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AND PONDKEEPER

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Photo: N.Y. Zoological Society

Not a four-eyed fish, but an unusual one in having two holes at the top of its head. The Siamese head-breather is described in an article on page 85

VOL. XX No. 5 1955

Editorial

TWO articles in this issue are concerned with metals in aquaria, the approach to the subject by the two authors being along different lines. Mr. Laurence Sandfield deals with the interaction of water with metals under various conditions, and in his article he indicates those metals most likely to have adverse effects on fishes. Our American contributor, Mr. Earl Schneider, also presents information concerning the toxic effects of copper and copper alloys in aquaria, but gives his experiences of the employment of controlled amounts of copper as a mode of treatment of parasitic diseases in fishes.

As stated in his article, it has long been known that copper is an effective chemical agent against aquatic parasites, but it is a material which must be used with care since it definitely comes under the heading of one in which the therapeutic hazard may exceed the disease risk. However, Mr. Schneider reports satisfactory results using the metal, and his observations on the improved health and growth rates of fishes kept in the mild copper concentrations arising from its presence in suitable aquatic environments are of special interest. Further information is required about the possible disadvantages of copper in egg-layer fry rearing tanks, since not only may fry be more susceptible to its action but it may destroy their Infusoria food. Indeed, only last month we printed a letter from a reader which indicated that a copper clip in an aquarium had caused the deaths of zebra fish fry. The chemical condition of the water in this instance may, of course, have been conducive to considerable solution of the metal.

This gives another example of the value of knowing something about the water in which fishes are being kept, particularly if experimental procedures are being carried out or accurate investigations are being made. For this reason we are pleased to include an article on determining water hardness by Mr. B. Calrow in this issue; the method he describes is the simplest one available and as he shows, can be used by the amateur who is without knowledge of the actual chemistry involved.

News from the PUBLIC AQUARIA

Reported by RAYMOND YATES

NORTH Wales is coming into the news lately with a new club at Llandudno and an aquarium at **Colwyn Bay.** The latter is a private venture and is limited to about one dozen tanks. Even so it is reported that roughly two thousand people visited it during the Easter holiday.

Belle Vue Aquarium (Manchester) now has a piranha which seems to be a better specimen than the one at South Bank. It shows its teeth in no uncertain manner and feeds readily on heart, meat and whiting. There is a pronounced black edge to the tail. A specimen of this size brings about £13. Another interesting variety from Germany are some blue angels which came in a consignment of ordinary angels. They are identical in every way except that they are a milky white colour tinged with blue. I do not think they are as attractive as the normal variety. Yet another unusual fish s another German importation, the moonlight gourami (*Trichogaster microlepis*). This fish lacks colour, being a silvery cream, the main feature being the exceptionally long ventrals which trail horizontally a good inch or more beyond the tail. Some marbled anabas were covered in white patches and were under treatment. Each about two inches long they were in a five gallon tank to which had been added about 250 mg. of aureomycin. This quantity costs about four shillings. As far as could be seen slow but steady progress was being made after a week's treatment.

I also saw some very large firemouth cichlids which had been shipped from Germany and suffered in transit. Almost all had received nasty knocks on their foreheads and their tails had been badly torn, but all these troubles had cleared up once at the aquarium. Some time ago this aquarium had some glowlights which grew up without tails. Many were thrown away but some were retained and at last growth commenced. Complete tails resulted in about four weeks. A new lion fish has been obtained and this shares a marine tank with the original lion fish, trigger fish, etc. A very large Malayan angel in this tank does not hesitate to brush against the lion fishes at very frequent intervals with no harmful results, and they, on their part, seem quite unperturbed. There seems to be more than one variety of lion fish, which, at this size bring about £6. Some rainbow characins from Africa appeared to have brought disease with them as all died within a few days, as also did some *lineatus* with which they were placed. I saw a large number of neons in quarantine, a wise move until it is certain that no trace of neon disease is present. A new idea was in use here for giving details of the fish on view. These had been typed out by stencil on black paper and were viewed by the public with a light behind the paper. The stencilled portion showed up clearly.

The aquarium at the Tower, **Blackpool** has been slightly enlarged and there are now about 33 tropical tanks apart from the usual cold water and marine tanks. Admission to the Tower building (2s. 6d.) includes admission to the aquarium so there are always plenty of visitors. The marine tanks were well up to the fine standard set by this famous aquarium as also were the cold water tanks, although there were only five of these. Few of the coldwater fish are under twelve inches long and I saw over two hundred good specimens of rudd, roach, dace, chub, perch, bream, carp, hi-goi, orfe, tench and golden tench, trout, bass and even sticklebacks. The trout had been reduced in number to about 30 but a new feature was a community tank of bass. A branch of a tree in one tank failed to give the desired effect as it was covered with an unpleasant fuzz. Another new feature was a small pool with four crocodiles, some lizards and quite small terrapins together with the inevitable hot house plants including the now popular rubber plant. The tropical tanks contained many choice fish at the time of my visit but this was at the time of the annual cleaning and re-setting period and many were not well cared for and were dirty or covered in unsightly blue-green algae. One of the reasons for this is that most tanks were very thickly planted with Indian fern. The South Bank aquarium gets over this difficulty by using many fewer plants per tank, and yet retains the effect. One tank of angels was so thickly planted with Indian fern that the fish could hardly move. Filters would have been useful in some of the tanks. I also noticed seven tanks with no names of the fish on view. Specially interesting were some really large blind cave fish, an anabantid tank which contained all the popular members except fighting fish, a tank of beacons and *H. pulcher*, another of harlequins and large scissor tails and some very good *T. ladigesi*. There were also some fine ruby barbs, tigers and rosy barbs, and also some superlative rosaceus. A pair of *Astronotus* were quite nine inches in length and an eight inch black shark appeared at home. A feature was some very long *Cabomba*, surely yards long, and also bacopa and water clover 18 inches high. The rockwork and strata used is very good. There were a number of six inch cichlids on view such as Jack Dempsey, festive, jewel, blue acara, etc. The total number of tropical fishes was about 500 and I counted some 55 species. The average number of fish to a tank was about fifteen. This aquarium is well worth a visit.

One of the most popular show places in the North is **Chester Zoo,** situated in delightful country within a fourpenny bus ride of the city centre. Admission is 2s. 6d. with a further charge of 6d. for the aquarium and a further 6d. for the reptile house. Parties can obtain reduced rates. The present aquarium is the second such structure at the zoo, the present building being completed in 1952. At the time of my last visit there were some 80 tanks, comprising 57 tropical, 21 coldwater and two marine with a further 60 reserve tanks back-stage for breeding and conditioning. The building is laid out inside in the form of a letter E, the overall length of all the tanks on view being around 337 feet. Natural lighting is provided from an all glass flat roof which results in a much better effect than from electric lighting. I counted approximately 80 varieties of fishes numbering something over five hundred specimens. Most tanks were very well populated although about a dozen had not more than two fish on show. A rather unusual feature was the fact that 99 per cent. of the plants in use were *Cryptocoryne*, all good plants. There was one fine Amazon sword but coldwater plants were conspicuous by their absence. The fish seemed in excellent fettle but nearly half the tanks were in need of a thorough spring-clean and one or two were really bad as a result of blue-green algae, sediment and neglect. A point against this aquarium is the fact that it has been built immediately opposite to the main entrance to the zoo and the noise of school parties leaving, assembling or even arriving becomes rather distracting. Some good rockwork is used for decoration and I also noticed fan coral and coal being used with effect. One large tank contained half-a-dozen enormous terrapins who shared their quarters with blue acaras and swordtails. A 12-inch hi-goi appeared to have lost both eyes, the sockets having contracted to tiny holes. This large fish seemed quite as adept as any blind cave fish in cruising round its quarters. A small lobster was an attractive marine item as also were special tanks displaying *Hydra*, planaria, etc.

The Fish with Holes in its Head

by JAMES W. ATZ
(Assistant Curator, New York Aquarium)

IF, in a game of charades, you were called upon to act out the word "fish," the chances are that you could make yourself most recognisably fish-like by looking wide-eyed while you puckered your lips and with them made motions as if blowing bubbles. Even persons whose acquaintance with living fish consists solely of a glance or two into a goldfish bowl would identify the unblinking eye and constantly opening and closing mouth as characteristic of the fish. In fact, so many people have noted how fish continuously take in water through their mouths that when we want to describe a heavy imbiber of our own species we say that he drinks like a fish.

Of course, most of us know the fish is not drinking all that water. Rather it is breathing it. Just as we must regularly take air into our lungs, so must the fish keep a continuous supply of water passing over its gills. But the differences between the breathing of man and fish embrace more than the dissimilarity between lungs and gills or air and water. In man the air enters the lungs by way of either nose or mouth and it leaves by the same two confluent ways, while in fish the water can enter only through the mouth, and it leaves the gills by an entirely different route, passing out under the gill-covers on either side of the rear of the head.

There are, however, so many different kinds of fishes—some 25,000 or more species—and so varied are they in structure and way of life, that the ichthyologist is not surprised when he finds exceptions to almost every generalisation that has ever been made about them. For example, there are a number of fishes that breathe air, like terrestrial animals, instead of water. Many of these drown if kept under water and not allowed to come to the surface to gulp air. Then there is a handful of fishes in which the nose communicates with the mouth. (The typical fish nose consists of a U-shaped tube, both ends of which communicate with the outside of the body). In these the nose may be used for breathing as well as smelling, the latter being its sole function in the vast majority of fishes.

The New York Aquarium recently acquired another outstanding example of a fish with peculiar methods of breathing. Although it possesses gills like any ordinary fish and breathes water, too, it can do this without taking any water at all into its mouth.

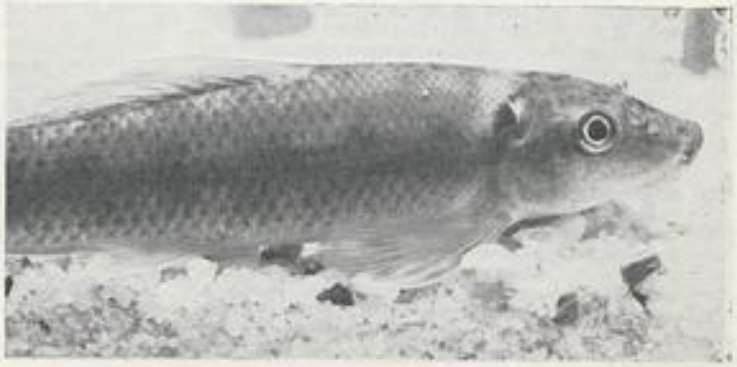
So far as we knew, this fish had never been kept in captivity before outside of its native Thailand, and had never been assigned a popular name—except for some local Siamese ones given to it. Its scientific name is *Gyrinocheilus aymonieri*. In order to provide the fish with a more descriptive, if no more euphonious appelation, we decided to call it the Siamese head-breather. As pointed out before, most fishes are mouth-breathers; the fact that *Gyrinocheilus* is not, is its greatest claim to ichthyological fame.

Looking at the Siamese head-breather for the first time, one is not impressed by any outstanding peculiarity in form or behaviour. Certainly it would not appear to warrant the distinction of being in any respect "the most remarkable of Oriental fresh-water fishes," as Dr. Hugh M. Smith, the great authority on Siamese fishes, once called it.[1] The fish looks and acts as if it were one of the many suckers that frequent the bottoms of streams and lakes of North America. Only an expert would be aware of the differences in conformation as well as fin and mouth structure that show that despite its rather sucker-like mouth and shape, it is not a sucker at all.

Its outstanding structural peculiarity might pass unnoticed, even though it is apparent once it has been pointed out. Behind each eye, just above the gill-cover, is a good-sized opening which seems to lead straight into the head. In our three-and-one-half inch specimen, each of these openings was slightly more than an eighth of an inch in its greatest dimension.

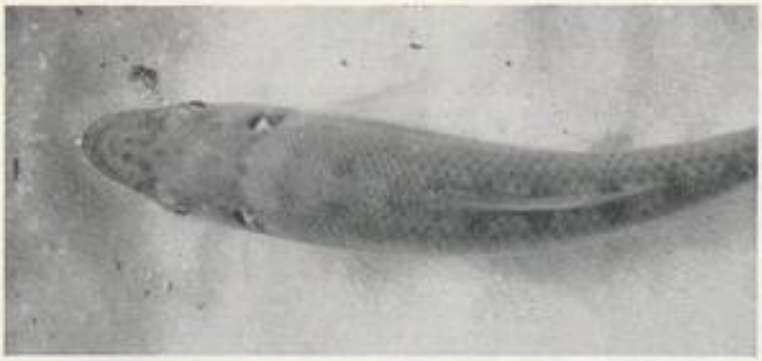
Just inside is a membranous flap of skin that undoubtedly acts as a valve, for it may be seen rapidly moving back and forth when the fish is breathing. At the same time, a thin flap running along the edge of the gill-cover, which lies directly below the opening, also vibrates so that it rapidly opens and closes the narrow slit separating the gill-cover from the body. Water for respiration enters the two openings and passes forward to the anterior limit of the gill chamber. Then it flows down and back over the gills, being drawn out through the opercular slit by means of the vibrating flap along the gill-cover's edge. Not much water can be drawn in through the two openings, but the extreme rapidity with which the opercular flaps move seems to compensate for this. As many as 240 back-and-forth move-

In its original form this article first appeared in "Animal Kingdom" in the May-June issue this year



The extra hole in this fish's head may be seen as a light grey vertical ellipse just in front of the combination black-and-white spot in line with the fish's eye. The opening lies between the eye and the spot. Here it is seen closed by the valve.

Photo: *N.Y. Zoological Society*



This top view of the Siamese head-breather shows the openings through which it respires clearly. Water entering these passes over the gills and leaves under the gill covers. In nature this species reaches a length of about 8 inches. This specimen, however, was only 3½ inches long.

Photo: N. Y. Zoological Society

ments per minute have been counted.[1] Apparently the head-breather cannot breathe in an ordinary manner, that is, through its mouth, even though that organ is still connected with the gill chamber on either side of the head.

The utility of this arrangement is obvious, once the head-breather's habitat and feeding methods are considered. The fish lives primarily in mountainous streams, and even when in an aquarium of standing water can be seen clinging to the bottom or sides by means of its sucking mouth, all the while breathing water through the two extra holes in its head. The ability to fasten itself to a rock for extended periods must keep the head-breather from being washed downstream by the torrential flow of water in its native streams. Moreover, it feeds exclusively, or almost so, on algae scraped from the surface of underwater stones. Here, too, the fish can occupy its sucking, scraping mouth entirely with food-getting while respiration takes care of itself. Like many other vegetarian fishes, the head-breather's intestine is long and coiled to allow ample space and time for the slow digestion of tough plant materials.

All this makes the Siamese head-breather and its close relative, the Bornean head-breather, *Gyrinocheilus pustulosus*, unique. No other fish exhibits such inhalent openings to the gills. Because of them and certain other more-or-less associated structures, ichthyologists have put these two species into a family of their own.[2]

Our specimen of head-breather came from one of the tanks of Mr. Sol Soberman, a Bronx County fish fancier. Mr. Soberman had recognised his fish as a queer one, but it was our head tankman, Mr. Joseph R. Armstrong (for whom the gold tetra, *Hemigrammus armstrongi*, was named) who identified it as a real rarity and urged Mr. Soberman to present it to the Aquarium. Mr. Soberman's fish apparently was the only one included in a large shipment of Oriental tropicals imported into the United States. Sometime later, in 1954, a number of additional head-breathers were successfully brought into this country by the well-known collector, M. Henri Rabaut.[3]

One of the most remarkable things about the Siamese head-breather is its ability to thrive in small standing aquaria. This faculty, which is highly unusual for a fish used to swift flowing waters, finds at least a partial explanation in the fact that the fish is not confined to mountain streams in nature but also occurs in still waters. Nevertheless, the aquarist must consider himself fortunate that this is indeed the case. More head-breathers will undoubtedly turn up, and when they do, they should easily be maintained both in the laboratory for study and in exhibition tanks for the public to see.

1 Smith, *Bull. U. S. Nat'l Mus.* (188) : 281-285, 1945.
2 Ramaswami, *Proc. Nat'l Inst. Sci India*, 18 (2) : 125-140, 1952.
3 Wolfsheimer, *Aquarium Journ.* 26 (6) : 137-139 ; 144, 1955.

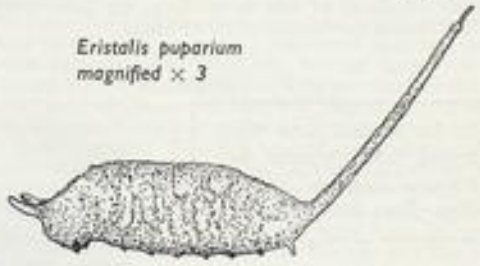
FRIENDS & FOES No. 38 (contd.) Rat-tailed "Maggot"

AFTER a few weeks as a larva, the rat-tailed maggot climbs sluggishly out of the water and pupates-attached to the soft muddy bank, or on a leaf or twig.

The puparium (outer case of the pupa) is sufficiently like the larva to be easily recognisable for what it is. Unlike many flies (gnats, mosquitoes, midges, etc.) the pupa remains motionless while the parts of the imagine develop. Frequently they can be found floating on the water surface, at the mercy of wind and current, and I am not certain that those found in such positions have not pupated at the surface instead of climbing out of the pond. It could be, of course, that they got out and failed to remain attached to the bank.

The flies which emerge from the puparia are handsome, bee-like creatures, and are excellent hoverers, haunting the vicinity of both cultivated and wild flowers. They are said to feed upon the nectar within the flowers, and may be responsible for a certain amount of pollination as they feed.

I have tried feeding rat-tailed maggots to several species of fishes, but they are not relished by any of them, and are more usually rejected than accepted. They are useful scavengers, but their presence in quantity in any body of water indicates unwholesome conditions, likely to adversely affect fishes.



Eristalis puparium magnified × 3

C. E. C. Cole

Tiger Barbs in a Community Tank

by V. ARLINGTON

Photo: Laurence E. Perkins

TIGER barbs are good community fish and their ways delightful to see. One evening I saw a comical but marvellous sight. A pair was in their favourite playground down on the left front of the tank. From the other side of the room they seemed to be standing on their scarlet ventral fins and looked ludicrously like two Victorian ladies chatting. Their colouring was wonderful; their silver-golden black-banded bodies flushed with a soft pink, glowed as if they had lighted candles inside them.

I went over and watched them through a magnifying glass. They stood mouth to mouth as if kissing each other, not glue-ily like gouramies, but with mouths lightly touching. They remained so for some time, then, with a quaint sedateness, began moving their heads from side to side, touching each other's cheeks as if kissing French fashion. They seemed very calm and presently gently swam away.

This particular tank was set up six years ago. I used tap water, and waited three weeks for the plants to establish before introducing the fish. Because I was impatient, I lost more tiger barbs than any other fish except perma black mollies. Youngsters lasted two, three, four weeks; older ones a little longer. Gradually, I had more success with them, for they and mollies like old water. Indeed, they have proved to be hardy, remarkably disease free and adaptable.

They like a well planted tank but when, for purposes of study, it was allowed to become decidedly sparse, they did very well. They like a water temperature of around 75° F. but if, owing to heater defect or power cuts, the temperature has fallen considerably, they have been unaffected. They do not like too many companions. They are easy to feed. They like most dried foods; like live foods, adore shrimps' eggs, raw liver, meat or fish, especially if they can snatch a bit torn off by other more industrious fish. They mightily relish their own eggs. Once at 4 a.m. I switched on the aquarium lights. The male began driving the female and they (and others, of course) greedily ate the eggs she scattered.

Tiger barbs stay in the bushes at night and enjoy brief daytime spells there, too. But usually they are well in the open and their scales gloriously reflect the light as they almost stand on their heads when eating food off the bottom, or rest on the glass. This is a particular habit of theirs. They usually rest high up on the front, head slightly pointing downwards. A pair resting together often slightly overlap and from across the room, look like a gorgeous opalescent butterfly. They stay motionless so long I used to investigate to see what was wrong, but when they are ready they cruise away. Probably they do it to get away from other fish for tiger barbs like their own company and make this clear to intruders.

For some time I couldn't understand why they were said to be very high-spirited and fin-nippers. Apart from a passing jab at others—which is the way of fish, anyway—they seemed averagely peaceful and no fins were torn. As for high spirits, they couldn't compare with harlequins when they went gay. But observing them in community tanks and by themselves it seems that among youngsters one might harry a victim, while older ones can be decidedly truculent and in a few cases, develop into merciless bullies.

I had a two-year-old female which took a sudden dislike to her mate. She would not leave him alone and bullied him to death in three weeks. Then, with peaceful interludes between, she bullied in turn a *Barbus schuberti*; a 3½ years-old black widow (which may have served her right for she had done more to frustrate my efforts at community tank breeding than any other fish), a lace-tailed guppy, and a gravid flame fish which so spiritedly returned her attacks that the tiger barb was glad to skulk behind the plants.

At first, when youngsters are added to the tank, the older ones find their persistent tailing annoying but after a few jabs at them they are all right. Give them a bunch of shrimps' eggs and they will soon be playing with it together on the bottom. If other fish come too near the older ones will quickly "shoo" them off. No one is going to butt in on their family party!

So far it seems to me that while youngsters can be prankish the older ones sometimes get up to definite larks. In one particular instance they gave point to the question ever in my mind when watching fish: Do they, can they, think? Not as we do, of course, but according to their stage of evolution and the world they live in. Such a query usually begets derisive laughter which, for the most part, seems merited. But now and again there seems an exciting possibility that, if they cannot think, at least fish know how to put their heads together, as the following incident shows. It happened when I got a male for a female which had been on her own for some time.

When introducing new fish to the tank it is interesting to watch for reactions and see how quickly they recognise their own kind. In this case recognition was instant. Almost before the jar was immersed to equalise water temperature, the female was up and down the sides trying to get to him, while he was nearly frantic to get to her. The moment I tilted the jar he was out and they swam happily around the tank together.

This annoyed a male serpae tetra resting in the *Myriophyllum* about two-thirds down, near the right hand side of the aquarium. Each time the tiger barbs came near he flicked round, darted between them and his vicious jabs scattered them in opposite directions. Then grumpily he returned to his lair in the *Myriophyllum*. This happened many times. I stopped it when the serpae began nipping their scarlet fins. They were far too lovely to be tattered. For some time the tiger barbs stayed peacefully at the left

top of the tank. Then they came slowly round to the front. Instead of trying to avoid the serpae as before, they deliberately swooped right under him, almost shaving his tail. The enraged serpae rushed out, snapping viciously at them. They separated and streaked gleefully out of reach.

They did this four times. Each time the serpae rushed a little further across the tank. The fifth time he rushed clear of the plants, and apparently this was what the barbs wanted. For in a swift and lovely movement they opened out, closed in on him like gangsters, jabbed from both sides at once and soundly slapped him with their bodies. The serpae fought back; darted up, down and round in evasive action but finally fled to safety in the *Myriophyllum*. Did the tiger barbs plan that lark when they were staying quietly at the top left of the tank? If so, which one had the idea and how did it communicate it to the other? For surely everything in the universe must be able to communicate with its kind, either by vibration and possibly other means not yet known to us.

Once more the barbs came round to bait the serpae but, fearing damage, I switched off the aquarium lights and sat over the other side of the room to watch. The room was now lit by only one low standard reading lamp, which left the back of the aquarium in darkness and made shadowy outlines of plants and rocks against which the reds, blues and yellows of the fish—even the sheen on the black swords—stood out sharply as they came to the bow front. I was watching the harlequins which usually stay high up towards the back, come right down front, when a flash on the bed at the left caught my eye. It was the tiger barbs apparently darting savagely at each other.

I switched on the aquarium lights and saw their incredible loveliness. They were head to tail, like a jewelled bracelet, going round and round as they do when courting or playing. They went faster and faster, reaching such a speed that they churned up the bed. Then away they flashed, to the top, bottom, front, back—all over the tank, playing the most amazing antics, leaping over each other at lightning speed as if having a hilarious game of leapfrog. The other fish gave them the stage, as they always do at such times. At last they sobered down. They went up to the light and looked indescribably beautiful as they rested on the front of the glass. Who can say at such times that the male is lovelier than the female? They didn't move for a long time and I was able to have a long look at them through the magnifying glass for signs of physical reaction after such exuberance.

Maturity only ripens their loveliness, unlike the black widow, for example, which gets wishy-washy with age (although aged black widows occasionally astonish one by sporting the deep black and silver of youth), so that it is well worth tolerating their mischievous spasms and an occasional torn fin on a victim. But their beauty can be disadvantageous, too. If one is trying to achieve a particular effect it can upset the balance; it certainly detracts from the attractiveness of less showy fish, and tiger barbs are most distracting when one is observing the ways of other fish for they cannot help stealing the limelight.

British Aquarists' Festival — 5-9 OCTOBER 1955

CASH prizes and the finest aquarists' trophies in the country are to be won by societies at the British Aquarists' Festival this year. The event is staged by the Federation of Northern Aquarium Societies in collaboration with *The Aquarist*.

Classes

Classes 1 to 5 are open only to societies.

Class 1. **Tropical Furnished Aquaria.**
Class 2. **Coldwater Furnished Aquaria.**
Class 3. **Six pairs of any Tropical and/or Coldwater Fishes.**
Class 4. **Display only.**
Class 5. **Complete exhibit** (being a combination of Classes 1 and 2 and Classes 3 and 4).

Societies can make entries either in Class 1 or in Class 2 but not both.

Class 6. **Pair of any variety of livebearer.**
Class 7. **Pair of a.v. coldwater Zsh.**
Class 8. **Pair of a.v. cichlid.**
Class 9. **Pair of a.v. labyrinth** (except *Betta splendens*).
Class 10. **Pair of** *Betta splendens*.
Class 11. **Pair of a.v. barb.**
Class 12. **Pair of a.v. characin.**
Class 13. **Pair of any other variety of tropical fish.**

In Class 4 judging will assess the staging and layout generally of the society's entry and will not take into account the quality of the fishes in the seven aquaria. Floor space measuring 12 feet by 8 feet will be allotted (an island site if required) for each entering society and this is to be made as attractive as possible by any means at the disposal of the competitors.

Show schedules can be obtained from Mr. S. W. Cooke, Spring Grove, Field Hill, Batley, Yorks. **Closing date** for entries will be midnight **29th August.**

An attractive display of grouped entries by the Urmston and District Aquarium Society at last year's F.N.A.S. Assembly

Copper in the Treatment of Diseases

by EARL SCHNEIDER
(New York, U.S.A.)

I WOULD like to outline some experiments I have performed and their results, involving the use of metallic copper in the prevention and treatment of various fish diseases and in general aquarium management.

In order to give a more lucid explanation it will be necessary, however, to review briefly the use of copper sulphate solutions in hatchery management. For many years copper sulphate has been recognised as a tool in the treatment of various diseases of fish. Although the widespread use of copper sulphate is evidence of its serviceability, its shortcomings are also well known. For example, there is very little margin for error between an effective dose and a toxic overdose. The effect upon fish varies greatly with differences in water conditions, such as the calcium content. The reaction to copper sulphate varies according to type of fish, their size and also their general condition. Certain species are more susceptible to injury from an excess of copper sulphate than are others. A fish in a weakened state might succumb to a treatment that would not affect a more vigorous one.

In spite of these drawbacks, copper sulphate has continued to be used because of the wide range of organisms against which it is effective, its relatively low cost and the ease of application. Among aquarium fishes, with their relatively high unit cost, greater over-all delicacy and the crowded conditions under which they are kept, copper sulphate has proved too toxic to come into general use. Add to the aforementioned the fact that frequently many different species of fish are kept together and that different species vary in their reaction to copper sulphate.

Using Metallic Copper

I felt that our inability to make greater use of copper sulphate was unfortunate since copper is so effective against many of the parasites that affect aquarium fishes, parasites for which other effective treatments have not yet been found. About seven years ago I began to experiment with metallic copper in the form of sheets or sponges and also with copper pennies. The advantages of using these instead of copper sulphate result from the fact that the amount of dissolved copper in the water is gradually built up, rather than started at full strength. Here are the various advantages of using metallic copper:

1. The fishes became accustomed to the gradual accumulation of dissolved copper and can tolerate a much stronger amount than they could otherwise.
2. By observation, it can be determined which fishes are reacting adversely to the copper and they can be removed before any extensive damage has been done.
3. By observation it can also be determined when a sufficient dosage has accumulated and treatment can then easily be stopped.
4. When the metallic copper is removed, the copper in solution "precipitates out" rapidly, thus obviating the necessity for extensive water changes.
5. The use of copper in this manner has proved more effective against various parasites, because freed from the fear of overdosage, the aquarist tends to employ stronger concentrations of copper than could otherwise be permitted.
6. Since this treatment is effective against a wide range of organisms, is most simple to administer, and apparently has no harmful effects on fish, it can be used when there has not been a positive determination of the causative disease organism and very frequently it shows astonishing results.
7. When a small amount of copper is kept in an aquarium, the fishes are healthier, grow faster and suffer less mortality than controls kept under comparable conditions but without copper.

Standard Method of Treatment

Frequent use of this treatment has enabled me to standardise the method. First of all, certain conditions must be considered for proper usage and to avoid dangerous concentrations. Water hardness does not seem to affect the treatment, but the proper determination of pH is important. If the water is acid, it must be adjusted to a pH slightly above neutral, 7.2 to 7.4 being satisfactory. A pH greater (more alkaline) than this will also give satisfactory results, but adjusting the pH over a greater range may have in itself harmful effects on the fish. Using metallic copper in an acid medium appears to increase the rate at which the copper enters into solution and therefore decreases the safety factor dangerously.

For the purpose of adjusting pH, the small kits sold for aquaria use in which bromthymol blue is the indicator are completely unsatisfactory. I have found them to be invariably inaccurate. I suggest the use of a pH meter or of one of the better kits; the booklets of coloured test paper that are available provide a reasonably accurate and inexpensive method of testing pH.

The effect of copper in precipitating mucus, especially on the gills, must also be considered. The addition of small amounts of pure common salt to the water greatly decreases this danger. The addition of one teaspoon of salt to each three gallons of water gives optimum results. Aeration during treatment is also a good practice.

While the amount of copper used may be varied, certain restrictions must be borne in mind. As the dissolved copper is constantly being combined with organic substances and thus removed from solution, too small an area of copper metal exposed to the water may result in an insufficient amount of copper solution becoming concentrated in the water. A greater amount of copper will frequently result in a greater concentration of copper within a shorter period of time and thus decrease the length of time required for a cure. The danger of using too much copper metal is that the concentration of copper in solution may become too great and damage to the fish may result.

The optimum dosage, as I have determined it by actual use, is 23 grams of copper sponge material to each 15 gallons of water, or 20 copper pennies to each single gallon of water. It is extremely important that the copper sponge used be pure copper and not an alloy. Certain alloys in addition to being toxic to fishes, do not appear to have any effect upon the organism against which the treatment is directed. When in doubt, it is advisable to use copper pennies as these are of uniform composition. It is unnecessary to use bright, newly minted pennies; old, dull ones do just as well.

(Copper "pennies" here refers to the American one cent. piece. This is slightly larger than our farthing.—EDITOR.)

Continued immersion of a piece of copper in an aquarium results in an insoluble coating being formed on the metal

dself. This prevents further utilisation of the copper. The uark appearance of the coated copper as contrasted with the ncoated metal is sufficient evidence of its unsuitability for urther use. It may be possible to dissolve this coating by immersing the copper in an acid solution. Up to the present I have not found it necessary to experiment with this. The low price of copper sponges and the relatively small amounts of water to be treated make it practical to provide a fresh piece of sponge for each treatment. The use of pennies does not, of course, affect their value. After the treatment is over, the pennies can be spent and banks provide an inexhaustible supply of new pennies whenever they should become necessary. However, the great amount of water in hatcheries that want to employ this treatment, might make it practical to experiment with the rejuvenation of used coppe:. Immersion of the copper in a dilute acid may effect the desired result.

In aquarium use, the following parasites have been positively identified and cured by the use of metallic copper. Controls that were untreated all died.

Chilodonella: A very hardy microscopic organism. All traces of *Chilodonella* were eliminated in 48 to 72 hours. The fish showed a marked improvement very rapidly. Within 24 hours the clamped fins and resting on the bottom, which are characteristic symptoms of this disorder, disappeared in mixed groups of platys. Untreated controls started to die in 10 days.

Gyrodactylus: This parasite causes a considerable loss among pool-raised fishes when they are crowded into dealers' tanks. A group of 100 guppies was separated into two 17 gallons aquariums. A copper sponge was placed with one group; the other group was untreated. A complete cure was affected in 72 hours. Members of the untreated group died gradually until at the end of three weeks there were only half a dozen emaciated specimens left.

Dactylogyrus: No controlled experiments were conducted with this parasite. However, the danger of gill flukes is well known. Positive identification was made microscopically and the organism eradicated by copper treatment within 48 hours.

Oodinium: Perhaps the most dramatic cure is effected against this tiny but hardy protozoan, which is the cause of the disease known as "velvet." Visible to the naked eye at certain stages in their life cycle, the parasites may be seen leaving the fish as the copper affects them. *Rasbora heteromorpha* heavily affected by *Oodinium* were divided into two groups. Twelve parasitised fish were placed in two gallons of water with 40 copper pennies and aeration was supplied. Within 24 hours all signs of the parasite were gone. After 48 hours the copper was removed. The fish were kept isolated for 14 days longer in order to determine whether there would be a recurrence of the disease. No further infection occurred. The 24 control fish remained untreated for a week during which time their condition gradually worsened as the infection increased. At the end of a week, however, because of the value of the fish, they were treated with copper and they all recovered.

Unidentified organisms: There are many parasitic and bacterial diseases of tropical fishes, the causative organisms of which are not known by the aquarist, although he recognises them by the similarity of the symptoms the fishes display. The so-called "angel fish disease" and the "*Betta* disease" are examples. These have responded readily to treatment with metallic copper.

Tolerance of Fish to Copper

The ability of fish to withstand heavy doses of copper when accustomed to them in gradually increasing amounts is really remarkable. For instance, some zebra danios were treated for *Oodinium* by placing a copper sponge in their 17 gallons aquarium. Although the disease was cured in 24 hours, the sponge was not removed. Ten days later, with the sponge still present, approximately 30 more zebra danios were added to the aquarium in one netful. They were all dead within ten minutes. When the zebra danios that had been in the aquarium were removed and placed in fresh, copper-free water with no preparation or gradual transition, the sudden change did not appear to affect them. The copper sponge was then removed and 24 hours later a new lot of zebra danios was placed in the aquarium which still contained the same water. The fish showed no symptoms of distress at all.

A small amount of copper maintained over a period of time in an aquarium appears to exercise a salubrious effect upon the fishes. Similar aquariums containing the same type of fishes do not appear to be as clear and healthy. Of course, this is only visual observation. However, the growth rate of copper-treated fish is markedly faster and their mortality rate lower. Their birth rate does not appear to be affected, live bearers bringing forth young as regularly as fishes in untreated aquaria.

There still remains much work to be done with copper. It is certain that it is effective against many more of the parasites that adversely affect fishes, than I have yet determined. It is probably also effective in the treatment of true fungus (*Saprolegnia*) and of various bacterial diseases. I wish to thank Mr. James W. Atz, Assistant Curator of the New York Aquarium, for his helpful advice and editorial assistance in the writing of this article.

Black Angels

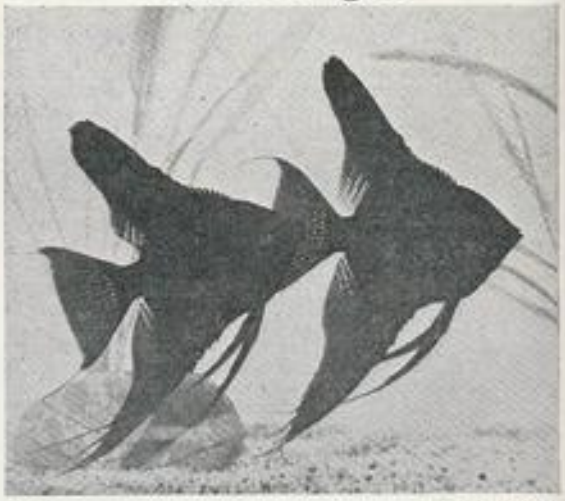


Photo: Gene Wolfsheimer

THE above photograph is taken from last month's issue of *The Aquarium Journal* (U.S.A.), in which an article by Mr. Gene Wolfsheimer of California announces the existence of a strain of jet black angel fish in America. The strain is not yet fully established in that not all of the young produced exhibit the attractive all-black coloration. Best specimens are totally black and their owner, Mr. James Ellis of California, has a number of these from which he is breeding. So-called black angel fish hitherto available have been only partly black—normal angels with over-emphasised black markings. An editorial note to the article states that commercial breeders in the east are promising that all-black angel fish will soon be available on the market.

AQUARIST'S Notebook——

by
RAYMOND YATES

ONE of the foremost and most popular breeders in the North is Mr. C. A. Blake, of Rochdale. Like most really experienced breeders he specialises, in particular in tiger barbs and velifera mollies. His results are astounding for size, colour and condition of fish and it is little wonder that he gets requests for fish from all parts of the country. He is also well known as an exhibitor and at his last ten shows managed to obtain 21 firsts, 13 seconds and 10 thirds including six diplomas, 20 trophies, six times "Best fish in the show," and no less than 22 specials. During a recent visit I asked him if he had any particular tips he would like to pass on for the benefit of readers, and he mentioned that he makes his own fish food which has about five main ingredients, one of which is dried cod roe. He also uses *Daphnia*, white worm, micro and Grindal worm but no *Tubifex*. He speaks very highly of "Liquifry" for all types of young fish, and considers his own form of dried food (mostly protein) better than live food in winter time. He is not keen on any form of dried egg, which he finds binding, a point on which many other breeders agree. He favours masses of plants, normal gravel and mild aeration. Feeding is the key to bringing fish on, and he thinks many livebearers fail to become good because they are left to themselves too soon. All too often, only half the fish are taking food; the other half still need Infusoria. Too many breeders do not realise this with the result that half their hatching fails to come on.

With tiger barbs he puts the breeders together about 3 p.m. on a Saturday afternoon and 24 hours later he usually has a spawning of roughly 500. He takes the adults out immediately. Infusoria should not be fed to young tigers as this may result in a form of fin-rot running through the brood. A prepared substitute dried food is given instead. He does not like spotless tanks, his own having plenty of mulm with no ill effects. In winter he keeps most of his fish at 65° F. which produces healthy fish for the following spring. Depth of water in breeding tanks is usually 12 inches. The reason for this is that only the really strong fry will then survive; the runts will die at birth if the water is so deep. As runts must die sooner or later he prefers it to be sooner. This is sound commonsense. Too many aquarists try to save every fish from a spawning. Velifera mollies often fail to grow, as most enthusiasts know, and he puts this down to lack of attention when fry, or easing off too soon. He likes plenty of space for them, plenty of salt, pH 7.0 and very regular and careful feeding.

In all, Mr. Blake has successfully spawned and reared to maturity over 30 different varieties of fish and he is especially proud of the grand ramirezis which were so brilliant and became known as "Blake's ramirezis" at any show. Like all other breeders he has had his failures, and one of these is the chocolate gourami. These fish are a mystery yet in the hobby and nobody knows how to breed them, or even how to sex them. For this reason the few specimens which show up are wild fish. They are very hardy indeed, stand all the stresses and strains of shows, but never look like breeding. Shy fish, they eat little and are very fastidious. Unlike most anabantids they very rarely visit the surface for air. Mr. Blake recently had some difficulty in hatching out the eggs of the snakeskin gourami, so he removed these to another tank and increased the temperature of the water to 105° F. Hatching was soon observed and he then allowed the temperature to fall to 80° F. Since then he has used this technique on several occasions with 100 per cent. success. His most recent spawnings have been with *Trichopsis pumilus*, an attractive fish which is not seen as often as it should be, probably because few aquarists are familiar with this fish which is less than two inches long when full grown, and combines the features of the *Betta* with those of the paradise fish. It is a shy fish and has none of the drawbacks of the *Betta*.

Mr. Blake spends most of his spare time in his fish house at the rear of his house, which stands on a hillside on the Halifax road, about three miles out of Rochdale. If you drop in on him you are almost certain to find another aquarist has beaten you to it. Tanks are heated by gas but there is emergency electric heating which is just as well, because, during the cold winter spell several aquarists suffered losses where the gas "froze."

* * *

Most fishkeepers keep other pets, or contemplate others. Many are held back by the feeling that they don't know much about other forms of domestic pets and thus miss a great deal of fun and interest. With this in view the Zoological Society of London has issued a small booklet of some 42 pages at a cost of one shilling which gives a great deal of information on pets for those in doubt. Pets are subdivided into five sections, mammals, birds, reptiles, fish and insects. The largest section is that on mammals and for each details are given as regards housing, food, approximate life, cage mates, diseases, breeding, general description, parasites and handling. Mammals included are monkeys, foxes, badgers, otters, mongooses, ferrets, hedgehogs, squirrels, hamsters, mice, rats, dormice, guinea pigs, rabbits, and a brief mention of dogs and cats, which are too large a topic for so small a booklet. Birds include the crow family, mynahs, weaver birds, waxbills, finches, macaws, parrots, cockatoos, budgerigars, parrakeets, doves, pigeons, etc., with details of most bird troubles and diseases. There is also a section on birds in the garden. Reptiles include tortoises, terrapins, lizards, chameleons, grass snakes and the insect section is small, being restricted to silkworms and stick insects only. There is a short section on goldfish and a similar section on tropicals. The Zoo authorities are to be congratulated on this issue, which will be of real help to many animal lovers.

* * *

Most aquarists who have been followers of the hobby for some time are rather hard-boiled as the saying goes. Some of them will spend hours in a dealer's shop looking round, asking numerous questions and buying very little. Boys who have been bitten by the aquarium-keeping bug are even worse and dealers and others with fish houses sometimes find these young enthusiasts rather a nuisance. One dealer hit on a very good method for turning this enthusiasm to account, insisting that they could only look round his fish house if they brought with them a jam-jar full of garden worms. This provided him with excellent live food in quantity without trouble or expense to himself. Another dealer has quite a number of tanks on the lower floor but upstairs has quite a gallery of tanks together with other pets, monkeys, birds, etc. He charges 3d. admission to go upstairs to see the "zoo" unless the viewer has made a purchase in the shop. Needless to say very few viewers pay the 3d. toll!

* * *

Familiarity breeds contempt in many walks of life and the more experienced fishkeeper reaches a stage when he takes his tank temperatures for granted. This is a mistake and the habit should be cultivated of always looking at tank temperatures first thing in the morning and last thing at

night. The main risks, of course, are chilling or overheating, and of the two the latter is usually the more dangerous. Small tanks change temperature much more quickly than large ones, both up and down, so that small tanks are a bad risk in every way. Large tanks cool very slowly when the heater fails to act but warm up rather quickly if the heat stays on so that a thermostat which sticks can quickly cause trouble if the heater is left on, and it is a large heater. Once the temperature passes 86° F. your fish are in danger, more particularly if they are large fish, overcrowded and with no aeration. It is difficult to give exact figures but even with aeration it is not easy to keep fish in the 90° to 95° range, although some stand the high temperature better than others, depending in some way on their species and also on general health. I have kept a tankful of mixed varieties for over six weeks at 95° F. during the day, lowering to 75° at night, but few fish could stand the high range all the time. At 100° F. almost all tropicals are dead, but anabantids survive, although they get the shimmies and are constantly at the surface. Fish in high temperatures are very active indeed, dashing about rather wildly and their colours are very brilliant.

Chilling is equally obvious because the fish tend to lie on the bottom with fins folded, weak colours and a low respiration rate. If the cover lights are on, however, the fish will be crowded under these, as this portion of the tank water will be slightly warmer. Chilling seems to numb tropicals so that they are unable to force themselves to breathe, with the result that they suffocate. Many tropicals will survive down to 55° F. although angels all die at 60° or even several degrees higher. It is quite commonplace to see a tank chilled down to the forties with all the fish dead except zebras or white clouds, which seem able to acclimatise themselves to the slow process of chilling. An aerator working with a chilled tank usually only forces cold air into the water and will not help the fish. A rapid increase of ten degrees in as many minutes often helps to save some of the fish. Technically, it has faults but it often works and low temperatures are fatal if neglected. White spot and shimmies often follow chill. Prevention is better than cure so keep an eye on your thermometers morning, noon and night. It pays in the long run. The best thermostats tend to drop in time and heaters don't last for ever.

* * *

Clubs are finding lecturers hard to get nowadays. Some clubs will retort that they have always been hard to get. It all depends, of course, on the geographical location of your club but those in the larger centres of population can no longer rely on regular speakers. Public speaking does not come naturally to many people and few aquarists, however experienced, can stand up for an hour or two and talk to other aquarists and retain their interest. A great deal depends on the first club the would-be speaker visits. If these are an enthusiastic crowd he feels he is appreciated, but some clubs make the speaker feel he is addressing a blank wall, and he loses heart and interest. Then again many good speakers have worn themselves out visiting clubs, and are tiring under the strain whilst others have probably used up all their material, because new ground must be covered when paying a second or subsequent visit to a society. At one time it was the vogue to have a fresh speaker every month but many clubs are reducing visits from outside lecturers to four or five a year. Some secretaries even try to fix up a lecture list twelve months in advance, but this is asking too much of speakers. How can one possibly make arrangements so many months distant?

Speakers are rarely appreciated by clubs insofar as the club members do not realise that the lecturer has given up perhaps five or six hours of his time to visit them, often with a long and tedious trip home on the last train with arrival home anything up to 2 a.m. and even later. Fog and frost, rain and snow and other arctic conditions make travel to clubs in winter of little attraction but this is the time when most clubs ask speakers along. Then again, do you treat your lecturer with understanding? I arrived at one club at 7 p.m., but endless club business went on and on and I was asked to begin my talk at 9.25 p.m. The trouble with most club meetings is that they start too late and members just don't try to get down early. The result is that lecturers are held up, waiting for a decent sized gathering, and they get very disheartened when they have to rush their stuff through at breakneck pace. Then again, the lecturer on technical subjects finds that only three or four club members really know what he is talking about, the other members have lost touch with the talk long ago and are only concerned with the tea break. Lecturing is fun, at times, but usually it is a thankless task which entails correspondence, hasty meals, tedious journeys, the carrying of heavy equipment, etc., frantic dashes for the last train, and arrivals home in the small hours. Clubs should realise that the lecturer is a vanishing race, and plan their club programmes with the realisation that, in the main, the club members will have to run most meetings in future.

* * *

The advantages of using peat are well known but it is not necessary to layer the bottom of the tank or even to use small bags filled with peat to put in the water. A cleaner method is to use an outside filter. These are really excellent and a splendid investment. I put in a three inch layer of glass wool on top of which I put a two inch layer of cotton wool. On the top of the cotton wool there is a three inch layer of sterilised peat. The peat cannot find its way into the tank water in messy form but the acidifying effect is achieved. The effect on plants like *Cabomba* and *Ambulia* is startling. I do not subscribe to the idea myself that peat-conditioned water prevents algae. It is true that little forms on the plants but given good lighting the tank sides are quickly covered. I mentioned recently the small peat pots for starting seedlings, and their use to the aquarist. A further use is for culturing white worm or, better still, Grindal worm. The peat pots absorb moisture but keep the worms in their places and the culture can be removed any time with a spoon, if necessary.

* * *

Most people if asked if they had ever had any octopus, cuttlefish or squid would shudder at the very idea of eating these creatures. The fact remains that they are a staple food of many marine fish and are equally popular as food with tropicals. Of course, one never sees cuttlefish offered for sale as food although it is marketed occasionally as crab or crab meat, rather in the way that rabbit has been served in some restaurants disguised as "chicken." Cuttlefish is very tasty and quite popular in Southern Europe. It has the advantage for the aquarium of remaining fresh quite a time. A little goes a remarkably long way.

* * *

If fish are to be left in the care of non-aquarists at holiday times it is a wise policy to prepare the new curator in good time. It is useless telling him all there is to know the night before you go away, or giving him written instructions at the last moment. It is better to ask the person who will be in charge to drop in three or four times during the fortnight before you go so that he can familiarise himself with your set-up, and ask any questions which may occur to him. He will be able to watch you on the job and will see just how much food is given and a hundred and one other aspects which can't be put on paper. Give your tanks a thorough clean-up before you go so that they start off perfect and check all the apparatus as far as possible. Apart from heating variations the worst risk is disease in your absence so the careful hobbyist does not introduce any new fish to his tanks for about two weeks prior to the start of his holiday.

JOURNAL of a Marine Aquarist

by L. R. BRIGHTWELL

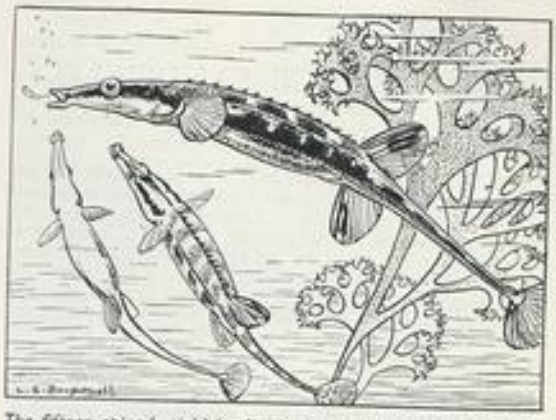
HAVING always in mind the difficulties to be met by marine aquarists living far inland (I was one myself for 30 years) the subject of food is an ever present difficulty. Mussels are not always in season, and even so no beast I have met will eat the fibrous gills or leathery foot. Sand hoppers are expensive, ten shillings and sixpence the half pint, but still worth it. Trapping sand hoppers is as tough as professional winkling, and winkles are at their best during the coldest months of the year. But when the tasty scallop is on the market, from mid or late October until the end of March there presents itself a food supply which may have been overlooked by many.

The scallop lies on the sea-bed with its flat shell uppermost, and this, in large specimens, may carry twice its weight in a concrete-like mass of worm tubes, composed of fine grit. The worm is a very beautiful object under a low power microscope. If one breaks open these tubes with a sharp knife, or chisel, a rich harvest of worms, all alive, may be reaped. Also scallops from the south coast are becoming increasingly favoured perches of the slipper limpet (*Crepidula fornicata*) the curse of oyster farmers. Though it is yet early to say how far this pest from the U.S.A. may make itself felt it is unlikely to menace scallop dredgers as it has the oyster farmer. The static, anchored oyster is not only robbed of its food but smothered.

The scallop on the other hand, as already dwelt on in a former article concerning "flying saucers," is a mobile creature, and though not, so far as we know migratory, can take flights of a yard or so, and thus find pastures new. The great scallop, *Pecten maximus*, is far less active than the queen, *P. opercularis*. The dark green crop (full of diatoms) is generally cut out as offal by we fussy English, and aquarists who conform to unreasoning and wasteful custom will find it readily accepted by another ultra-fussy feeder, the hermit crab.

* * *

The longer one keeps this crustacean the more fascinating it proves. The hermit will not tackle any tough meat, like most crabs and members of the prawn and lobster clan. It likes its food sloppy. Much time is spent sifting grit through its hairy claws, and its respiratory system can set up a current wafting fine food particles towards it. Lately, I watched a mere babe methodically pick the spines from a small sea urchin, and then insert the tip of one claw into one of the minute holes serving as outlets for the tube feet. It was much like watching its giant cousin, the tropical "robber crab," pick one of the eye holes of a coconut. Getting a half Nelson on this minute fulcrum, it exerted its (in proportion to its size) enormous strength, and away came a big piece of the hard, shelly test. After that the urchin's spiral gut, largely filled with mud, was leisurely sorted out to the last particle.



The fifteen spined stickleback is a hardy marine species which will breed in a 24 ins. aquarium. Daphnia and brine shrimp provide the best foods for this fish

After thirty years of inland, and four of "on the spot" marine aquarium keeping, surprises come thick and fast as ever, thicker and faster, perhaps. In putting fresh sand, or introducing empty shells or creviced bits of rock one cannot be too careful to make sure no unwanteds are introduced by accident. Lately, a tank that has given no trouble at all began to be a problem. Small hermits lost legs and claws to an extent scarcely compatible even with the hermit's notorious pugnacity. Then one of two prawns, over two years in residence vanished, bar a few shell fragments. Even the basket whelks, those ideal scavengers showed injuries no prawn or hermit could inflict; their operculums had been removed. Finally, a bit of joint packing was not where it should be . . . and the studio floor flooded.

The leak put right, and tank refilled, I solved the mystery late one night by flashlight. Out of the sand rose a thumb nail sized shore crab that I had never knowingly introduced. The nuisance must have been hidden, when only pin's head size (just out of the larval state) . . . and operating only by night, or during my many absences on business, had the time of its destructive life. I remember once at a Research Station seeing a number of these crabs being kept, each in a separate tank (the *only* way to keep a shore crab for any length of time) and overhearing a visitor say, fatuously, "the poor dears look so lonely!"

Just try giving *Carcinus maenas* a playmate or two, and see what happens . . . even if you try to stage a boy meets girl romance. I've had it!

* * *

A fish par-excellence which I can recommend is the marine stickleback, *Spinachia vulgaris*. It is handsome, hardy, and quickly becomes tame. At Plymouth it has actually nested in a three foot tank, using the tough knotted wrack *Ascobyllum*. But so far as my experience goes it *must* have small live food. Blood worms and *Daphnia* make a good substitute for whatever it finds in the sea.

* * *

A final tip for marine aquarists living on or near the coast. Carry home all the seaweed you can lift and shake it out in a bucket of sea-water. Vast numbers of small amphipods will result at almost any season. A magnificent live fish food and cheaper than "hoppers."

Behaviour of Metals in Aquaria

by LAURENCE SANDFIELD

THE fact that conditions may arise in aquaria that are deleterious to the life and health of our fish is too well known to emphasise. Emphasis must, rather, be laid on prevention. The primary need is to know what these dangers are, and then for every individual to evolve his personal methods of avoiding them. Such efforts are often empiric in the extreme, but without empiric research science would lose a good deal of its vitality. Apart from purely biological aspects of aquarium ecology, there are environmental considerations, not the least of which is the chemical constitution of the water. Here is where the materials used in tank and accessory construction assume great importance. Unless these are properly constructed, corrosion may take place and result in dangerous conditions.

Most of the materials found in our tanks are chemically active, i.e., they will combine with greater or less readiness with the other chemicals present. Bear in mind that the word "chemical" is used here in its widest sense. It refers literally to everything in the universe that can be weighed and measured, other than radiation. Water, our prime concern and, indeed, "the cradle of life" is itself active. Having both oxygen and carbon dioxide in solution through natural processes, the activity of both it and they are considerably enhanced. The presence of oxygen is, indeed, a great help to an immense number of chemical reactions.

Under the right conditions, carbon dioxide, water and oxygen will react with most metals. The ideal tank, therefore, is one with no possible metallic contact with either water or water vapour. However, glass tanks being somewhat fragile and plastic ones yet something of a dream, the strong iron-framed tank has come into practically universal use. Concrete tanks are not, as far as I know, made commercially, and therefore are not considered here.

Corrosion

Corrosion is a chemical process—either as a direct or as an electro-chemical attack—both being phases of the same fundamental process. Immersion in water favours electro-chemical attack.

Corrosion affects metals in three ways:—

(1) Superficial. This leaves the metal beneath the corrosion products unchanged. The corrosion products of iron afford no protection, therefore it will ultimately rust away.

(2) Intercrystalline penetration leading to brittleness. We are not too concerned with this. It leads to metallic weakness.

(3) Complete change in metallic composition.

Sea water—marine aquarists please note—will completely remove zinc from brass, leaving copper. It will also remove any zinc coating from metallic containers, rendering these gravely dangerous for marine aquarists. It is, indeed, a vicious corrosive, iron being strongly attacked. Conversely, iron immersed in distilled water in the absence of air or carbon dioxide will remain bright.

Most metals when exposed to air become covered by a thin film, usually an oxide. This has an inhibiting effect on corrosion. For example, aluminium has a film of oxides which hinders attack by many salt solutions. This can be seen on the inside of many aluminium tank hoods as a light-absorbing dullness. It can be removed by abrasion, but relative to its thickness it takes a lot of abrading. Stainless steels owe their immunity to complex oxides, many working together to produce the resistance to staining, and therefore also to corrosion. This quality is known as passivity, and ordinary carbon steels, such as the black mild steel used in the "iron" framed tank, do not possess it.

The factors which affect the corrosion rate of metals immersed in liquid, particularly water, fall into two groups.

GROUP 1—**Metallic Factors:**

(a) Chemical and physical characteristics. (Physical characteristics = scratched or polished, rough or smooth.)
(b) Presence of impurities in metal surface.

GROUP 2—**Environmental Factors:**

(a) Temperature. Higher the temperature, the quicker the corrosion.
(b) Amount of oxygen dissolved in water.
(c) Rate of oxygen supply and replenishment. (Artificial aeration speeds corrosion.)
(d) Acidity of solution.
(e) Presence of dissolved salts.
(f) Relative movement of solution and metal. See parenthetical note at (c).

Hard waters are, in general, less corrosive than soft waters, because of their ability to deposit protective surface films. Here the cold-water fan, knowing his pets' greater tolerance of hard water conditions, can laugh at his warmth-loving brother.

Specific Metals

A few specific instances will be given here, as it is in such that the information most needed by aquarists is found. Remember always that water wherever it is met is, unless it is distilled, never pure. Invariably something from the surrounding environment has gone into solution in it, and the most prevalent element found in this state is oxygen. Once this has happened, the forming of aqueous solution through corrosion is rendered relatively easy. As our subject is the behaviour of metals, here is how the most commonly used metals are liable to behave.

1. *Copper.*—This is corroded rapidly in water where oxygen is in solution. This is a very good reason for not, *repeat not*, suspending anything such as heaters or thermostats or thermometers in your tank by the means of copper wires or clips. The result of copper corroding when immersed is a green suspension of copper hydroxide and carbonate. This has an adverse effect on fleshy tissues. This is also a good reason for keeping brass and phosphor-bronze parts of food canning machinery well away from the actual point of filling, for these chemicals are at least as poisonous to humans as to fish. Their presence in food of any kind is frowned upon—putting it mildly—by the Ministry of Food.

2. *Zinc and Iron.*—Both these tend to dissolve easily in dilute acids. The rate of corrosion increases up to 80° C. (112° F.) in the presence of oxygen. Above that it tends to decrease. Pure zinc tends to corrode slowly, but the impurities usually present speed up the rate.

3. *Duralumin.*—This alloy is not so resistant to corrosion as aluminium.

4. *Magnesium.*—This corrodes more easily than dural. Corrosion is affected by the presence of dissolved salts.

For example, in distilled water, plus oxygen, iron will corrode more readily than magnesium, which in its turn will corrode more readily than zinc in the same medium. On the other hand, in sea water, with its great percentage of dissolved salts, magnesium will corrode more readily than zinc, and zinc more readily than iron, thus neatly turning the distilled water sequence inside out.

There is also a speed-up of corrosion in the presence of any two metals which form electro-chemical couples. When present in a solution, these corrode in the same way as the metals in a crude electric battery, such as the Leclanche cell. For instance:—

Steel or iron	plus	copper	—Iron corrodes.
,, ,, ,,	,,	brass	—Iron corrodes.
,, ,, ,,	,,	zinc	—Zinc corrodes.
Aluminium	,,	copper	—Aluminium corrodes.
,,	,,	brass	—Aluminium corrodes.
,,	,,	iron	—Safe.
Tin	,,	iron	—Iron corrodes.
Copper	,,	zinc	—Both corrode. Virulent in all ways.
Copper	,,	tin	—Tin corrodes.

All the above, except one, are poisonous to some degree because of the corrosion rate increase. This may load the solution above the tolerance level of the animal life present. The normal corrosion rate of iron does not appear to be harmful, even when the corrosion is carried on over a long period. I have therefore listed this as safe, although it may be possible that the percentage of iron oxide in the water is kept low because of the replacement of water during regular servicing.

One must be careful where plating is concerned. Cadmium and nickle plating are poisonous, so if plated objects must be used, either submerged or within condensation range, chromium is the best bet.

Metal and Fish Eggs

It would be interesting to know if the presence of corroded metal in solution has any effect on the eggs of those fish which are essentially bred in soft acid water. *Hyphessobrycon innesi* are well known for the tendency of their eggs to disintegrate. The presence of ultra-violet light has been held largely responsible for this, and undoubtedly has something to do with it. In their native habitat, these characins breed in shady places, where U.V. light is attenuated, if present at all.

However, I would like to suggest the following experiment:—

Pairs already known to have produced fertile eggs to be brought to breeding conditions and bred in (a) an ordinary unprotected tank (control); (b) an all-glass tank; (c) a steel or iron-framed tank with the metal parts protected by a passive substance. At the beginning, all the water to be chemically identical as near as possible. Having run and tabulated the results, re-run the whole experiment with the same fish in darkness or shady conditions. The results should, I think, be interesting.

Looking at characins as a whole, it would seem that it is possible that all of these may be affected in the way I have suggested above, as most of the known species inhabit waters of varying degrees of acidity.

Another matter to consider is the use of self-galvanisers for the de-rusting of tank frames. These are liable to contain zinc suspended in a fluid, so their danger to aquarists is obvious.

Regarding waterproof paints, the bitumen paints seem about the best. Cellulose, while being passive itself, is not very proof against intrusive vapour, although an extremely thick coating consisting of one layer of primer followed by several undercoats and two or three finishers should be helpful if applied to bright new metal. Plastic stove enamels and vitreous enamels would appear to be quite helpful, their hardness probably being a deciding factor. Stainless steels provide the ideal answer, but their cost renders them too expensive for most aquarists.

Obviously, the use of glass and passive plastics for immersed apparatus is essential. If you are going wisely to earth your tank hood, for your fishes' sake use a chromium plated securing screw. Renew it monthly in case it is plated brass. Even a pin prick will let in vapour and corrosion will lift the plating. Result: mortality, worry, expense. A recently developed process of bonding passive plastics to metals seems likely to help aquarists, and if some manufacturer were to turn out a line of tanks with the top frame at least coated thus, at reachable prices he would earn a lot of money and our undying gratitude.

Meanwhile, where marine aquarists are concerned the use of glass tanks or bitumen paints seems the best solution. I was born at the seaside, and learned early that my fellows despised iron because it rusted so quickly . . . we were 20 minutes' walk from the sea.

British Bitterling

THE following appeared under the heading "Lancashire Fishes" in the Miscellany column of the *Manchester Guardian* of 3rd May, indicating that bitterling carp have become established here.

"Lancashire's interest in fishes is not confined to the fried sort which have made the Bolton supper bar world famous. South Lancashire, from whose waters the Merseyside Naturalists' Association has recently sent to the British Museum specimens of a new British fish, the bitterling, can justify the retention of its canals in which anglers and aquarists are so interested, and the preservation of its lakes and flashes from pollution. Several strange fishes discovered here by distinguished naturalists in former years seem now to be extinct. Yarrell in his *History of British Fishes* described a new British fish from Lancashire called the azurine or blue roach. Nobody seems to have caught one that satisfied the experts for the past century, and there is still some confusion as to whether or not it was a bluish variety of the common rudd or of the roach, the consensus of opinion favouring the former.

"In 1865, Crouch's *British Fishes* gave a coloured plate of the azurine. Its haunts in Knowsley Park and Croxteth have been thoroughly combed without producing any more. The British Museum decided in 1908 it was a bluish variety of rudd, such as occurs in the middle of Continental Europe, the home of the bitterling. Yarrell also described in his *British Fishes* another new fish from Lancashire which has since become extinct, the braining. This inhabited the river Alt and Sankey Brook, as well as the Cheshire Weaver, and this has long been accepted as a variety of the common dace which still inhabits many Lancashire and Cheshire rivers, thanks to the protection and restocking afforded by anglers' societies. An account of the bitterling's long history in the canals and lakes of South Lancashire appeared in a recent issue of the journal of the Salmon and Trout Association. The chance that it was the origin of Yarrell's azurine is not considered likely, as the specimens of azurine from Lancashire in the British Museum are a variety of rudd."

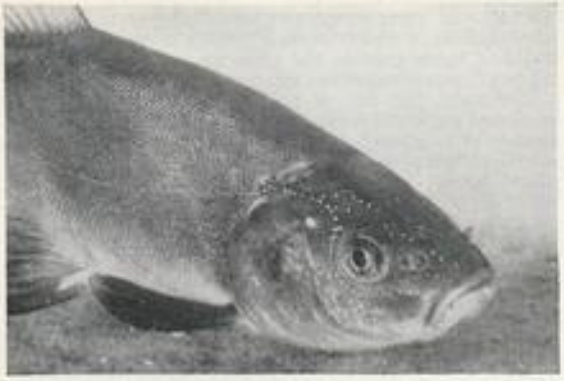
I submit that now this fish is breeding in British waters it should be classed as a British fish; hitherto it has been classified under foreign coldwater fish. I would be interested to see other readers' views on this and any other points regarding this very interesting little fish.

B. CURRIE, Rickmansworth, Herts.

Some Observations

by N. E. PERKINS

Photographs by
LAURENCE E. PERKINS



Head of common tench showing the course of the lateral line continuation in the head region

MOST fish feed from the bottom at times but we are concerned here with those types which rarely leave the lower levels and which, in many cases, are actually in contact with the bottom for the greater part of their lives. It will be found that these types usually have very specialised sense organs to adapt them to a condition of poor light and possibly, on occasions where weed banks are dense, to no light at all.

One such fish is the barbel, a species fairly common in England where it is to be found chiefly in the Thames, Trent and Avon. It is typical of this type of fish, being cylindrical in form with a ventral mouth supplied with four well-developed barbels. Examine this mouth carefully and note how the thick lips and the barbels are covered with small excrescences; these little bumps fulfil a very important function, i.e. to taste food before it enters the mouth and from this, incidentally, to accurately locate it. Couple this with a keen sense of smell and we have the necessary equipment to manage without eyesight.

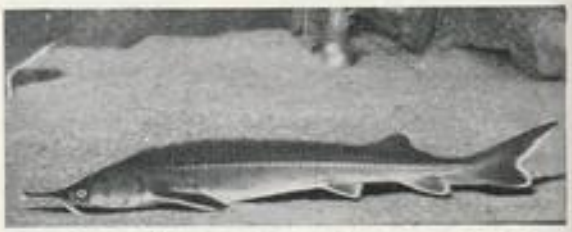
Whilst keeping barbel I have noticed that although they would not move for food dropped at a distance from them (because they knew they were being watched) any that touched the barbels was immediately drawn into the ventrally disposed mouth by its powerful suction. On first keeping this variety I noticed a peculiarity about the caudal fin which I had not known of before, and since it conflicts with all illustrations of this species I made great efforts to clear the matter up. First, I examined numerous specimens and found that all exhibited the peculiar unbalanced tail. I then wrote to Dr. Trewavas of the British Museum, but apart from suggesting that they had worn away the lower lobe, she was unable to offer any assistance. I then examined Dr. Tate Regan's book on British freshwater fish and found that here, again, line drawings and sketches depicted a fish with an equally-lobed tail.

I next wrote to the British Marine Biological Research Station at Lake Windermere and received a reply from Dr. W. E. Frost in which he stated that he was sorry he could give me no personal information on the subject but suggested breeding the normal-tailed with the type I had referred to. Obviously, he considered that normal types existed. My main query as to whether the type I had was a mutant form remained unanswered by authorities, but from subsequent information and observation I am of the opinion that barbel have possessed this peculiar unbalanced organ for a great many years. I must confess that I find it hard to believe that scientists should overlook such an obvious and interesting feature. The interest of the unbalance lies, of course, in its similarity to the primitive heterocercal tail found in dogfish and sturgeon.

One might imagine that such information would prove of interest to anglers for, of all our coarse fish, the barbel is the gamest, being certain to provide a tremendous tussle before being landed and this primarily because of the tail formation. However, when an article, suitably illustrated, was sent to angling publications, they were not interested. though one editor, whilst admitting how interesting he found the information, considered it unsuitable for his readers! I have often been amazed at the appalling ignorance of anglers in general but I suppose one cannot be surprised when their various journals show such indifference. It is, however, a great pity, to my mind, that more interest cannot be stimulated amongst this section of the community, for here we have a potential source of vital information about the habits of British freshwater fish of which so little is known.

Another bottom-feeder, the tench, has found an alternative to the thick fleshy barbels for, whilst it does possess a pair, these are but poorly developed and unsuitable for the work required to be done. In the tench it will be noticed that the lateral line is visible over its complete course, i.e.

Common barbel—a fish with ventral mouth, large barbels and a tail with imbalanced lobes

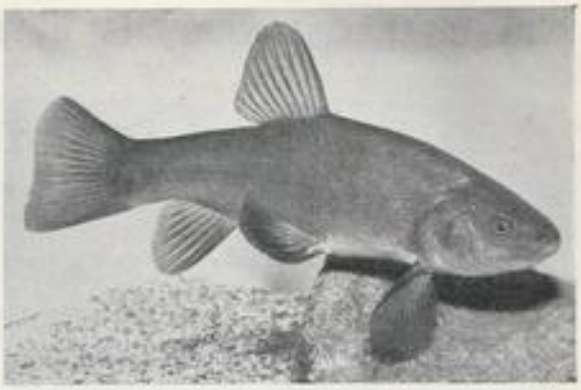


The sterlet (small variety of sturgeon) possesses the primitive "heterocercal tail"

on Bottom-feeders

from the caudal peduncle to the gill cleft and thence over the head to the area above the lips. It branches on leaving the body portion, one branch travelling above the eye while the other runs below it. Small ducts leading to this surface canal appear to be well developed as can be quite clearly seen from the illustration. Now, it has been experimentally demonstrated that the lateral line organ is responsible for reception of low frequency waves such as might be caused by footfalls on the river bank, movements of insects near at hand or even passing fish. Of course, the lateral line is usually extended over the head in fish but in other species it lies well below the surface and has no conspicuous communicating ducts such as we find in tench. This development may well account for the peculiar tales one hears from tench fishermen to the effect that whilst none may be caught at a certain pond for years, a day may arrive when many may be taken only to be followed by another long period without success. It is obvious that such a fish must be approached with great caution for he will register the smallest sound. Should, however, one be fortunate enough to fish submerged weed banks, the possibility of his capture is greatly enhanced.

It is characteristic of most of these bottom-feeders that the eye is small (in contrast to deep water marine species) but any deficiency in eyesight is more than balanced by the development of these specialised senses. Another point about some of the more extreme types, i.e. barbel, gudgeon and catfish is that their specific gravity is greater than water and considerable exertion is required to keep them off the bottom. Watch a gudgeon trying to browse off vegetation on a vertical wall and note how continuous movement is required to keep him at a certain level whilst other fish such as roach, dace, carp or goldfish browse at their leisure.



Common tench

In the Water Garden in AUGUST *by Astilbes*

ALTHOUGH the water garden will look after itself fairly well during this month it is a good plan to give a little attention now and again to keep everything tidy. All dead water lily flowers should be removed as soon as faded as this may encourage others to form, although some species have the flower buds partly developed at the beginning of the year and so cannot be encouraged to form more. However, the removal of dead flowers not only keeps up the strength of the plant but prevents the decaying bud and stem from polluting the water. Where any water lily leaves become discoloured they should also be removed. The cause of this should be investigated. It may be found that there are many young snails on the under side of the leaves or some other pest is eating parts away.

When the water lilies appear to be completely covering the water surface it is necessary to remove some of the leaves and this can be done by tying a table knife to a long pole and cutting the stem well below the surface of the water. Too many leaves on a plant in a small pond will mean that many will grow up out of the water and the appearance will be spoilt. Although it is not the correct time to plant water lilies, if any have become too crowded and some fresh pieces are needed for another pond it is possible to cut off pieces and transplant them as long as the root-stocks are not left out of the water too long.

It may be found that some types of water plants which send their leaves well above the water may become infested with green or black fly. In certain cases these can do a lot of damage and one of the plants which suffers from these pests is the double flowered *Sagittaria japonica alba flor pleno*. The small carnation-like flowers can be quite spoilt by the blight and, of course, one needs to be very careful not to spray with any insecticide as the occupants of the pond would be harmed by this. If clear water is used and the plant strongly sprayed the fly can be knocked off into the water when the fish may eat them, especially if golden orfe are in the pond.

If long periods of time elapse without rain it is good policy to spray over the surface of the pond with a fine hose now and again to remove the dust and soot; especially is this necessary in towns. Not only will this spraying freshen up the surface of the water but the leaves of the surface plants will benefit also. Make sure that any evaporation of water from the pond is made up at weekly intervals as it is not good to allow the height of the water to vary too much for many of the water plants. A steady level is better than a fluctuating one. Watch for blanket or flannel weed. If this gets a strong hold it is very difficult to eradicate. It is a form of algae and can thrive when conditions suit it well, growing like so much very thin strong twine, and can so engulf a plant that it kills it.

When a pond is badly infested with this weed it is no easy task to clear it. If a broken stick is used the end can be inserted into a bunch of the weed and if twisted much can be pulled out. A rake can be used in a large pond and there is a tool on the market for the purpose. Once the surface of the water gets plenty of leaves on it to shade out much of the strong sun-light it will be found that the blanket weed gradually dies out. Whilst waiting for the leaves to grow, it is well to remove as much of the weed as possible by hand, etc., so that it does not get too strong a hold.

Some water plants are attacked by caterpillars of certain moths, and when leaves are seen which have had holes eaten in them a search will generally bring the culprit to light. An occasional tap on the tall growing stems of water plants will cause the caterpillars to drop off into the water. The plants growing at the water's edge must receive attention now. Remove all flower stalks as soon as the flower fades unless seed is required. As a rule it is much better to refrain from trying to save one's own seed as the seedsman has a better opportunity of doing this than you have. Your own seed may have been crossed with an inferior species or variety and so may be useless.

Armoured Catfish

(Callichthys callichthys)

ORDER:—Ostariophysi, from Greek *ostarion*—a little bone, and Greek *physa*—a bladder.

FAMILY:—Callichthyidae, from Greek *kallos*—pretty, beautiful; and Greek *ichthys*—a fish.

SPECIES:—*Callichthys callichthys*, from Greek *kallos*—pretty, beautiful; and *ichthys*—a fish.

CALLICHTHYS callichthys is probably the "type" fish of the armoured catfishes. It is certainly the best protected, being without scales, but provided with two rows of very tough overlapping plates on either side of its body. Its ventral surface is covered with tough skin. Yet this armour seems unnecessary, for, in the aquarium at least, it seems to have no enemies and lives peaceably with all manner of species.

It is not hard to see why it has never reached a high place in the estimation of most aquarists. To start with most fishkeepers are first attracted by colour, second by liveliness, and thirdly by size. Habits rank fourth. No-one could truthfully state that *Callichthys* is a colourful species—nor has it beauty of outline to compensate for lack of colour. It is drab.

Nocturnal Habit

Young fishes of both sexes are a dull brown, but as they mature the female becomes much lighter than the male, and, of course, rounder in the body as she fills with eggs. Lively enough at night, judging from the faint noises as they come up to the water surface for a "bite" of fresh air, they remain quiet during daylight hours, for the most part lying behind or on rocks at the back of the aquarium. As far as size goes, mature specimens reach over four inches, and this alone is sufficient in many aquarists' eyes to bar them from their collections of "toy" fishes.

Nevertheless, I consider the habits and useful work performed by these "scavengers" to amply justify their inclusion in a community tank or the provision of a special aquarium in which to observe their breeding habits. They are not fussy about water, being quite happy in alkaline—in fact breeding is almost always in alkaline water. This saves treating the average tapwater supply. Temperature requirements can be met if the water is raised to between 80°-85° F.

Live food such as *Tubifex* worms, of which the fishes are extremely fond, should be liberally fed for some days to bring them into first class condition. When seen, the female will soon show whether she is swelling with roe, and she will also be seen to be getting lighter in colour—almost a grey, instead of the chocolate brown of the male. Probably nothing further will be noticed until one morning you will notice the female is thinner, and may show signs of torn fins, as though she has been scrapping. This is not invariably the case.

Having no doubt read accounts of these fishes building bubble nests for the reception of their eggs you will look carefully around the tank for signs of one. As likely as not there will be no sign, although the male may be more active

Callichthys callichthys

and constantly visit the surface of the water, fussing around under a floating leaf. If so, carefully turn the floating leaf over for examination. If the fishes have spawned, the male will resent the intrusion of your fingers and may attack them, otherwise he will just swim away in seeming fright.

Eggs are laid in rows, cichlid fashion, on the underside of floating leaves. They are strongly adhesive, and may be over 200 in number. After being laid, the male will build a bubble nest, or at least blow a few bubbles under the eggs. This buoys them up and may serve as camouflage. The exact purpose is really unknown, for without a nest the eggs are still fertile, and hatch in the normal manner. Neither parent touches the eggs, although the male shows signs of nervousness if the female approaches too near, as though he does not trust her implicitly.

The male fish does not maintain an unceasing vigil, venturing away from the nest quite often for short periods. He seems to spend the nights in the same way, for switching on the light after dark frequently shows him on guard. This is necessary, indeed, for during the night planarians, snails, *Asellus*, and other egg-lovers will attempt to raid the nest. The tiny eyes of *Callichthys* do not argue keen vision, but they must either see or smell their prey and nocturnal raiders. Perhaps they have "cat's eyes!"

Fry Rearing

At a temperature of 80° F. or over the eggs will hatch in from four to five days; the tiny fry—about six to the inch—fall to the bottom of the tank. It is necessary that they find food, which must be small. They probably eat a proportion of Infusoria, but without analysing the contents of their guts it is impossible to say definitely one way or the other. Pulverised earthworms, *Tubifex*, or micro worms are likely to be eaten with relish. As the young grow, small *Daphnia* can be given. If too slow to catch the living creatures, the youngsters will obtain useful chemicals from the moulted carapaces.

Whole micro worms can be fed. These little worms will live for three weeks or more under water, which gives the fry plenty of time to find them. With ample food, in a high temperature, the young grow rapidly and may reach an inch and a half in a matter of four or five months.

One surprising thing about *Callichthys*, once it has decided to spawn, is its insatiability. Spawning follows spawning for perhaps a couple of months—at intervals of three to four days. It is strange, under such circumstances, that the species is not often offered for sale. What happens to all the youngsters? Probably dealers refuse to buy them, as they did mine, because there is no demand. That was a pity, for a heat failure put paid to all of them a few nights later, and I have seen none since to replace them.

If I get the chance, I'll have another pair or two, for I am not satisfied about their breeding behaviour yet—too much of it takes place in the dark.

How Hard is Your Tap Water?

by B. CALROW
(Hendon Aquatic Society)

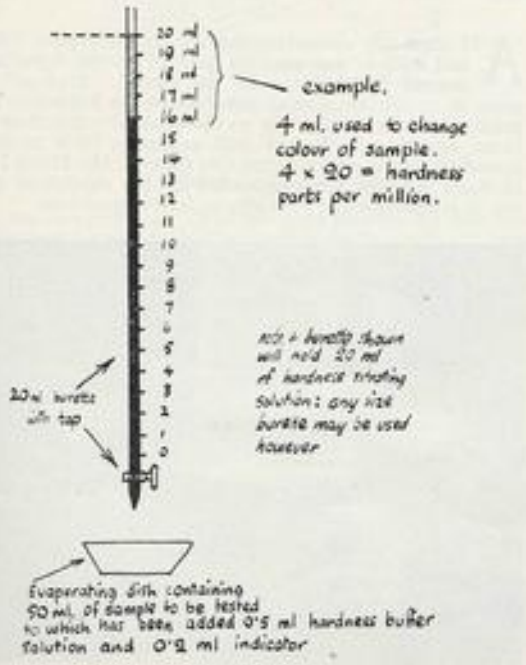
MUCH has been written recently on the subject of water hardness and its bearing on fish breeding. Perhaps adding to the mystery of this subject to we laymen is the fact that no accurate popular method of checking has been available to us, and those who have delved into the systems employing a standard soap solution have not been impressed by the "wide range" results found when employing such methods.

The new and accurate method described by Schwarzenbach uses only three reagents, and with these, an evaporating dish, a 50 ml. measure and a burette, any amateur can arrive at a figure of total hardness. In the method developed by Schwarzenbach for measuring hardness the disodium salt of ethylene-diamine-tetra-acetic acid separates calcium and magnesium ions from the solution as an un-ionised complex, and the ability of the salt to do this is applied in this system of accurate volumetric determination through the medium of the indicator, which reacts to the removal of the ions.

The accuracy of the system plus the human element of detecting the colour change about to be described, shows the figure of degrees of hardness, or parts per million hardness so simply, that an average team of persons working the same water over a series of tests will give the same figure at the first attempt. The three reagents employed are hardness buffer solution, hardness titrating solution, and hardness indicator. These can be supplied by any chemist and a good supply will cost about one pound.

Photo: J. & R. Skipper

Equipment used in hardness testing. Left to right—burette with tap over sample beaker, glass droppers in 50 ml. measure, indicator solution, buffer solution and hardness titrating solution



I should at this stage describe the 50 ml. measure as being but a small graduated glass jar, with a small lip to enable easy pouring. The evaporating dish is but a small enamel dish or basin and is likewise obtainable at any chemist. The burette, usually the more difficult article to obtain, is a graduated glass tube, with a small tap at the base, holding either 50 ml., 25 ml., or any convenient similar amount. In addition it is also necessary to have a couple of glass droppers calibrated to the fine grade enabling a measure of 0.2 ml. and 0.5 ml. To commence the test it is necessary to fill the burette with hardness titrating solution.

The sample of water to be tested is then measured in a 50 ml. measure jar or glass and poured into the evaporating dish; to this latter is added 0.5 ml. of hardness buffer solution and 0.2 ml. of hardness indicator. *The sample will then turn pink in colour.* Slowly turn the burette tap so that the hardness titrating solution runs into the evaporating jar containing the sample under test, and watch carefully, stirring all the time with a glass rod. Near the "end point" the sample will take up a faint blue coloration, and the "end point" is reached when the red changes completely to blue; frequently the complete change is made within a drip or two from the burette, and therefore it is necessary to take care to allow but a slow discharge from the burette.

When the blue coloration is complete, note the number of ml. used of titrating solution and multiply by 20. This will give you the total hardness in parts per million. To convert this figure to degrees of *Clark's* hardness divide the figure by 14.3. It is becoming more common nowadays for all authorities to quote total hardness in parts per million. In the test described the hardness buffer solution

is added to prevent interference by traces of iron or copper.

The only difficulty with this method is confronted when very hard water is to be tested, and in that case I have noticed that the complete colour change takes a comparatively larger amount of hardness titrating solution, and it is, therefore, more difficult to discern when the blue change has been reached. On the other hand when one is checking very soft water the complete colour change is made with one single drip, and in that case the burette must be discharging with a very slow flow.

How foolish it is to see in a breeding article "tapwater was used," when we consider the vast variation in the hardness of various locality tap water. For example, in Burnham-on-Crouch, Essex, the hardness in parts per million is 25, while in Elstree it is 210. In Blackburn, 20 parts per million, and in Chesterton (Cambs.) up to 430 parts per million. The rain collected around the London area is between 5 and 40 p.p.m. (and very dirty, too!)

Hardness is expressed differently in different countries, and that will probably come as a shock to those who read or translate the many continental publications on fish breeding. In France hardness is conveniently expressed as parts of $CaCO_3$ (calcium carbonate) per 100,000 parts of water; if therefore, a solution contains "x" parts of $CaCO_3$ in 100,000 parts of water, it possesses "x" degrees of hardness. In Germany, each degree of hardness indicates 1 part of CaO (calcium oxide) in 100,000 parts of water. The term "English degree of hardness" is sometimes applied to the hardness based upon grains of $CaCO_3$ per gallon of water. (1 Imperial gallon = 70,000 grains). In the U.S.A., hardness is given in terms of grains of $CaCO_3$ per U.S. gallon, which is five-sixths as large as the Imperial gallon. Therefore: 1 "French" degree = 0.56 "German" degree = 0.70 "English" degree = 0.585 "U.S." degree.

So it remains, tap water or rain water, various as it is around the country, you can at least read it for yourself, and if you were lucky enough to collect the 8.3 inches that fell in October, 1903, then spare some pity for your grandad who got but a miserable 0.1 inch in February, 1891!

Photo: J. & R. Skipper

Water hardness testing in progress at a Hendon A.S. meeting (Messrs. J. Robertshaw and B. Calrow)

References

G. Schwarzenbach and H. Ackerman. Komplexone V. Die Athylendiamine-tetraessisaure. *Helvetica Chimica Acta* 30, 1798 (1947).

W. Biedermann and G. Schwarzenbach. Die Komplexometric Titration der Erdalkalien und einiger anderer Metalle mit Eriochroenschwarz *T. Chimia* (Switz.), 2, 56 (1948).

Cinema Aquaria Display

AN unusually comprehensive display of tropical fishes and aquaria was seen by patrons of the Streatham Astoria (Odeon) cinema last month. Arranged to serve as an introduction to fish-keeping for beginners the emphasis of the display was on the decorative functions of home aquaria; a framed wall aquarium in a modern furnished setting was one attractive feature. Mr. Philip Dee of Ascot Aquaria was responsible for the exhibition and was in attendance every evening to answer questions.

Photos: Laurence E. Perkins

Above—the display of small aquaria housing single tropical species with identifying labels and ribbons leading from each to large maps of the world to indicate regions of origin. Right—Mr. Philip Dee (left) discusses one of the exhibits with the Astoria (Odeon) manager Mr. F. G. Archer.

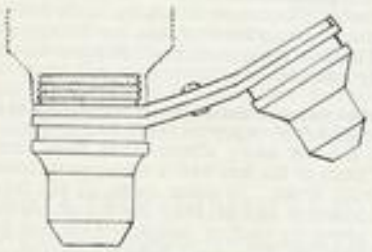
Microscopy for the Aquarist—II

by C. E. C. COLE

BY this time most of you will have had a little experience of changing from one low power objective to another somewhat higher power, and *vice versa*. With the simple apparatus at present at our command we have done this the hard way—by unscrewing the first objective from the nosepiece of the microscope, placing it on the table, picking up the other one, and rescrewing it into the nosepiece. And how many times have you nearly dropped one or the other of the objectives you handle? This is quite easily done unless the greatest care is taken, and once bounced on the stage, the table, or the floor, the objective seldom gives of its best. Repairs or replacements are costly.

For your own sakes, therefore, when either removing or fitting an objective to the nosepiece, always use the right hand for turning, and two fingers of the left hand to support the objective just under its collar. Rack up the body tube to the highest position first to give yourselves plenty of working space. It would obviously be better if we had no need to do all this unscrewing and refitting.

Fortunately, there is an extremely useful accessory which is quite easily obtainable, called a revolving nosepiece. This consists of a circular plate in which provision is made to screw two, three, or four objectives. Above the plate is a dust proof metal cover, securely fitted by a central rivet. From the dust cover projects a single, threaded, and short, tube which screws into the body tube of the microscope in place of an objective. The objective holder can then be rotated and as each hole comes under the nosepiece of the microscope it is held securely in position by a spring.

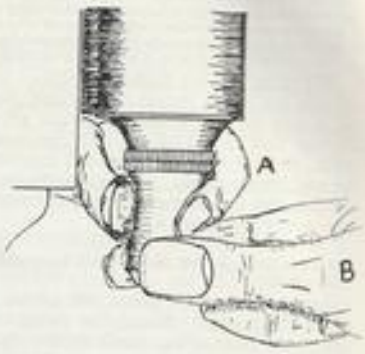


Old type of double nose-piece

Modern makes are all on the same pattern, but occasionally an old type "double" nosepiece can be purchased quite cheaply secondhand, and is worth purchasing if a more expensive one is out of the question. There was a time years ago when I considered these accessories as far too expensive, but they are so useful and speedy when much work is done, and save so many accidents with objectives, that I now consider they are worth every penny paid for them. I cannot say this, however, without adding a word of caution.

Most second-hand outfits contain a miscellaneous assortment of objectives by different makers, vastly different in length. Consequently, it is necessary to rack up well clear of the stage each time a fresh objective is to be revolved into position. Otherwise, sooner or later you will turn the nosepiece and crash the new objective on to the stage, or slide its face across the edge of the stage clips, doing it absolutely no good at all.

Where a set of the original objectives (provided with the microscope when it was new) is used, this danger is absent, for most reliable manufacturers foresee difficulties and ensure that if properly screwed in, in an ascending or descending order of powers, each objective will adequately clear stage and clips. Not only this but once any of the series is focused accurately the others will be almost in focus immediately they are swung into position—another saving in time.



To change objective — support objective with thumb and finger of left hand (A) and unscrew the objective with thumb and finger of right hand (B)

When buying a second-hand revolving nosepiece, test it for accurate centring. Arrange a slide upon the stage and focus with the object absolutely in the centre of the field of view. Now revolve the nosepiece until the second objective clicks home, and re-focus. The object should still appear in the centre of the field. If it seems to have moved left or right, up or down, the objective holder is not properly centred. A trifle out is of no consequence, but only a little latitude is permissible.

Test each objective in turn. See also that the dust cover is securely clamped over the holder—that there is no play or looseness in any direction. The springs should be intact and hold the objectives firmly in position. Current prices for some of the best makes of revolving nosepieces are tabulated below.

Specification	Maker	Price £ s. d.
Double revolving nosepiece ..	Baker	2 8 0
	Beck	2 12 6
	Prior	2 8 0
	Watson	3 0 0
Triple revolving nosepiece ..	Baker	2 16 0
	Beck	2 17 6
	Prior	2 16 0
	Watson	3 6 0
Quadruple revolving nosepiece ..	Baker	3 4 0
	Beck	3 2 6
	Prior	3 4 0
	Watson	3 16 0

Modern triple nose-piece

OUR EXPERTS' ANSWERS TO READERS' QUERIES

Many queries from readers of "The Aquarist" are answered by post each month, all aspects of fish-keeping being covered. Not all queries and answers can be published, and a stamped self-addressed envelope should be sent so that a direct reply can be given.

I am a newcomer to the fascinating hobby of aquarium-keeping and would like your advice on something which is worrying me. I have noticed that the sandy floor of the aquarium is becoming carpeted with what looks like a cob-webby white growth. What is this growth, and will it affect the health of the fishes?

We think you are feeding the fishes too often or too much. If you are using excess dried food, this would soon result in a sort of greyish-white mould appearing on the sand. Scrape this mould off the sand by using a piece of cane or stick, then siphon the loosened fragments into a bucket or jar and empty away. So long as the fishes in your aquarium are healthy and not gasping at the surface of the water, do not worry any more about it.

Please can you tell me where I may obtain gauze for breeding zebra fish?

If you mean wire gauze, we advise you not to use it for a breeding trap. Metals in contact with water for any length of time often result in the fish contracting metal-poisoning and other diseases. Most of the larger dealers sell plastic sheeting perforated with tiny holes which, though allowing the eggs to sink through, are too small to be negotiated by the adult fish. On the other hand, fine-meshed white curtain net may be used. This should be attached to all four corners of the aquarium, and the middle part allowed to droop like a bag in the water. Glass marbles and washed, rounded pebbles also make a good trap to save the eggs of zebra fish. If the fish are spawned in shallow water, the eggs will fall into the interstices of the marbles or stones before the parent fish get the chance to eat them. Of course, after spawning is over, the adult fish should be removed to another aquarium.

I should be grateful if you would furnish me with a few names of exotic water plants which do not need a very high temperature. My aquarium is maintained at a temperature of about 60° F.

The undermentioned plants should do very well in a brightly illuminated aquarium maintained at a temperature of about 60° F. *Vallisneria spiralis, V. torta, Sagittaria natans, S. sinensis, Ludwigia moullertii, Fontinalis gracilis, Acorus gramineus, A. pusillus, Ceratophyllum demersum, Utricularia prehensilis, Cabomba caroliniana,* and the various green species of *Myriophyllum.* The bronze-foliaged and red species of milfoil quickly die down in cold water.

I have just purchased two young firemouth cichlids. I have placed them in an 18 ins. by 10 ins. by 10 ins. tank. Is this large enough for them: and please can you tell me something about their breeding habits and proper feeding?

Your young firemouths should flourish quite well in the tank you mention, but naturally, all the larger-growing fishes attain better development and colour when they are given plenty of room in a spacious aquarium. The firemouth breeds in the typical cichlid manner, laying its eggs on a cleaned piece of rockwork, the side of the aquarium, or even the floor of the tank after the sand has been fanned away. Feed your fish on chopped earthworms, insects out of the garden, tiny pieces of raw, washed liver, red meat, and the usual live foods.

As the glass sides of my aquarium are covered with algae, I have decided to empty the water out, remove plants, fishes and compost, and set the tank up afresh. I have been wondering whether there is anything I can buy to kill the algae, and stop it from forming on the glass in the future.?

Algae will form on the glass sides of a tank even after the most drastic treatment, for it is a natural growth like weeds in a garden. Too much bright light encourages it to grow, and it flourishes best in alkaline or hard water. Acid water, and partial shade will keep it in check. Most aquarists scrape it from the front panel of glass with a razor blade fixed in a metal holder, or piece of stick. The scrapings which sink to the bottom should be dip-tubed or siphoned out of the aquarium.

I should very much like to set up a tropical aquarium, but I am rather worried about using an electric heater to keep the water warm. You see, I have a tiny daughter who is very inquisitive, and I fear that she will put her hand in the water and get a shock.

We think your best plan would be to "earth" the aquarium by fixing a short length of lead wire to the frame, and running a stout copper wire from the frame to earth. The lead wire should protrude into the water. Besides this precautionary measure, make sure that you keep the aquarium top covered with a heavy piece of smooth-edged glass or hood-shaped enamelled cover. A close-fitting cover will prevent your little daughter putting her hands in the water, or meddling with the heater.

Among the fishes in my community aquarium, I have a perma black female mollie. She appears to be gravid, yet the only other livebearers I have in this aquarium are guppies, swordtails and platys. Is it possible for a female mollie to be fertilised by other livebearer males?

Yes, it is possible for a female mollie to be fertilised by a male guppy, platy or swordtail, but such an occurrence is rare, and any young born seldom live for more than a few days. The few youngsters that do grow to maturity are invariably infertile.

I should be very grateful if you can tell me how to treat fin-rot which has got a hold on several of my rosy barbs.

If the fish are badly affected, net them and paint the diseased parts of the fins with a saltwater solution or iodine diluted with water. In some cases, all the fish need is a general building up of their condition. This may be brought about by feeding exclusively on live food, pieces of raw meat or fish, and Bemax. At the same time, maintain scrupulous cleanliness in the aquarium, and an even temperature.

I have recently purchased a pair of tiger barbs, but I am not certain how to distinguish the male from the female. Can you help me, please?

The male fish is slimmer in build and wears brighter colours. When the fish are ready to breed, the male's colours are noticeably more vivid than the female's, and a female barb in breeding condition shows plump sides.

My tank of guppies has become stricken with some disease. The fish keep dashing about and rubbing themselves on the sand. Up till the time of writing, a guppy or two has been found dead on the bottom almost every other day. Please can you help me to cure this disease?

We suggest you try the following treatment: Dissolve 15 grains of methylene blue in three and a half fluid ounces of water. Add this solution drop by drop to the aquarium until the water turns noticeably blue. Give a few degrees more heat, and keep the temperature higher than normal for a week or two. If the fish fail to respond to this treatment, try placing them in a quart of tepid water to which has been added eight drops of household ammonia. Leave them in this solution for about a couple of minutes, then remove them to fresh water. In a case such as yours, it

would be advisable to empty the aquarium water away, pour boiling water over the compost (after it has been removed from the aquarium), and wipe the inside of the aquarium with a wet cloth sprinkled with plenty of salt, rubbing well into the corners and along the inside edge of the frame.

Can I keep *Corydoras* catfish with guppies; that is to say, will the catfish harm them in any way?

Corydoras catfish are well-behaved and peaceful. They will eat any food left over after the guppies have been fed, but to make sure that the catfish get their proper share of food, it is a wise plan to introduce some food into the tank after dark. The catfish will feed when the guppies are resting close to the top of the water.

Some time ago I bred some fighting fish. The fry were kept well supplied with *Infusoria*, but after a week or two they started to die off like the proverbial flies in winter time. A friend suggested that the baby fish died because they were unable to develop their labyrinth organs. I cannot understand why this should be so, for I reduced the level of the water to about five inches. Can you give me any more information, please?

A lot of newcomers to breeding labyrinth or air-breathing fish fail to realise that the fry will die if they cannot break through the water surface. A scum covering the top of the water is fatal to the fry of fighting fish, gouramies and the like. After the fry have become free-swimming, it is advisable to draw a sheet of newspaper across the surface of the water every other day, more often than this if the aquarium is situated in a smoky atmosphere, or is heated by paraffin lamps.

I am a beginner in tropical fishkeeping and wish to stock my aquarium with small, inexpensive fish. I am very attracted to zebra fish and white cloud mountain minnows, but I have been told that it is impossible to keep these two species together. Is this true?

We do not think this is true. The fact is that zebra fish like and can withstand plenty of heat while the minnows prefer cooler conditions and will soon die if kept in a temperature of above 80° F. If you place the two species together and keep the temperature within the region of 72° F., we do not think you will have any trouble. You must remember though, that zebra fish are short-lived, and seldom live much longer than two years; so when you buy your fish from a dealer do try and obtain young fish to begin with.

I have had two neon tetras in my community tank for more than a month. Although they seem to be quite healthy, they are not anywhere near so brightly coloured as they were when I first bought them. Do you think these fish are ill in any way?

We do not think your neon tetras are ill. Possibly your aquarium water is not acid enough for them, or the overhead light is a bit too bright. Neons colour up best in acid water and against a dark background and bottom, with the top light broken up by plenty of plant life growing close to the surface of the water.

I have been told that the addition of some salt to aquarium water improves it. Is this true, and what sort of salt should be used?

It is perfectly true that some species of fish do appreciate some salt in the water. On the other hand, catfish and some species of underwater plants do not like salt in the water. Among the fishes that can withstand strongly saline conditions are guppies, scats, puffer fish and mollies. The best salt to use in the aquarium is evaporated sea salt, which may be obtained from a chemist's shop, or ordinary kitchen salt, not the refined salt which is adulterated with chemicals to prevent it from clogging or forming into a hard lump when kept in a packet. A teaspoonful of salt to every gallon of water is about the right amount to use; and once the initial amount has been added to the aquarium do not add any more or else you will convert your aquarium into a brine bath.

My fish are suffering from a curious illness or disease. They appear to be swimming—that is, agitating their pectoral fins violently—but keep in the same spot. Some of them appear to be wasting away. Can you please tell me what is wrong with them?

The symptoms you described in your letter are indicative of a chill. We suggest that you raise the temperature of the water about five degrees above normal, and keep it that way for a week to a fortnight. Reducing the level of the water often helps to relieve the condition. Feed the fish on live food or pieces of meat or liver. If any of the fish do not respond favourably to treatment, it is kinder to destroy them.

COLDWATER FISHKEEPING QUERIES *answered by* A. BOARDER

In an answer to a query you say that only in ponds with a dense mass of plants for the fry to take cover is it possible to rear many fish. I know a mill pond with a temperature of 75° to 85° F. which is six to ten feet deep, with rough stone sides and concrete bottom. There is no plant life whatever but the pond is full of goldfish and carp which breed profusely; how do you account for this?

I was speaking of small coldwater ponds. The pond you mention is essentially a tropical one and this makes a difference. Goldfish eggs would hatch in such a pond in not more than three days, which means that the eggs are subjected to the danger of being eaten for a much less period than would be the case in the ordinary garden pond to which I was referring. The average time for hatching in a garden pond would be more like ten days to a fortnight. The mill pond may also contain so much live food that the parents could find enough food without eating the eggs and fry. For all that I am willing to bet that for every egg there which produces an adult fish eventually, there are a hundred at least which do not do so.

I have a steel frame for an aquarium 4 feet by 2 feet by 2 feet. What is the minimum size glass to withstand the pressure of water?

To be on the safe side I advise you to use no less than three-eighth inch glass. This should be quite all right but quarter plate may not be enough to stand the strain, especially if it received a knock when full of water. The water the tank would contain would weigh something in the region of 1,000 lbs., and so the need for strength is obvious.

For over 25 years I have had a pond and get hundreds of tadpoles. I have 20 to 30 goldfish in my pond and every year the tadpoles disappear before they get their legs. This year they all vanished over-night. I have never seen a goldfish interested in or eat a tadpole, so what happens to them?

If the tadpoles are frogs, then the goldfish would eat them as fast as they started free-swimming. A three inch goldfish could eat all the tadpoles from one batch of eggs in a day or so if it started on them as soon as they left the jelly. I rear many hundreds each year to a full size so that I can feed my fish with them. Then as soon as they are dropped into the water the goldfish seize them immediately and none are left in a few minutes. If I left the tadpoles to hatch in the pond with the fish I should not expect to see any tadpoles get to a size large enough to make much of a meal for the fishes.

Would you please let me know if it is safe to leave my two coldwater fantails for a fortnight, the tank is 20 ins. by 10 ins. by 10 ins.?

It will be quite safe for you to leave your fishes without any artificial feeding for a fortnight. You may have some

doubts because of what was said on television by a so-called breeder and dealer in fish. He stated that tropical fishes could be left for periods up to a fortnight without food, whereas coldwater fishes could not be so left but must be fed. This was ridiculous and misleading and the aquarist should have known better. I always leave my coldwater fishes for periods of a fortnight each year and although they are never artificially fed during my absence I have never yet found any fish the worse for the experience. Of course, it must be realised that goldfish are omnivorous, and so eat a certain amount of vegetable matter which they will find in any well planted tank. Even though there may be no plants whatever in the tank it will still be possible to leave the fishes safely. Before you go away give no extra food whatever. If you do, this may remain uneaten for a time and then pollute the water to the danger to the fish. If possible place the tank in the coldest and darkest part of the room and it will be found better than if the sun reached it. During last winter I had some half-inch fantails go nearly five months without them being fed by me. They appeared none the worse for their fast but, of course, the temperature rarely rose above 40° F. There is a food which is fairly safe to leave with fishes, and that is the live type. However, this can be overdone as too much food may mean the production of too much waste matter; this in turn can cause pollution.

I have recently bought a Japanese fantail goldfish. The fish in question has a single anal fin and the tail although double has the top portion joined. An aquarist friend says that the fish is not a Japanese fantail but a throw-out from an ordinary fantail strain. Is this correct?

The name Japanese fantail is often given to any fantail as the type was probably evolved in Japan. What constitutes a real fantail under British Standards must have a double anal fin, or it could be disqualified at a show. Also the top portion of the tail or caudal fin must be divided three-quarters of its length. In any strain of fantails many such fish as yours are bred each year. From even the best of strains it is possible to get single anals, improperly paired ones and even no anal fins at all. As for the tail this can vary tremendously. Some are all right, others have the top of the tail joined which are called web-tails, and others have a single upper part and a double lower. These are called tri-tails. If any of these types have come from a good well-established strain it is possible for them to breed some fish as good or perhaps better than any they came from, and if the best of their youngsters are used for further breeding everything may be well.

I have been feeding my goldfish with *Tubifex* worms and now find that the sand is infested with them which the fish do not seem able to pull out even when I refrain from feeding them. How can I deal with this problem?

I do not think you have anything to worry over at all. If the worms remain in the tank they will do little harm and you can be sure that you will have some live food always available if needed. Should you go away on holiday and have to leave the fish to themselves they would have a natural source of live food all prepared for them. Although your fish may appear to be unable to catch the worms before they withdraw into the sand you will find that once they get really hungry they will soon learn how to wait for and catch the *Tubifex*.

Having nothing else ready I have paired a female "copper" fantail (believed to be one of your strain) to a coloured fish. This should give me an opportunity of starting a line of my own. Can you tell me what percentage of coloured fish I may get from the youngsters?

I do not think your fish was of my strain as I have never had one of my fish fail to colour at least the year following the hatching; sometimes they colour as early as three months. The copper or bronze fish may never change colour now as you say you have had it 3½ years. I would never breed from a scaled fantail which had not changed colour in a few months, certainly not one taking more than 12 months. You may get many fry which will change colour early but you will also get many which will not. If you breed from the youngsters which have changed early, their young may still carry the tendency to take too long in colouring and pass on this bad trait again. It is a long enough task to breed a strain of fairly quick colouring fish without deliberately breeding from one which shows a tendency to be long in colouring. Good though your fish may be in all other points I would not breed from it in the expectation of being able to establish a strain. If you start with the right fish you are benefiting from the work and experience of other breeders and must be on a shorter track.

I have a 36 ins. by 12 ins. by 12 ins. tank on my window sill and although the fish and plants are healthy there is a lot of algae, green water and blanket weed in the tank. How can I avoid this?

The tank is in such a position that it is very difficult to be able to keep the water clear and to prevent blanket weed and algae from forming. I realise that it may not be possible for you to be able to place the tank in a better position, but it would be much better if the tank could stand so that the light reached only the end of the tank. This means that the tank would then stand at right angles to the window. As long as you get too much bright daylight you may be troubled with the algae, etc. You can easily test this for yourself. Place some water in a tank and keep it in the dark; the water will never go green. If you place the water in full daylight the water will soon become green through the growth of algae. If you must keep the tank in the window you will have to cover the glass nearest either with thick paper or paint it in a suitable shade to go with the window paint-work. It is quite simple really, cut down the light and you cut down the algae.

I cleaned out my pond and after re-filling I found that the water went cloudy in a few days whereas it had previously remained clear. Is this because of the absence of growing water plants?

If you clean out a pond and remove the water plants it is almost like filling a pond with fresh water for the first time after it has been made. Water goes through a certain process when various types of Infusoria and bacteria work out their own life cycles. During this process the water will become cloudy but it usually gets all right again especially when the water plants have had a chance to start growing. The mere fact of emptying and re-filling will not solve your problem but if you have patience you will find that the water will become clear; however, do not start feeding your fish with more food than can be quickly eaten or cloudiness will always be present.

I have a shallow goldfish pond and would like to know if you can recommend a suitable paint which will not injure the fish, either in green or blue?

I do not think that it is a good plan to use paint on the concrete of your pond where the water and weather can have effects on it. Most ponds soon get a greenish colour when they are established and this natural colouring would be far better than any form of paint. If a colouring agent is used when the concrete is being mixed this could be all right but once the pond is made I do not think that painting will be a safe and lasting method of camouflage.

My daughter is desirous of having a small aquarium in her bedroom. Is there anything against this as I have heard that it is not advisable?

I see no harm whatever from having a tank in the bedroom. Over 50 years ago I had one in mine among much other live-stock and I have not had any ill effects as yet. The only snag was that my mother made it a strict rule that I kept the room thoroughly clean myself; as long as I did that all was well.

our readers write

Readers are invited to express their views and opinions on subjects of interest to aquarists. The Editor reserves the right to shorten letters when considered necessary and is not responsible for the opinions expressed by correspondents.

Address letters to The Editor, *The Aquarist*, The Butts, Half Acre, Brentford, Middlesex

Aquarium Backgrounds

TO paint a background for your aquarium you do not need to be an artist. All that is needed are the following artists' oil colours in small tubes costing a few pence each and a ½ inch artist's stiff oil colours brush: one tube each of gamboge, white, Prussian blue, sepia and drier. Any oil paint already in your possession can in fact be used.

The secret of success is to start in the darkest corner first. With the sepia roughly stipple the bottom three inches of glass and then stipple some gamboge on top to give the effect of gravel. Mix some gamboge and Prussian blue to give a leafy green and with long upwards strokes of the brush starting from one spot rough out a fine giant *Vallisneria* or *Cryptocoryne*. Follow this with varying shades of green (by adding gamboge to make the green more yellow or Prussian blue to darken the green), painting thinnish lines sweeping and curving upwards; these are the stalks and from these stipple fine fern-like fronds extending in places to the top of the stalks.

When all the desired plants have been painted in, mix Prussian blue and white to a sky-blue colour and fill in all the glass not already painted with this. Finally, while the green paint is still wet a few short strokes in sepia rising from the crowns of the plants will give a shaded depth to the plants. If the appearance of rocks is required mix sepia with white and paint these in before starting on the plants. It is advisable to view the tank from the front to make sure the effect is a natural one. None of the colours should be very dark or one loses the lovely effect of looking a great distance under water, for if the job is well done this is the appearance given. I have painted all my tanks like this and some for my friends who were afraid to do it themselves until they saw how very simple the job can be. The great advantage of painting one's own tank is that varying size of aquaria does not create any difficulty and the paint lasts indefinitely.

OLIVE M. MATTHEWS.
Heatley Heath, nr. Warrington

Endurance

THIS month I happened to be transferring some of my fish out of one tank into a carrying can. I had netted most of them, and had caught a full-size Siamese fighting fish (male) in the net; the fish jumped right out of the net, only to land four feet below on to concrete. Quickly and carefully I picked it up and replaced it in the tank. The fish lay motionless on the bottom of the tank as if dead. I netted it again, and it put up little resistance; when placed in the tin it went directly to the bottom. All the fish in the tin were then taken to a school exhibition ten miles away. I put them all into a fresh tank which had been left standing without fish for a few days. Eighteen hours later the Siamese fighting fish had made itself a bubble nest on the surface of the water inside a plastic feeding ring.

R. J. TYLEY, Maidstone.

Coloration of Goldfish

AFTER having read many articles on the above subject I made arrangements to obtain fish reputed to be of the finest strain in this country. In December, 1954, I procured 11 fish, six well shaped and five with bad faults in finnage; of the well shaped fish one was already completely coloured whilst another was commencing; all the remainder were the initial colour, this I was informed was due to a bad summer with "lack of sunshine."

In January of this year I took nine of the fish to my place of employment, steam heated and water maintained at a constant 60° F.; the remaining two fish I put in my outdoor pond. During February I gave one of the fish which was well shaped but had no anal fins, ultra violet light radiation twice daily, commencing at three minutes morning and afternoon and finally working up to 10 minutes morning and afternoon during the last week of that month; the container was 2½ inches deep, most of the articles stating that U.V.R. does not penetrate below the depth of three inches.

The end of March saw still no change but during April I fell a victim to "flu" and on my return after a fortnight's absence I was delighted to see a marked change in four of the well shaped fish, darkening of the back with bleaching of the belly. The fish coloured when purchased had assumed the rich golden colour whilst the fish partly changed had gone from the brassy to a light lemon yellow.

On 1st May all fish were placed in the outdoor pond, 10 ft. by 4 ft. and fed on a variety of live foods, and by the end of the month I had six golden fantails. June ending, all fish are doing well and I have seven coloured, whilst the fish that received the U.V.R. has just commenced to change, this leaves one fish of the nine kept all the winter at 60° F. to colour. The two fish retained in the pond for the winter show no indication at all of coloration although feeding, etc., since the pond fish have been active, have been precisely the same.

It would appear to me, a "tyro," that the most important factor after having obtained your progeny from a quick colouring strain is heat, either natural or artificial, and that U.V.R. has no part whatsoever in getting the "Gold into Goldfish."

W. A. Wicks, Fratton, Portsmouth.

Cacti in the Fish House

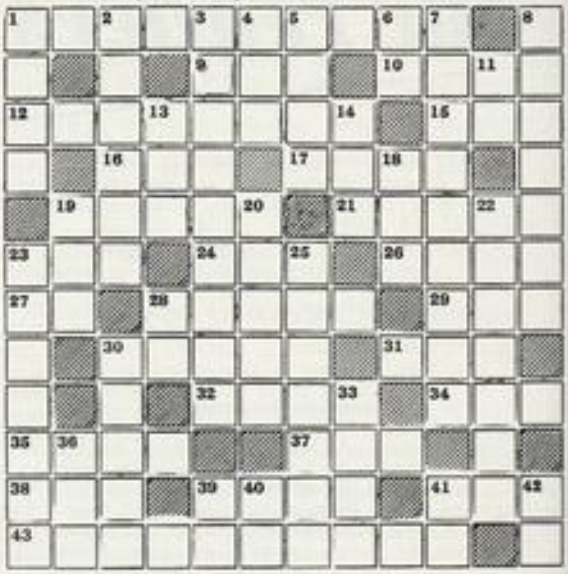
MANY cacti can be raised from seed providing a little warmth is available. The top of a tropical tank will often prove an ideal place for germinating the seeds as the best temperature for this is about 70°F. For the successful germination of seeds three main things are necessary. These are warmth, moisture and air. Some cactus seeds are very tiny and it is with these types that great care must be taken. It is a fact that many seeds of all types of plants fail to germinate if they are sown too deeply in the ground. With the small kinds of cactus seeds this is where many people fail in their efforts. Most kinds will germinate if they are just lying on the top of the soil and not covered at all. One general rule with seed sowing is to cover the seeds by their own thickness of soil. As some kinds of cactus seeds are not more than one-fortieth of an inch in diameter it can be realised how difficult it would be to give the seeds such a covering. Try to get fresh cactus seeds as these will be more likely to grow than stale ones. The best medium for planting them in is John Innes Seed compost, which can be purchased from any good nurseryman. Sieve a little through a perforated zinc sieve and place in half pots or pans. Cover the drainage hole with a crock and then add the coarse material from the compost, about a third of the pot. Then add a little unsifted, finishing with about an inch of the fine on top. Firm this down slightly and sprinkle the cactus seeds on the surface. The soil should be about half an inch from the top of the pan. The seeds can be pressed into the soil a little and sometimes a covering with tiny stones, one stone deep, is beneficial. These small stones prevent the soil from drying out too quickly and form some protection for the seeds. Aquarium compost does for this purpose as long as all the fine sand has been sifted out.

PICK YOUR ANSWER

1. "It wasn't the wine," murmured Mr. Snodgrass, in a broken voice. "It was the . . ." The missing word from the quotation from *Pickwick Papers* is: (a) Crab. (b) Lobster. (c) Mackerel. (d) Salmon.
2. Which of these species bears a distinct "Rivulus spot"? (a) *Rivulus dorni.* (b) *Rivulus isthmensis.* (c) *Rivulus strigatus.* (d) *Rivulus urophthalmus.*
3. Which one of the following species swims head downwards at an angle of about 45 degrees? (a) *Abramites microcephalus.* (b) *Alestes chaperi.* (c) *Arnoldichthys spilopterus.* (d) *Astyanax bimaculatus.*
4. The popular name of *Crenuchus benl* is: (a) Gold-striped characin. (b) Loreto characin. (c) Striped characin. (d) Swordtail characin.

The AQUARIST Crossword

Compiled by J. LAUGHLAND



CLUES ACROSS

1 Instrument essential to the aquarist studying Infusoria, for example (10)
9 Abbreviation of the lover's patron saint, or of popular aquarium plant (3)
10 Their eggs were formerly regarded as the standard food for goldfish (4)
12 I laud wig as a tank plant (8)
15 A hint, perhaps; or a rod with a tip (3)
16 Immerse in water (3)
17 Soft substance in centre of dicotyledonous plants (4)
19 Good smoke (5)
21 Regal (5)
23 Married woman's title (3)
24 Fish eggs (3)
26 "And you," as Caesar said to Brutus (2, 2)
27 Cockney hail (2)
28 Small river fish but could make a loch (5)
29 African prince of the *Rasbora* (3)
30 Perceive by feeling (5)
31 If you get this one you are what it means: wordmaster (3)
32 Craft (4)
34 One German in winning vein (3)
35 Beautiful moisture loving plant (4)
37 One-celled fruit, with hardened pericarp, with one seed (3)
38 Bring forth young (3)
39 Musical work sounds like cat call (4)
41 Abbreviated unit of current consumption (3)
43 Echinoderms sounding like sure winners at the aquarist show (4, 6)

CLUES DOWN

1 Aquarists' word for debris found at bottom of tanks. Not in dictionary (4)
2 Fly whose aquatic larvae build shells of sand, twigs, etc. (6)
3 Producing eggs which are hatched in the body of the parent (9)
4 Wilt; but in aquarists' parlance a most popular plant (3)
5 This fastening has many uses for aquarists (4)
6 Male parent in paragenesis (2)
7 White worms (9)
8 Water louse (7)
11 Second word of 26 Across (2)
13 Only half a wiggle (3)
14 Medium employed in aeration (3)
18 Pedal extremity (3)
19 Weep (3)
20 *Ramus* (5)
22 Reversion to an original ancestral type (7)
23 Darkies of the tank (7)
25 Sea-urchin (7)
28 Look from loach (2)
30 Little Catherine's train disturbed (5)
33 Shove (4)
36 Water this is a vole (3)
39 Of this the answer is plain at first glance (2)
40 Mixed type (2)
41 As 39 Down (2)

5. The flowers of *Cardamine lyrata* are: (a) Blue. (b) Red. (c) White. (d) Yellow.
6. *Hottonia* was named after Peter Hotton (1648-1709) professor of botany at: (a) Cambridge. (b) Heidelberg. (c) Oxford. (d) Leyden.

G.F.H.

(Solutions on page 108)

News from AQUARISTS' SOCIETIES

Monthly reports from Secretaries of aquarists' societies for inclusion on this page should reach the Editor by the 5th of the month preceding the month of publication.

A copy of *The Aquarist's Directory of Aquarium Societies* will be sent free to any reader on receipt of a stamped, self-addressed envelope.

AT the Federation of **Guppy Breeders' Societies** annual show this year open classes will be staged for any type male or female guppy and also open breeders' classes. Closing date for entries is 3rd September—for details see "Aquarist's Calendar" over page.

* * *

PROGRAMME for the next six months' activities of the **Lambeth Aquarist Society** is now complete and a copy will be supplied on request to the secretary, Mr. D. G. W. Page, 18, Clive Road, London, S.E.21.

* * *

MEETING PLACE of the **Newcastle-on-Tyne and District Aquarists' Society** is now the Liberal Club, 98, Pilgrim Street, Newcastle-on-Tyne 1, and meeting night is the second Wednesday of each month.

* * *

FOLLOWING the successful third annual show held by the **Dunstable and District Aquarist Society** a monthly meeting was held at which the speaker, Mr. J. H. Gloyne, also judged a table show and presented the annual show prizes. Mr. Gloyne's talk was on "Artistic Aquaria."

* * *

EXHIBITION of aquaria by members of **Guildford and District Aquarist Club** is being staged in the foyer of the Odeon Cinema, Guildford, by invitation of the manager of the theatre, from 8th to 20th August.

* * *

LIVE specimens were demonstrated by micro-projector at a recent meeting of the **Peterborough and District Aquarists' Society** when Mr. T. Furneaux was the evening's speaker. The specimens included goldfish eggs, live *Daphnia*, a newly born guppy and a larval newt.

* * *

PISCES **Aquarist Club (Dulwich)** members now meet at The Heber Arms, Heber Road, Dulwich, London, S.E.22 on alternate Fridays. Details of meetings can be obtained from the secretary Mr. F. S. Sayers, 3, Rokell House, Beckenham Hill Road, Beckenham, Kent.

* * *

TABLE shows are now regular features at the meetings of the **Tyneside Aquatic and Biological Society**, and at each show members give ten minute talks on their exhibits. Another idea that has provided material for an evening talk is the appointment of an "outside reporter" describing visited members' fish-houses.

* * *

BREEDING characins was the subject of a lecture by Mr. R. Marshall to the **Coventry Pool and Aquarium Society** last month. Outings of the society have been planned for September (to Shirley Aquatics) and October (to the British Aquarists' Festival at Manchester).

* * *

NEXT meeting of the **Kidderminster and District Aquarists' Society** will be held on Thursday, 25th August at the Victoria Club Rooms, Green Street, Kidderminster at 7.30 p.m. Last month's meeting included a talk by Mr. C. W. Horrell on electrical equipment and some slides of live foods such as micro worms were projected. The society is considering installing a community aquarium in the local library.

Have you seen ?

the announcement of details on page 88 concerning this year's

BRITISH AQUARISTS FESTIVAL

ANNUAL open show of **Chester and District Aquarist Society** was staged last month. Entries exceeded expectations and attendance was good although financially the show was disappointing. Judges, Messrs. A. McDowell (Salford) and E. R. Owen (Didsbury) remarked on the high quality of entries. Prizes were presented by the Mayor of Chester on the last day of the show. Best fish in the show was judged to be an *Aphyosemion bivittatum* owned by Mr. C. Morrison, who was awarded the Mottershead Trophy.

* * *

MEETING room of the **Yeovil Aquarist Society** was packed full when the society's first annual table show was staged last month. The exhibits were judged by Mr. V. Jones, curator of the Bristol Zoo Aquarium, who also gave members a talk on all aspects of coldwater and tropical fishkeeping. Best fish of the year (a pair of scats) won for Mrs. M. Bryant the award of the Stainer Shield; a Bristol shubunkin owned by Mr. W. Reeves gained the Rogers Shield for the best coldwater fish.

The "World Aquarist"

THIRD issue of the *World Aquarist*, official organ of the World Federation of Aquarists, has been issued. It contains an illustrated announcement of the agenda for the Federation's general meeting to be held on 13th August at de Lairesse Hall, Binnenhof, The Hague, Holland. Other material in this July issue, in English, includes an article on tape recording, talks by H. A. Nichols, news from societies all over the world, book reviews and some selected abstracts of articles from aquarium journals.

Sandown Zoo

AT the opening of a new Children's Zoo at Sandown, Isle of Wight, last month, Mr. George Cansdale, its technical director, said that nearly 17 million people in the British Isles keep either a cat, a dog, a cage bird or an aquarium. His estimate of the number of people keeping tropical or coldwater fishes was nearly one million and a half a million for devotees of snakes, tortoises and other reptiles. "Britain may still enjoy its reputation as a nation of shopkeepers but we are rapidly becoming a nation of pet-keepers into the bargain," said Mr. Cansdale. The new zoo, which covers five and a half acres, will eventually house about 400 animals and birds.

Corrections

IT is regretted that mistakes in names of societies were made in two captions to pictures published in the July issue of *The Aquarist*. On page 60 the "opened book" display of aquaria should have been credited to the **Doncaster Naturalists' Society**, whose work it was, and on page 81 the pictured presentation to Mr. C. A. Illake was made in respect of his successes at the **Rochdale and District Aquarist Society** fourth annual show. Apologies are offered to both societies for any inconvenience caused by the errors.

General view of the Southampton and District A.S. sixth annual show, which was visited by over 2,000 people. The Intertown Furnished Aquaria award was won by the Southampton Society

Smiling group of Hendon A.S. members photographed with the National Aquarist Society shield awarded to the society for the highest number of points gained at the National show this year.

Aquarist's Calendar

18th-20th August—**Welsh National Aquarists' Society** "Welsh Aquarists' Show" at the Park Hotel, Cardiff.

19th-20th August—**Kirkcaldy and District Aquarist Society** first annual show at Boys' Brigade Hall, Kirkcaldy, Fife. Schedules from show secretary, Mr. A. Blair, 14, Miller Street, Gallatown, Kirkcaldy, Fife.

20th-21st August—**Leyton Aquaria Society** annual open show (in conjunction with Borough of Leyton Show) at Coronation Gardens, Leyton. Saturday: 3.30-9 p.m.; Sunday: 12 a.m.-8 p.m. Schedules from show secretary, Mr. R. Bergdahl, 49, Overton Drive, Wanstead, London, E.11.

24th-27th August—**Kettering and District Aquarists' Society** annual open show at the Co-operative and Labour Institute, Kettering.

24th-27th August—**Oldham and District Aquarist Society** fifth annual open show. Details from Mr. Tripp, 197, King Street, Oldham, Lancs (Phone: Main 7025).

25th-27th August—**Midland Aquatic Show** at Bingley Hall, Birmingham.

25th-27th August—**Banbury and District Aquaria Society** show. Details from show secretary Mr. A. Simmonds, Hadsham Cottage, Horley, nr. Banbury.

31st August - 3rd September — **Leicester Aquarist Society** annual show at St. Mark's Schoolroom, Belgrave Road, Leicester. Show secretary, Mr. E. L. Matthews, 61, Ainsdale Road, Leicester.

31st August-3rd September—**Association of South London Aquarist Societies** annual exhibition at Adult School Hall, Benhill Avenue, Sutton, Surrey. Opening 3 p.m. first day, 10 a.m. others. Details from secretary Mr. S. Davies, 16, Milton Road, Wallington, Surrey.

31st August-10th September—**Nottingham and District Aquarists' Society** annual show.

3rd September—**High Wycombe and District Aquarist Society** annual open show on the Rye, High Wycombe. Schedules available from show secretary Mr. K. H. Palmer, 3, Dedmere Rise, Marlow, Bucks.

8th September—**Yeovil and District Aquarist Society** furnished aquaria exhibition at Yeovil Agricultural Show.

8th-10th September—**Coventry Pool and Aquarium Society** annual show at Queen's Road Baptist Church Hall. Opening 2.30 p.m. first day, 10 a.m. others.

10th-11th September—**Willesden and District Aquarists' Club** show at the Willesden Show, Roundwood Park, Willesden.

9th - 10th September — **Bethnal Green Aquatic Society** show. Details and show schedules from show secretary Mr. F. Fox, 130, Whitecross Street, Old Street, London, E.C.1.

15th-17th September—**Peterborough and District Aquarists' Society** annual open show at St. Paul's Hall, New England, Peterborough. Schedules from secretary Mrs. Y. J. Stockdale, 2, Home Place, Eastgate, Peterborough.

16th September—**British Herpetological Society** (London Group) meeting: "Young Animals," 7 p.m., at the Linnean Society's Rooms, Burlington House, Piccadilly, London, W.1.

17th September—**Lambeth Aquarist Society** annual show at St. Luke's Church Hall, Norwood High Street, London, S.E.27.

23rd-24th September—**Rhondda Aquarist Society** first annual open show at the Boys' Club, Treorchy, Rhondda. Details and show schedules from secretary Mr. S. Rosser, 16, Dunraven Street, Treherbert, Rhondda, South Wales.

24th - 25th September — **Federation of Guppy Breeders' Societies** show at the Pavilion Cafeteria, Zoological Gardens, Regent's Park London, N.W.1.

24th September—**Dublin Society of Aquarists** annual show, 3 p.m. to 6 p.m. at 89, Walkinstown Road, Crumlin, Dublin. Entries confined to members of societies affiliated to the Irish Federation of Aquarists' Societies.

30th September-1st October—**Bristol Aquarists' Society** annual open show and exhibition at the Central Y.M.C.A. Concert Hall, Colston Street (Trenchard Street entrance), Bristol. Schedules available from secretary Mrs. G. Grimston, 10, Queens Road, Knowle, Bristol 4. Closing date 12th September.

5th-9th October—**British Aquarists' Festival** organised by the Federation of Northern Aquarium Societies in collaboration with *The Aquarist* at Belle Vue Zoological Gardens, Manchester. Schedules available from show secretary Mr. S. W. Cooke, Spring Grove, Field Hill, Batley, Yorks. Closing date 29th August.

13th-15th October—**Reading, Oxford and High Wycombe Aquaria Societies** annual Three Counties Show at the Palmer Hall, Reading. Schedules available from Mr. F. H. Crane, 26, Kensington Road, Reading.

27th-30th October—**Accrington and District Aquarist Society** sixth annual show at the Town Hall, Accrington. Details and schedules from show secretary Mr. F. W. Hartley, 47, Tremellen Street, Accrington, Lancs.

Secretary Changes

CHANGES of secretaries and addresses have been reported from the following societies: **Croydon Tropical Breeders' Circle** (Mr. G. F. Boyce, Pixham, 67, Nimrod Road, Streatham, London, S.W.16); **Kidderminster and District Aquarists' Society** (Mr. L. Lane, Abberley School-house, Abberley Road, Kidderminster, Worcs.); **Merseyside Aquarist Society** (Mrs. V. C. Walker, 46, Cambridge Avenue, Great Crosby, Liverpool 23).

The Aquarist's Badge

PRODUCED in response to numerous requests from readers, this attractive silver, red and blue substantial metal emblem for the aquarist can now be obtained at cost price by all readers of *The Aquarist*. The design is pictured here (actual size). Two forms of the badge, one fitting the lapel button-hole and the other having a brooch-type fastening, are available.

To obtain your badge send a postal order for 1s. 9d. **together with the Aquarist's Badge Token cut from page vi,** to Aquarist's Badge, *The Aquarist*, The Butts, Half Acre, Brentford, Middlesex, and please specify which type of fitting you require.

Crossword Solution

M	I	C	R	O	S	C	O	P	E	■	A	■	■	■
U	■	A	■	V	A	L	■	A	N	T	S	■	■	■
L	U	D	W	I	G	I	A	■	C	U	E	■	■	■
M	■	D	I	P	■	P	I	T	H	■	L	■	■	■
■	C	I	G	A	R	■	R	O	Y	A	L	■	■	■
M	R	S	■	R	O	E	■	E	T	T	U	■	■	■
O	Y	■	L	O	A	C	H	■	R	A	S	■	■	■
L	■	T	O	U	C	H	■	L	A	V	■	■	■	■
L	■	R	■	S	H	I	P	■	E	I	N	■	■	■
I	R	I	S	■	■	N	U	T	■	S	■	■	■	■
E	A	N	■	O	P	U	S	■	A	M	P	■	■	■
S	T	A	R	F	I	S	H	E	S	■	H	■	■	■

PICK YOUR ANSWER (Solution)
1 (d). 2 (b). 3 (a). 4 (a). 5 (c). (d). 9