in-general (*Stead*); Breeding the Striped Gourami (*Simpson*); Notes and news.

APRIL. The Surinam Toad (*Deckert*); Cichlasoma nigrofasciatum (*Brind*); Keeping Living Food Alive (*Innes*); Beware the Dragonfly (*Gordon*); An Electrolytic Aerator (*Putnam*); Water Lilies, Some Cultural and Historical Notes (*Pring*); Beef vs. Liver, notes and news.

A sign noticed in a pet shop window: "Water Snewts, the Best Acquarum Scalvengers. —15 sents."

June, 1919 15c Copy

Aquatic Life

Aquatic Life

Vol. IV. June, 1919 No. 10

An international monthly magazine devoted to the study, care and breeding of fishes and other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
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Popular and scientific artic'es and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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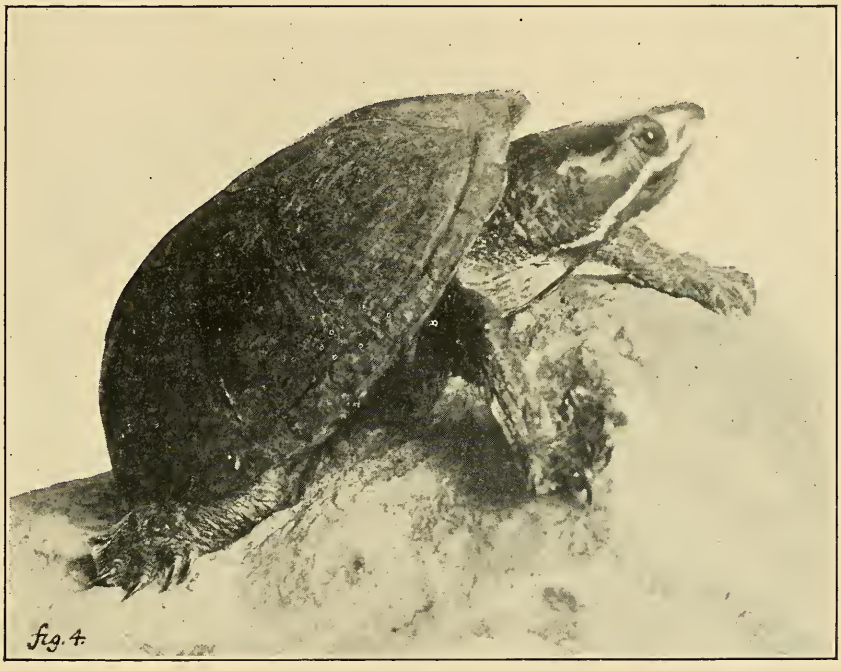
Observations on the Chelonians of North America. III.

DR. R. W. SHUFELDT, C. M. Z. S.



Aromochelys odoratus **Common Musk Turtle**

No group of turtles in our chelonian fauna are more thoroughly aquatic in their habits than are those composing the family *Cinosternidae*. Most of the species are North American in the matter of habitat, and herpelotologists generally have relegated the eight or nine known species to the two genera *Aromochelys* and *Cinosternum*. They are all small types, and upon comparison have pretty much the same general appearance. Their best differentiating characters are to be seen in the *plastron* or ventral part of the shell. The inner median margins of the carapace are joined by a transverse *rigid bridge*, to which is hinged in front and behind the plastronic lobes, which are ligamentously hinged, and so movable. They close up tightly before and behind at the will of the animal, and much in the same way as it is accomplished in our well-known terrestrial box tortoises. Indeed, so perfect is this closing in *Cinosternum*, that in some localities these forms are known as box turtles.

Superficially, the carapace is extremely

smooth in these small chelonians, oval in outline, and devoid of any projecting border.

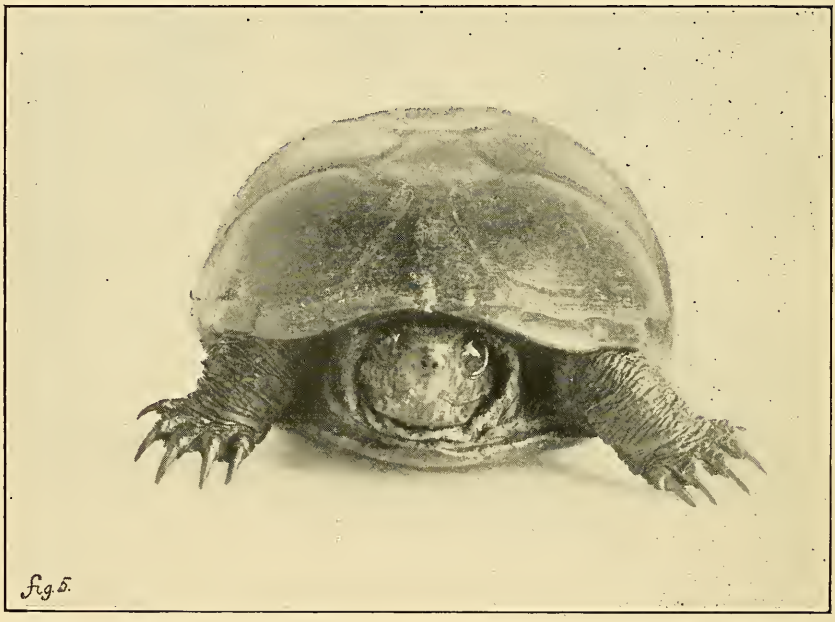
On an average they possess a length of some five inches, with a corresponding width, while their general coloration is a dark brown, with but very few markings of any kind.

We have three species of Musk Turtles (*Aromochelys*), and they are confined to eastern North America. In them the plastron is extremely narrow, and affords but indifferent protection to the body and limbs.

Our common Musk Turtle is here shown in Figure 4, somewhat reduced; it is easily recognized by the two yellow stripes on either side of its head, and by the unkeeled carapace. Its scientific name is *Aromochelys odoratus,* which is well deserved on account of its musky odor, given off whenever the animal is angry or excited. It ranges from lower Canada to the Florida peninsula and westward to the Rockies. It quite closely resembles the Southern Musk Turtle (*A. tristycha*), which is found from Georgia westward to Texas, and in all the Gulf States.

In *A. carinatus,* the Keeled Musk Turtle, the gray head is speckled all over with small, round, dark-colored spots—black in some individuals, while its carapace is conspicuously keeled. We meet with it in favorable localities from Georgia to eastern Arizona.

Sufficient material is now in the hands of science with respect to the genus *Aromochelys* to make more or less extensive comparisons of the three species referred to above, as well as with those of the forms inhabitating certain parts of the



Cinosternum pennsylvanicum **Common Mud Turtle**

Guinas, Brazil, Mexico and Central America. As a result of such examinations, it can be shown that the external characters presented upon the part of these musk turtles exhibit but very slight differences in the various species most nearly affined to each other. As a matter of fact, so close is the approach of one species to another in several instances that to scientifically distinguish the forms compared is by no means always an easy matter. Up to the present time the matter of color, of the form of the shields of the plastron, and of the head markings have chiefly been employed for specific distinction; but these appear to have been of no avail in many instances, and what is really needed in the premises is a far more extensive series of specimens from the entire range of the two genera, and a very careful review of characters and morphology of the representatives of the entire group.

Turtles of this family are entirely aquatic by nature, and are inhabitants of swampy localities in the neighborhood of sluggish, muddy streams, in which they are perfectly at home. Their form and brown colors tend largely to protect them, as they are not easily observed in such places. Very young specimens, and even some of the adults, often have a growth of green moss on their backs, and this circumstance still further enhances their chance of being taken for some stone on the bottom, of similar size and shape as the turtle, with such a growth upon it.

When caught, Musk Turtles promptly snap at anything within their reach, being as vicious and vindictive in such respects as any true snapping turtle (*Chelydra*) that ever lived. Indeed, there is something about them that reminds one of a true snapper.

When excited and handled, they give forth a powerful musky odor, which is responsible for the vernacular name that has been bestowed upon all members of the family. This odor is peculiar, and I know of nothing which exactly resembles it in nature outside of the chelonian order. Sometimes an old snapper will have a faint smell about him that is generally recognized with promptness by the naturalist who studies living specimens of them.

As most fishermen will tell you, musk turtles are great fellows to get after baited hooks in the water, while the fisherman is angling in streams where these turtles live. If hooked, they cramble about in all directions, and with such forceful determination to free themselves that the gentleman of the rod is frequently—prior to exposing the victim—led to believe that he has hooked the prize fish of the entire season. Some by no means polite language usually follows upon the luckless turtle being pulled into sight at the surface of the muddy water of his otherwise peaceful home.

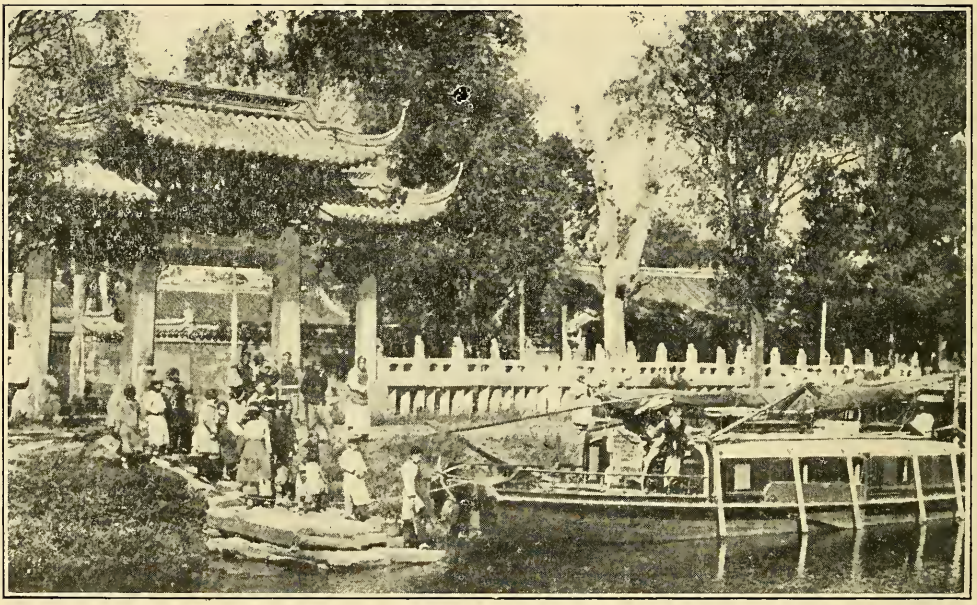
In Figure 4 of the present article we have the reproduction of a photograph of mine of an adult male specimen of the Common Musk Turtle (*A. odoratus*), which I had in my possession for several months; the stripes on the side of the head are well shown. Upon the other hand, a fine front view is given of an adult example of the Common Mud Turtle (*C. pennsylvanicum*), which is also from one of my photographs, the animal having been loaned me by Mr. Edward S. Schmid, of Washington. Much is yet to be learned about these abundant forms of our common turtles, especially with respect to their breeding habits, their eggs, their young, their structure, and their exact ranges. Such point will be touched upon in the next following part of the present series, where additional figures of them will be presented.

Contented men—aquarists.

Goldfish in China

They're selling goldfish within the shadow of the great gate of Shanghai shown in the illustration. When Mr. Erwin O. Freund, of the Chicago Aquarium Society, told the editor of his intention to prowl through strange lands, he was admonished to keep an eye open for fishes and "make connections." Thus far, in China, nothing has been found to make an American goldfish fancier envious of the Orient. The goldfishes seem little a missionary who has spent twenty years in China. During this time the only goldfish she saw were common sorts brought by the Chinese pupils to the teachers as gifts.

During our talk about fishes Miss Wood told me of an interesting experience in Japan. During the Boxer uprising in China many of the missionaries were hurried out of the danger zone and taken to Japan, her objective being Hakodate. Here rooms were secured at one



more than the average double-tails annually brought from the East in great quantities by the Pacific coast importers. In the streets of Shanghai itinerant dealers offer the fishes in spherical globes, with short, narrow neck, so small that a fish can barely be dropped through! Every dealer sells Daphnia.

China has ever been a land of mysteries, and no less so far as goldfish are concerned. Peculiar forms have been described as being bred there, but on information so meagre that a doubt has existed as to their being established breeds. Mrs. Poyser recently entertained place and meals at another. One day, at the restaurant, she was surprised to come upon a gentleman, obviously an American, garbed in big hip boots, etcetera, and looking anything but a tourist. She concluded he was a farmer, but wondered what an American farmer could be doing in Japan. Later, when an opportunity was afforded to ask the question, the gentleman replied that he *was* sort of a farmer, and extended an invitation to view his produce—*a collection of fishes!* Then the mystery was solved. The farmer was David Starr Jordan. I wonder if Doctor Jordan recalls this incident!—*W. A. P.*

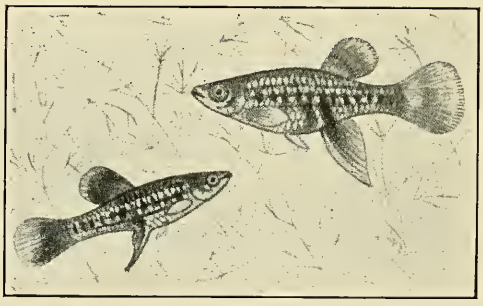
GAMBUSIA EPISCOPI

WALTER LANNOY BRIND, F. Z. S.

The name Gambusia is derived from the Spanish word "gambusio," meaning an insignificant little thing, next to nothing. Our American representative of the genus, *Gambusia affinis,* is known to all aquarists, and *episcopi* is but slightly more attractive, which isn't saying very much. In nature this fish is restricted to the Canal Zone, and is found in ditches along the waterway from coast to coast. It was first made known to aquarists by Rachow, of Hamburg, who secured specimens in 1911. The identity of the examples was established by Professor Steindachner, of Vienna, to whom Rachow forwarded specimens. I am under the impression that it was Steindachner who later, probably when in a more critical mood, placed it in the genus *Priapichthys,* and under this name it will be found in some of the systematic works. The specific name comes from the Latin word "Episcopus," meaning Bishop (Spanish, Obispo), and its use as the specific name of our subject concerns the occurrence of the fish about the Spanish-American town of Obispo.

The Obispo Gambusia is somewhat like *G. nicaraguensis,* but rather more slender. The most distinctive markings appear to be the six to ten vertical, narrow, dark stripes, which, however, are more or less evanescent, varying in intensity and disappearing entirely when an example is caught and placed in a glass vessel for examination. The back is olive, similar to *affinis* and *nicaraguensis,* shading to silvery white below. The anal fin, in both sexes, bears a characteristic blue-black spot; dorsal and caudal clear, with rows of small dots. It is a more graceful fish than others of the genus, and in size does not exceed one and three-fourths inches, the male being smaller than the female.

Breeding in the aquarium is no more difficult than with other and better known viviparous fishes. Gravid females should be isolated, each in a separate shallow



Gambusia episcopi

tank, with plenty of bushy plants among which the young may find shelter and protection from the appetite of the mother, who will surely devour them upon discovery; hence wise aquarists watch the breeding tanks and remove the female when she is apparently spent. In such tanks be not niggardly with the plants, there can scarcely be too many, and the mass had well be grouped at the bottom as well as floating. *Anacharis, Myriophyllum*—most anything that can be spared from other tanks—can be utilized.

Aquarium conditions suitable for most tropical fishes will be to the liking of this one. The tank should be clean, covered with a sheet of glass, well planted, and so situated with relation to the source of light that a luxurious growth will be developed. The temperature should be

maintained between 70 and 75 degrees Fahrenheit.

All the species of *Gambusia* are carnivorous, so living food, such as Enchytræids and Daphne should be provided, but if nothing better can be had, raw scraped beefsteak may be used.

At the present there are few if any specimens of this species in American aquaria, but it shouldn't be hard to obtain. Let me urge those who may be fortunate enough to secure it to avoid senseless attempts at hybridization. Though a beautiful cross has been secured from *Xiphorus helleri* and *Platypoecilus maculatus rubra,* it does not follow that all attempts will, even if progeny be secured, bring desirable results, and especially as few aquarists seem inclined to make studies sufficiently exhaustive to be considered contributions to science. With reference to indiscriminate crossing, let me point to the numerous mongrels from the various forms of *Platypoecilus maculatus,* none as desirable as the parental varieties.

Insomnia in Goldfish

Recently in "All Sorts" you sagely advised a correspondent signing "Sam Hill" to add half a pint of laudanum to the water containing his goldfish in order to cure them of sleeplessness. I think this is too much laudanum.

For many years I have made goldfish a study, and while I usually have the highest regard for your opinion, I am obliged to disagree with you in this instance. I do not believe in administering laudanum, even in small quantities, to goldfish suffering from insomnia. If goldfish are given sleeping potions to induce slumber it will not be long until they become dopefish, and then they will require drugs all the time.

I once had two goldfish which were troubled with sleeplessness, and I cured them in a very simple manner.

After mature deliberation, I decided that the reason the goldfish could not sleep was owing to the absence of wave motion in their natural environment.

To supply this wave motion, I placed two small rockers on the bottom of the bowl, and when the hour arrived when all respectable goldfish ought to be abed and asleep I would take my place beside the bowl and rock it gently, at the same time crooning a soft lullaby. In a few moments the two goldfish would be sound asleep, then I myself would sneak softly upstairs to bed.

Possibly the reason Sam Hill's goldfish could not sleep was because they were too cold at nights. I made for each of my goldfish a cunning little nightie out of red flannel, also a nightcap for each one, crochetted from baby blue yarn, with long strings and tassels. When the goldfish were asleep these tassels would float on top of the water.

When I first put the nighties on the goldfish they tore around the bowl until they made the water fairly boil. You see, not being used to wearing flannel next to their skin, they found it scratchy, but they soon became accustomed to it.

In the morning all I had to do in order to wake them up was to tug gently on the tassels, whereupon they would open their eyes and swim to the top of the water and lie on the surface, waiting for me to remove their nighties. After that I would give them a good rub-down and then they would be ready for the day's swim.—*"Queenie,"* in The Boston Post.

When you hear a man boasting that he understands women, you may know that he has never been married.

Plenty of plants, plenty of water in a big aquarium, and *few* fishes, means fine, healthy fishes if you meet their demand for living foods.

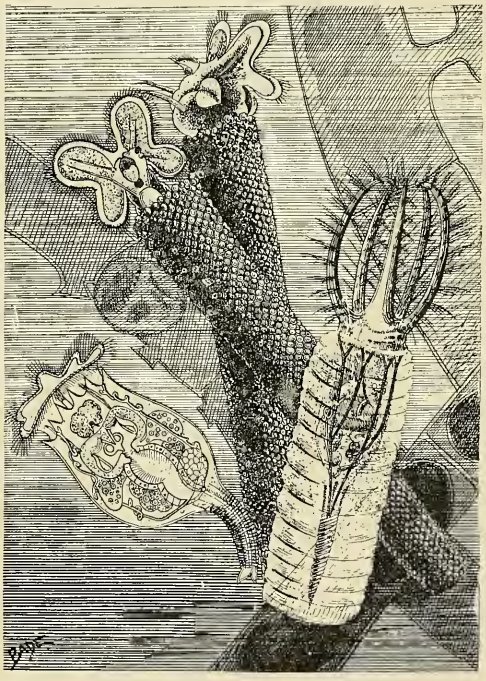
The Wheel Animalcules

DR. E. BADE

Among the minute animals which people the water, the rotifers or "wheel bearers," Rotatoria, form a very interesting class. Only a few of them reach even three millimeters in length, and they are giants of the race; usually they vary between one-twentieth and one-tenth mm. in length (a millimeter is approximately one twenty-fifth of an inch). These little fellows put dramatic movements into the life of the pond. Some sport around in the clear water, "Knights of the Lists," bearing mighty lances, as do others thorns. Others are sessile on plants, on the lower surface of lily pads, for instance. A few live in the sea; some, in the intestines of worms and molluscs, lead parasitic lives, but the species most numerous are those that prefer the quiet backwaters of streams, the bottoms of plant-grown ponds or the puddles in swamps. One family, the Bdelloidæ, occurs in the moss of house-roofs and in the lichen-growths of tree-trunks and rocks.

The older naturalists called them wheel animals, and this popular name has persisted. The anterior end of the body carries a retractile ciliated apparatus, the so-called "wheel organ," which varies considerably in appearance in the different species. This organ, thickly beset with cilia, has a twofold purpose, serving for locomotion and also creating a current in the water whereby edible substances are brought to the ever hungry maw. The "wheel" appears circular for one moment, escalloped the next, then frilled, lobed, even branched or armlike. Through a compound microscope the ceaseless play of the cilia gives the impression of the spokes of a revolving wheel. This appearance is so deceptive that the first observers assumed it as a fact that the animals carried a wheel; hence the name.

By adding a little cocaine or quincegum to the water in which the animals are being examined microscopically the

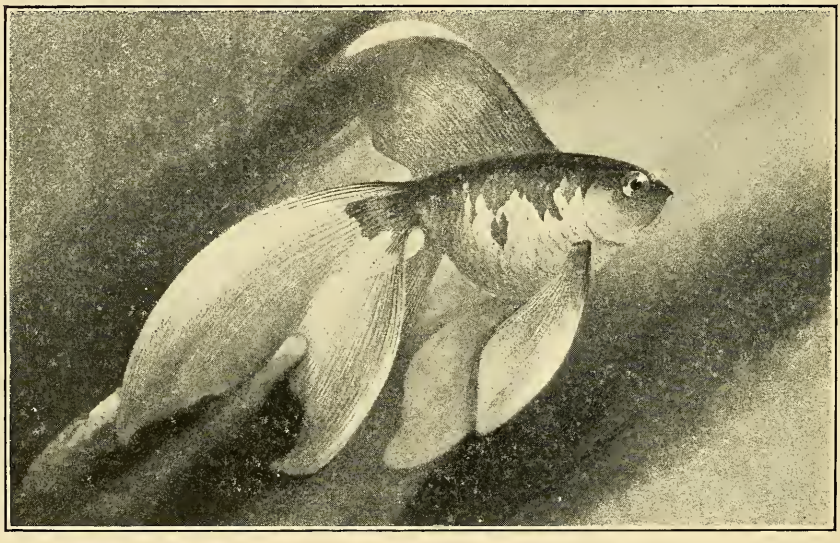


Brachionus urceolaris, Melicerta ringens and Stephanoceros eichhorni

play of the cilia slackens, and it can then be seen that the apparent wheel in motion is simply very minute hairs (the cilia), which rhythmically beat the water. But the little wheel organ is not the sole point of interest with these fellows. Even now their exact position in the zoological system is not quite clear.

Ehrenberg classed them as "Infusoria," but that was a century ago, when the unicellular animals, the Protozoa, were not definitely understood. Similar looking creatures were grouped together, and as one-celled ciliated infusoria frequently recall many rotifers in appearance, all were promptly put together as of one ralationship. Today the rotifers are classed near the worms, that great class or group of animals which still serves as a catch-all for the zoologist. Here is placed everything which cannot be definitely associated elsewhere. We know that these animals are many-celled and highly organized, and offer as an excuse for their position among the w'rms their affinities with certain larval forms of the Trochophora type. In them the cilia are at first much developed, but in the end are restricted to certain localities of the body, one of which appears constant about the mouth. Hence the conclusion that our wheel animalcules are exceedingly primitive forms, with close relations to the progenitors of the phylum or genealogical tree of the Vermes (worms).

The rotifers have a motile dental apparatus, a stomach of many cells, an intestine, salivary and renal glands, brain, nerves and red eyes. The microscope



Sonnet to A Goldfish*

MARY BURDITT

Epitome of all the art of As'a,
Slow waving fins of black and silver sheen,
And gold-rimmed eyes a-staring mid the green;
A wealth of grace and beauty without measure,
A living, moving, Oriental treasure.
A surfeit to mine eyes, a happy mesne
Betwixt the flare of life and death's dull screen,
O, mute, mysterious object of my pleasure!
Thy scales, g'lt-edged—a sparkling coat of mail,
Thy satin browns inlaid with burnished crescents,
Thou fragile, glistening, sheeny, languid thing,
With scarlet gills and gently flowing tail;
Pose on, small fish, in shimmering golden essence,
Joy to mine eye, rest to my spirit bring.

*The specimen illustrated, a Feather-tail or Japanese Nymph Goldfish, was bred in Australia by Albert Gale, Esq.

reveals these organs in operation. You seem to look through a window at a delicate clockwork, so transparent is the skin of most of them. Manifold are their shapes. Free swimmers have balancers and other attachments assisting them in floating and swimming. Most of the sessile species construct protective casings of foreign matter (*Melicerta*), or exude jelly-like covering (*Floscularia*). Others are merely attached by a pedicel ending in a sucking disc. *Melicerta ringens,* as an example of a case-builder, possesses a so-called "pill-organ," which is an open sac fringed with cilia, placed immediately below the mouth. This sac catches stray little grainlets and turns them into pills with the aid of mucus or slime. These are then carried out and deposited along the upper edge of the case, the entire case being built from such pellets.

Rotifers can withstand drying up—dessication—for some time, being then blown about with the dust and thus carried far and wide. When they again reach water they flourish as before. This state of anabiosis (lifelessness) is a well-known phenomenon shown by many microorganisms which, after two hundred years of observation, still is not well explained. Rotifers can remain in this inert condition for months and years with impunity. Possibly they exude a jelly-like substance which permits the retention of the modicum of moisture which carries the animals through this period of drought.

Life is very elastic and adaptable to many contradictory phases, and even then may triumph over death. Perhaps even these minute "wheel bearers" may possess organs within their bodies whose significance is so far unknown to us. The illustration shows three species very much magnified.

A little attention every day keeps "ole man death" away—from your fishes.

Red-colored Water

A few months ago one of the most productive of the "daphne ponds" of the aquarists of Philadelphia assumed the color of red ink, and thereafter was dubbed the "ink pond." A brief investigation has failed to disclose the cause of the condition. Barring the effects of an occasional oiling by the local health authorities, *Daphnia* (apparently one of the many varieties of *D. pulex*) and rotifers do not find the water inimical, while the protozoan fauna is normal. The coloring seems to be due to a soluble inorganic dye which did not form a precipitate after standing for a week in a graduate.

The last report on the fisheries of New South Wales makes the following comments on red-colored waters in Australia:

"In April several patches of red-colored water were observed in different parts of Middle Harbour, particularly in Long Bay, Sailor Bay, and Sugarloaf Bay.

"Samples of the water were forwarded to the Government Analyst, who chemically examined them, and found a heavy proportion of suspended solids, chiefly organic, and reported that it was possible that the amount of oxygen dissolved in the water was much reduced, but no substance injurious to fish life was traced.

"Many years ago a similar phenomenon occurred in the waters of some of the more secluded bays of Sydney Harbour, notably in Blackwattle Bay. The red color appeared in patches, which gradually spread over the whole of the waters. The matter was investigated at the time, and the color found to be due to protozoa, more particularly to a then undescribed species of Peredinium.

"The red coloration in Middle Harbour disappeared naturally in the course of a few weeks, without having any apparent ill effects on fish or oyster life."

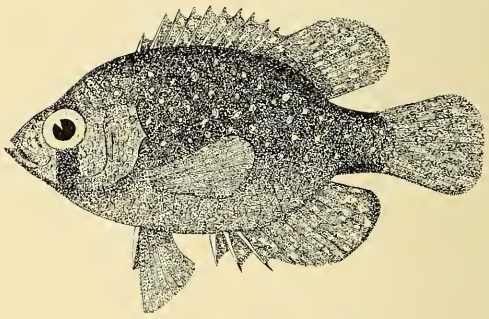
Peridinium is a genus of flagellate protozoans also represented in the United States. The species are quite small, measuring from forty to sixty twenty-five thousandths of an inch, and in color may be green, yellow or brown.—*Editor.*

A Study of the Diamond Bass

MAX TRELL

Compared to the goldfish which, in the finest of tanks and in the best of health is but a stupid, conventional fellow, the Diamond Bass is, as a representative of the vigorous outdoors, flushed with the spirit of freedom and motion. Few other fishes show that same ceaseless activity, that same nervous restlessness. It seems heartless on my part to confine him within the four glass sides of the aquarium, to force him to rub noses with half-caste sunfishes, and, above all, to feed him common house flies and 64-cent sirloin steak, when I know his palate craves more regal fare. But I have a suspicion that he likes his home, with all its incongruity, for in every drop of its twenty gallons he is the sole and undisputed master.

When he was added to the family, several years ago, I was amazed at the alacrity with which he fell into the position of leader. He drew an imaginary line behind the front glass and proceeded to patrol his post, keeping a wary eye on the small sunfish, never permitting them to form in schools, as was their wont. The more closely I observed his actions the more firmly was I convinced of the existence of a silent means of communication between them. He had only to stop a moment, cock his eye in the direction of the culprits, when off they would scatter as if the devil was at their tails. Though his attitude was menacing, he never actually mauled them, which made his assumed pugnaciousness the more interesting. From the goldfish he remained politely aloof, seeming to reason that if he did not notice he would find no pretext to molest them. Occasionally, however, when a big red fellow made a great commotion in his anxiety to extricate himself from plant entanglements, the Bass would rush to the scene, disturb a few inquisitive sunfish, and hover about the spot until he had assured himself that nothing more interesting might be expected. The attitude of the goldfish was queer and somewhat amusing. Not only did they fail to appreciate his dignity, but added insult by nibbling his fins at every opportunity. Rather than call him a coward, which would be much too degrading, I will say that he had admirable control of his temper, on these occasions retreating to the rear, that he might restrain himself more securely.



The Diamond Bass

His reactions to live food, especially flies, were remarkable. No sooner did he spy one on the surface than he forgot his likes and dislikes, letting the sunfish gather unnoticed about his nose; for the moment there was but one matter worthy of consideration. He observed the victim cautiously, making sure it was genuine, and, getting the correct angle, poised himself perpendicularly below and sprang upon it, splashing the water with the

downward sweep of his tail as he headed for the bottom with the prize. A moment later he was again on the watch, cool and self-possessed, as if nothing had marred the perfect serenity of his ways.

Three months later I gave him a companion, a brother bass, and I cannot say he welcomed the new arrival. It was larger and darker than the old boarder, and immediately assumed the office of chief of police, sending the old-timer into exile among the sunfish, for whom he (the latter) suddenly professed a warm friendship. Bass No. 2 exhibited all the characteristics of the former incumbent to a surprising degree, and became acclimated with a rapidity and thoroughness that knows no comparison.

I said before that the new bass was darker than the first. So he was. But a few days later I rubbed my eyes and looked again. The tables were turned. The darker was now the lighter one. Where before were dark vertical bars bright dots gleamed on the background. Truly the Diamond Bass is a curious fish!

Bass No. 2 performs his duties with tireless vigilance. While he does not always treat his brother with affection, it cannot be said that he is quite as insignificant in his eyes as the sunfish. Bass No. 1, on the other hand, is meek and humble in the presence of his kinsman, and either consorts with the sunfish (who admittedly have the worst of the bargain) or wanders desultorily among the plants. But let the reigning fish absent himself, our dispossessed monarch dons his brightest coat and comports with all the splendor of his better days.

Don't be selfish. Keep your tanks presentable and let others enjoy a look.

In his desire to be known as a good fellow many a man has gone to the bad through overtraining.

Crappie Spawn in Washington Aquarium

During the night of May 25-26, about 6000 eggs were deposited by one of a lot of crappie that for several years had been in the Bureau of Fisheries aquarium in Washington. The eggs were attached to a dense growth of algæ covering stones in the obliquely inclined back of the bank, and some of them were practically at the surface. The male fish zealously guarded the eggs and kept the water about them in constant motion with his pectoral fins. Other fish were kept away, and any objects that came near the eggs were savagely bitten. If a person placed his hand within six inches of the surface of the water, the male fish would leap clear of the water and strike the hand viciously.

The first young were observed on the morning of May 28, and all the fertile eggs had hatched by the morning of May 31. It is estimated that about 40 per cent. of the eggs produced strong fry. The fry when first hatched are about three-sixteenths inch in length and perfectly transparent.

About 1500 fry were removed with a siphon and placed in two balanced aquariums, where they will be kept under observation to determine rate of growth, best food, etc.

Perfectly good money was spent for the following advertisement, which appeared in a Philadelphia newspaper. We present it, without name and address, as an example of the sort of hash a newspaper compositor, who knows fish solely as something good to eat—said to be *"brain food"* too—makes out of excellent copy. Here it is:

"A VISIT to my conservatory will ze time well spent; calico and Moore telescopes, ducks and rose, $2.50 a piece; loaded gypins, 50 cents a pair; red smoils, baby gash and gachmia at all times."

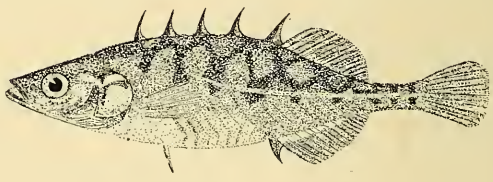
THE BROOK STICKLEBACK

DR. E. EUGENE BARKER

New York State College of Agriculture

In some of our shallow, weed-choked pools and ditches there lives a most interesting little fish—the brook or five-spined stickleback (*Eucalia inconstans Kirtland.*) He is so well accustomed to living in stagnant water that he can easily be transferred to an aquarium, where he thrives well and is sure to prove an interesting pet. He is diminutive in size—the largest adults measuring barely over one and one-half inch in length. The males are bright in color, having a veiling of black over an olive-green ground color, which lightens to yellow on the belly. The females are somewhat lighter in color. They are extremely pugnacious little fishes, and show resentment when another fish approaches, even one of their own kind. The spines on the back gristle up like hairs on a dog's back, and with a vicious lunge, the tiny bit of fury rushes, open-mouthed, at the innocent intruder. Often the fish's emotion is registered by a dark flush that sweeps over his body for the time being. It is interesting to note that, when these fishes are transferred to a light or a dark bottom, the color changes in accord with the background. They are voracious feeders and thrive on bits of angleworms, or of fresh meat if it is cut into fine enough pieces.

Like other members of the stickleback family, the brook stickleback is most interesting, perhaps, in his family habits. A true nest is built by the male, in which the female deposits her eggs, and the male remains on guard to protect it until after the young have hatched. Some species nest readily in the aquarium, but the brook stickleback has not been observed to do so, at least as far as the writer's experience and knowledge go. On one occasion, however, a male fish was seen guarding his nest in a pond. He was captured and brought home and placed in an aquarium, together with his nest and its contents. As soon as all was settled he assumed again his proprietary air, and stood guard over the little home and



Eucalia inconstans

its precious contents. At one side of the nest there is almost always a small hole through which the eggs can be seen inside it. This fish often approached the opening, and if any of the eggs protruded from it he took them into his mouth, and, backing away a short distance, blew them back again securely into the nest. He swam constantly around the nest, from time to time coming close to it and beating his pectoral fins rapidly, like the wings of a hummingbird as it poises before a flower; he would thus draw a current of water through the nest and aerate the eggs. If any other fish were put into the aquarium, even a female of his own species, he would bristle, flush dark and dart viciously at the stranger and chase it away from the vicinity of his nest.

In the wild state, nesting is begun while the water is still at a low temperature, between 40 and 50 degrees Fahren-

heit, although in the shallow surface water, at the margin of a pool where the nest is always built, the water may be as warm as 70 degrees. In central New York State nesting may begin before the middle of April. It continues until late in May. The nest itself is a very dainty structure. It is always built of the materials at hand, which, of course, renders it inconspicuous, indeed, almost invisible amidst its surroundings.

The first nests are built before vegetation has begun to grow in the pools. The only suitable materials that the builder finds at hand are fine fibers, blades of dead grass and the like. These are loosely woven together and held in place by means of a thread which is produced by the male (as in other species of stickleback) from a secretion of the kidneys. It coagulates and hardens upon contact with the water, thus forming a thread suitable for binding together the materials of the nest. As the season advances and vegetation begins to appear in the pools, the nests are made mostly of green algæ, sometimes with sprouting seeds upon them. They are delicate little structures, spherical in shape, about three-quarters of an inch in diameter, and with a small round hole on one side through which the eggs are placed within the nest. This little round ball of a home is tethered to a rootlet, submerged blade of grass or some similar attachment, and appears so much like a bit of the general mass of debris around it, or the masses of green algae, that it can be discovered only with the greatest diligence.

The eggs are about one milimeter in diameter, transparent and light yellowish in color. They hatch in about eight or nine days when the water is as warm as 65 degrees. The young fishes are about 5 mm. long when they hatch. At first they still have a very large yolk-sac attached to them, which contains enough nourishment to keep them for several days. It soon is all absorbed, however, and the tiny fishling grows fast. For the first few days he attaches himself to some still object by the tip end of his head—possibly by means of a viscid spot. The mouth is almost vertical, but soon becomes terminal. In two weeks' time many sharp teeth make their appearance on the lower jaw. All this while the young fry is so transparent that all his inside affairs and private workings can be as easily observed as one can see a gardener at work inside his greenhouse. The primitive backbone, with its developing rays, later to become ribs and spines, the heart pulsating at the rate of 108 beats to the minute, even the corpuscles of the blood flowing along the channels of the arteries, can be plainly seen. The eyes are the biggest and most conspicuous organs, because of their dark color, and take up about one-third of the size of the whole head. They are moved rapidly in the sockets, together, like the wheels of an automobile. Before the fishes hatch there are a few black, star-shaped or moss-shaped chromatophores, or color spots on the embryo. Later, small, orange-colored ones appear, and then yellow ones, so that by the time the fish is a week old he is almost golden in color and quite a pretty little fellow. From this time on, as soon as the yolk is all absorbed and the mouth parts are well developed, the little fellows swim about freely amongst the vegetation and find their own food in the minute forms of life with which all water vegetation and debris teems.—*The Scientific Monthly.*

You never can tell. Sometimes a fellow is a kicker merely in self-defense.

Dame Fortune never smiles on a man who deliberately stares her out of countenance.

SOCIETY NEWS

The Aquarium and Goldfish Fanciers' Societies of Philadelphia are formulating plans for the annual public exhibition of fancy gold and tropical fishes. As in past years, the exhibition will be held in Horticultural Hall, Fairmount Park, early in October. The exact dates and other details will be published in future numbers of Aquatic Life.—Francis K. Christine, *Secretary, Philadelphia Goldfish Fanciers' Society.*

On the 1st of March, at the invitation of Mrs. J. F. Mellor, the members of the South Australian Aquarium Society paid a visit to her fine old gardens and ponds at Fulham. Mrs. Mellor called attention to the collection of fancy goldfish, and demonstrated her method of feeding. The fish are fed entirely on a duckweed, *Lemna trisulca,* as her experience has indicated that if meat or other fattening food is given, a fish laden with spawn in the breeding season often dies. The duckweed, which is a floating species, is propogated in large tubs for the purpose. The fish seem to enjoy this diet, and are quite tame and healthy. The party was then conducted about the garden to view the birds, the collection containing representatives of most of the Australian cockatoos.

Mr. S. Mellor conducted the visitors to a nearby pool, where much interesting aquatic life was obtained. Specimens were taken of the beautiful little blue-spot goby, *Mugilogobius galwayi.* This fish was quite recently described as new to science by the President, Mr. Edgar R. Waite, who, together with Mr. B. B. Beck, was one of the party. Aquatic plants and other specimens for aquaria were collected.—Herbert M. Hale, *Honorary Secretary.*

Just as predicted in the last notice, the Essex County Aquarium Society is now in an era of rapid advancement. This year we have had five very successful affairs, at which all manner of aquarium material—small tanks, fishes, plants and sundry items—was disposed of to the advantage of both Society and winners.

One meeting was given to a general discussion of fish foods, which afforded all present a chance to gather a "flock" of ideas for menus for fishes. Very recently a junket was taken to one of the nearby streams for the purpose of collecting native material. Many fishes, tadpoles, newts, turtles and plants were found. The weather conditions were ideal, and all returned home with wet feet and a good appetite, together with many specimens.

Membership is steadily increasing. By way of advertising the activities of the organization, we have distributed a large number of posters throughout Newark and the nearby towns.—Charles M. Breder, Jr., *Secretary.*

"How to Maintain Our Native Fishes in Home Aquaria" was the subject discussed by the Chicago Aquarium Society at the meeting on June 13th. Many specimens from nearby streams and ponds were on exhibition. With a projection lantern fishes were shown on the screen from slides loaned by the Field Museum of Natural History. The sequel to the meeting was a mournful dirge, sung by all the members, entitled *"The Last Call for Keedy's C. A. S. Punch."* Hereafter the meetings will be all "pep" and no punch.—A. Y. Adcock, *Secretary.*

The best effort, physical and mental, is done on an empty stomach.

Aquatic Life

1918—1919

SEPTEMBER, 1918. The Blood-fin (*Heede*); Breeding Haplochilus cameronensis (*Nelles*); The Spotted Gourami (*Kearns*); Japanese Snail (*Boyd*); Aquarium Water and Its Restoration (*Dormeier*); Aquarium Heater (*Hale*); Fish Foods (*Heede*); Happy Families, Breeding Habits of Mud-minnow, notes and news.

OCTOBER. Aquarium Heating (*Breder*); Hemiramphus fluviatilis (*Brind*); Mollienisia latipinna (*Heede*); Blue-tailed Skink (*Deckert*); Factors Controlling the Development of Tropical Aquarium Fishes (*Webber*); Snails in Aquaria (*Gale*); Habits of Black Bass, The Pipe-fish, notes, etc.

NOVEMBER. American Live-bearing Tooth-carps (*Bade*); Aquarium Notes (*Leitholf*); Notes on Krefftius adspersus (*Freund*); The Anatomy of the Fish (*Clark*); Breeding Habits of Burmese Eel (*Finckh*); A Bloated Axolotl (*Waite*); The Name "Water Flea," notes and news.

DECEMBER. Cynolebias bellottii (*Brind*); Tillaea recurva and Other Notes (*Finckh*); Another Tank Heater (*Kuhn*); Aquarist vs. Aquarian (*Mellen*); Emotions of Fishes (*Gale*); A Cigar Box Aquarium (*Modesto*); Florida Notes (*Carlton*); Photosynthesis, Miscellaneous notes, news, etc.

JANUARY, 1919. Limia caudofasciata (*Leitholf*); Classification of Fishes (*Stead*); Color Changes of the Chub-sucker (*Hubbs*); *Neetroplus carpintis* (*Brind*); A Simple Heated Aquarium (*Finckh*); Notes on the Breeding Habits of the Pigmy Sunfish (*Poyser*); Goldfish Farm of Kichigoro Akiyama, notes and news.

FEBRUARY. Polycentropsis abbreviata (*Brind*); Chologaster cornutus, the Fish of the Dismal Swamp (*Welsh*); A Wood Aquarium (*Pilkington*); Danio malabaricus (*Leitholf*); Notes on Native Fishes (*Pray*); Managing the Aquarium (*Innes*); Reactions of Fishes to Habit-forming Drugs, The Boston Show, A True Fish Story, notes and news.

MARCH. Breeding the Goldfish (*Hanna*); Observations on the Chelonians of North America, Part I (*Shufeldt*); Lucania ommata (*Welsh*); Apistogramma agassizi (*Heede*); The Water-fleas (*Tompkins*); Viviparous Fishes-in-general (*Stead*); Breeding the Striped Gourami (*Simpson*); Notes and news.

APRIL. The Surinam Toad (*Deckert*); Cichlasoma nigrofasciatum (*Brind*); Keeping Living Food Alive (*Innes*); Beware the Dragonfly (*Gordon*); An Electrolytic Aerator (*Putnam*); Water Lilies, Some Cultural and Historical Notes (*Pring*); Beef vs. Liver, notes and news.

MAY. Nanostomus eques (*Brind*); The Water Horse-tail (*Wobler*); Observations on the Chelonians of North America, Part III (*Shufeldt*); I Became a Fancier (*Proctor*); A Peculiar Planorbis (*Breder*); Association and Color Discrimination in Mudminnows and Sticklebacks (*White*); The Hay Infusion Microcosm (*Woodruff*); The Bladderworts, notes and news.

July, 1919 15c Copy

Aquatic Life

Aquatic Life

Vol. IV. July, 1919 No. 11

An international monthly magazine devoted to the study, care and breeding of fishes and other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
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Popular and scientific articles and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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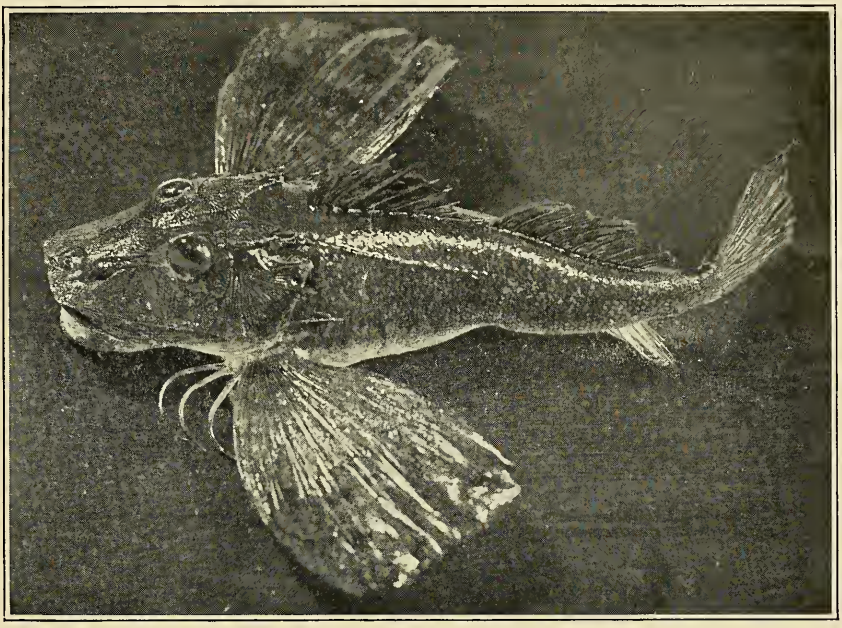
A BIG-HEADED GURNARD

HENRY W. FOWLER

The Academy of Natural Sciences of Philadelphia



Big-Headed Gurnard **Photograph by S. A. Scrimshaw**

The accompanying photograph, evidently that of the big-headed gurnard (*Prionotus tribulus*), represents a species very abundant in the Gulf of Mexico, and occasionally found northward on our Atlantic coast to Long Island. I have never met with it in the northern part of its range or seen it among the multitudes of gurnards or sea-robins examined along the New Jersey, Delaware, Maryland and Virginia coasts. On these shores, however, we have a very comman allied gurnard or sea-robin, in the long-finned species, *Prionotus strigatus*. The chief distinction, and it appears clearly in the photograph, is the presence of a small thorn or spine at the centre of radiating lines, or striæ, on the cheek bone directly below the front of the eye. Both fishes are beautifully colored when alive, and the waved dark lines on the large pectoral fins give most pleasing effects.

The subject of the photograph was caught by Mr. S. A. Scrimshaw, at Pensacola, Florida, and was about a foot in length. It is described as vicious and tenacious of life, living five hours after removal from the water. The water in which it was caught was 22 feet deep.

Gurnards are peculiar looking fishes, with large, bony heads, often furnished with prominent spines. These spines usually become less pronounced or obsolete, even disappearing with age. Their teeth are very fine or minute, and in bands, thus serviceable in securing their prey. This consists of invertebrates, such as worms, crustaceans, mollusks, etc. A very characteristic development is the three lower pectoral rays, which are really modified tactile organs. The gurnard, being a bottom dweller, moves close over the stones and sand, and uses these rays, which appear like fingers or claws, in its hunt for food. By probing and feeling about the crevices the presence of prey is detected, as the rays are highly sensory.

Some species of gurnards live in deep water, and these are red in color. Likewise the flesh, which, though seldom valued as food in our region, is quite palatable, and its usual pink color suggests salmon. Many gurnards utter grunting sounds, by contracting the air-vessel, and the name gurnard was originally applied with reference to these sounds, which are very noticeable as the fish are taken from the water. Other names are pig-fish and grunt, and at Nantucket we heard "Peter-grunter," derived from the same habit.

It may be interesting to note that only two species of gurnards occur on our New Jersey coast. Of these I have records or examined material as follows:

Short-finned Gurnard (*Prionotus carolinus*). Atlantic County (Atlantic City, Somer's Point); Cape May County (Anglesea, Beesley's Point, Cape May, Corson's Inlet, Ludlam Bay, Sea Isle City, Townsend's Inlet); Monmouth County (Belford, Long Branch, Sandy Hook).

Long-finned Gurnard (*Prionotus strigatus*). Atlantic County (Absecon, Atlantic City); Cape May County (Anglesea, Avalon, Beesley's Point, Cape May, Corson's Inlet, Five Fathom Bank, Grassy Sound, Ludlam Bay, McCrie's Shoal, Ocean City, Old Eph Buoy, Sea Isle City, Stone Harbor); Monmouth County (Belford, Long Branch, Manasquan, Sandy Hook).

French War Orphans

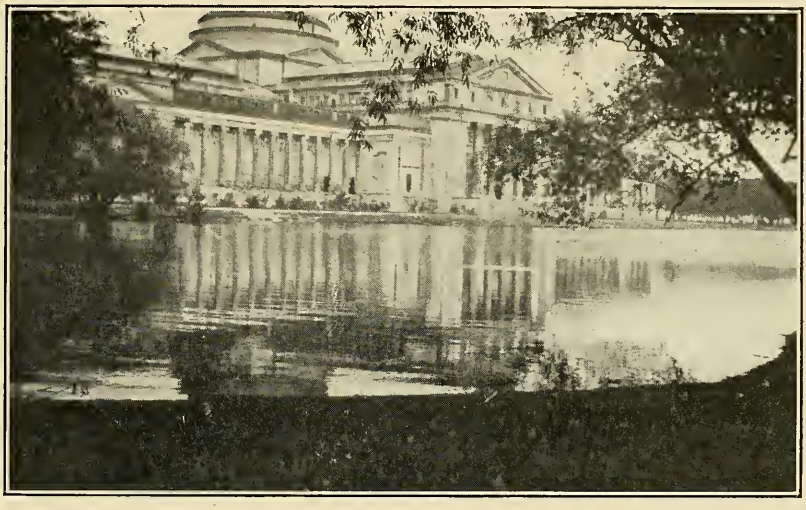
The children of France have not yet emerged from the shadow of the war. With peace assured, and a happier future opening before them, it becomes increasingly evident that the child life of France has suffered a shock from which it is difficult to rally; while the birth rate has dropped to 8 to each 1000 population.

The Fatherless Children of France, an American organization co-operating with a similar one in Paris of which Marshal Joffre is the head, reports that of the children receiving American aid to the extent of 10 cents a day under its plan of securing American godmothers for the little French war waifs, its records show an average of 700 children's deaths per month since the armistice. The help of the American godmothers came too late to save these undernourished nerve-shocked little ones.

Mrs. Walter S. Brewster, of Chicago, vice chairman of the Fatherless Children of France, has been appointed chairman of a campaign to secure American aid for the 60,000 little war orphans whose names were on the lists of the organization as "unadopted" before the signing of the armistice. Ten cents will care for a child for an entire day; $3.00 for a month; while for $36.50 a year the donor may select a child from the lists at the organization's headquarters and be placed in correspondence with it. To adopt a child or make a donation write for information to Mrs. Walter S. Brewster, Room 634, 410 S. Michigan avenue, Chicago.

The Nesting Habits of Certain Sunfishes as Observed in a Park Lagoon in Chicago

CARL L. HUBBS, Field Museum and Chicago Aquarium Society



View of the Lagoon in Jackson Park, Chicago, were the observations were made

Just back of the present building of the Field Museum of Natural History, in Jackson Park, Chicago, there lies one basin of a series of pretty lagoons, which are connected with one another and with Lake Michigan by means of narrow channels. These lagoons are well supplied with fish life. The writer has records of more than forty species, of which those belonging to the sunfish family (Centrarchidæ) are in many ways the most interesting to him, as well as to the numerous small boys who delight in dodging the park police to catch these little fishes from the shore. As this locality is so readily accessible to the writer, he was able during the spring of this year to make daily observations here on the nesting habits of the sunfishes. Although many, and perhaps all, of the facts determined have already been recorded or are generally well-known, nevertheless these notes may be of interest to the readers of AQUATIC LIFE.

The species which was first observed nesting is one which is not popularly associated with the sunfishes, though belonging to the same family and having similar habits, namely the large-mouthed black bass (*Micropterus salmoides*). The nests of this species, found only during the latter half of May and the first half of June, were all circles of exposed stony or gravelly bottom, surrounded by the finer bottom material—first a ring of sand and then one of silt—thrown out-

ward by the bass in forming the nest. They were usually located in a small, cleared area among pond weeds (*Potamogeton*). The diameter of the central or gravelly portion of the nest, throughout which the eggs were found concealed, varied between one and two feet; the extreme diameter, from one and one-half to three feet. Most of the bass nests were in depths greater than two feet, and at distances from the shore greater than ten feet.

The single warmouth bass (*Chaenobryttus gulosus*) observed breeding in the lagoon was found on June 11, over its nest, about fifteen feet from shore. The nest, which resembled that of the black bass, was located at a depth of about three feet in a cleared area in a thick growth of *Potamogeton*. The fish was affected with fungus, and died two days later.

A green sunfish (*Lepomis cyanellus*) was found guarding its eggs on June 20. No nest whatever had been constructed, the eggs being attached to willow rootlets, which here projected thickly into the water at the very edge of the lagoon. The guardian fish, presumably the male, was very brilliantly colored; back and sides metallic green, rather indistinctly barred, grading into coppery below, each scale margined with darker; the cheeks with emerald spots and streaks, more interrupted than those of the pumpkin-seed; the opercular flap greenish black, margined with coppery; soft dorsal and anal fins each with a black spot at base of the last rays, the former fin with a narrow, the latter with a wide margin of orange. This fish was surprisingly "tame," repeatedly taking an earthworm from one's fingers, permitting itself to be touched, and rising to one's hand on the surface of the water, and only gently biting at one's fingers, like a dog at play, when the eggs were being examined in the rootlets. Occasionally it circled off to a distance of about two feet, but returned at once; even after being caught and examined a moment, it came back in about two minutes from the deeper water in which it had temporarily taken refuge. On the next two days, however, the fish darted off immediately upon approach.

After a few warm days, the last of the month of May, the two commoner species of sunfishes, the pumpkin-seed (*Lepomis gibbosus*) and the blue-gill (*Lepomis incisor*) began breeding at approximately the same time in scattered localities throughout the lagoon. The number of nests gradually became more numerous, the breeding season for each species reaching its height between June 15 and June 20. A few days of hot weather then terminated their breeding; careful search from shore and boat disclosed no new or occupied nests during the last few days of June or the first few of July.

That sunfishes do not always construct their own nests is proved by the following instance. A blue gill was observed guarding a certain nest in the lagoon on June 15, 16 and 17; on June 18 it was not in evidence, but a pumpkin-seed was swimming about the nest, though not actually resting on it; on the morning of June 19 apparently the same pumpkin-seed was guarding a mass of eggs in the nest, but by noon of the same day most of the eggs had been removed (by small boys?), and in the evening the male was observed spawning again with a female on the same nest.

If a man calls you a fool call him another; that is, if you are curious to learn something worse about yourself.

"We are never too old to learn," quoted the Wise Guy. "No, the difficulty is we are sometimes too young," replied the Simple Mug.

BADIS BADIS

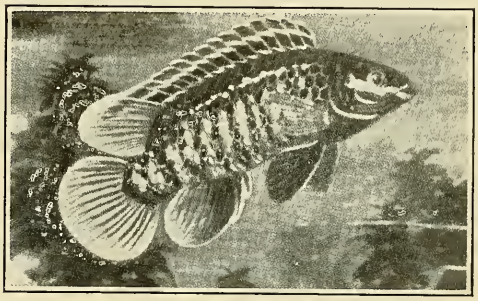
WALTER LANNOY BRIND, F. Z. S.

The earliest data I possess concerning *Badis badis*—Blue-fin (Blauflosser) as the Germans call it—is of the year 1906, but the species was surely taken into Germany before that time. Paul Matte, of Lankwitz, had bred the fish at that time, and had told Stansch how to proceed to get the best results. I met with it first in Berlin, in 1910, purchasing a couple of pairs from F. Olaf Andersen. From these I raised a brood in Berlin, and another, a year later, in Chicago.

Following the plan of Matte, a flower pot was placed upright in the sand of the aquarium bottom, and filled to within three inches of the top with sand. The eggs are deposited in a hollow in the sand within the pot, and are thereafter, until hatched, guarded by the male, who vigorously fans them with his fins. With a temperature of 77 degrees the fry appear three days after oviposition. Four days later the young are unceremoniously "kicked out" to make room for another brood. The female, however, should be removed immediately after the eggs are deposited. In nature the female would wander off as a matter of course, and the next mating of the male would be with another female.

Burkhardt, of Breslau, told me that he failed to provide a flower-pot, whereupon the fish dug a hole in the sand among the plants. He observed that in spawning the sexes became locked in a close embrace like Paradise fish, and that with each contact the eggs were sprayed into the sand-hollow. The male cared for the eggs and the young until they left the nest.

When the female is removed from the male, if further litters are desired, she may well be placed in a tank similarly equipped with a flower pot, and there rested for a couple of weeks. The male, after removal from the fry and being well fed alone for a shorter period, can again be placed with her. By thus moving the



Badis badis

fish about, quite a large number could be raised from a single pair, and this also applies to other fishes of similar breeding habits.

Badis is a small freshwater fish from India, and in nature spawns in holes in the banks of streams. During breeding activities the male assumes bright colors, suggesting the familiar Paradise fish. Vertical dark blue stripes appear on an orange, reddish-yellow or golden brown ground color having a bluish sheen. The female is somber in comparison. The body is elongated, compressed from side to side, and clumsy in general appearance. The dorsal fin is long, that is, in respect to its base, running from a point behind the head well back to the caudal peduncle. In the male the lobe of the dorsal terminates in a point; in the female

it is obtuse. The color of this fin is changeable from light to dark blue and purple, with a horizontal band or stripe, and in the male, with the upper edge rich green. The base of the anal fin of the male bears an orange spot. A large example will measure two inches.

Temperatures from 70 to 75 degrees will be sufficient for adults, but the young should be accorded more warmth until several months old. Live foods, Daphne, Cyclops and Enchytraeids, should be preferably fed.

(Certain writers indicate that the eggs of *Badis badis* are deposited *on* the flower pot, but are otherwise in accord with Mr. Brind.—*Editor.*)

Philadelphia Aquarium

When the average person thinks of fish a picture of a peaceful little glass globe, containing two or three goldfish, a tadpole, a bunch of weed and a little stone castle, is what usually floats before the vision of the mind. Yet life beneath the waters of the world presents one of the great undeveloped fields for study, if not the greatest known to man.

Up to within a comparatively few years ago there was very little knowledge of the habits, foods, life, traits and breeding of fish, with the exception of the few varieties that had been cultivated, such as the Japanese carp and goldfish. In recent years, however, the study of fish has come to be recognized as important, not only the study of fresh water, but of the deep sea varieties of the finny tribe. Through the work of the pioneers in this study and investigation the problem of conserving the fish of the streams and lakes of the world has been met to a great extent.

It has long been recognized by ichthyologists that there was only one way to gain anything like complete data of any kind concerning fish, and that is through the medium of the aquarium. Not only for its uses in providing a field for the study of fish and because of attractiveness the aquarium on a large scale has come to be an institution in many of the large cities of the world. New York and many European cities have handsome structures containing marvelous assortments of fish. Philadelphia also has its aquarium, already a fairly well developed institution and one that, when completed, will compare favorably with any for the plans for it have been made along lines far more advanced than any of the others. This has been possible because of the experience of the others.

The plans in accordance with which the local aquarium is being developed on the site of the old Gratz Mansion and Spring Garden pumping station, just below the Fairmount Dam on the Schuylkill River, make it not only possible for the ichthyologist and nature student to delve into the lore of the water denizens, but also afford the sightseer a better opportunity to view the fish than the New York or any other aquarium. The tanks are so arranged that the light falls directly on the surface of the water. Everything has been done to depict as nearly as possible the natural habitat of the inhabitants of the tanks.

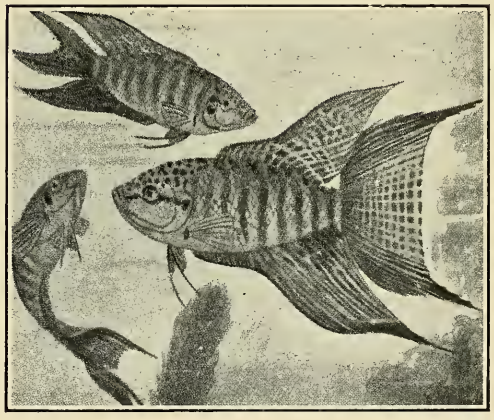
THE PARADISE FISH

HARRY W. BALLEISEN

The Paradise fish, *Macropodus viridi-auratus*, of Asia, has long been a most familiar aquarium fish. In a number of characteristics it is a splendid fish for the novice fancier of exotic fishes. It is beautifully colored, sufficiently different in shape from just an "ordinary fish," and has interesting breeding habits. But the most important feature concerns winter conditions. Most tropical fishes must be maintained constantly at not less than 65 degrees, which is not an easy feat, even in a well-heated home. The Paradise fish, in contrast, can endure 45 degrees, but it is well to keep it warmer if possible. In addition, being a labyrinth fish, and provided with the means to use atmospheric air, coming to the surface at intervals for a supply, it can endure foul water. In other words, it will not suffer like other fishes if you neglect the aquarium.

Now for the one detrimental characteristic. Our subject is a fighter, and is well able to maul another, male or female, unmercifully. But this can be overcome by keeping a goodly number together, each individual, wary of an attack from behind, perforce becomes pacific. Not all fin-tearing, however, will be eliminated, but the rents will soon mend. Though a slow fish, in the sense that it is not gifted with nervous activity, it is a jumper, and for this reason the aquarium should be covered with a piece of glass, which has the added advantage of conserving and equalizing the temperature.

During the spring and summer, when the temperature is 75 degrees and above, the male puts on his brilliant colors, which are hard to describe in detail. The body is brown, with a greenish cast, with apparent vertical stripes of blue, plus a reddish hue; fins of various shades of red, with some brown, blue and yellow. His fins are long, sharp-ended, and ribbon-like; now contracted, again spread like the tail of the proverbial peacock. The female is smaller, with rounded fins; light brown in color, which changes to a gray tone when breeding.



Macropodus viridi-auratus (Paradise Fish)

When a male and a gravid female have mated, a procedure sometimes made of many battles, even unto the death of an undesired female, the male builds his floating nest of bubbles, rising to the surface for air and discharging it, coated with mucus, in the selected location; repeating the operation innumerable times. Then, coaxing the female to a position below, he winds himself about her, a gentle pressure expelling the eggs. These he catches dexterously in his mouth, even recovering those falling to the bottom, and blows them into the nest. Spawning may continue throughout the day, and

when completed the female should be removed.

The nest is carefully tended by the male, falling eggs being replaced and new bubbles added if the structure need strengthening. During extremely warm weather the young appear 36 hours later. Paternal interest continues for perhaps four days longer, during which the young are kept within bounds, which means the nest. Gradually the nest is spread out and new bubbles added, until the fry are able to swim freely. The male should now be removed; otherwise he will devour the young he has so carefully nursed.

The fry should be provided with Infusoria in plenty, to be later followed by Daphne.

How quaint, queer and quizzical are aquarium fishes—and aquarists—to newspaper reporters. In a New York sheet we read of the wonderful "Helleri," which builds a nest of bubbles and then proceeds to bring forth the young alive. Further, Pa Helleri plays hob (we hesitate to use a term more in rhyme with the fish's name) with Ma Helleri if she fails to appreciate his attempts at home-building.

Another paper tells us of a gorgeous red, white and blue goldfish—the "Liberty Fish"—originated in northern New Jersey, after years of painstaking effort by the owner. The account assures us that the fish is unique. That the reporter made a careful study of the situation is evident, because he mentions that the Red Drumfish, Bluefish and Whitefish were not called upon to lend their colors to the new animal. Of course, in this new goldfish, you recognize the popular calico broadtail. Who wants any other kind nowadays? The story reminds us of the romance of *Sagittaria natans,* published twenty years ago, from the pen of a then well-known goldfish fancier.

During the famous days of King Arthur two brave knights did battle because they could not agree as to the wording on a sign. They were both right and both wrong—the sign had two sides!

Since the first stroke of time ignorance has bred strife, and knowledge harmony. Knowledge is the world's greatest asset. Advertising is the power that distributes knowledge.

Advertising is the point of contact between the producer and the purchaser. Through it public opinion is swayed and action started. The great body of people may only judge a business through its advertising. Judicious advertising, economical advertising, consists in placing the announcement where it will reach the greatest number of prospective buyers. Aquatic Life is a highly specialized advertising medium for the breeder of aquarium fishes, every reader having a direct interest. It follows, therefore, that, regardless of the lower or higher cost of space in other mediums, advertisements in Aquatic Life bring the greatest number of orders.

Krefftius adspersus is certainly a beautiful little fish. I have kept specimens for years, feeding mosquito larvæ in summer and tiny earthworms in winter. It used to be quite common in our Torrens, and was used by anglers as live bait for perch. Now we must go up the Murray if we want examples for our aquaria. The introduction of perch and goldfish in our rivers is without doubt clearing out many of the smaller native fishes.—Herbert M. Hale, *South Australia Aquarium Society.*

As long as any one is dissatisfied there's hope.

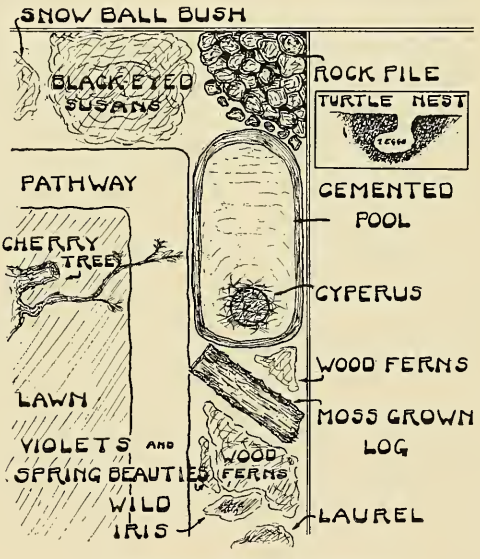
The Garden a Terrarium

CHARLES M. BREDER, JR.

The aquarist with a garden at his disposal, and broad tendencies in nature-study, should not miss the opportunity afforded by a large open-air terrarium. An attempt along this line in no way interferes with the horticultural projects of other members of the family, unless the entire space is given over to a bit of the great outdoors. On the other hand, if but a few of the lower vertebrates are desired, these can be so selected as to be a real asset in any vegetable or flower garden, consuming, as they do, large numbers of pests.

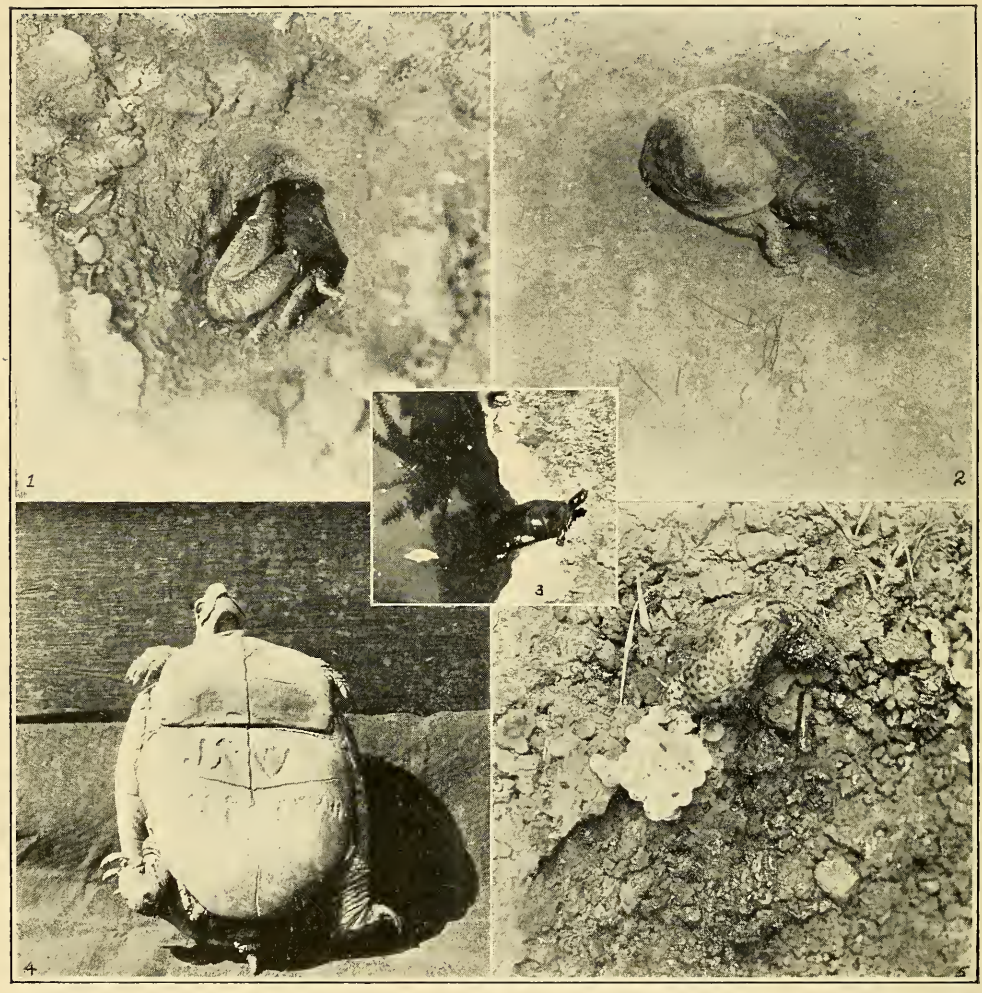
One of the best and most easily procured is the common box tortoise (*Cistudo carolina*). They are possessed of a good disposition, harmless, and useful in keeping the invading insect army in control, as well as having a good grade of intelligence for chelonians. Dr. Charles C. Abbott, in a report of the Geological Survey of New Jersey, writes: "A very abundant species, that should be encouraged in every garden in the State, as they wage an unending war against a multitude of noxious creatures. The habit of cutting initials upon the shell of this animal has resulted in proving it to be an animal of long life. Instances of this, showing the animal to have been from 50 to 80 years of age, have come under the notice of the writer."

A photograph is presented showing one collected by the author in 1912. Carved on its plastron appears "J. S. V., Sept. XXVIII, 1888." The latter part of the inscription is now almost effaced, but it was quite plain at the time the specimen was taken. The initials were identified as those of J. S. Van Horn, whose brother remembered being present at the "engraving match" when a boy. That the specimen was rediscovered near the same place demonstrates that it was not a great wanderer. Mr. Van Horn stated that the tortoise was just as large when the carving took place, but 24 years is a long period over which to carry a mental measurement. The species is widely distributed and will be found in most of our eastern woodlands.



Plan of Author's Garden

It has been stated that their food consists almost entirely of vegetable matter but those in the terrarium of the writer have only been observed to take cherries that had fallen from a tree in the yard, as far as this class of food is concerned. Their preference has been for earthworms and slugs, the elimination of which, from a gardening viewpoint, is



1. *Gelasimus sp.* (Fiddler Crab) in its garden burrow. 2. *Cistudo carolina* (Box Tortoise) eating an earthworm. 3. *Chrysemys picta* (Painted Turtle) basking in the sunshine. 4. The inscribed plastron of *Cistudo*. 5. *Limax sp.* (Garden Slug) with a recently deposited egg mass. Photographs by the author.

decidedly beneficial. Inasmuch as the garden is small, these items of food are limited, so the tortoises are fed chopped beef, which they seem to prefer after the taste is acquired. It has been said that lettuce, cabbage and milk will be taken, but the present specimens refuse all three.

The members of the family claim considerable intelligence for these reptiles, even insisting that they recognize those who feed them, and, further, exhibit fear in the presence of strangers by withdrawing into their shells. At any rate, they are always near the house when hungry, departing for the fern bed when satisfied. It is hardly probable that continued series of such coincidences could occur for more than six years without a reason, so it is attributed to their knowledge of the whereabouts of food. In autumn, when the days become short and the nights chilly, the tortoises make efforts to gain admittance to their winter quar-

ters, which has been screened during the summer to keep out the prowling cats. The spot is under the porch, the earth being covered with loose leaves.

The younger of the two, a female, appears more intelligent than the older or monogramed one, and has now been in the garden for nine years.

The breeding habits, as observed twice, are most interesting. The female selected a spot, both times the most sandy location, and proceeded to excavate a hole with her hind feet. This was done in a most amusing manner, the feet moving alternately with a slow, jerky stroke that moved but little earth. The process took the better part of two days, and the result was a hole shaped as in the sketch. The extremities of her hind feet, pointing forward, enabled her to undercut the earth in the manner indicated. After the eggs were deposited, the hole was filled level with the surrounding surface of the ground, and both times some small stones crowned the achievement, but it is not clear whether this was intentional or merely accidental. With this accomplished no further attention was given the nest by the female. Misfortune was the lot of both nests, as the eggs failed to hatch, being probably killed by low temperatures during the nights. Seven eggs were deposited in each nest, the shells being flexible or leathery to the touch, and a "dead" white in color.

In addition to the purely terrestrial tortoise, several species of aquatic turtles may be kept if provision is made to gratify their water-loving nature. A sunken tub, or better, a concrete pool, is all they require, and in a water garden they are entirely at home, although large examples may damage tender aquatic plants.

Specimens of the painted turtle (*Chrysemys picta*) hibernated with the box tortoises in the earth under the porch, but were always out and about earlier in the spring, though they retired later in the autumn. During the cold weather of the winter of 1917-18 they froze, not digging in as deep as *Cistudo*. The aquatic forms never become quite as tame as the box tortoise, but will at times take worms or meat from the fingers if offered them in the tank.

It is an amusing fact that a small specimen will often mistake the tail of a larger comrade for a fat and juicy worm and grasp it with vigor, which causes a great commotion until the offender discovers the mistake and relinquishes his hold. Due to its roughness, no harm befalls the tail. These turtles seem much more sociable than the land species, and will usually be noted in parties of several, whereas the box tortoise is solitary. This holds good in both domesticated and wild states.

When tadpoles kept in aquaria complete their metamorphosis, and become frogs or toads, they may well share the garden with the chelonians, though, while small, there is a possibility that they may form a meal for the latter. When they reach a fair size their activity is their protection, while their usefulness in devouring noxious insects is their chief recommendation, aside from interesting habits and grotesque actions.

If a large bed of ferns and mosses be given a place, a picturesque feature can be created by liberating a number of large-shelled land snails. Turtles, however, consider them dainty morsels to be devoured on discovery. Too many may cause damage to the plants, so but few should be introduced at any one time.

If space can be given to native plants a much more beautiful terrarium can be developed. A shady nook, unsuited for ordinary cultivated kinds, is just the situ-

ation for ferns and woodland plants. A brief list of suitable plans follows:

Ferns. Wood fern (*Dryopteris spinulosa*), Shield fern (*D. marginalis*), Crested fern (*D. cristata*), Bracken (*Pteris aquilina*), Maiden Hair (*Adiantum pedatum*), Christmas fern (*Polystichum acrostichoides*), Beech fern (*Phegopteris hexagonoptera*) and Sensitive fern (*Onoclea sensibilis*).

Shrubs. Wild Azalea (*Azalea nudiflora*), Rhododendrons (*Rhododendron sp.*), Spice bush (*Benzoin aestivale*) and Laurel (*Kalmia latifolia*).

Herbaceous Plants. Spring Beauty (*Claytonia virginica*), White, Purple and Yellow Violets (*Viola sp.*), Day Lily (*Hemerocallis fulva*), Tiger Lily (*Lilium tigrinum*), Yellow Adder's Tongue (*Erythronium americanum*), Pink Lady's Slipper (*Cypripedium acaule*), Partridge Berry (*Mitchella repens*), Jack-in-the-Pulpit (*Arisaema triphyllum*), Spotted Wintergreen or Pipsissewa (*Chimaphila maculata*), Wood Anemone (*Anemone quinquefolia*) and Hepatica (*Hepatica triloba*).

Those named are among the best for the purpose, either because of their hardiness, beauty or the ease by which they may be obtained. Detailed descriptions, natural habitats and range, and suggestions for cultivation will be found in wild flower guides and horticultural handbooks. Mosses and lichen-grown logs add to the general attractiveness of the wild flower garden.

A rather unusual addition to the terrarium is possible if a sand or mud bank is prepared along one side of the cement pool, the animal being none other than the familiar Fiddler Crab (*Gelasimus sp.*) This can be collected in almost any salt marsh along the New Jersey coast, and will do fairly well in fresh water; better if it can be made slightly brackish. They present a most ludicrous appearance as they run along sidewise, waving the one gigantic claw frantically, as if calling the world to see something of crab interest. The common freshwater crayfish (*Cambarus sp.*) can more readily be kept in the same manner. Raw beef and earthworms will form their principal foods.

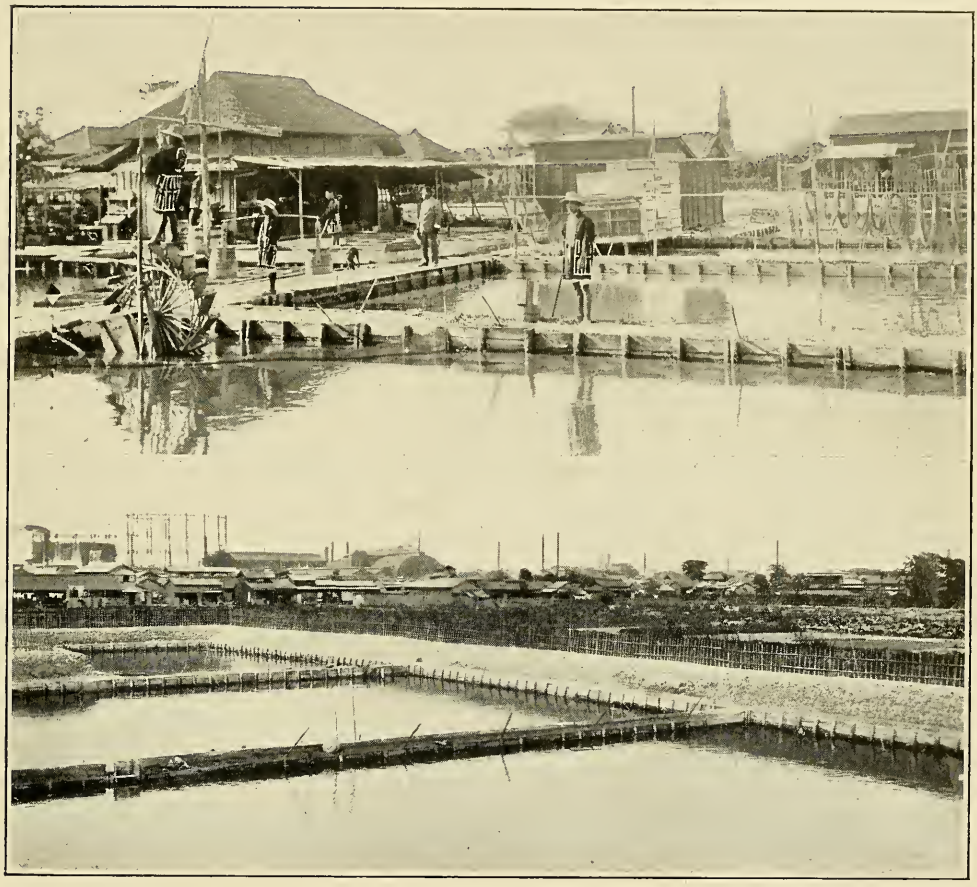
The fence surrounding the garden should be made quite tight at the base, as otherwise some of the creatures might wander from the premises. For this reason our harmless snakes have been omitted from the discussion.

If the lawn is kept in the conventional fashion, it should be gone over with a rake before mowing, to prevent a possible violent death of some of the animals. Frogs are prone to rest or search for food in the open grass adjacent to their watery home.

Work on modifications of this garden terrarium, to conform to individual conditions, will mean many delightful hours at home and in the field, and cannot fail to inculcate the many sides of nature.

To enable migratory fish to pass such barriers as waterfalls and dams when ascending a river to spawn, the Canadian Commissioner of Fisheries has developed an elevator which is apparently practicable. It has been placed in service at a 24-foot fall in the St. Croix River, N. B., and is operating successfully, says *Popular Mechanics Magazine*.

In part, the device consists of a vertical shaft erected several feet from the falls. Guides, or walls, radiate from both sides of the structure to the opposite banks of the stream, so that fish are led to it. A cage in which the latter are trapped and carried to the top of the shaft, where they are automatically dumped into a sluiceway and discharged into the water on the upstream side of the barrier, is hoisted by means of a counterpoise tank, which is periodically filled with



Glimpses of the Akiyama Goldfish Farm, Tokyo, Japan

Photographs by Eiichiro Nakashima

water from a supply reservoir surmounting the tower. The cage and tank are secured to the opposite ends of a cable that passes over pulleys at the top of the shaft.

The fish compartment is provided with two doors, one at each end. When it is at the bottom of the shaft beneath the water one of these gates is raised to permit fish to enter. On the other hand, an auxiliary door on the shaft lets down and prevents fish from swimming around to the back side of the guides or into the space normally occupied by the carried, when the latter ascends.

THE POOR FISH!—"I hear you are going to marry Archie Blueblood?" said one society woman to another. "Is it true?"

"Marry him!" exclaimed the other. "Not likely. What on earth could I do with him? He's rejected from the army, he can't ride, he can't play tennis, golf, nor, for that matter, can he even drive a motor car!"

"Oh!" said the friend, "but he can swim beautifully, you know."

"Swim, indeed! Now, I ask you, would you like a husband you had to keep in an aquarium?"—*London Blighty.*

You remark as to dropping the guppys into the pringle and snoodling them out with a niblick. This would not do at all. These little fellows belong to the famous Whiffenpoof family. The only successful way to capture them is to wait until they have dug their holes in the water and are waiting for prey. Then throw a loose-running slip-noose over the top of the hole and start the funnygraph playing "Home, Sweet Home." This causes them to weep copiously. Their only alternatives are to remain where they are, ignominiously drowning in their salt tears, or to protrude their heads above water. The moment a little head is thrust above, twitch the noose quickly and you will have caught your guppy.

There is quite a good deal to learn about the habits of each fish. The swordtails, for instance, have a terrible weakness for whetstones. Just drop a whetstone into the water and there will be a fight to see which shall get his tail sharpened first. If you have thoughtfully placed some small gobs of soft tar on the whetstone they soon become entangled, and all you need do is pick them right off with your fingers. But be careful not to get cut on the tails of those which might have been sharpened.—*Guild.*

The Ridgewood Aquarium Society will hold its annual exhibition on August 30th, 31st and September 1st, in the public school, Forest and Putnam avenues, Ridgewood Heights, Brooklyn, New York. This is expected to be the largest exhibition ever given in Brooklyn. Cups, diplomas and ribbons will be awarded. The Society extends a cordial invitation to all aquarists to enter fishes, aquaria and terraria. For entry blanks and further information, address the writer at 11 Union street, Brooklyn, N. Y.—A. Currie, *Secretary.*

The Fairmount Park Commission, Philadelphia, has granted permission to the associated aquarium and goldfish societies to hold the annual exhibition in Horticultural Hall, on October 4th, 5th and 6th. This show brings out the greatest goldfish bred in America, and the widest variety of tropical and native species. Letters of inquiry should be addressed to the writer at 518 Belgrade street, Philadelphia.—F. H. Christine, *Secretary.*

The eighth annual exhibition of the Brooklyn Aquarium Society will be held in the Brooklyn Museum of Arts and Sciences, September 11th to 14th, inclusive.

Los Angeles has the unique pet shop called "Birdland." The owner, L. M. Grider, when he retired from the real estate business in 1910, conceived the idea of creating a different sort of bird store that he might not only sell pets, but gratify his desire to have them about him. The result is a beautiful building and a splendid collection. A recent innovation is "Birdland News," a four-page paper which is to be issued at irregular intervals. It contains notes of interest to pet lovers and dealers, with current prices of available stock.

What's become of that fine ——— you had the last time I was here? Jumped out and naturally dried up! *Moral:* Keep your tanks covered.

The small boy feels that he is in hard luck. Just when he has mastered his geography the map of Europe will be made all over again.

A prophet is without honor in his own country. Are you studying native fishes? Before the war many American species were much in demand in Germany.

NOTICE: Hugo C. Nelles, Dealer and Breeder of Tropical Fishes, is now located at 10440 115th Street, Richmond Hill, Long Island, New York. He will carry first-class stock only, as has been his policy in the past. A cordial invitation is extended to customers and friends to visit his modern, up-to-date conservatory.

Aquatic Life

1919

MARCH. Breeding the Goldfish (*Hanna*); Observations on the Chelonians of North America, Part I (*Shufeldt*); Lucania ommata (*Welsh*); Apistogramma agassizi (*Heede*); The Water-fleas (*Tompkins*); Viviparous Fishes-in-general (*Stead*); Breeding the Striped Gourami (*Simpson*); Notes and news.

APRIL. The Surinam Toad (*Deckert*); Cichlasoma nigrofasciatum (*Brind*); Keeping Living Food Alive (*Innes*); Beware the Dragonfly (*Gordon*); An Electrolytic Aerator (*Putnam*); Water Lilies, Some Cultural and Historical Notes (*Pring*); Beef vs. Liver, notes and news.

MAY. Nanostomus eques (*Brind*); The Water Horse-tail (*Wobler*); Observations on the Chelonians of North America, Part II. (*Shufeldt*); I Became a Fancier (*Proctor*); A Peculiar Planorbis (*Breder*); Association and Color Discrimination in Mudminnows and Sticklebacks (*White*); The Hay Infusion Microcosm (*Woodruff*); The Bladderworts, notes and news.

JUNE. Observations on the Chelonians of North America, Part III (*Shufeldt*); Gambusia episcopi (*Brind*); The Wheel Animalcules (*Bade*); Sonnet to a Goldfish (*Burditt*); A Study of the Diamond Bass (*Trell*); The Brook Stickleback (*Barker*); Goldfish in China, Red-colored Water, Crappie Spawn in Washington Aquarium, and Society News.

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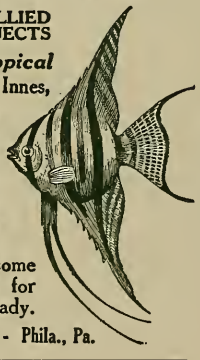

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Aquatic Life

Aquatic Life

Vol. IV. August, 1919 No. 12

An international monthly magazine devoted to the study, care and breeding of fishes and other animals and plants in the home aquarium and terrarium.

W. A. POYSER.....EDITOR
JOSEPH E. BAUSMAN .....PUBLISHER
542 East Girard Avenue ..... Philadelphia

Entered as second-class matter, September 2d, 1915, at the Post Office, Philadelphia, Pa., under Act of March 3d, 1879.

Popular and scientific articles and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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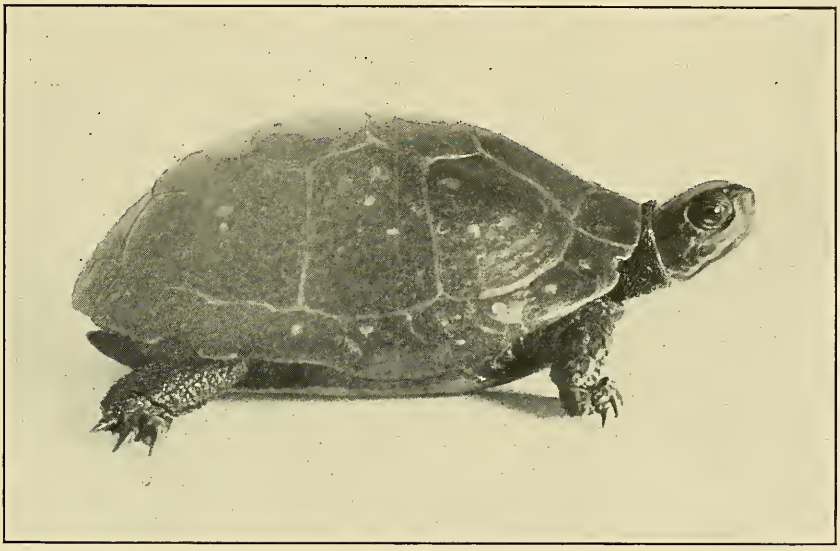
Observations on the Chelonians of North America. IV.

DR. R. W. SHUFELDT, C. M. Z. S.



Melanemys guttatus **Spotted Turtle**

Most writers on our turtles and terrapins include in this group—that is, the genus *Chelopus*—four species, namely, the Spotted Turtle *(Chelopus guttatus)*, Muhlenberg's Turtle *(C. muhlenbergii)*, the Western Pond Turtle *(C. marmoratus)*, and the Wood Terrapin *(C. insculptus)*. Living specimens of all these forms have been studied by me, together with their structure and habits, many times during the past half-century. In 1866 I had some forty living specimens of our common Spotted Turtle, ranging all the way from those just out of the egg to ones of very advanced age. Even at the present time I have a very beautiful specimen of this species—a female—which I have recently photographed, and a reproduction of which illustrates the present article. It has been kept in one of the aquariums in my study, and upon the 10th of July, 1919, she laid an egg; a second one on the 24th of the same month, and a third two days afterward. This is now three weeks ago, and none have been laid since. I photographed these three eggs, and they are shown here, natural size. Again, above these eggs, there is a reproduction of an egg of the common Musk Turtle *(Aromochelys odoratus)*, and this I also photographed, natural size, the specimen hav-

ing been presented to me by Mr. Edward S. Schmid, of Washington, who had a number of this species of turtle in a tank at his establishment. These figures show very well the slight difference in the form of the eggs of the two genera. All are pure white and ellipsoidal in form.

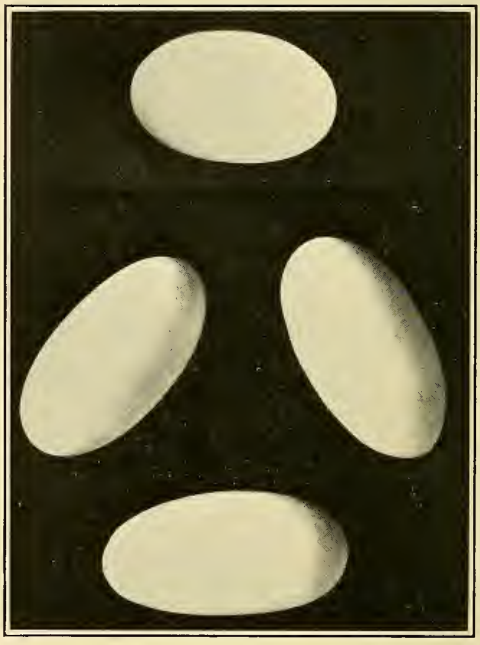
Our common Spotted Turtle is so well known that it requires no special description. The upper shell is always black, with scattered, round, yellow spots; the plastron may be yellow or salmon color, with a central figure of black, the latter subject to great variation. The head is black with yellow markings, particularly with a deep yellow spot over the auricular opening.

This familiar pond turtle is almost entirely aquatic by habit, being found in streams, ponds, ditches with water in them, etc. It feeds under water, and will eat of the leaves of certain plants, such as lettuce and the like. The male has a long tail and the female a very short one. It occurs from Northern Maine to North Carolina, westward to the Mississippi Valley. It rarely exceeds four inches in length of shell or carapace.

The Western Pond Turtle, with habits quite similar to the last, is also a blackish species, yellow spots and dashes marking each shield of the carapace, the dashes running from the shield's centre to its margin in every instance. The brown limbs are spotted with yellow or black, as is also the head. This is a Pacific Coast species, and the only species of pond turtle of that entire region.

Muhlenberg's Turtle is also a black species with yellow blotches on its plastron, and a very distinctive bright orange spot on either side of the head, not far from the auricular opening. It runs about four inches for the length of its shell, and is aquatic in its habits. Thus far it has been found only in New York, New Jersey and Pennsylvania—Staten Island being the centre of its abundance.

Coming to the Wood Terrapin, a species I have had in confinement for months at a time, we have under consideration a species that is strictly a *land tortoise*, which may attain a length of carapace of seven inches. It is fond of damp woods, and takes to the water only as it rambles around through them. The



species is of an affectionate disposition and wonderfully intelligent for a chelonian. This is an entirely different reptile from any of the foregoing species, its carapace having a conspicuous keel, each shield of which is deeply marked with concentric grooves, giving the while a sculptured appearance as though done with some tool or other. This shell is of a pale earth-brown, with radiating yellow lines and various spots on each shield. Limbs and top of head dull salmon color, or in some specimens a brighter red.

Doubtless there are a number of anatomical points that are quite different in the Wood Terrapin, as compared with the corresponding ones in any of the three Pond Turtles described above. As to its external characters, they are each and all entirely different when we come to contrast them with those of the Spotted Turtle, of the Western Pond, and those of Muhlenberg's Turtle.

The distinctive external characters of the three pond turtles on the one hand, and the Wood Terrapin on the other, have, together with their habits, been sufficiently set forth above, obviating the necessity for their tabulation here. The marked differences have long been known to herpetologists who are familiar with them. All this points to the fact that the Wood Terrapin is an entirely different species of reptile from any of the Pond Turtles. This being the case, it represents a different genus among chelonians, and this difference should be recognized through drawing the necessary generic lines.

I therefore here suggest that the three above referred to Pond Turtles, now in the genus *Chelopus,* be removed from that group and made to form a genus by themselves, for which I propose the name of *Melanemys,* which refers to their general black color. These turtles will then stand thus:

Melanemys guttatus
Melanemys muhlenbergii
Melanemys marmoratus.

The Wood Terrapin will remain *Chelopus insculptus,* which is the name it now bears in science.

Lots of men are liars who never even tried to catch a fish.

Hard work always stands at the top of the list of factors in success.

Marine Aquaria

At the meeting of the South Australian Aquarium Society, in March, the presidential address was delivered by Mr. Edgar R. Waite, F. L. S., who demonstrated the principles and practices of the marine aquarium. After detailing some of the physical properties of sea water, its density, salinity, composition and so on, Mr. Waite remarked:

"In keeping aquaria we seek to translate to our own homes a little bit of Nature, one of the bits of which few people have any knowledge. We do not, however, try to reproduce the mountain torrent, which may have a fauna and flora quite its own, not even the conditions found in an ordinary stream. We rather attempt to copy the stagnant, often slimy pool, whose surface may be forbidding, but whose water beneath is often clean and limpid. Such a pool inclosed in glass walls we can nowadays place in our rooms and preserve in excellent condition with very little attention.

Turning to the immediate subject of our discourse, we may ask where shall we find a similar ocean pool? The answer must be a negative one, and it is evident, therefore, that the conditions required for maintaining a marine aquarium must be different from those with which we are familiar as votaries of freshwater aquaria. The ocean is ever in motion, and its waters are being continually revivified by its often enormous billows. We cannot, therefore, attempt to translate a cubic yard of open ocean to our drawing room. On rocky shores we often find pools left by the receding tide, full of sparkling water and bright green seaweeds, among which lurks a wealth of life. This, then, must be our guide, but it is to be remembered that

Concluded on page 160

IGNATZ STEINHART

Photo by Moulin, 1916

The STEINHART AQUARIUM

SAN FRANCISCO

It is expected that San Francisco will soon have the most comprehensive and best equipped aquarium in America.

This has been made possible by the late Ignatz Steinhart, who was one of San Francisco's most prominent business men and most honored citizens. Mr. Steinhart had long contemplated establishing a public aquarium in San Francisco, as had his brother, Sigmund Steinhart, before him. When Sigmund Steinhart died, in 1910, he left a certain sum with his brother with which to establish an aquarium, should it be found feasible to do so. Various and divers difficulties arose, however, and the idea was practically abandoned.

But, in 1916, soon after Dr. Barton Warren Everman went from the Bureau of Fisheries, in Washington, to San Francisco to become the director of the Museum of the California Academy of Sciences, Dr. Everman discussed with Mr. Steinhart the value to the public that a great aquarium in San Francisco would possess. As a result of these discussions, Mr. Steinhart's interest in the matter revived. The one difficulty which caused Mr. Steinhart to hesitate was that presented by the question of control. He felt that any management which made political control possible should be avoided. For that reason he would not place it under city control. When he was told that the New York aquarium, originally under the Board of Park Commissioners, was, upon the initiative of the Park Commissioners themselves, transferred to the New Zoological Society, in order to free it of politics, the city continuing to furnish the funds for maintenance but having nothing whatever to do with the management, Mr. Steinhart asked if the California Academy was not similar to the New York Zoological Society in being entirely free from political influences. When assured that it is, he decided then and there to give to the California Academy of Sciences the funds for the building and equipment.

It was his wish that the aquarium might be established and in operation in his lifetime, but, to the very great regret of the Academy and all California, this was not to be; for Mr. Steinhart, after only a few days' illness, died May 15, 1917.

When the will was made public it was learned that Mr. Steinhart had bequeathed to the California Academy of Sciences $250,000 for the erection and completion of a public aquarium building upon the following conditions:

(1) That the aquarium be located in Golden Gate Park adjoining, or adjacent to, the Museum of the California Academy of Sciences. (2) That the control, management and superintendence be under the California Academy of Sciences. (3) That the city of San Francisco supply to the California Academy of Sciences the funds adequate for maintenance, and, (4) That the aquarium be known as the Steinhart Aquarium.

Mr. Jesse W. Lillienthal, Jr., executor of the Steinhart estate, has recently

informed Dr. Everman that he expects to pay over to the Academy within a few weeks the entire quarter of a million dollars and that it is his desire that the aquarium be in operation as soon as possible. It is therefore quite probable that building operations will begin very soon.

The city of San Francisco is to be congratulated on having had as honored and public-spirited citizens, Sigmund and Ignatz Steinhart—men of vision and large sympathies, who, having prospered in this world, decided to do this splendid thing for the people among whom they lived.

San Francisco and California are also to be congratulated upon having as one of their great institutions the California Academy of Sciences, which is doing so much for science and education in the land.

The name of Steinhart will ever be honored and revered by the thousands who will daily visit the Steinhart Aquarium, where they will, through observation and study, receive entertainment and instruction regarding the varied and interesting forms of aquatic life which will there be displayed.

Marine Aquaria

Concluded from page 157

twice daily this little garden-like pool is thoroughly scoured by the tides, a condition we cannot hope to reproduce unless we live quite close to the sea, and the work entailed in carrying sea water would soon dampen the ardor of the most enthusiastic. I recently saw some delightful exhibits of marine life maintained by this means. One of the German settlers in New Ireland took great pleasure in keeping, in large glass basins, specimens culled from the ocean close to his bungalow, but the water was changed daily, and new life introduced by native labor—a luxury which cannot be enjoyed in White Australia.

Apart from large and expensive apparatus, such as is installed in public aquaria, our endeavors to maintain a marine aquarium must be on a very modest scale. The tanks must be quite shallow, so that a large aerating surface is presented; they must admit a minimum amount of light in order to retard excessive vegetable growth, which is much more active than in fresh water, and during warm weather provision for artificial aeration must be made. The aquarist also must be content with smaller and fewer animals than he would introduce into fresh water tanks. The chances of success are greatly enhanced if quite half the total quantity of water in the tank is kept in absolute darkness, but with free access to the lighted part so that circulation of the water is promoted."

The address was illustrated with apparatus and blackboard drawings, and the president mentioned that he had maintained a marine aquarium for seven years, during which period the water was not changed, fresh water only being added to replace loss by evaporation. The correct density of the water was assured by testing with a salinometer, or by observing a pair of specific gravity bulbs, one of which floated and the other remained at the bottom. Any change in the relative position of the bulbs would indicate that the salinity was incorrect and required to be adjusted. As an indication of the success of the installation, it was mentioned that pipe-fishes and sea-horses had bred in Mr. Waite's aquarium.—Herbert M. Hale, *Honorary Secretary.*

A man does not amount to much unless he can prove it.

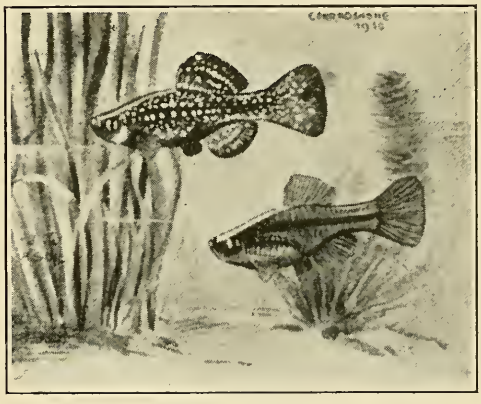
LEBIAS SOPHIAE

WALTER LANNOY BRIND, F. Z. S.

With the World War a matter of the past, and with the ships dashing over the seas unmenaced by hostile submarines, it is not too much to believe that *Lebias sophias* will be one of the fishes sought by collectors of aquarium fishes who penetrate Asia. I doubt if it was ever brought to America, but in 1910 it had been secured by the Germans, and was bred in the fishery on Lake Tegel, known by the high-sounding name of "Vereinigten Zierfischzuchtereien in Conradshohe." This was but a short time after my return to the United States from Berlin, so I missed the chance to add this species to the large number I brought with me, many of which are now prime favorites with American aquarists.

The genus Lebias belongs to the "egg-laying tooth-carp group" of the aquarist, which comprises such forms as *Haplochilus, Rivulus, Fundulus* and so on. The breeding habits of Lebias sophias are quite like those of our native (Southern) *Fundulus chrysotus*. The eggs are deposited in small lots, one, two or three, on the leaves of *Myriophyllum* or such other fine-leaved plant as may be provided. Breeding is said to be easy, but not profitable from a standpoint of numbers, as but few eggs seem to be spawned at a time, and but a small percentage hatch to grow to maturity. This would seem to indicate that when we are fortunate enough to secure the fish, it will be one to be placed in the costly class, to remain there.

The male of the species, as is so often the case, is by far the showiest of the pair. In breeding periods it becomes a beautiful deep blue, sprinkled with metallic green and silver spots; hence it might well be given the common name silver-spangled lebias. When the individual is in prime condition the dorsal and anal fins are orange, with rows of



Lebias sophiae

black spots and black edges. The female is quite insignificant, being of a dirty, clayish, yellow-gray, with a dark lateral stripe and some mottlings of dark brown at times showing on the sides. The length of the male is about two inches, a trifle longer than the female.

Love-making is chronic with the male. Never was there such an ardent lover, nor a more resentful bit of viciousness when his suit is rejected. The female is coy and shrinking, hiding as much as permitted amongst the thickets of bushy plants. And plenty of plants *must* be provided.

Coming as it does from brackish wat-

ers, of Persia, it follows that a similar degree of salinity should be simulated in the aquarium, in fact it is absolutely necessary, especially insofar as breeding is concerned. Further, inability to reproduce in the aquarium the precise conditions of its native environment may account for the small numbers the Germans were able to rear. A temperature of about 75 degrees seems best suited.

An investigation of an epidemic among the fish in the St. Lawrence River at Ogdensburg, N. Y., was made by the Bureau of Fisheries during the first week in July. E. A. Cooper, superintendent of the New York Fish Hatchery, had reported that large numbers of fish were dying in the ponds and also in the river.

The epidemic was at its height during the first two weeks in June and then decreased rapidly in severity. At the time of the investigation the disease had entirely disappeared from the ponds and only a few diseased fish were taken in the river. None of these appeared to be seriously affected by the disease.

The fish taken in the river showed two distinct types of lesions on the skin. On the bullheads and catfish the infected areas were very distinct, about ½ to 1-inch in diameter and bright red in color, due to the complete destruction of the epidermus, thus exposing the inflamed dermis beneath.

The diseased areas in the skin of bass and suckers had a very different appearance. They were irregular in shape and so indistinct as to attract attention only on close examination. The most marked characteristic was a faint reddish border around the scales, due to a slight extravasation of blood into the epidermis.

A microscopic examination of sections of skin from the infected areas indicates that the disease in bullheads and catfish is probably distinct from that in the bass and suckers. In the former the disease is apparently due to bacteria which are present in enormous numbers in the disintegrating epidermis. These bacteria are not present in the lesions on bass and suckers, and the cause of this disease is at present problematic.

The manufacture of pearl buttons from mussel shells began in 1891 and the rapid increase in the business soon threatened the destruction of the mussels. The United States Government in consequence entered upon a series of investigations as to the practicability of propagating mussels artificially. This is a commercial problem, yet success depends upon a knowledge of the life history of the mussel, which has been gained by various investigators in theoretical work. The life history is unusual. After the young mussel develops from the egg to a larval form called "Glochidium," barely visible to the naked human eye, it is discharged into the water where it develops further or dies, depending on whether it has an opportunity to attach itself to some fish. If chance favors it, it takes up the life of a parasite until far enough developed to leave the fish, drop to the bottom of the stream, and enter upon the life of the adult mussel. The task, therefore, of artificially breeding mussels, involves the bringing together of suitable fish and the young, almost microscopic, glochidia. Investigations have shown that a moderate sized fish may successfully carry from one thousand to two thousand of these parasitic guests.—*American Museum Journal.*

Patience is the right bower of success.

Jordanella floridae has been safely transported to Australia, where it has bred in the ponds of H. E. Finckh, Esq.

THE SENSES OF FISHES

C. JUDSON HERRICK

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Our human world is a very limited part of nature. The unaided senses of primitive man open a few doors of communication between the individual and his surroundings, through which the sum total of his knowledge of things as they are must be derived. Science has greatly enlarged the efficiency of the natural sense organs—the microscope and the telescope have extended the range of vision, the periscope enables us to see around a corner, the spectroscope, photographic plate, X-ray machine, and innumerable other aids have enabled us to see deeper into nature. But no new senses have been developd and our furthest scientific advances and most recondite philosophical theories must be based in last analysis on such fragmentary knowledge of the cosmos as is revealed to us by our senses. Great realms of nature remain wholly unexplored, although new artificial aids permit constant advances into the hitherto unknown—Hertzian waves and wireless telegraphy, ions and the new chemistry, electrons and the new physics.

Fortunately the traditional five senses do not represent our whole physiological equipment for this task. In fact, the human animal is endowed with about twenty distinct senses, including two in the ear, at least four in the skin, and numerous others in the deep tissues, such as muscle sense, hunger, thirst and other visceral senses.

It is well known that fishes and other lower vertebrates possess numerous types of sense organs quite unlike anything in our own bodies, and it is quite impossible for us to form any conception of what the world appears like to these animals except in so far as their sensory equipment is similar to our own. Even the companionable dog, who responds so sympathetically and intelligently to our moods, lives in a very different world. Recent experiments have shown that his sense of vision is very imperfect, especially for details of form, and everybody knows the inconceivable delicacy of the hound's sense of smell. With us vision is the dominant sense and our mental imagery is largely in terms of things seen. Even a blind man will say, "I see how it is," when he comprehends a demonstration.

What sort of a world is it to a dog, whose finest experiences and chief interests are in terms of odors? And how does it feel to be a catfish, provided not only with large olfactory organs whose central nervous centers make up almost all of the cerebral hemispheres of the brain, but also with innumerable taste buds all over the mucous lining of the mouth and gills and freely distributed over the entire outer skin from the barblets ("feelers") around the mouth to the tail fin? We cannot conceive the epicurean delights which such an animal may feel when he swims into the water surrounding a juicy piece of fresh meat, by whose odorous and savory juices he is bathed. One wonders, parenthetically, how far the fish himself is able to conceive or even enjoy the pleasures of life. With how much mind of any sort the

fish is endowed is at present an unsolved riddle; but it is certain that his behavior complex is of very different pattern from ours and whatever mind he may have would surely be as different as the pattern of his sense experience is different.

Let us pursue this line of inquiry further and review what is known of the other senses of our catfish. This fish has small and poorly developed eyes and is largely nocturnal in habit, lying concealed in dark corners during the day. The retina has remarkable powers of adaptation to differences in illumination and the fish is very sensitive to changes in intensity of light. But the eye is not the only light-sensitive organ. Experiments with blinded fish show that the entire skin surface is sensitive to differences of light intensity, a not uncommon feature of aquatic animals. The image-forming power of the eye is probably not very good. Some catfishes, it is true, will take a spoon hook, and probably a bait must always be in motion if it is to be sensed by the eye. The usual method of feeding is to trail the bottom with the barblets, which are very efficient organs of both touch and taste, and when contact is made with a worm or other suitable food to turn sharply and snap it up.

Just as the eyes are supplemented in their functions by the skin, which has a very feeble sensitiveness to light, so the highly refined chemical sense organs in the nose and taste buds are also supplemented by a chemical sense in the general skin. In some other fishes which have been carefully tested the general skin surface is found to be very sensitive to chemicals in solution, to some substances more sensitive, in fact, than are the taste buds themselves.

In fishes, as in men, the ear contains two quite different sense organs—the organ of hearing and the organ of the sense of equilibrium. The latter lies in the semi-circular canals, which in form and function are similar to those in the human body. Indeed, the semi-circular canals probably play a larger part in the behavior of the fish, since maintaining perfect equilibrium is a more difficult matter for a fish suspended in water of about the same specific gravity as the body than for a man walking on solid ground. But when the man essays to fly, his semi-circular canals again take a dominant place in his sensory equipment. In the practical testing of the fitness of men who are candidates for the Air Service of the Army the most important point to be determined is whether the semi-circular canals are functioning normally.

Whether fishes hear at all has been hotly controverted. That they are very sensitive to mechanical jars and vibrations all agree, but it has been difficult to prove whether their responses to these vibrations are brought about through their ears or by refined cutaneous sensibility. The ingenious experiments of Parker have shown that both of these organs serve and that, in fact, fishes do hear true sound waves of rather low pitch with their ears. To tones of high pitch they are deaf and probably they have no power of tone analysis, that is, they can hear a noise but cannot tell one tone from another.

The fishes can boast no superiority over ourselves in being able to respond to low tones by both the ear and the skin. We can do the same, as can readily be shown by lightly touching the sounding board of a piano or organ when a low tone is struck. The same tone heard by the ear can be readily felt by the finger tips. But for perceiving still

slower vibratory movements we, with all our boasted brain power, must admit ourselves inferior to the fishes. They possess an elaborate system of cutaneous and subcutaneous sense organs of which we have not a vestige. These so-called lateral line organs in the catfish comprise a complex system of fine tubes under the skin, the lateral line canals, and two kinds of sense organs in the skin, the pit organs. The canals ramify in various directions in the head and the main lateral canal extends along the side of the body back to the tail. They were formerly supposed to be for the secretion of mucus and are still often called the mucous canals. But they are now known to contain numerous small sense organs which respond to slow vibratory movements of the water. The pit organs are scattered over the skin, the smaller ones each in a flask-shaped pit with a narrow mouth and the less numerous larger ones exposed on the surface.

The lateral line sense organs are all supplied by a single system of nerves related to the nerves of the ear, and quite distinct from those for the general tactile and chemical senses of the skin and cutaneous taste buds. That the lateral line organs respond to slow vibratory movements has been clearly shown by Parker, but the distinctive features of the pit organs are unknown and, in fact, our knowledge of the functions of the system as a whole is still very incomplete.

It is clear that cutaneous organs of touch, lateral line organs, and the organs of equilibrium and hearing in the internal ear form a graded series, and all have probably been derived in evolution from a primitive type of tactile organ. When therefore we both hear and feel a musical tone of the piano we are reminded of the long and dramatic history of the very intricate human auditory organ, whose first and last stages both may function at the same time in our own bodies.

We cannot here recount the details of the long series of very tedious scientific investigations required to replace the conjectures of amateur naturalists and fisherfolk by accurate knowledge of the sensory life of fishes. And even with this precise information we are far from a true understanding of the fishes' minds. To learn the structure and behavior of any animal requires only sufficient scientific skill and industry, but to understand the mind of an animal is the most baffling of all scientific questions.

Our own thoughts are purely personal matters. Even with the aid of language, facial expression and gesture, we are able to communicate our ideas and feelings to our intimate friends only imperfectly, and this difficulty is multiplied many fold when we try to understand even the most intelligent of the brutes. The only recourse is to see how an animal behaves in a given situation and then in the light of what we know of human and animal bodily structure and function try to imagine how we would think in such a situation, taking into account the animal's limitations of nervous organization. Obviously this is a poor and uncertain method at best, and no wonder many psychologists have given up the problem in despair and decided that the only scientific procedure is to pay no attention to animals' minds and limit our inquiry to their objective behavior. Indeed, so impressed are some of them by the futility of scientific study of even the human mind by introspection that they advocate throwing overboard the whole science of psychology. But this is too like sinking the ship, cargo and all, to get rid of the rats.

No, if we wish to attain the heights of a true understanding of the significance

of mind in evolution, we must keep to the steep trail and not yield to the temptation to take smoother paths leading to rest shelters by the way. But we must watch our steps. By this I mean that, although we can interpret the animal mind only in terms of our own experience, yet we must not uncritically read our thoughts and feelings back into animals' minds. The only safe rule is to assume that an animal acts reflexly or unconsciously except when it can be shown that the unconscious mechanisms are inadequate to account for the behavior and intelligence alone is adequate. And these are very difficult things to prove in regard to animals so far removed from us in behavior type as are the fishes.

The popular dramatization of animal life and imputation to them of human thoughts and feelings may have a certain justification for literary or pedagogic purposes, the same as other fairy stories. But let it not be forgotten that this is fiction for children, not science nor the foundation for science; and there is a long, long road to travel before we shall be able to understand in any but the most shadowy outlines what a fish's mind is really like.—By permission, from *Natural History,* Journal of the American Museum.

"I went over to Iona to do some shopping," explained our neighbor, "and I've been laughing ever since."

"There was an awful crowd on the streets, and it wasn't Saturday, so I didn't know what was the matter. But a clerk in a store told me that the circus was in town. To think I'd forgotten that—and missed the parade, too! But it was too late to think about circuses; so I finished my shopping and got some ice cream and then went to the station to get the 5.30 for home.

"There was quite a crowd in the depot—people going home from the circus, mostly. I noticed one woman all dressed in her best, and carefully holding a covered tin pail on her lap. Every now and then she would take the cover off, look in, and then put the cover on again. Then another woman came in and spoke to the woman with the pail:

"Well, did you have a good time?" she said. "And what are you taking home—something good to eat?"

"No," smiled the other, "I'll bet you can't guess what I've got in this pail, so I'll show you. And she removed the cover.

"Goldfish!" exclaimed the woman, taking a look. "Did you buy them here? I thought you had some at home."

"These are the ones I had at home. You see I wanted to go to the circus, and there was nobody at home to leave them with, so I brought them along."

"I went outside to laugh, and I laughed all the way home. It's a wonder she didn't bring the cow, too."—Exchange.

Make a Note

Heretofore a volume of Aquatic Life has consisted of the numbers from September to August of the year following. The present volume, IV, will be continued to the end of the year, thus making it include 16 numbers. The purpose of this departure is to make Volume V, and subsequent volumes, coincide with the calendar year. The status of subscriptions is not affected.

The fellow with the original thought is a lap ahead of the other man and gets the big pay.

Did you ever notice that the young fellow who always has a lot of girls runnin' after him always marries the plainest lookin' one of the bunch?

Aquatic Life

1918—1919

SEPTEMBER, 1918. The Blood-fin (*Heede*); Breeding Haplochilus cameronensis (*Nelles*); The Spotted Gourami (*Kearns*); Japanese Snail (*Boyd*); Aquarium Water and Its Restoration (*Dormeier*); Aquarium Heater (*Hale*); Fish Foods (*Heede*); Happy Families, Breeding Habits of Mud-minnow, notes and news.

OCTOBER. Aquarium Heating (*Breder*); Hemiramphus fluviatilis (*Brind*); Mollienisia latipinna (*Heede*); Blue-tailed Skink (*Deckert*); Factors Controlling the Development of Tropical Aquarium Fishes (*Webber*); Snails in Aquaria (*Gale*); Habits of Black Bass, The Pipe-fish, notes, etc.

NOVEMBER. American Live-bearing Tooth-carps (*Bade*); Aquarium Notes (*Leitholf*); Notes on Krefftius adspersus (*Freund*); The Anatomy of the Fish (*Clark*); Breeding Habits of Burmese Eel (*Finckh*); A Bloated Axolotl (*Waite*); The Name "Water Flea," notes and news.

DECEMBER. Cynolebias bellottii (*Brind*); Tillaea recurva and Other Notes (*Finckh*); Another Tank Heater (*Kuhn*); Aquarist vs. Aquarian (*Mellen*); Emotions of Fishes (*Gale*); A Cigar Box Aquarium (*Modesto*); Florida Notes (*Carlton*); Photosynthesis, Miscellaneous notes, news, etc.

JANUARY, 1919. Limia caudofasciata (*Leitholf*); Classification of Fishes (*Stead*); Color Changes of the Chub-sucker (*Hubbs*); *Neetroplus carpintis* (*Brind*); A Simple Heated Aquarium (*Finckh*); Notes on the Breeding Habits of the Pigmy Sunfish (*Poyser*); Goldfish Farm of Kichigoro Akiyama, notes and news.

FEBRUARY. Polycentropsis abbreviata (*Brind*); Cho'ogaster cornutus, the Fish of the Dismal Swamp (*Welsh*); A Wood Aquarium (*Pilkington*); Danio malabaricus (*Leitholf*); Notes on Native Fishes (*Pray*); Managing the Aquarium (*Innes*); Reactions of Fishes to Habit-forming Drugs, The Boston Show, A True Fish Story, notes and news.

MARCH. Breeding the Goldfish (*Hanna*); Observations on the Chelonians of North America, Part I (*Shufeldt*); Lucania ommata (*Welsh*); Apistogramma agassizi (*Heede*); The Water-fleas (*Tompkins*); Viviparous Fishes-in-general (*Stead*); Breeding the Striped Gourami (*Simpson*); Notes and news.

APRIL. The Surinam Toad (*Deckert*); Cichlasoma nigrofasciatum (*Brind*); Keeping Living Food Alive (*Innes*); Beware the Dragonfly (*Gordon*); An Electrolytic Aerator (*Putnam*); Water Lilies, Some Cultural and Historical Notes (*Pring*); Beef vs. Liver, notes and news.

MAY. Nanostomus eques (*Brind*); The Water Horse-tail (*Wobler*); Observations on the Chelonians of North America, Part II. (*Shufeldt*); I Became a Fancier (*Proctor*); A Peculiar Planorbis (*Breder*); Association and Color Discrimination in Mudminnows and Sticklebacks (*White*); The Hay Infusion Microcosm (*Woodruff*); The Bladderworts, notes and news.

JUNE. Observations on the Chelonians of North America, Part III (*Shufeldt*); Gambusia episcopi (*Brind*); The Wheel Animalcules (*Bade*); Sonnet to a Goldfish (*Burditt*); A Study of the Diamond Bass (*Trell*); The Brook Stickleback (*Barker*); Goldfish in China, Red-colored Water, Crappie Spawn in Washington Aquarium, and Society News.

JULY. A Big-headed Gurnard (*Fowler*); The Nesting Habits of Certain Sunfishes as Observed in a Park Lagoon in Chicago (*Hubbs*); Badis badis (*Brind*); The Paradise Fish (*Balleisen*); The Garden a Terrarium (*Breder*); Philadelphia Aquarium, A Fish Elevator, Akiyama Goldfish Farm, notes and news.

Society News

The West Philadelphia Goldfish Fanciers' Association meets on the first Thursday of each month (except July and August), in Hamilton Hall, 5236 Market street, at 8 P. M. Take any car to Market street, transfer to the elevated.

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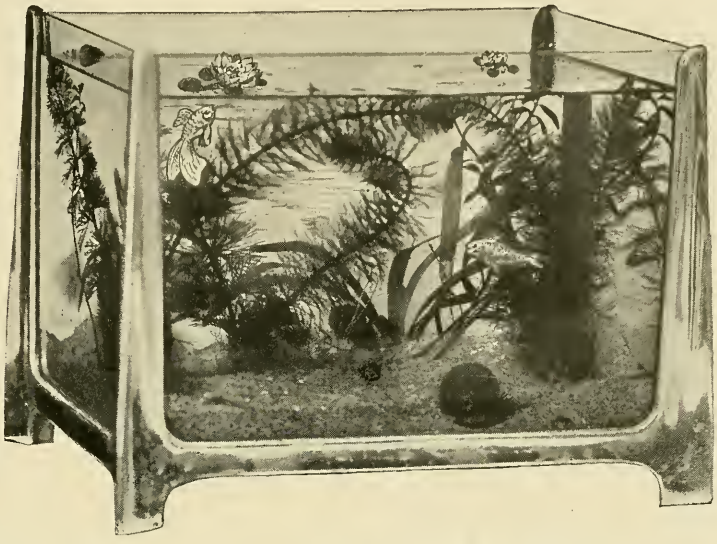

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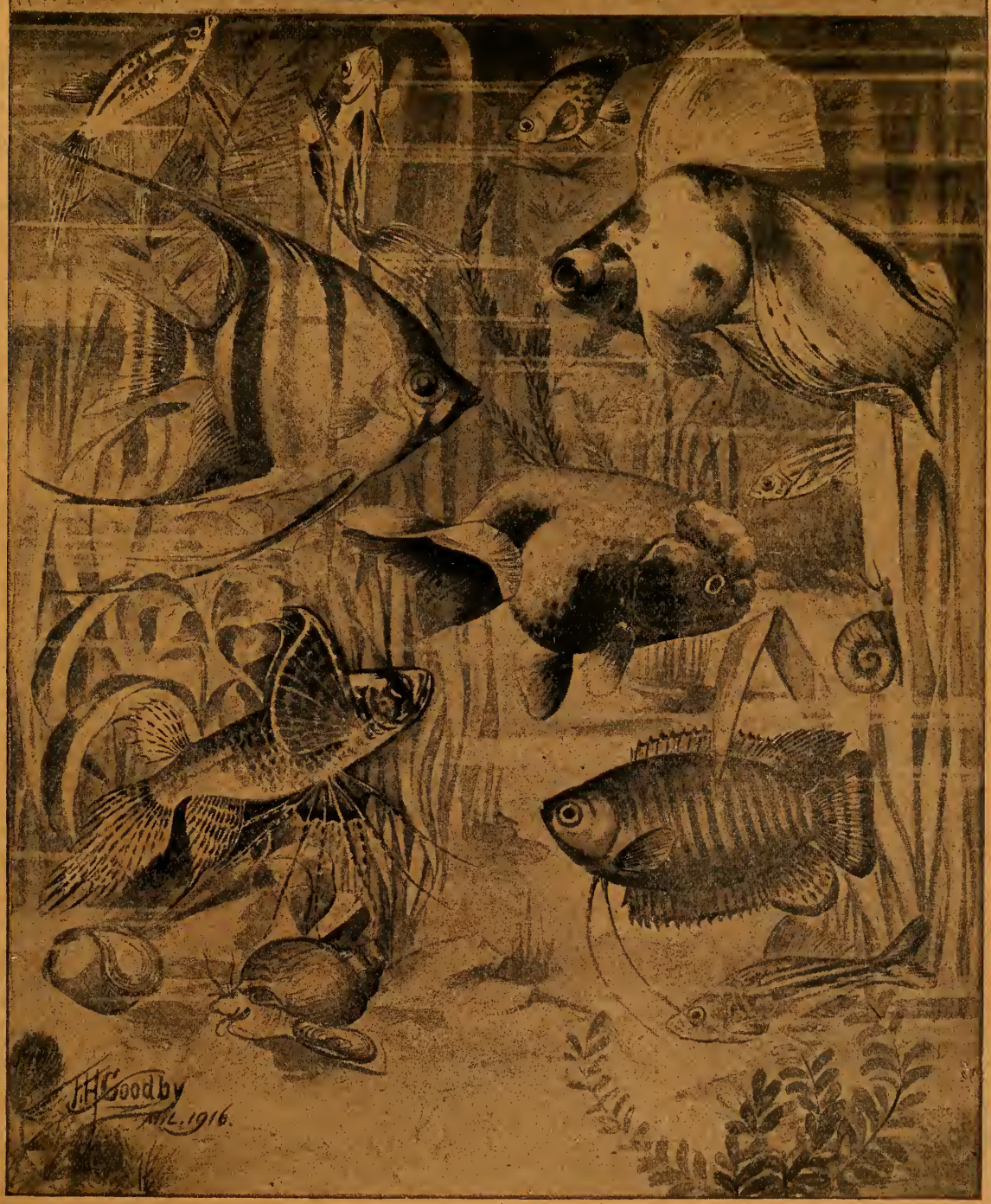
Aquatic Life



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W. A. POYSER.....EDITOR
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Popular and scientific artic'es and notes on subjects pertaining to the aquarium and terrarium, and to the habits of fishes in general, are always wanted for "Aquatic Life." Readers are invited to join in making it a medium of mutual help by contributing to it the results of their studies. The pages are always open to anyone having information of interest to the aquarist and student of aquatic biology. Manuscripts, books for review and general correspondence should be addressed to the editor.

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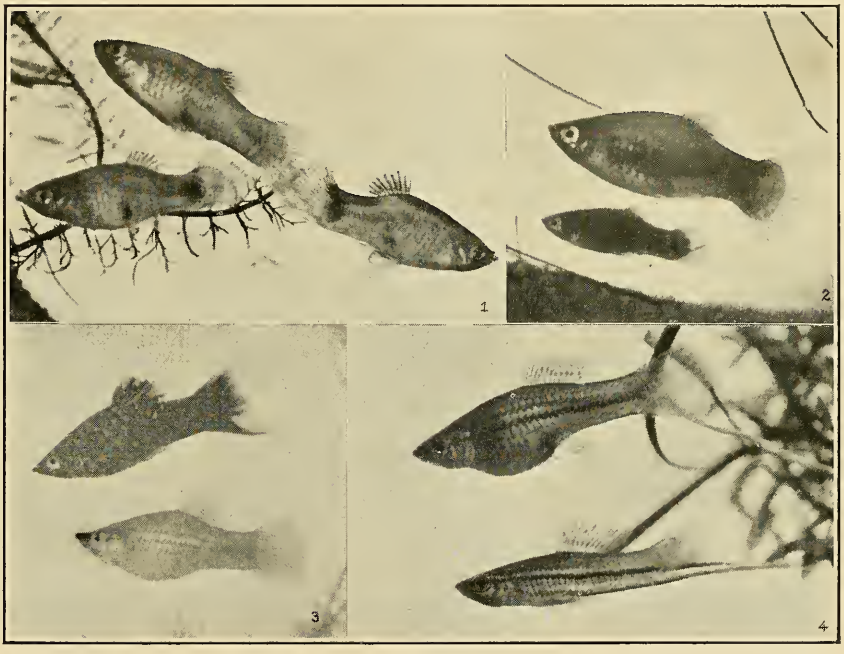
Platypoecilus maculatus

WALTER LANNOY BRIND, F. Z. S.



1. Platypoecilus maculatus. 2. Platypoecilus maculata nigra. 3. Hybrid from Platypoecilus maculatus rubra and Xiphophorus helleri. 4. Xiphophorus helleri, female above, male below. Photographs by Dr. E. Bade.

Down in the countries of Central America, in the same general localities frequented by the swordtails, we find the members of the genus Platypoecilus. These fishes resemble small, short-bodied swordtails, but lack their characteristic "sword," though some fine specimens of *Platypoecilus maculatus rubra* occasionally exhibit a tendency in this direction, and this without having been crossed with *Xiphophorus* which, by the way, is not difficult to accomplish. Meek in his work, "The Freshwater Fishes of Mexico," lists *P. maculatus, P. variatus* and *P. nelsoni. Platypoecilus quitzeoensis B.* A. Bean (1898) having previously been made the type of a new genus, *Zoogoneticus,* need not be mentioned.

Most of us are acquainted with *P. maculatus,* the first species of the genus secured by aquarists, and, in fact, unless we consider the variants developed by

aquarists as nominal species, the only one. The ground color of the common form of this little fish—the largest specimens never exceed two inches in length—is olivaceous, shading to pearly white on the belly. At the base of the tail is a dark crescent-shaped patch, and several similar marks about the middle of the body, all of which may be prominent or indistinct and in some specimens wanting. In the male the dorsal fin is russet-marked; other fins clear save that the anal of the female has a narrow black border. The first two or three rays of the anal of the male are modified to permit it to function as an intromittant organ. Some handsome males show a patch of metallic turquoise blue on the sides and occasionally a female is so marked.

Meek remarks that the color markings of this species are more variable than any other species he had examined. This is substantiated by the several forms now so well-known and distinct as to have been given names. The red form (*rubra*), is the most attractive. The bodies in both sexes are orange-vermillion in color, and most intense in the male. Specimens not marked with tiny black dots are considered most desirable. In *nigra* (sometimes incorrectly called *pulchra*), a velvety-black blotch, varying in size, appears on the sides, otherwise it is similar to the common form. In the aquarium it contrasts splendidly with *rubra*. In the spotted form (*pulchra*) the body color is cold straw overlaid with black spots more or less evenly distributed. Brunning, in his Ichthyologisches Handlexicon mentions but one species, *P. maculatus,* the others being considered mere color variants, and in this the writer concurs. The forms interbreed indiscriminately, and transient forms of all sorts are common in collections.

All the varieties are excellent aquarium fishes and will thrive and breed if the temperature is maintained between 70 and 80 degrees, Fahrenheit. The procedure is the same as with other livebearing species. Merely place the female, when she indicates by distended abdomen that a brood may be expected, alone in a small aquarium, providing plenty of plants. Make observations at frequent intervals, and remove the female when the fry arrive.

For the young the food par excellence is Daphne, following later with enchytraeids, but it is entirely possible to raise the young on prepared foods, making certain that the granules are suitable in size.

In some sections the aquarists call *Platypoecilus* the moon-fish, the forms being distinguished as red, black, blue and spotted.

Philadelphia Exhibition

The recent public exhibition of the associated aquarium and goldfish societies, of Philadelphia, held in Horticultural Hall, was quite equal to those of past years as far as the goldfish was concerned, while a new mark was established for exotic fishes, both in number of species and in the general excellence of the specimens.

Considering each aquarium as a unit originality was lacking save with one. This tank, with a simple, polished mahogany frame, was the gem of the show. In it several black-banded sunfish, Mesogonisteus chaetodon, swam unobtrusively among well arranged plants of several species, making a picture not to be forgotten.

The newspapers of Philadelphia were quite generous and not a small part of the attendance was due to this form of publicity, augmented by window posters and cards.

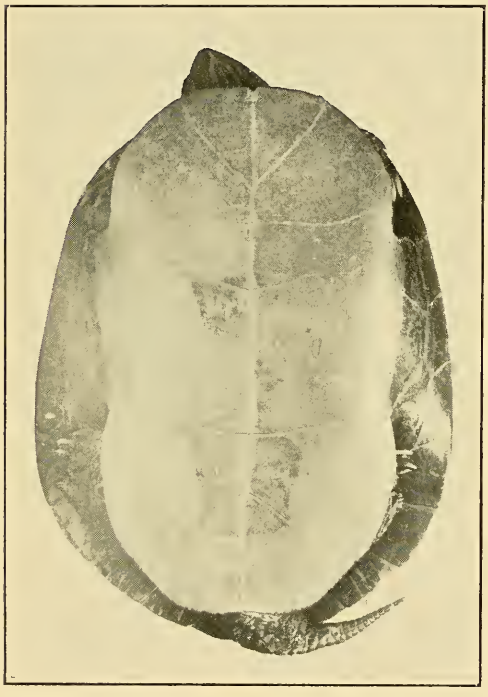
Observations on the Chelonians of North America. V.

DR. R. W. SHUFELDT, C. M. Z. S.

Large male specimen of the Florida Terrapin, *Chrysemys floridana*, seen upon ventral view and much reduced.

We have in the South a very remarkable terrapin that, in so far as I am aware, appears to be confined in its range to the Peninsula of Florida and Southern Georgia. It belongs to the genus *Chrysemys* and is known as *C. Floridona* or the Florida terrapin. This species I had never before seen alive until a magnificent specimen was kindly sent me by Mr. R. H. Young, of Haines City, Florida. Shortly after its arrival in excellent condition, at my home in Washington, I had the opportunity to examine some eight or ten other living specimens at the United States National Museum, which had been forwarded by a collector from Adel, Georgia. None of these latter, however, was as large as the young specimen, this having a length of carapace of over fourteen inches. That individual is now in the National Zoological Park at Washington, as is also the largest of the Adel specimens, the former having been presented by me after I had secured a number of photographs of it. One of these is here reproduced in Figure 1, taken on ventral view. All this part of the shell is pale yellow, and the

markings there seen are abrasions from the plastron having rubbed against the box in which it traveled from its Florida home. Several of the Adel specimens had the plastron beautifully blotched with intense black, the ground color being a very pale yellow. It will be remembered that the plastron in our Painted Terrapin is also yellow, and in the adult rarely has any markings upon it. (Fig.



Chrysemys picta *

2.) Sometimes in this species, however, the plastron is of a rich deep buff color, and may have some central markings upon it of a deeper shade.

No difficulty is encountered in identifying the Florida terrapin—that is, adult specimens of it, for it has the smallest head for its size of any other species in this country, while its carapace mounds up in a dome-like fashion that is unique, to say the least of it. This form of the shell is not fully developed until the animal is adult, younger individuals having the carapace much as we see it in other species of the genus. Florida terrapins, as a rule, have the carapace of a blackish brown color, sometimes marked with bars of a lighter shade. Centrally, the marginal scutes present a yellowish bar, but this character, too, may be quite dim. Its jet black head has fine linear markings of pale yellow, with a strong stripe of the same color running posteriorly from either eye to the neck. The stripes on the chin are much lighter or even whitish.

As to its habits, they probably do not differ very much from those of other species of the genus; still, we stand in need of some good account of these in nature, as there does not seem to be any such extant at the present time.

*The Painted Terrapin. Ventral view of a male, reduced. Presented by Mr. Edward S. Schmid, of Washington, D. C. Both specimens photographed from life by the author.

Daphne is scarce during the winter months, and not all of us find it convenient to collect the larvae of *Corethra*, but every aquarist can provide enchytraeid worms.

A box of any convenient size, partly filled with soil, kept constantly moistened with milk and water, and properly started with a "nest" of the white worms can eventually be made to yield a gratifying supply. Occasional small portions of mashed potatoes, oatmeal, corn starch pudding, unflavored, or bread and milk, will be the needed worm-food. This should be buried just below the surface. A little observation will determine the proper quantity and frequency of feeding. To gather worms, lay a slice of bread well moistened with milk on the soil, and a few hours later they will be found beneath it in little clumps, readily removed with small forceps.

Notes on the Life-History of Planorbis corneus and Other Freshwater Mollusks

WILLIAM T. WEBSTER, F. R. M. S.

At the previous meeting of this society I had the pleasure of bringing to your notice the occurrence of a red form of *Planorbis corneus,* and in stating the fact that many freshwater snails cannot live in association with the *Cypridae.* At the time I made this communication, I did not quite know the extent and scope of this society, and my remarks were confined to a few bare facts. I hope, tonight, to go into the matter more fully; but there are still several matters indefinite which I hope to clear up at some future date.

I do not make any pretensions to being considered an authority on the subject of freshwater snails; my interest is entirely centred in their utility as food for fishes. In this respect the subject is one of very considerable importance, and possibly this red form has a far greater value than any other, that is, if it be left to the judgment of fishes, and if after a trial, it may be found to improve the flavor of fishes as food for man. I am pleased to say that in fish culture circles, and in other directions, considerable interest is being taken respecting this snail. I have distributed quantities over a wide area, and there is probably little danger now of its becoming extinct.

In the early summer I had the pleasure of conducting one of your fellows to the pond where it was found, and you will be interested to know that we were able to find abundant evidence that the red colony was an old established one, and the snail had even acquired a local name.

With further material for study, many interesting features have been brought to light. Several specimens have been found with nearly white bodies and normal shells, and some have been discovered with red bodies and white or nearly white shells. Most specimens over one year old are completely perforated in the centre. In many cases the hole is quite small, whilst in others the perforation is large, and only the outer, or body, whorl remained. In the early summer all these perforations were neatly sealed —quite as perfectly as if done in a turning lathe, and there was nothing to indicate that they had ever possessed an apex. Later in the season, the sealing became ragged as further erosion took place. It is interesting to record that nearly every specimen with a large hole, if lifted carefully by hand, had a young *Sphaerium corneum* attached to the centre—the bivalve dropped away when a scoop was used for collecting.

On carefully examining the tentacles many peculiarities are observed. Some have both extremely long, slender and well matched. Some have one long and one short; the shorter is left or right indiscriminately. Some have two very short tentacles, stunted and conical. A few were found doing well, entirely without, and the places where they should have been were indicated by the merest suggestion. Some specimens have the left tentacles bifurcated, and these having been isolated and mated, all the young proved normal. None has been found with a single tentacle.

The mating of the red form with the normal always produces dark offspring, and if two of these dark ones are mated,

red progeny results; but I am not able to say to what extent this agrees with the Mendelian theory. Continual mating of the red considerably improves the brilliance of color. As before remarked, this red form is a sort of albino. I have been unable to find any satisfactory literature dealing with albinism in the lower animals; even the best authorities on fishes dismiss the subject with few words, and no attempt at explanation. Certainly, departure from the normal is productive of much change in the temperament of albinos and transitory albinos. They become more easily tamed, and lend themselves to domestication. The observation of a normal green and a golden tench is quite an object lesson, they differ in habits entirely. Also the difference of character exhibited by a golden and a white orfe will be instructive, as this carries albinism a stage further; nothing need be said of goldfish. In this way, the red *Planorbis* shows evidences of capabilities of domestication unknown in the normal.

Those of you who have read Fabre's monumental observations on insect life, will have been struck with the difficulties he encountered when trying to induce a lowly creature to vary its procedure in opposition to its instinctive habits. Other observers have claimed successes in overcoming the persistent efforts of these animals to retain their instinctive habits, and you will agree with me that it is highly desirable such observations should be carefully confirmed in every detail, before being brought forward as facts. It is obvious there must be some limit to animal resources, and that the creature only succumbs to interference when certain secretions become exhausted, and the animal is compelled to give up the struggle. Freshwater snails have an intelligence, and are capable of being taught to acquire knowledge apart from instinctive habits. The acquired can be interfered with without resentment, as snails in general are quite good tempered creatures; but when an effort is made to turn a snail aside from its instinctive desires, grave difficulties arise.

For the study of the freshwater snails small aquariums are not to be recommended. I find, I get the best results in a bell glass nearly 30 inches in diameter, the bottom filled with a mixture of sand and shell grit up to where the sides become vertical, and having a depth of about 20-in. of water. Such an aquarium should contain well established and growing plants—*Vallisneria* for choice, and should be capable of being rotated or inspected all round.

Jeffreys says, "Land and freshwater snails, as well as slugs, are for the most part herbivorous," also, "Several kinds of *Planorbis* (freshwater snails) yield, on being irritated, a quantity of their own purple blood; these are vegetable eaters." In the face of these definite declarations I feel some diffidence in raising objection to the accuracy of the statements; but I must, in the interests of truth, say that *Planorbis corneus*, and probably some others, are more carnivorous than herbivorous. In fact, I can scarcely imagine *corneus* being a vegetarian, if animal food is obtainable. In a pond there must be constant deaths of minute animals, and unimaginable numbers of tragedies from which the mollusc may obtain some share, and never be at a loss for animal matter. During the warm weather *Planorbis corneus* will devour incredible quantities of animal food, and it will grow faster and do better on a flesh diet than on vegetation. I have fed it upon animal food exclusively, tough muscular table scraps, and I have made every effort humanly possible to deprive it of

plant food, and in such circumstances it thrived exceedingly well, and attained a large size.

Turning to the subject of thread spinning, this can be observed and studied with certain success if a large aquarium, as previously described, is used. A self-supporting vessel is essential, as the water must not be disturbed, and the growing plants must be in sufficient profusion to keep the water from becoming foul with a small population of a hundred or more adults. When the snails have settled down, put in one large piece of meat, more than is likely to be consumed under two or three days, or renew in exactly the same place without disturbing the plants. Soon a vertical thread will be seen reaching from bottom to top and probably more or less attached at intervals, to some upright leaf of *Vallisneria*. This thread will be observed to gradually thicken as each snail in passing along it adds its contribution of slimy matter, and in quite a short time a rope of respectable proportions is formed, leading from the unconsumed meat to the surface of the water, where many ramifications will be found. This rope sometimes becomes thicker than the thumb of a man. There will be a constant procession of snails up and down the rope, and it is interesting to watch a snail leisurely travelling on the surface come into contact with one of the surface ramification lines. In an instant, the sluggish creature becomes alert and quickens its pace. As far as I have been able to judge there is never a mistake as to the direction, and in a little time the snail reaches the thick vertical rope and commences its descent. There is much interest centred here, as in a dense colony many snails may be on the rope, and a descending snail will not give way to an ascending one. The hungry snail clings tenaciously to the guiding line, and the repleted snail must give way. As the rope is usually somewhat irregular, and one side more or less attached to plants, there are places which offer a limited traveling surface, and only one snail can be in possession. When the conditions are ideal for observation, and the travellers many, much amusement will reward the observer.

Anyone who has read Fabre on the processionary caterpillar will remember he describes how these creatures live in large numbers in a common dwelling-house, and on leaving which, for feeding purposes, spin a thin line of silk. Each caterpillar in the procession adds its line to the existing one until it branches off on its own account, and these lines are used for the purpose of finding the way back home, just as a cord or rope would be used in the exploration of an intricate cave. There seems to be a curious resemblance of methods of snail and caterpillar, and this is the most remarkable seeing that a snail after a good meal, puts up with all sorts of annoyances from descending snails rather than leave the guiding line, although it has the power to float to the surface. *Planorbis corneus,* as is well known, can rise to the surface from the bottom like a cork, or sink like a stone, and it apparently has considerable control over the rate of fall and rise. In a deep aquarium a falling snail will frequently retard its progress very perceptibly as it nears the bottom, and a rising snail will often carry a piece of meat more than its own weight, without any visible difference to the normal rate of ascension, which shows there must be a considerable latitude of power. I have never been able to witness, when there has been no suspicion of interference, a snail voluntarily fall to the *bottom*, and ascend to the surface

again, either by creeping or otherwise. The return to the surface requires a long observation, as it remains feeding a considerable time. Apparently this is an instinctive habit and interference is resented. If the fallen snail is lightly touched it will discharge some air, and, if irritated to the extent of *complete* discharge, it will at once creep to the surface for a renewal. I was fortunately able, a few days ago, to observe a specimen of *corneus* in its second year, gently drop about nine or ten inches below the water surface or half the depth of the tank. It came to a momentary halt, and then floated back to the surface. In this instance, there was no interference in any way, and the snail had no assistance from a spun thread. This is the only case I have seen, although I have for years carefully watched the progress of every falling animal presenting the opportunity for observation. This is an important fact to record, as I have long thought *corneus* possessed some such power, as a fallen snail on reaching the bottom, often has some trouble to attach itself, and this act of *corneus* is particularly interesting to witness. This, and many other observations, are better seen with snails that have been in confinement a long time and have overcome their natural nervousness. Many snails observed whilst creeping from the bottom to the surface will, if gently detached when well on the journey, at once rise to the surface, but this experiment is the most successful with those which are educated to being frequently handled.

I regret I have never been able to satisfactorily ascertain the age a snail may reach, as most of my attempts have been more or less upset by the attentions of *Cypris,* nor have I been able to observe the number of eggs a snail may actually produce for the same reason. Two specimens of *corneus,* two years old, under observation from the first to the twenty-second of July this year, laid twenty-two batches of eggs, but when hatching began it confused further count.

The statement that freshwater snails are in the habit of creeping out of the water and on doing so die, is frequently met with in books dealing with the univalves, and observers are warned to provide covers for their tanks. This precaution is unnecessary if reasonable care is taken to keep the captives under proper conditions. A freshwater snail is a somewhat intelligent creature, and is capable of acquiring knowledge apart from mere instinct, and erratic movements on the part of the creature can only be interpreted in one way—ignorance is no excuse for cruelty. Aquarium keepers, no doubt, have had the misfortune to find a newly-introduced fish dead or dying, having leapt from its new home. The common minnow affords a good illustration. If this fish is put into a new home it is quite common for it to jump out, especially during the first night, evidently seeking its old quarters. If the tank is covered, in most cases for one night only, all danger is past and the fish settles down. Fish do not like changes—nor do snails. If an escaped snail is put back into its new home it usually accepts the situation if this is not impossible. When snails, which have been kept for some time, are found above the water line, suspicion is at once directed to the presence of enemies or foul water.

One species, *Limnaea pereger,* has had a name imposed upon it describing it as a restless creature, and as far as I can see, without just cause. Certainly, *L. pereger* exhibits characteristics peculiar to itself. It is the only freshwater snail I know of which can, and does, catch

little fish and tadpoles, and devours them. It is much sought after by the larger fishes, which take it greedily. It is common to see this snail just above the water line; but in every case I have investigated, it has been there to escape its enemies, and not from choice. Whenever this snail is found out of its element it is almost a certainty that the water, if good, contains predatory fishes. I have experimentally kept a number of specimens of *L. peregер* in a tiny dish, 2½ inches in diameter, containing under one inch of water, for some months. When first introduced, they all escaped over the edge in the night once, and one individual twice, and then settled down.

L. palustris behaves in much the same way in shallow water.

Snails subjected to constant transference from one vessel to another, get accustomed to changes, and make no attempt to escape. The various species of freshwater snails seem able to live together, in harmony, perhaps with one exception. Some time ago I placed a half-grown *L. peregер* in a small vessel with two dozen *P. corneus,* about two months old. Within twelve hours all the latter were dead, and I have not repeated the experiment.

Bateman in his book, "Freshwater Aquaria," says that *Neritina fluviatilis* will not live in confinement, and mentions the matter in order to save this snail unnecessary suffering. I have recently had a letter from a correspondent of repute, who tells me this snail has thrived for years in an aquarium. It is highly important that causes of failure should be sought for before definite statements are recorded.

As I have a good many *Planorbes* collected for me, I receive quite a number with injured shells, and consequently subjects for observation. Every injured snail I have had has been given a chance to live, and has been observed closely. *P. corneus* is seldom able to repair a serious fracture. Recently I have observed one replace quite a large piece of the outer lip, and in another case a brave but vain attempt was made to replace nearly the whole of the large whorl. In most cases a *tiny* fracture of the outer lip is given up in despair, and the animal dies. A fracture of the outer whorl, large or small, behind an intact orifice, *corneus* is utterly unable to repair. I have witnessed many attempts, and the animal always dies. A great many of the pond snails are eroded in numerous small spots, which in time become perforations, and in some instances mere pinholes. The death of the snail always occurs when the perforation becomes complete, no matter where situated. From this evidence, it is very strange to find the eroded apex of the red form so well mended as previously described.

As to the enmity of the *Cypridae;* this is a carefully ascertained fact, confirmed by very many experiments, and is quite beyond doubt. The matter can be easily put to test by taking some snail spawn and the weed to which it is attached, and placing this in a bowl together with *Cypris,* collected from a ditch. A control experiment should be made, carefully eliminating the crustacean. *Cypris* is almost ubiquitous; it makes its appearance even when the utmost care is taken to guard against it. There are numerous species of the *Cypridae,* and I am not prepared to admit that all are sinners. I prefer to suspect the smaller kinds, but in any case, the enemy is the one that is nearly always present. The larger kinds seem to be ignored by the snails. It is still a matter of doubt as to what takes place. From observations I have repeatedly made, I find the snails usually

imprison a foreign body in their shells and perish whilst waiting for the discomfort to pass away. Possibly something like this happens in the case of *Cypris* finding an entrance, and the crustacean is, by no means, a desirable prisoner. The larger kinds of snails are the chief victims of *Cypris—P. Vortex,* to some extent, and the smaller snails are able to escape the attentions of *Cypris*—possibly being so small there is little room for an entrance. When snail breeding all through a summer has been a failure, any snails hatching out at the advent of cold weather, when *Cypris* has disappeared until the spring, almost invariably live through the winter. It is quite distressing to witness the efforts made by snails to escape the tiny persecutor, and little snails may often be seen above the water-line in great numbers, trying to place themselves beyond the enemy's reach, whilst the larger snails attach themselves to a flat surface, and do not protrude their bodies beyond the protective limits of the orifice of the shell, and can be observed in this uncomfortable position for long periods.

To establish new colonies of freshwater snails, quite a small pond will produce immense numbers. A broad-leaved water-plant is usually chosen on which to affix eggs, and *Potamogeton natans* is probably one of the best. A few sticklebacks (no other fish) should be introduced for the purpose of getting rid of *Cypris*. The fishes may take toll of snail fry to some extent, but their services far outweigh other considerations. A handful of duckweed should be sown to carpet the surface of the water, and hide the snails from the ravages of water birds and other visitants. A pond such as described has been found extremely successful in several instances. —Read at a meeting of the *Malacological Society of London.* (Courtesy of the *Fishing Gazette.*)

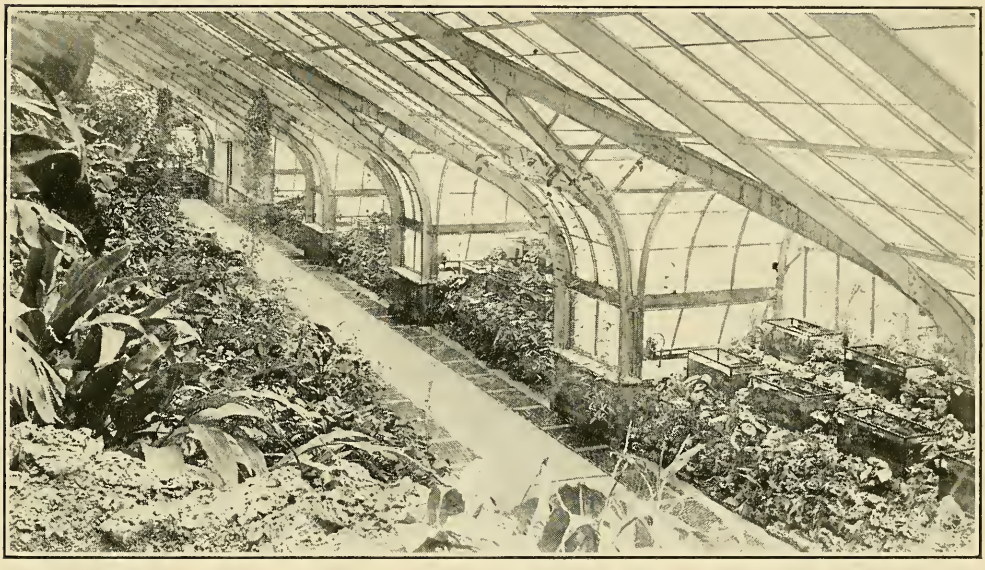
Naples Aquarium

Whoever visits Naples makes a mistake if he misses the great aquarium, the most complete in the world. Indeed, the world of science contributes to its support. Our Smithsonian Institution makes to it annually a donation of money. Here are to be seen the sea creatures of the Mediterranean, alive and content. In great glass compartments are the many swimming and creeping things that live beneath the surface of that semi-tropic sea. Separated are they from each other, because most of them agree about as do the lion and the lamb. Here we see a tank in which we behold a number of creatures that somewhat resemble a great brown shoe, with two glaring eyes in the heel. From beneath come eight arms that everlastingly stretch out and again contract, like India rubber. They project themselves, now here, now there; they grasp whatever they touch, they seize a bit of food, and then the arm contracts. Into the stomach beneath the eye of the creature it is irresistibly drawn. But while this is occurring the other arms are stretching in and out, are slipping up and down, are searching near and far for anything possible. The creature moves as though it too were a prey of these rubber arms which stick by rows of suckers to whatever they touch, and which have the power of grasping a man and drawing him down to the ocean's depths, as easily as they do an unfortunate fish This is the octopus, and the Mediterranean Sea is filled therewith.

Next we turn to a tank in which at first glance we see only rough stones and sand, but on closer examination we perceive that some of the rough stones are alive. They are fish that have the power of imitating the objects among which they lie, both in color and form. This one is reddish, that one is brown or black

or yellow, in accordance with the objects near at hand. Hideous creatures are they, lying there silently, awaiting a fish that fails to perceive that stones such as they have mouths. Now the sand moves, a darting creature rises from it, and then slowly settles down—to become sand again. It is a great flat fish that, now we have located it, is seen to lie so close to the sand, and to so nearly resemble it,

Go now to the market place in Naples. There we find the same hideous creatures—sold as food. Here are baskets of the octopus, the same rubber-like arms, the same glaring eyes. This basket may contain a number of small ones, that basket a few arms chopped off from a very large one. Here are the repulsive fish that resemble stones, there the transparent squids, next the cuttle fish,



Aquaria in the Conservatory of the Missouri Botanical Garden

as to make it impossible to tell where sand ends and fish begins. There are others about; we see their still eye looking upward, but no one can trace their bodies.

The next tank contains crabs, with legs two feet in length. There are tanks of coral, of sharks, of transparent squids, the cuttle fish, and hosts of fish and creatures of all colors, shapes, sizes and habits. The water is as clear as air, the creatures live before our eyes, the most instructive object lesson of the world concerning aquatic life of this most interesting sea.

not less unsightly. In fact, whatever the sea breeds, seems to be a food for man, or to feed upon man. It is a question, I take it, as to which is the stronger. Sometimes the man eats the octopus, again the octopus eats the man. Whoever travels as I am now traveling, needs leave his squeamish stomach at home. Ask no questions. Eat whatever others eat. That is good philosophy, and it is good breeding, too. Withal, it is but a difference in education. The man who eats the slimy oyster or the slippery clam needs not criticize him who considers the octopus a delicacy, nor yet should the

man who eats lobster be sensitive or impatient if his host serves him a not less ungainly horned creature instead. All of these appeal to divers palates in sundry degrees, so why quibble?—John W. Lloyd in *"The American Angler."*

Xiphophorus montezumae

The Montezuma Swordtail, recently illustrated and described as new (meaning new to aquarists, not to science), in a foreign journal, was originally described by Jordan and Snyder in the Bulletin of the United States Fish Commission in 1900 (p. 131, fig. 11).

The body of this species is a trifle deeper than the familiar *Xiphophorus helleri,* with the dorsal region somewhat elevated, suggesting *Platypoecilus.* The general color is yellowish-olive, with an indistinct lateral band. The scales of the upper part of the body have dark edges forming stripes. Occasional individuals have a dark blotch at the base of the caudal fin or a few such marks on the side. Caudal appendage, or "sword," bordered above and below with black, and approximately as long as the body. Length about two and three-fourths inches.

St. Louis Society

The Saint Louis Aquarium Society recently held a reorganization meeting at which all offices were declared vacant, new officers being elected as follows: *Chairman,* Paul Hohenstein; *vice-chairman,* James T. Westlake; *treasurer,* Frank Moran; *secretary,* John Wetzel.

Enthusiasm for a local public aquarium, quiescent for some time past, has been revived. To direct public attention to the movement, twenty-eight large aquaria, stocked with a wide variety of fishes, have been installed in the alcoves of a conservatory in the Missouri Botanical gardens. This was made possible through the generosity of Mrs. William M. Sloan and Messrs. Westlake, Nugent, Fox and Blair. Rearing and breeding tanks have been installed in another hothouse, which, with occasional presentations of fishes and plants, will serve to maintain the exhibition tanks at all times in attractive condition.—*Paul Hohenstein*

A high school professor, cleaning out his desk in preparation for the new scholastic year, discovered some old examination papers and, after much persuasion, agreed to make public some of the startling theories propounded by his biology students in their entrance examinations. A review of the papers revealed the following original facts—or rather discoveries: "The swimmerets of the crayfish are used for walking; the chelae of crayfish are modified to smile; fishes' eyes are not visible; fresh water fish will not live in water; the parts that make up the blood are the stomach and heart; all mammals' bodies are partially covered with air; the nervous system of the frog is a sympathetic one; the frog has a sense of speech; the frog takes in water which flows out just behind or near the ear; mimicry is the kind of animal that shoots out poison so as to escape without being hurt, as the skunk."

The freshwater shrimp is a cunning creature; it is quickly adaptive to the requirements of its environment. I once placed a single shrimp in a small bell glass aquarium with a small perch, and, although the fish hunted the shrimp for many months, it never succeeded in capturing it. The crustacean became very wily, and eluded capture by its extraordinary movements, which must have been to a large extent acquired under the novel conditions.—*W. T. Webster.*

Aquatic Life

1918—1919

SEPTEMBER, 1918. The Blood-fin (*Heede*); Breeding Haplochilus cameronensis (*Nelles*); The Spotted Gourami (*Kearns*); Japanese Snail (*Boyd*); Aquarium Water and Its Restoration (*Dormeier*); Aquarium Heater (*Hale*); Fish Foods (*Heede*); Happy Families, Breeding Habits of Mud-minnow, notes and news.

OCTOBER. Aquarium Heating (*Breder*); Hemiramphus fluviatilis (*Brind*); Mollienisia latipinna (*Heede*); Blue-tailed Skink (*Deckert*); Factors Controlling the Development of Tropical Aquarium Fishes (*Webber*); Snails in Aquaria (*Gale*); Habits of Black Bass, The Pipe-fish, notes, etc.

NOVEMBER. American Live-bearing Tooth-carps (*Bade*); Aquarium Notes (*Leitholf*); Notes on Krefftius adspersus (*Freund*); The Anatomy of the Fish (*Clark*); Breeding Habits of Burmese Eel (*Finckh*); A Bloated Axolotl (*Waite*); The Name "Water Flea," notes and news.

DECEMBER. Cynolebias bellottii (*Brind*); Tillaea recurva and Other Notes (*Finckh*); Another Tank Heater (*Kuhn*); Aquarist vs. Aquarian (*Mellen*); Emotions of Fishes (*Gale*); A Cigar Box Aquarium (*Modesto*); Florida Notes (*Carlton*); Photosynthesis, Miscellaneous notes, news, etc.

JANUARY, 1919. Limia caudofasciata (*Leitholf*); Classification of Fishes (*Stead*); Color Changes of the Chub-sucker (*Hubbs*); *Neetroplus carpintis* (*Brind*); A Simple Heated Aquarium (*Finckh*); Notes on the Breeding Habits of the Pigmy Sunfish (*Poyser*); Goldfish Farm of Kichigoro Akiyama, notes and news.

FEBRUARY. Polycentropsis abbreviata (*Brind*); Cho'ogaster cornutus, the Fish of the Dismal Swamp (*Welsh*); A Wood Aquarium (*Pilkington*); Danio malabaricus (*Leitholf*); Notes on Native Fishes (*Pray*); Managing the Aquarium (*Innes*); Reactions of Fishes to Habit-forming Drugs, The Boston Show, A True Fish Story, notes and news.

MARCH. Breeding the Goldfish (*Hanna*); Observations on the Chelonians of North America, Part I (*Shufeldt*); Lucania ommata (*Welsh*); Apistogramma agassizi (*Heede*); The Water-fleas (*Tompkins*); Viviparous Fishes-in-general (*Stead*); Breeding the Striped Gourami (*Simpson*); Notes and news.

APRIL. The Surinam Toad (*Deckert*); Cichlasoma nigrofasciatum (*Brind*); Keeping Living Food Alive (*Innes*); Beware the Dragonfly (*Gordon*); An Electrolytic Aerator (*Putnam*); Water Lilies, Some Cultural and Historical Notes (*Pring*); Beef vs. Liver, notes and news.

MAY. Nanostomus eques (*Brind*); The Water Horse-tail (*Wobler*); Observations on the Chelonians of North America, Part II. (*Shufeldt*); I Became a Fancier (*Proctor*); A Peculiar Planorbis (*Breder*); Association and Color Discrimination in Mudminnows and Sticklebacks (*White*); The Hay Infusion Microcosm (*Woodruff*); The Bladderworts, notes and news.

JUNE. Observations on the Chelonians of North America, Part III (*Shufeldt*); Gambusia episcopi (*Brind*); The Wheel Animalcules (*Bade*); Sonnet to a Goldfish (*Burditt*); A Study of the Diamond Bass (*Trell*); The Brook Stickleback (*Barker*); Goldfish in China, Red-colored Water, Crappie Spawn in Washington Aquarium, and Society News.

JULY. A Big-headed Gurnard (*Fowler*); The Nesting Habits of Certain Sunfishes as Observed in a Park Lagoon in Chicago (*Hubbs*); Badis badis (*Brind*); The Paradise Fish (*Balleisen*); The Garden a Terrarium (*Breder*); Philadelphia Aquarium, A Fish Elevator, Akiyama Goldfish Farm, notes and news.

AUGUST. Observations on the Chelonians of North America, Part IV (*Shufeldt*); The Steinhart Aquarium, with portrait of Ignatz Steinhart; Lebias sophiæ (*Brind*); The Senses of Fishes (*Herrick*); Marine Aquaria, An Epidemic Among Fishes, Manufacture of Pearl Buttons, etc.

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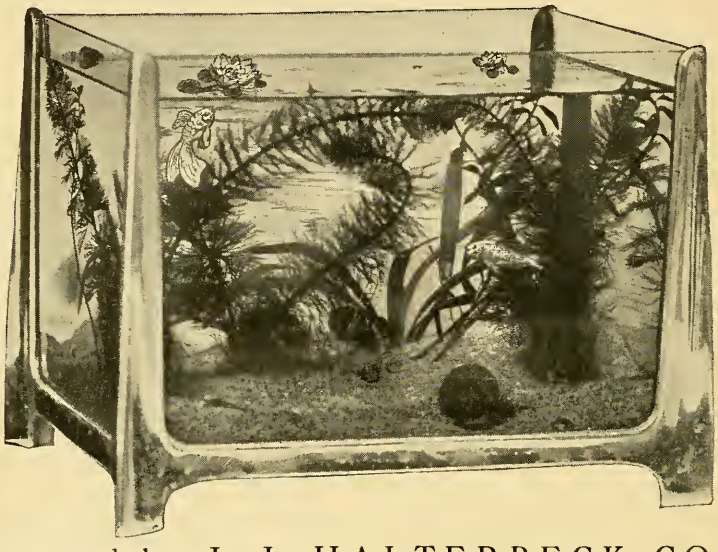

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