

# The AQUARIST AND PONDKEEPER

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## Editorial

AN organ of fishes that has long excited the curiosity of the scientist is the swim bladder. This gas-filled bag shows diversity of shape and arrangement in different species, and in some fishes, as related by Mr. N. E. Perkins in his article on the stone loach in this issue, its more frequently assumed activity as an organ facilitating the swimming of a fish, by reducing its body weight in the water, has been altered to make it a sound-producing structure.

Experiments at the Marine Biological Station at Plymouth have shown that a fish such as the nursehound, normally without a swim bladder, has to support about one-twentieth of its body weight recorded in air when it is swimming in water, whereas a fish with a swim bladder has its body load in water effectively reduced to about one-hundredth of its value in air. Fishes with swim bladders were shown to deal but poorly with any extra body load, however, although a nursehound could still swim when extra weight amounting to up to one-quarter of its weight in air was added to it. The advantage the bladder gives is the relative ease with which a fish can stay poised in mid-water. In accord with this is the fact that those freshwater species in which the organ is much reduced or profoundly modified are all bottom-dwellers. It is noticeable that many of these bottom-dwellers have just the frontal part of the bladder, and this is encased in bone and linked by bony structures to the ear of the fish.

This arrangement has led to the suggestion that such fishes use their modified swim bladder as an auxiliary hearing organ. Results of experiments lend support to this, for several species tested are found to be capable of perceiving a wider range of sound frequencies than fishes without the link between ear and modified bladder. When it is considered that in yet other fishes the organ is used for storing oxygen, and that the way in which gas enters the bladder at all is still imperfectly understood, its challenge to and attraction for the biologist can be appreciated.

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## Starting a Tropical Aquarium—6 by AQUARIUS

IT is possible that a few minor faults may show up after your new tank has been set up for a month or two. Within a week or so of commencing it is probable that the water may turn green through too much floating green algae, but do not start to do anything drastic, such as emptying the tank and restarting, as many of these small faults will often right themselves. Before the water plants have started to make new growth it is difficult to keep the water as clear as necessary, but after a time the water can clear by itself and no further trouble may be experienced.

Few tanks can be set up which will not show some discoloration of the water after a week or so, as it is almost impossible to set up a fresh tank and ensure that all the plants are well rooted, settled and able to do one of their main tasks. I have known tanks look quite cloudy within a week of having been set up, and they have cleared themselves in a short space of time if left alone. Of course, the possibility of the water clearing is governed to a large extent by what has caused the clouding. For instance, if it is just a normal development of "greening," this can clear up as the plants get stronger and make good growth. If, on the other hand, the clouding has been caused by bad management, then it will not clear of its own unless the reason for the trouble is removed.

### Green Water

"Greening" is usually caused by too much sunlight reaching the tank. Green algae will not form in darkness, and so if this trouble appears it may be that the tank is in too light a position. Shield part of the tank from direct light for a time, and the green algae may disappear. If, however, the water takes on a dirty milky hue it is quite probable that you have been giving too much dried food. The fine-dust-like particles found in some packet foods is often uneaten and it then soon sets up very bad conditions in the water. The clouding is sometimes caused by the presence of myriads of tiny Infusoria which have been encouraged by the foul conditions. Anything which starts to decompose in water will soon become a breeding ground for Infusoria, and so the necessity for care with feeding is apparent. Never give more food than can be cleared up in a short time and only feed when the fish appear to be ready for it. Never give the whole feed at first. Just offer the smallest portion and if this is cleared up some more can be given. It is safer to under-feed than to overdo it, especially soon after the tank has been set up.

Another sign of over-feeding is when a film of scum forms over part of the compost at the bottom. This should be siphoned off and some more water added. The weekly servicing of the tank should remove almost a fifth of the water. Do not strain this and return it to the tank; throw it away and add fresh water. Although a tank can be kept for years without having to empty it completely, I know that it does everything in the tank good if a good proportion of the water can be changed now and again. Many aquarists find that after a number of months some of their fishes appear to be in ill-health, and they cannot pin-point the trouble. They never appear to realise that the water may have become stale.

### Water Changing

Some types of wasting diseases which attack tropicals at times may be due to the fact that the water has become too stale, and the fishes lose their bright health in consequence. So do not be afraid of changing part of the water when the servicing takes place. It will be found that for the average tank of 24 ins. by 12 ins. by 12 ins. the removal of about four gallons each week will be of great assistance in keeping everything in good working order. Make sure that the

fresh water has a temperature of about that of the tank water, although a little difference will harm neither plants or fishes.

Although over-feeding with dried foods is the chief cause of foul water this can also be caused by giving too much live foods. *Daphnia* will rarely cause trouble, but be careful with such foods as *Tubifex* and white worms. If too much of these is given when the fishes are not in too good condition it will be found that some of the food will pass through the fishes in an undigested condition. This can easily turn the water sour, so do not at any time give too much live food. This is especially the case when going away on holiday for a time. Some aquarists think that they are doing a wise thing to give unlimited live food just before going in the hope that there will be enough food for the fishes for a fortnight. What happens is that the fishes gorge themselves, and become so satiated that they suck in and kill much of the live food and then spit it out again. In consequence there is a large amount of dead worms left at the bottom of the tank which will pollute the water in a short time.

Remember that anyone can set up a tank, but it takes a careful aquarist to keep one running for years in good order, and one main cause of trouble is overfeeding.

The plants may give some trouble after a time, and if so, a little thought may give you the clue as to what is wrong. In the first place some plants do not take kindly to light from under their roots. If your tank has a clear glass base it is possible that as the roots form and reach this position the plant fails. It is always a good idea to blacken out the base of the tank. Many plants will not thrive unless they get the right amount of light. You can only find out by experiment how much direct light to give.

### Experiments with Lighting

If the tank is in such a position that it gets hardly any direct light you will have to experiment with the overhead lighting to see what power lamps give the best results. It is surprising how changing the power of the lamps can affect the plants. If any particular species of water plant does not seem to succeed in your tank, there does not appear to be any sense in trying to get it to grow; there are many more which will do well, and these can be found by trial and error. Some tanks will grow almost anything, whereas others are good for certain kinds but no good for others.

The necessary pruning of the plants should be carried out at the weekly servicing, and where plants are grown up and spreading over the top of the water some of the stems should be shortened. Do not deal with all at once, but after cutting back a few it will be found that they are shooting from the base, and then is the time to shorten the others that were left on the plant.

If any floating plants have been used it may be necessary to thin these out. Such plants as *Salvinia* can soon spread and cover the surface. The light from your lamps will not then be able to reach into the tank for the benefit of the other plants. On the other hand, it may be found that if your tank water has turned green the covering of the surface of the water with floating plants will cause the water to clear in about a week. Neither the plants nor fishes seem to suffer if the top is covered with floating plants, as long as sufficient light can get to the water from the front or sides.

Once the tank has a good balance of growing water plants and healthy water, it will be found that the fishes will thrive, and little trouble will occur. Most fishes do well in a tank which is in good condition, but some trouble may appear among them, and these will be dealt with in the next articles of this series.



## Paradise Fish

(*Macropodus opercularis*)

ORDER: Labyrinthici, from Greek *labyrinthos*—a tortuous passage, and Latin *icius*—suffix indicating possession of a character.

FAMILY: Anabantidae—from Greek *anabantos*—gone up, or *anabaino*—to go up, plus Latin *idae*—a suffix added to stems of generic names to form family names.

GENUS: *Macropodus*, from Greek *makros*—long or large, and *podos*—foot, and *opercularis* from Latin *operculum*—a cover, or lid.

THE paradise fish was the first bubble-nest builder to be introduced to aquarists, well over half a century ago, when tropical fishkeeping, as we now know it, was unheard of. How, then, did the fish manage to live?

They are not hot-water fishes—they can stand 80° F. and over for considerable periods, but it shortens their lives materially. At the other end of the scale, they can withstand temperatures near freezing, and this is why they lived before heating water was indulged in. They are happiest in from 65° to 70° F.

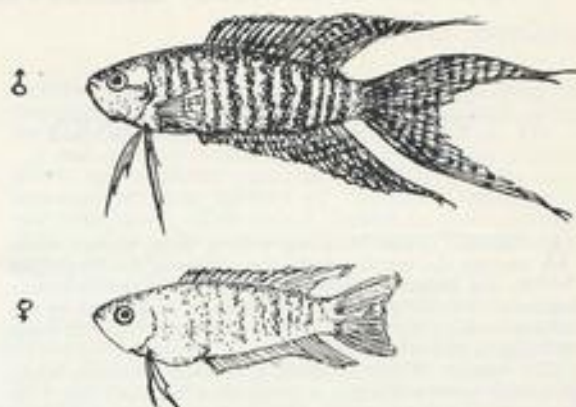
Originally hailing from the rice fields of China, the paradise fish has been very extensively bred both in this country and in America, and on the continent. Unfortunately, the males are singularly aggressive, and although occasionally they live in harmony with other species in community tanks, it is advisable to devote a small aquarium to the exclusive use of a single male, with a second one given over to a female or two.

I have never been able to understand why, at the first fish exhibition held after the war, first prize for furnished aquaria was awarded to a tank containing several very large male paradise fishes. They were excellent specimens, and made a grand showing, but it was contrary to all rules to promote harmony to place them together. The strangest thing was that they did not show any signs of aggressiveness during the few hours of the exhibition, which just goes to show that it is impossible to guarantee anything!

It is difficult to give an adequate word picture of the astonishing beauty of an adult male paradise fish, particularly during his courtship of the female, or while he is building a bubble nest for the reception of her eggs. Red, and peacock blue, orange and emerald green, in stripes and dots, splashes and spangles, and covering not only the complete body, but extending to the outermost extremities of all the long, flowing fins, burnished overall with a metallic lustre, and glowing with constantly varying intensity—this is but a poor description, but will have to do.

By comparison, the female of the species is a drab, uninteresting creature—anaemic, short finned, and timid, filling up with eggs every two or three days so that she more often than not looks as though she has swallowed a marble, and ready to flee at the slightest sign of the approach of her hellion husband. He has a fascination for her, however, so that she succumbs to his advances and allows him to enfold her in a close embrace beneath the bubble nest. After each embrace, while the two bodies lie motionless for a second or two, a group of whitish eggs the size of a pinhead, fall slowly downwards through the water.

Suddenly the male, and then the female, stir themselves,



Male (top) and female paradise fish

come out of their trance-like state, and swim around gathering the eggs in their mouths, taking them to the surface and spitting them into the heart of the bubbles.

Periodic embracing goes on until the female is spent. Now the mood of the male changes, and he rushes at her with fins outspread and mouth agape, tearing her fins, and drawing blood from her body if she is not lively enough to dodge his attacks. She has served his purpose, he wants her out of the way, and the quicker the better.

All wise aquarists remove the female immediately spawning is over. Apart from the question of the danger to her life, the agitation of the water during the wife-beating can frequently cause the breaking up of the nest and the loss of much of its contents.

Once the female is gone, the male will normally settle down to conduct a ceaseless vigil over the nest and eggs. He will replace broken bubbles or add to them. He will shift eggs from one position to a more favourable one, and occasionally may even construct a completely fresh nest and transfer all the eggs to it.

All the time he will retain his brilliant hue. Hatching normally starts within 48 hours of the eggs being placed in the nest. With the movement of the young in the nest, father's vigilance is redoubled. If any of his youngsters fall out of bed, he is there to catch them before they land on the tank bottom, and to replace them.

Sometimes, especially if he has not been well fed before spawning, his hunger will overcome his paternal scruples, and the babies form his breakfast. Yet I have known a male paradise ignore *Daphnia* until the babies were free-swimming, presumably because he might eat them by mistake if he made a wild grab for food.

The fry are very small—only the tiniest of live animal and vegetable foods will be taken. *Paramecia*, for instance, are far too large for them to tackle. In the absence of suitable live food, powdered egg can be substituted. The right quantity is difficult to estimate, however, and any uneaten will, unless removed quickly, begin to decompose and pollute the water.

It is useless to say that this does not matter because paradise fishes can supplement their air supply at the water surface. The adults can, but the fry cannot until their labyrinth organs are formed, and these do not begin to develop until they are two to three weeks old.

At this time they are particularly susceptible to chill, and the aquarium should be kept closely covered to prevent

(Continued at foot of next page)



# A Scientific Institute by the Black Sea

by LYUBEN SHEKERDJISKY

A BEAUTIFUL building with a large terrace overlooking the sea stands on the shores of the Black Sea in the Bulgarian port of Stalin. It is the Scientific Institute of Fishing, or the Aquarium as it is called by the holiday-makers that come by the thousand from all parts of Bulgaria and other countries.

The history of the Institute goes back 50 years, when Bulgarian scientists began to investigate the Black Sea. In fact the Black Sea Research Institute, the so-called Marine Biological Station, began to function 25 years ago. It was then that the Aquarium was set up too, but it has since undergone considerable re-organisation. To-day it is staffed by a large number of scientific and technical workers—ichthyologists, hydrobiologists, hydrologists and chemists. They work in up-to-date laboratories and have a special survey ship which often does its work accompanied by a plane from the fishing-survey service.

The numerous problems set before the Institute are of great practical importance: to locate the shoals of fishes and dolphins and determine the direction and nature of their movement; to study the make-up and distribution of the flora and fauna along the Bulgarian coast which serve as foods for fishes; to study the hydrological regime of the Black Sea water; to determine the most suitable kinds of fishing tackle and to seek the most efficient technique for survey and fishing; to seek ways and means for increasing the catch in the freshwater pools and newly built dams; to study the parasites, diseases and pests of fishes.

The basic problem is the survey of fishes in the Black Sea. The systematic investigations of the Bulgarian ichthyologists these last few years have made it possible to refute the old conception that the Black Sea is poor in fishes. It has been determined that 200 million tons of plankton organisms such as diatoms, flagellates, Infusoria, worms, water lice, larvae of mussels and snails, and other microscopic animals and plants that fish feed on, develop in the sea yearly. In this respect the Black Sea is richer than the Mediterranean. It naturally follows that where there is much food, there are many fishes.

This is also supported by another fact. As is well known, there are about a million dolphins in the Black Sea. Since a dolphin eats about ten kilogrammes of fishes a day, all dolphins living in the Black Sea eat two million tons a year. The sea is poor only with regard to species. The fauna numbers about 1,500 species, 176 of which are fishes, whereas in the Mediterranean there are about 6,000. This is owing to the high percentage of salt, the presence of hydrogen sulphide in the lower water layers and the comparatively low temperature of the water. For these reasons not all species of the Aegean and the Marmora Sea have migrated to the Black Sea.

The Black Sea fauna is well represented in the Aquarium. At present the latter is the only Aquarium of Black Sea fishes. There used to be one in Sevastopol, but it was destroyed in the Second World War. Classified exhibits of fishes are arranged in glass tanks and in the museum. Here are the mammals, crustaceans, molluscs, and the small animals and plants of the Black Sea flora and fauna. Of particular interest to Bulgarian fishing are the

pelagic fishes, such as bonito, mackerel, scad, grey mullet, whitebait, anchovy, *Laspialosa pontica* and bluefish, which pass in shoals along the Bulgarian coast every spring and autumn; the deep-sea fishes such as turbot, sole, red mullet, and bullhead, which move to the shallows in spring; the valuable *Acipenser* genus (cod, sturgeon), and *Acipenser stellatus*, which dwell in the sea but cast their spawn in the larger rivers. When the latter fish reach sexual maturity, they grow to the weight of 500 kilogrammes each and some of them even 1,000 kg.

The mammals of greatest economic importance are the dolphins. They bring increasing profit to Bulgarian fishermen, owing to the great interest there is in their hides, fat, meat and bones. The Bulgarian shore is also visited by seals. They are to be found near Cape Kaliakra and Cape Maslinen, but not often. The State takes special measures to preserve this valuable species.

Another deep-sea fish dwelling in the Black Sea is the shark, which is up to a metre long and bears its young alive. The sea red gurnet has strongly developed, blue pectoral fins, and its body is coloured orange-red. The roker and sting-ray also belong to this group. The sting-ray has a thorn on its tail at whose base there is a poison gland. The scorpion fish is also poisonous. There are often poisonous fishes in the Black Sea.

Among the molluscs exhibited in the Aquarium, the black mussels are of practical importance. They dwell in large quantities up to 80 metres below the surface. At present the question of building a large plant for mussel flour is being investigated; this is used as a component part of fodder. There are also oysters along the coast. Of the crustaceans, shrimps are the edible variety in the Black Sea. Lobsters sometimes come through from the Bosphorus, and can be seen at the Aquarium too.

The tank with sea horses and sea needles is also of interest. They offer the visitors a good reason to joke: "Here it is the male that bears children!" they laugh. In fact the males of both the sea horse and the sea needle have on their abdomens little bags in which the females lay their eggs to be fertilised. It is from these bags that the young come into the world. The whole process can be observed by the visitors who crowd the halls of the Aquarium every day.

The museum contains rare fossils from the former Sarmatic Sea that existed here 12 million years ago, as well as numerous maps of hydrological survey, diagrams of periodical observations and many other documents of scientific research on the flora, fauna, hydrology and history of the Black Sea.

The Institute is often visited by scientists from various European countries, who utilise the scientific data. It has published many volumes of scientific literature and maintains contact with almost all marine institutes in the world.

## Paradise Fish

(Continued from the preceding page)

draughts upon the surface of the water. Many a good, healthy spawning has been lost through neglect of this precaution. Overcrowding will stunt growth, and as the fry get older, more and more tanks must be pressed into service if the aim is to raise large numbers.

Perhaps it is more humane to cull the fry constantly, leaving only the best and most vigorous to grow on, and to serve the others to large cichlids—Dempseys, angels, acaras, and the like.

THE AQUARIST



# One Fathom Down

A Study of the River Aquascape

by a Freshwater Botanist

by M. GORMAN

RECENTLY, there have been many films dealing with divers and frogmen and undersea exploration. But no-one has yet ventured to penetrate the lakes and rivers of the world and add to our knowledge of freshwater life. So, being an aquarist myself, and knowing that the majority of aquarists have freshwater aquariums, I decided to embark on a singular experiment last summer—the underwater investigation of English rivers and lakes.

My first set-back was when I realised that aqualungs and diving equipment were far beyond my means. But on seeing the film "Under the Coral Reef," where many descents without equipment or oxygen were made, I felt newly inspired. It might even be possible to go down with nothing but a deep breath and a pair of goggles. The only information I could extract from my public library on the subject was that Japanese oyster women can remain submerged comfortably for 1½ minutes; and that the world record for submersion without oxygen is six minutes!

## Underwater Practice

With this encouragement I paid a visit to the local baths. After a deep breath, down I went, only to come up gasping after a couple of yards. Again I tried, and again. Finally, I learnt the secret of underwater swimming. A deep breath should be taken and then held completely till re-surfacing. If bubbles are released under water, the respiratory system starts functioning, and it is difficult to retain the breath any longer. But if the whole breath is held from the start to finish it is possible to remain submerged for quite a period of time.

After I had learnt to swim under water for one minute, I went along to the river Avon, near Rugby. The river seemed to be deepest where it widened out before entering the reservoir, and therefore I made this the site of my first experiment in freshwater exploration.

Before entering the water I took a few deep breaths. This is necessary in order to ensure a sufficient supply of oxygen in the blood. Then, raising my ribs well up I took a still deeper breath and dived in. For the first three or four feet of my descent I could see nothing but vivid green all about me. This I realised was the algae caused by intense sunlight on the surface layer. Quite abruptly the water became clearer and colder. I was about seven feet deep by now. Still no bottom. I decided to swim horizontally.

Suddenly, I saw a beautiful sight. To my left was a plateau of clay slightly higher than the surrounding ground. It was covered with what appeared to be large Indian ferns with feathery leaves about 18 inches long. Later, I identified it as *Oenanthe phellandrium*—the water dropwort.

Swimming on further I found myself enveloped in a forest of long spiky leaves and stems. It was the submerged foliage of *Potamogeton natans*. Looking upwards I could vaguely make out the surface through the algae belt. It seemed to be a lattice-work of black oval shapes, which I guessed must be the floating leaves of the floating pondweed against the sun.

At this stage I felt my breath giving out, and I headed towards the bank. I surfaced against a belt of thick rushes and took in a much-needed gulp of fresh air. I spent the

next five minutes swimming idly over the surface doing the breast-stroke. This incidentally, is by far the most powerful stroke to use under water.

I had seen the submarine beauty of *Oenanthe phellandrium*, and wondered what other plants grew down there that aquarists were ignorant of. By now I felt eager to submerge again. This time I decided to head vertically downward in order to reach the bottom. What would it reveal, I asked myself.

I dived. Through the vivid green, into the clearer, colder layer, and still downwards. About 1½ fathoms down my hands came in contact with a thick bushy mat. I peered through my goggles. To my astonishment the whole base of the river as far as the eye could see was covered with a dark green carpet of *Elodea*. So this was where the enigmatic plant was growing! Over the last four years I had witnessed the rapid disappearance of *Elodea* from all its usual haunts, and had attributed this to the weakening of the strain owing to too much self-propagation. Now I could see it growing in all its old exuberance but at a much lower depth. What was the answer to the riddle, I wondered.

I swam on over the carpet. In the distance I could see a cluster of tall stately plants with huge reddish-brown foliage. *Potamogeton lucens*! Each translucent leaf was about seven inches long and two inches wide. If only aquarists could see this plant in full glory they would not cry out for their *Aponogeton* and sword plants as much as they do!

But I had little time to stop and admire it. My lungs were bursting through lack of concentration on retaining my air. Kicking my feet against the bottom I shot up to the surface through a network of *Callitriche* and remained there, treading water while my eyes became accustomed to the sunlight again.

About eight feet from the further bank grew a colony of arrowheads. I decided to swim over and investigate. Submerging about three yards away from the plants I was surprised to find myself in clear water from the start. Where was the algae belt? Four strokes later I found myself in almost pitch-dark water. In panic I shot up to the surface and emerged with my head covered in green vegetation. I had been swimming beneath a carpet of duckweed!

Still, I was determined to investigate the arrowheads. I chose a clump where there was no duckweed and followed the stems down. To my surprise I found that the ribbon-like underwater leaves were often four feet in length—how they dwarfed the so-called giant *Sagittaria* sold by the dealers!

"What an adventure!" I mused to myself, while getting dressed. But my most thrilling discovery was yet to come.

## The Secluded Lake

The following Saturday I decided to explore the depths of a secluded lake not far from Rugby. It looked dark and foreboding—not the place one would normally choose for a swim! Yet I was determined to see what it concealed in its depths. I took in a deep breath, raising my hands high above my shoulders, and plunged in.

The water was remarkably warm, I noticed, probably because it was stagnant. It was also a good deal clearer than it appeared. Deeper I glided, deeper. Still no sign of vegetation. Suddenly my hands touched the bottom, churning up a cloud of ashey grey mud. I edged away from the cloud to get a clearer view of the bottom. To my surprise it was covered with thousands of slender spikes



coated with grey mud. They stretched as far as my eyes could see. I grabbed a handful and shot to the surface.

Then, treading water, I inspected my catch. My rapid ascent had apparently changed its colour from a dirty grey to a brilliant green. I looked hard at the cluster of green needles in my hand. It couldn't be! I looked again. Yes, it was; it was hair grass all right. When I got home I verified it in a book of illustrated water plants. Yes, it was definitely *Eleocharis acicularis*!

You can imagine my astonishment. Hair grass in the middle of England! The plant that dealers import from tropical climes. On later excursions I was to get more surprises. *Fontinalis*, *Nuphar*, spatterdocks, red *Myrio-*

*phyllum* and many other prized aquarium plants all grow in our native waters.

Well, there it is, aquarists. It can be very exciting exploring the freshwater ponds and rivers of England. There is so little known about underwater life inland. We are not even sure whether the Loch Ness monster exists or not! But remember that you must know how to swim well underwater, and then wait for a bright summer before you can begin any investigation; and remember also that the English "underwater scape" is not usually so picturesque as the tropical coral reefs you are shown on the screen! But there are treasures there amongst the English water lilies, and if you want to—you can find them.



## A "Pagoda Aquarium"

*designed by*

JOHN W. LANGTON

As a regular reader of *The Aquarist*, I have noticed the conflict of ideas on the subject of whether or not to enclose the aquarium, or to leave it in its stark beauty of angle-iron and sheet metal. I have viewed with great trepidation the very fancy enclosures for drawing room installation, such as the cocktail cabinet or the book case, or even enclosures in walls, and wondered how one really copes with the cleaning, etc., in such circumstances.

However, after reading the discussion, I must say I came down very heavily on the side of the camouflagers. I do not really think, even in this functional age, that iron angle and sheet metal, even when fabricated by experts, is very beautiful to gaze upon. Very certainly to me now, the view through the aquarium glass was considerably robbed by seeing, say, a deep sheet metal cover cocked on the top.

I have two tanks—one about 48 ins. by 24 ins. by 24 ins. deep and one the usual small 18 ins. by 12 ins. by 12 ins. In the large tank, the surrounding metal is much less obvious, but after reading the various articles I decided to try something in the way of covering in the small tank. Both my tanks are kept in the conservatory, so my ideas on enclosure ran rather naturally on some combination of tank and garden.

The result is shown in the photograph. A pagoda in a small Japanese garden. It may not be everybody's art form, but I do maintain it looks better and brighter than the sheet metal set-up I had previously.

The tank is enclosed by a plywood frame just dropping

over it, and the lid fits loosely by a spigot into the top of the frame. The lid is also of wood, except for the corrugations of brass strip taken from an old motor radiator. The windows are covered in Perspex, and a strip light is fitted into the roof dome. The back windows are open, and the light heat and air lines are fed though the back of the frame.

The tank stands on a plinth which is inside a garden box. The bottom of this box has a zinc drainer, to drain off any moisture from the bottom of the compost. The garden has only just been started, with small cacti, etc., and it is hoped to add to these plants in due course. There are two small lawns coming into being, one at either side of the pagoda, and a few Japanese figures complete the ensemble. The whole garden stands on what was an old kitchen table, with the sides covered in by plywood, with the electric switches at the back.

The finishing is in bright colours, a blue pagoda with golden roof, yellow steps, a red garden box on a black table picked out in gold paint. No trepidation is felt in cleaning. The lid and frame can be lifted off in two twos, and if a little water drops during the cleaning, well, it does the garden good.

The tank has mostly neons with a few angels growing up to go into the big tank. The effect is good in daylight, or in the evening with the light on. I am now seeking another idea to do something about the large tank. It might even be a Mandarin's palace!



# AQUARIST'S Notebook

by

RAYMOND YATES



**T**IMES change and we with time. In the aquarium world there is no doubt that considerable changes are taking place in the presentation of shows. The public is simply not attending shows in the numbers of a few years ago and the question arises "What does the public want?" Your guess is as good as mine, but it is safe to say that they don't find much attraction in long rows of bare show tanks and, with this in mind, many clubs have put on shows where all the tanks on view have been furnished aquaria of one sort or another. In this way tanks have been made attractive to every visitor and the space required has been reduced, as also, to a lesser extent has the work of setting up. On the other hand each tank probably competes in several classes, which makes harder work for the judge and creates difficulties for the enthusiasts who want to weigh up the class pointings. On the whole, this is a move in the right direction.

The general public, after all, are potential aquarists, and they are far more likely to be attracted to the hobby by a few well-set-up furnished aquaria than by any number of bare single-fish show tanks. The last British Aquarists' Festival at Belle Vue, Manchester took this idea a stage beyond, by having only entries by clubs, and each club entry was produced in the form of a decorative setting such as a sunken galleon, tanks fitted in T.V. sets, fitted lounge, oriental temple, a river with underwater views and so on. Some clubs have added to the attraction of the show by including animals and birds, apart from the usual reptiles which one expects to see.

Most shows are not advertised enough. You need a "write-up" before the show, not after the event. It is true, of course, that shows are not now quite the red-hot news they once were to the local press, and it is getting more difficult to find a new angle, which is what a newspaper demands. Some shows are very hard to find, as the organisers never think of putting boards or notices at the entrance, with the result that the timid give up the search. Some time ago I received a complimentary ticket to a show in a certain town but could find nobody who even knew of the street where it was being held. Finally I asked a constable, who informed me that there was no street of that name in the town, even if it was printed on my ticket! I tracked the show down at last, but it took me an hour to find it. It is very rarely that one ever sees bills in shop windows advertising a show, even in the windows of pet shops.

Then there is the vexed question of tickets. Some clubs push these out in quantity to their members, practically giving them to bring any back unsold. A much better method is to have a large number of tickets printed which do NOT admit—everybody pays at the door. These are sent out or given out to friends and interested members of the public, as also to schools, youth clubs and the like. These are real advertisements which find their way into the most unlikely places, and which do bring the public along. Another advantage is that all the cash is got in at the show, and there is no long weary period afterwards of trying to contact absent members for their ticket money. The issue of a few complimentary tickets is a wise course, almost always these produce more paying visitors who would not otherwise have come. Programmes are no longer needed with smaller shows. Details of winners etc. can be put up on a board for those interested to peruse. A really good raffle, "guess how many fish," or what you will win brings in the money, and some form of refreshment counter is a must.

Some judges have done so much judging that it is time they had a rest. The hobby is well established now and clubs should not hesitate to call in new or unknown judges;

too often you hear comments such as, "If old so and so is judging you'll never win unless you have such-and-such rock," or "Only black-and-white fish ever have a chance with him." How much better to have a judge whose likes and dislikes are an unknown factor. Some clubs say that if they had no show there would be no club. This is rather overdrawn, but the moral is that members want to exhibit one way or another and feel the fun of competition. The answer is in more table shows throughout the year where this is possible. The specialists can be catered for by having one night for barbs, another night for fighters, live-bearers, and so on, but at every table show there should be an open class for those members who have none of the specific variety on show, but who can bring down other fishes and still compete in the open section.

Most fishkeepers have at least one community tank but few would agree as to which fishes should be kept to make a perfect set-up. After all, it is a matter of taste. Hobbyists see fishes differently. Some look for colour, aesthetic appeal, rarity, others for size, long life, adaptability, low price, ease of replacement; still others admire the unusual, the quaint, humorous appeal, and parental care. It is not possible to combine all these in one community tank but an effort can be made to cover a wide range so that your tank offers a real cross section of the finny world. I have one run on this basis which contains the following varieties: leeri gourami, fighter, pal fish, glowlights, festive and key-hole cichlids, *Barbus tetrazona* and *partipentazona*, nigger barbs, swordtails and platys, *Rasbora einthoveni* and *leptosoma*, *Corydoras julii* and *paleatus*, *Copeina arnoldi*, *Pyrrhulina vittata*, *Plecostomus*, *Otocinclus affinis*, zebras and *Pelmatochromis kiribensis*. This collection gives you just about everything and makes a true passing show.

Literature on the hobby invariably suggests that micro worms cannot be kept for longer than about 10 days, after which period the reader is advised to throw away the culture and start another. This is simply not true and is misleading for newcomers. No doubt some people do make some wretchedly smelly cultures, but the average set-up will last for many months. If there is a reasonable quantity of the culture medium it will last a very long time because it should be remembered that the worms are only on the surface of the culture. This can be turned over with a spoon more or less indefinitely, and there is no need to worry about the worms being smothered or drowned at the bottom of the dish. Cold weather will not kill off the culture provided it doesn't dry out entirely or freeze, and I have often kept such cultures all through the winter for six months or more at temperatures in the thirties. If your culture looks far gone or dried up with no sign of life, just add a little warm water, stir it up well and place near the fire to gradually warm up the culture. Almost before you know it the writhing surface will tell you that you still have your culture. Dealers often have such cultures for sale in stoppered bottles for weeks. Of course, if you are feeding micro to young fish you will naturally do better if you feed your micro fresh medium about once a week and, in such a case, it is easy to scoop the surface worms from the old culture and begin another one.



A recent reader's letter took exception to some notes of mine in the January "Notebook"; it said, in effect, "No aquarium experiments are worth doing unless done by a scientist." In fact there are no experts in the hobby. The longer one is in it the less one discovers one knows. At least that has been my experience, after almost 40 years' fishkeeping. Every aquarist is a fish scientist, and every aquarist has to try out his own theories and make his own experiments. Sometimes he works on his own ideas, more often on those of others which have appeared in print. Much is learned this way, but the pity is that all too often it is not recorded and the information is lost. If only more and more aquarists could keep records the hobby would benefit. The Nottingham society has done something in this line, and perhaps others are working to the same end. Few hobbyists have scientific minds, but this does not stop their search for the why and wherefore of the hobby. We owe almost all we know about fishkeeping to the ordinary fanciers: clergymen, printers, businessmen, electricians, policemen, who have made the hobby what it is. A few, a very few, scientists have helped. Let us give credit therefore to the ordinary chap whose unscientific approach has made the problems of the hobby easier to face with the passage of the years. It is not by accident that the phrase "Blinding them with science" has come into common use; it creeps into everything to-day—T.V., radio, farming and so on. Personally, I am all for the scientific approach, and am, in fact, a teacher of science myself, but one has to keep a sense of proportion. Our hobby has got where it has by the interest and hard work of many aquarists who knew nothing of biology, zoology, botany or even medicine. Live and let live.

I have mentioned treatments for eye diseases and injuries before and aquarium books offer suggestions for such troubles. Eye injuries are quite rare, however, and no hobbyist need worry unduly. Where injury occurs fungus often follows and this is both unsightly and dangerous. A fish which has lost an eye can live in an aquarium but one is constantly reminded of the disability and it is best removed. I once saw a fish in a show with one eye, and the judges' comments, which read, "This fish has one eye, the judge has two." Eyes certainly show health, and a fish with glazed eyes is off colour if nothing else. Fishes which have been grossly underfed usually have a flat stomach and possibly sink in behind the gills, but this is not all, the eyes too tend to sink into their sockets in a way which, once seen, is unmistakable. The eyes of cichlids can demonstrate this forcibly, probably because they normally appear quite prominent. Fishes can go blind, and this is not always obvious to the owner. Angel fish are the ones most prone to this trouble, usually when kept in very hard water. Few aquarium fishes have binocular vision, so that the majority have a blind area immediately in front of their noses. Where the nose is wide this area is increased and accounts for the unusual behaviour of some of our finny friends at feeding time.

It sometimes happens that hobbyists have a really filthy tank, the floor of which is covered with decomposing dried food but in which fish seem to be quite at home and untroubled. Remember these fish have slowly acclimatised themselves to the bad conditions—if you introduce other fish they can be seriously affected, if not killed. Where conditions are really bad a bottom fish such as *Corydoras* would die within a day.

Once upon a time the base-heated tank was very popular, but few of these are seen about now, particularly at shows. Base-heated tanks have their own special problems, not the least of which is the fact that certain fish are unsuitable for them and may suffer. At one show during the very

hot weather last year base-heated tanks housed *Corydoras* and other catfish and some losses resulted. Fish which spend almost all their lives on the bottom will suffer if subjected to continued base heat or decomposing food and black gravel in quantity, or both combined. *Corydoras* will stand a great deal of rough handling but they will not stand these two discomforts long, and they do not tolerate salt. *Corydoras* are such long-lived fish normally that they are worth taking care of when such conditions arise.

A firm in Alabama is now marketing a small coffin for dead pets. The casket is described as being designed in good taste, lined and padded and water resistant. It is available in three sizes, in either pink or blue. Aquarists will feel glad that this is intended for larger pets than the usually keep! What do hobbyists do with their dead fishes? Probably the majority find their way to the dustbin or the fire, although a very convenient method of disposal is via the toilet. Where fishes are particularly good specimens or have suffered from the effects of obvious disease it is sometimes better to pickle them in formalin so that they can be brought out later for discussion.

All aquaria should have access to some daylight every day but it occasionally happens that a tank is situated against a far wall well away from a window, so that electric cover lights have to suffice. In such circumstances it is possible sometimes to provide some sunshine for an hour or two daily by using a mirror suitably tilted to reflect the sunshine directly on to the tank. Where this is done the plants prosper, as also does the algae. I used this method for some years with a bedroom tank about 15 feet from the window by tilting the dressing table mirror to reflect the morning sun.

Some time ago I saw some tanks which had been got up in the form of a water garden based on the design of the willow-pattern plate. The tanks were filled with water to a depth of about three inches, facing the viewer at the front of the tank. Various plants made up the land portions including succulents, moss, ferns, cypress, willow and even miniature orange trees. Tiny bridges, pagodas and even figures completed the effect although one had the doves suspended on wires, and rotating from the heat of the cover lamps. Methylene blue had been used in one case to colour the water, but here the effect was lost. In any case goldfish look pale against this tint.

Generations of inbreeding in ponds, mill lodges and other enclosed waters has often resulted in queer progeny, especially in the carp family. A frequent feature is the lack of a dorsal or ventral fin or both. However, I have never come across this aspect in tropical fish until I came to take a close view of a dozen marbled *Anabas*. These fish were all about two inches long and were the young from a spawning in Germany, probably the only spawning of these fish on record. Of the 12 fish I counted five with perfect fins; the other seven had only one ventral and in every case the missing fin was the left ventral. There was no question of any damage, fighting or biting; these fish had been born with only one ventral. Has any reader come across anything of this nature before?

Illustrations of *Symphysodon discus* fish are wonderful when in colour, but if you look closely at the fish themselves you will observe that almost all the colour is in the fins—mainly the dorsal and the anal. The two ventrals are also well coloured, but small, and the tail is devoid of any vestige of coloration. The red eye is a gem and brilliant markings appear on the forehead and nose. The only colour on the body is the bar pattern, which comes and goes.



# Revised Show Standards for GOLDFISH

REVISED standards for goldfish varieties have been published by the Federation of British Aquatic Societies in the form of loose leaves to fit the case supplied for the standards for barbs previously issued. This system of loose leaves is a very good one, as it enables the Federation to issue later standards at any convenient time as an addition.

The previous standards for goldfish were published in 1947, and have been quite useful since then. There were points which needed alteration and some of these have been dealt with in the fresh issue. I think the best feature is the improved method of illustration. In the first illustrations there were mostly outline drawings which were almost a caricature, as some of the sketches bore little resemblance to actual fishes. However, the new ones are much better and convey immediately the required appearance of each type.

There are one or two additions to the types recognised. The new list includes: common goldfish, including the London shubunkin, comet, Bristol shubunkin, nymph, fantail, veiltail, moor, oranda and lionhead. The new ones are the nymph, and London shubunkin. I favour the inclusion of the London shubunkin as this is a handsome fish for the outdoor pond, being usually more hardy there than the Bristol. The inclusion of the nymph is, however, a very bad move. I know that it was done to please a society, but surely the Federation should have held out against this fish. In future any society that wants another type recognised will only have to press for it to have the ruling of the Federation set at naught.

Let us see what this nymph is actually like. For those who are not familiar with this type, it can best be visualised as a single-tailed veiltail. In other words it is an utter runt which appears at times among the best strains of veiltails and fantails. As such it is as far removed from the parent fish as is possible. Surely no fish which can be produced as a runt when breeding a specific variety should deserve recognition, especially when one realises that a particular variety such as the celestial is still not recognised.

I breed a strain of red-scaled fantails that is claimed by many to be the finest prizewinning strain in the country. I have been breeding this strain continuously for the past 20 years, always using as near perfect specimens for breeding as is possible. Yet among the fry I get many odd shapes;



instead of the divided tail I get some with the tail partly or not divided, also some with the top half of the tail single and the lower double. Then there are the extremes with a single tail. These are obviously the worst runts, as they are further from the ideal than any others. Now although even the joined tails are not recognised, the single-tailed ones are. Probably I should be pleased that there will be a market for my worst runts in future, for I usually give these away. However, I am disgusted with the whole ruling, as I consider it to be a retrograde step.

Why the celestial is not recognised I cannot imagine, as there have been many good specimens seen here for several years now, and this is a fish which is not likely to be bred from any other variety as an accident. There is also no mention of the pearl scales, and although I do not consider these or even the bubble-eyes to be worthy of a separate standard, they could have been mentioned as being possible for recognition as a pearl-scaled veiltail or fantail is admissible with large nasal flaps (pom-poms), and telescopic eyes. The bubble-eye could also be recognised as a type variety of the celestial.

In the old standards the pointings for the various varieties of fancy goldfish differed largely in their special peculiarities, such as heavier pointings for the colour of the shubunkin, tail of the fantail and veiltail, hood of the oranda and lionhead, but under the new system all this has been scrapped, apparently to make it simple. The system adopted is for one set of points for all fishes. This is as follows:—Size, 20; Body, 20; Colour, 20; Fins, 20; Condition and Department, 20; total, 100. I consider that this system is all right for tropicals and British freshwater fishes and for the common goldfish, but for the varieties of the latter the pointings are quite wrong. With this new method it is possible for the big, bad fish to beat a small, good one.

This is no good for the fancy. Although I am the first to admit that a good big one should beat a good little one, I am sure that with the pointings as they are it will be bad for the specialist breeder. Fancy giving the same amount of points for size and condition, etc., as for colour and finnage!

With the shubunkin the 20 points possible for colour can be outweighed by the 40 for size and condition, and we shall get a big fish with poor colour beating a smaller fish with excellent colour. As the colour is the most important feature in the shubunkin it can be seen that it should have the largest proportion of points. Take the case of the veil-

(Continued at foot of next page)



Laurence E. Perkins

Pair of lionhead goldfish photographed at London Aquarium



# JOURNAL of a Marine Aquarist

by L. R. BRIGHTWELL

AFTER 60 years of marine-aquarium keeping, I am still astonished at the slow progress this fascinating study has made. There is a big outbreak of small Marine Aquariums on the South Devon coast, other efforts are being made sporadically, but amongst home aquarists, and the clubs they support, interest is small. The vast resources of the sea, and its infinite possibilities as applied to small aquaria, find little space in the aquatic press, and less in clubland. It is the more surprising when one considers the wealth of good, cheap and labour-saving gadgets within everyone's reach. How those pioneers of Gosse's time would have stared at the facilities offered! And while the home aquarist—punch-drunk to the many over-plugged species of "trops" scans the catalogues for so-called new arrivals, and wonders if his purse will run to it, the sea teems with fresh possibilities coming within everyone's reach at every tide.

New to my 18 ins. cubic tanks are the so-called swimming crabs. About eight species haunt home waters. They will be found figured only in the archaic works of Bell and Leech, both hard to come by, the last mentioned virtually unbuyable. One swimming crab, *Portunus puber*, the "velvet fiddler," or "crabe enrage" of France, is to be avoided. It is a born destroyer, fearing only the octopus. But two others, *P. holsatus* and *P. depurator*, do well in a small tank, and harm prawns, hermits and small fishes never; but of course as with all beasts they must be well fed.

*P. depurator*—the "cleanser" or "purifier," is ideal. It is primarily a tireless scavenger, although presenting all the quaint characteristics of its class. Known to trawlermen as "flyers," and "skimmers," swimming crabs, though of general shore crab formation, have the last pair of walking legs flattened into oval paddles, and with these the crab takes wonderful swallow-like flights through the water, at high speed. In warm weather it will literally dance on the surface, making one think a bird must have fallen into the water. In cold it spends much time half-buried in the sand, thereby keeping the tank floor well aerated, and largely free from that destructive, all-destroying black bacteria too well known to every aquarist. The cleanser crab purges the tank floor of every particle that is left and might mean ruin to the general set-up. No doubt the males can fight like dogs at times but on the whole *P. depurator* and *holsatus* give little trouble.

The embryology is like that of most crabs and has been described and beautifully figured by Dr. Marie Lebour. As a show piece either of these species is charming. The big hind paddles are rainbow-tinted, blue predominating, and carried high above the back when not in use, the crab daintily poised on its needle-pointed toes. At night it becomes very active, taking long swallow flights and scouring the tank for scraps. A large mussel, shelled, is easily disposed of.

It is amazing how little has been done to explore the fauna of the White-Dover area of the Channel since the close of last century. 1916 saw the demise of the last of the Victorian naturalists. In the scanty literature on our crustacea, for example, a strange little crab, called by Sinel the "thumb-nail" crab, but known only as *Thia polita*, is described by all as rare. Yet recently we found plaice and sole crammed with this crab, which favours deep water and burrows in fine sand. The front of the carapace is fringed with a dense belt of fine hairs, but of the crab's



A SWIMMING CRAB

habits and the significance of this beard nothing at all has been recorded.

Far be it from me, as a contributor to *The Aquarist* since its birth, to criticise. But if a mild suggestion may be offered, why not a little more salt in some writers' essays? The sea has made us, it gets our boys and young men—inspires them to run away from home. Yet the sea takes few aquarists to its all-embracing arms. I wonder why? It can't be that the sea is too far from us. I was 50 yards from the sea when I first found this ideal perch at Peacehaven. I am now only 47 yards—you should have heard that cliff fall we had last night!

## Revised Show Standards

(Continued from the preceding page)

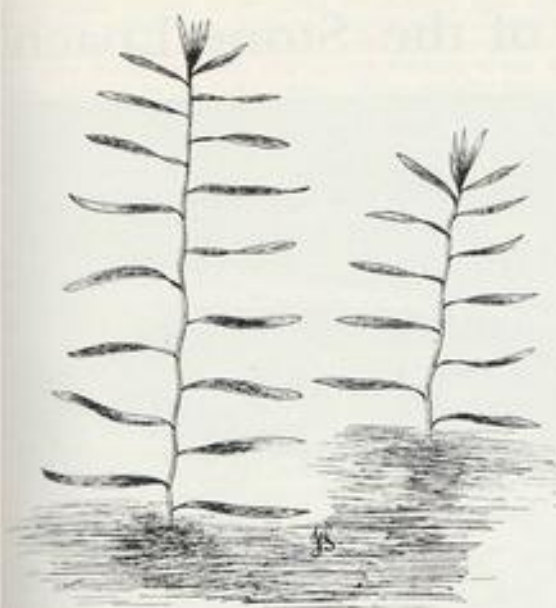
tail and fantail: only 20 points are permissible for fins, and these include the tail. The tail is the main special feature of these two types, but it can be seen that the very few points allotted to the tail will make very little difference against the possible winning of many points for size and condition.

Now let us consider the oranda and lionhead; the main feature that distinguishes them from other types is the hood, yet the new pointings allow nothing for it. Judges will be forced to do a lot of wangling with this pointing system to be sure that the best of the type wins irrespective of size, etc.

In their remarks the Federation points out that opinions were sought from many judges and breeders before their decisions were arrived at. I question this, as although I lay no claim to be an expert, I have judged many of the leading classes of fancy goldfish for several years and do claim to have a good deal of experience with fantails, and my opinion was not asked for until the whole illustrations and pointings had been decided upon. I then found that the photo of a fantail which had been used as a specimen was obviously a throw-out from a veiltail breeding.

A. Boarder





ON several occasions I have heard it said of *Heteranthera zosteraefolia* that it is a disappointing subject, or "not much of a plant," and presumably, if the remarks are anything to go by, the plant will have been promptly dismissed from the tanks of those aquarists with no further consideration. This is a pity, because *H. zosteraefolia* when planted in a manner appropriate to the type of subject, and given the right conditions for healthy development, is capable of providing a very pleasant and characteristic shade of light green in the aquarium, thus enhancing the darker greens of other subjects.

It has a slender stem from which grow the long, narrow leaves alternately on each side. The root system, like the

## Heteranthera *zosteraefolia*

An attractive aquarium plant with  
the rarely used common name  
"mud plantain"

by JAS. STOTT

rest of the plant, is slender, but capable of penetrating a considerable depth and over a surprisingly large area. Requiring plenty of light to give of its best, this is a plant which is suitable for those parts of the aquarium receiving maximum illumination and, being a slender subject, it should be planted in thickets. Thus, while the thickets of *H. zosteraefolia* are receiving the necessary high intensity of light they require, the shade they produce makes ideal positions for shade-loving subjects.

When conditions are satisfactory for good growth this plant develops rapidly, soon reaching the surface, where the slender stem rests limp on the top of the water. The plant appears to appreciate a thin under dressing of peat fibre, but this is not essential if the use of peat under the compost is not desired. What is essential, in my opinion, however, for good results is a temperature not less than 72° F. and, most important of all, bright top light.

Propagation may be carried out by means of cuttings, which are planted in the gravel, when roots are quickly formed. They should not, however, be placed in full shade, as the beginner might be tempted to do with the idea in mind that it will be beneficial until roots are formed. They should be placed in a position where medium light will be obtained. This will avoid thin, drawn development. After about 10 days or a fortnight, when signs of growth are seen they may be transferred to a position receiving full light. *H. zosteraefolia* is a native of South America.

### FRIENDS & FOES No. 46

#### NEUROPTERA

PHYLUM: Arthropoda, from Greek *arthron*—joint, and *podos*—foot.

CLASS: Hexapoda, from Greek *hex*—six, and *podos*—foot.

THE Neuroptera are closely related to the Megaloptera (see May issue) and were for many years thought to be part of the same order. British species are few—four belonging to the family Sisyridae (genus *Sityra*), and only one to the Osmylidae. This latter species is fairly large, with a body of almost half-an-inch, with wings two-and-a-half times the body length, and broad in proportion, brown spotted and many veined. The eggs, laid in rows, are creamy white and secured to the leaves of waterside vegetation, from which the tiny larvae hatch and make their way to clumps of moss at the water edge. They do not possess gills, but breathe through spiracles. They enter water to feed, preying upon *Chironomus* larvae and the like, first paralysing their victims before sucking them dry. Fully grown larvae reach three-fifths of an inch in

### Lace-wings



Fully grown *Osmylus* larva ( $\times 3$ )

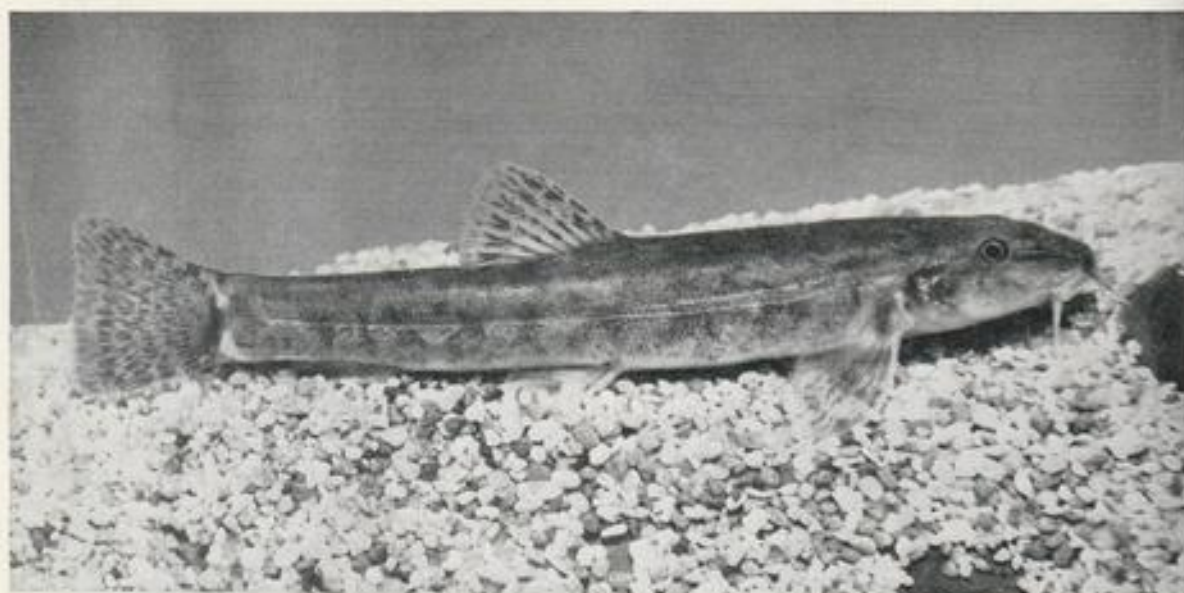
length. They are reputed to spend a considerable time as larvae before constructing silken cocoons in which to pupate. These may be found in the late spring months amongst waterside moss. The pupa emerges from the cocoon before fully adult, and awaits a final moult before becoming an imago.

The male uses scent glands to attract females. They seek him out once he emits the scent and after a preliminary courtship mating ensues. The whole process was fully described by Withycombe in 1923 [*Notes on the Biology of some British Neuroptera (Planipennia)*].

C. E. C. Cole



## Some Unusual Features of the Stone Loach



Stone loach (*Cobitis barbatula*)

by N. E. PERKINS

Photographs by LAURENCE E. PERKINS

**T**HE common British stone loach (*Cobitis barbatula*) is an engaging little fish, quite as pretty and interesting as any of the foreign tropical loaches that are so frequently to be seen. Unfortunately, as with all coldwater fishes, it is that much more difficult to maintain than its tropical relatives, and is therefore neglected.

I have found that it has a great objection to deep water, and if kept continually in a normal aquarium of some 12 ins. depth soon shows signs of discomfort, climbing the weed much as would a newt in an effort to establish itself nearer to the surface. With this in mind I transferred two specimens to a tank in which, for the past three years, I have kept crayfish. This tank, which is a 24 ins. by 12 ins. by 12 ins., contains not more than 1½ gallons of water, the surface of which is broken by large lumps of chalk which rise above the water level.

Since crayfish occasionally catch and eat small fishes I wondered how the four which occupy this tank would respond to the introduction of the loaches. However, though the crayfish were very excited the loaches remained quite unconcerned and even tried to hide beneath them. When the crayfish attempted to grasp the loach (and at first they made violent efforts in this direction) it appeared that they were unable to get a grip on their eel-like bodies, and after numerous attempts they gave it up. At last the community settled down and has appeared comfortable ever since. The habits of these two very different types of creature appear to be somewhat similar, since both make periodic sallies in quest of food, only to retire later beneath

the stones and chalk so that just their heads protrude. It is quite common to find the loach in a coiled position so that both the tail and the head are visible side by side, the body being curved around the cavity chosen as a retreat.

One noticeable feature about these fish is the fact that their specific gravity is very much greater than that of water, and it is only with great effort that they are able to leave the bottom at all, and it is impossible for them to remain at the surface without additional support. Externally, the



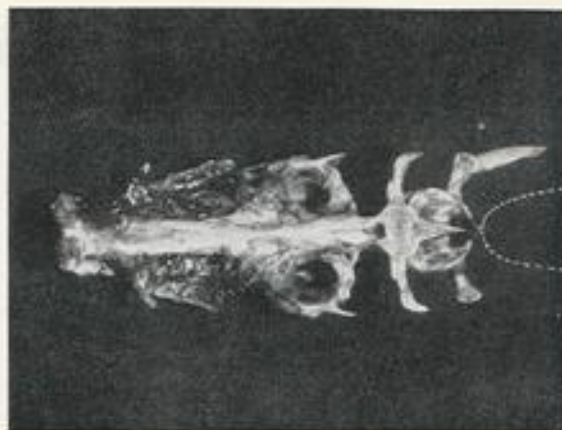
Dissected head of stone loach showing two bony capsules disposed at right angles to the spinal column, each with a muscular attachment to the floor of the mouth



stone loach appears to be rather an ordinary little fish, somewhat similar to the gudgeon, but internally something peculiar has been in progress for, unlike other members of the carp family to which this species belongs, it has no swim bladder in the body cavity. What remains of this organ is directly above the heart, and is enclosed in two bony capsules formed by considerable modification of the first three vertebrae, including the Weberian ossicles, which have ceased to exist as such. Moreover, instead of the swim bladders lying one behind the other as is usual, they are now arranged side by side.

By examining the Weberian ossicles of the barbel one may conjecture how the bony capsules of the loach have been formed, for although the barbel has a well-developed swim bladder, normally placed, for some reason or other the tripus of the Weberian ossicles has become fused with other bone formation to make two cup-shaped caps, the purpose of which seems obscure, though it is noticeable that the posterior ends of the tripus, which are supposed to impinge upon the swim bladder in members of the carp family, have become produced to form two spring-like curves above the point of attachment of the bladder.

The main points of interest with the loach are: (1) That the bladders are so reduced that they have little if any effect on the specific gravity of the fish, and (2) that well-developed muscles are evident from the posterior end of each bladder to a common juncture in the floor of the throat, where the two coracoids meet. There is also a band of muscle which joins the other two muscles shortly after they leave the capsules, and this passes directly under the gullet. It may well be that this construction is to enable sound to be produced, as is the case with the weakfish,



Skull of barbel showing cup-shaped caps. Position of the swim bladder is indicated by the broken line (right)

which also has a muscle by means of which the air bladder can be set in vibration. The resulting noise is audible through 50 feet of water. However, I cannot say that I have heard any kind of noise from the loaches, although this is nothing to go by for it may be mainly, or only, to do with mating, as is presumed with the weakfish, since here it is the male only that is endowed with this muscle.

## The Glass Catfish (*Kryptopterus bicirrhus*)

by JACK HEMS

**K**RYPTOPTERUS *bicirrhus*, as the fish is properly known in ichthyological circles, is one of the curiosities or oddities of the aquarium world. It is a true catfish, a member of the family Siluridae, yet it prefers to hover in mid-water in a slightly head-upward position, rather than spend its time grubbing in the sanded floor of the aquarium as is the custom of the majority of catfishes. Furthermore, the species is quite transparent, the body resembling a piece of untinted glass or Perspex.

The anteriorly placed dorsal fin is reduced to a mere single upstanding bristle. The anal fin extends from just behind the forward-placed vent to the root of the tail. This long fin ripples perpetually, like a flat ribbon of weed caught in a current of water. A single pair of long, silvery barbels or whiskers project forward from the snout.

The internal organs are bunched together close behind the head; they are enclosed in an opaque, silverish sac. The actual skeletal structure of the fish is clearly visible; so that the aquarist with time to spare may amuse himself trying to count the number of bones in the fish's body. The body itself is flattened or compressed from side-to-side, after the manner of *Pterophyllum* (angel fish). Strangely enough, although the body is so glass-like, when a bright light shines immediately overhead, or through the fish, many prismatic colours flash and twinkle to enchant the beholder's eye.

*K. bicirrhus* is native to Siam and the (Dutch) East Indies, where it is said to be quite common in streams, lakes and rivers. But though it hails from warm fresh waters, it is

not at all delicate in captivity, and is quite comfortable at an average 'tropical' temperature; that is to say, about 75°F.

Owing to the transparency of the body, the fish shows up best in clear, sediment-free water, and against a rich green or dark-painted background. An attractive natural background for the fish may be made up of massed *Cryptocoryne griffithii* plants, or a treble row, each row staggered, of *Vallisneria spiralis*.

Although dried food will be taken as it descends through the water, the fish should be given plenty of chopped earthworm, or living food such as *Daphnia*, *Tubifex*, bloodworms and the like to keep it in good health and spirits. Like most catfishes, *K. bicirrhus* prefers to take its food in half-light or complete darkness.

It is said that, in the wild state, the species attains a length of about six inches, but aquarium specimens measuring more than three inches in length are not easy to find in public or private aquaria. Perhaps lack of certain live food, or mineral elements in the water, precludes full development.

Although *K. bicirrhus* makes an interesting and harmless addition to the community tank, its companions should be chosen with care, for bullying fishes or boisterous fishes will quickly make its life a misery by nipping at its body and barbels, and by keeping it away from food. A few weeks of such treatment usually leads to rapid decline and death. But when placed with inoffensive tank-mates such as pearl danios, neon tetras, harlequin fish and similar types, the species should live for several years.

Although *K. bicirrhus* is usually referred to as the glass catfish, it is sometimes called the transparent catfish, and, more rarely, the Sumatran ghost fish. So far as I am aware, the species has never been bred in the aquarium, which should give owners of this unusual-looking catfish something to think about.



## In the Water Garden in June by ASTILBES

NOW is the time when the water gardener can sit back and admire the results of his earlier work. If all has turned out as planned there will be little actual alterations or additions to be done. Most of the water lilies should be flowering by now, and when visiting public gardens where they grow it is a good plan to take note of any particular variety which catches your eye. Make sure, however, before ordering that the plant will be suitable in your pond. The depth and size will often make all the difference as to whether a fresh plant will do well in your pond or not.

If your water lilies are not flowering as well as previously it will be a good plan to try to discover the reason. Lack of flowers can be caused not only by lack of nourishment but can also occur when a very vigorous plant has too little room in which to develop. The ideal is when a water lily has a number of almost equally sized leaves spreading out over the surface of the water, with none above it. Under these conditions the flowers will appear between those leaves and look very fine.

Once the water lily gets too crowded the leaves cannot find space on the water and so grow up into the air, with the result that the look of the plant is spoiled, and the flowers, even if produced, never quite look as well. If a number of fishes are in the pond it is probable that they will produce sufficient nourishment with their droppings to keep the plants healthy and growing. Ponds without fishes would have to have some added fertiliser to ensure that the water plants continued to thrive. Most ponds, especially those near a town, will get a great deal of sediment fall into them naturally, as the pondkeeper will soon realise when he comes to clean out his pond.

I do not consider that artificial fertilisers are necessary when fishes are in a pond. If the water plants were planted in old turves there should be enough nutriment to set the plants off to a good start. The fishes and debris falling in the water will then give enough extra nourishment to assist the plants.

The under-water oxygenating plants will grow very rapidly at this time of the year and it may be necessary to thin these out a little. A lot will depend on the warmth of the water, as once the temperature rises above 65° F. you will find that the plants grow at a fast rate, and if not curbed may cover too much space. Although a lot of work is not essential it must not be thought that a pond will look after itself once it is made. There must be some pruning and rearranging or the water will become filled with plant life in a short time.

Where it is hoped that young fishes may be reared it is a good plan to afford some form of protection for the eggs and fry once hatched. If the water plants are well established and there are some small thickets many fry will be able to escape the attention of the parent fishes. Without some form of protection it is probable that few fry will live to make adult fishes. A fine wire screen can be placed near one end of the pond, and although it is possible that some of the fry can swim through this and get among the older fishes, it will be found that many fry will soon learn that it is safer in the screened part and remain there.

A little duck weed, *Lemna*, can be placed on the water. This will serve a useful purpose. If it spreads well it can change green water into fine clear-spring-like water in a short space of time. The growth will check excess light reaching the water, and the green algae will be choked out. Goldfish will also eat much of this weed if they are hungry, and if you are going away for a long period it is a good idea to give a fair amount of duck weed before you leave. Some people find that once they have introduced the duck weed



Photo 1

Water lily *Laydekeri lilacea*

Lawrence E. Perkins

it spreads at such a rate that it soon covers the whole surface of the water. Should this happen there are one or two ways of controlling it. If possible, the garden hose can be turned into the pond, when the weed can be flooded off. If not, most of the weed can be washed with the hose to one side, where it can be raked or netted out. It will always die down in the winter, but will generally reappear in the following spring.

If you find that holes are appearing in some of the above-water leaves of your plants it may be that they are attacked by the caterpillars or larvae of certain moths. Green and black fly can also attack some plants and their flowers. Insecticides cannot be used if there are any fishes in the pond, and it will be found that the garden hose will again prove useful for washing the pests from the plants. Even a garden syringe can be of great value for washing off pests from the leaves.

Do watch the temperature of the water, especially in hot weather. If it reaches 80° F. or over it is a good plan to add some fresh tap water, especially if you have any golden orfe in the pond. Failure to see that there is sufficient oxygen in the water may mean the loss of some cherished fishes.

### Vancouver Aquarium

CITIZENS of Vancouver, B.C., Canada are being asked to subscribe 25,000 memberships at two dollars each to the Vancouver Public Aquarium Association to provide a public aquarium in Stanley Park. The federal and provincial governments and the City of Vancouver have already made equal grants totalling 300,000 dollars towards building the aquarium, and it is hoped that it will open this autumn. Facilities are to be included at the aquarium for university zoological research laboratories. It is estimated that the yearly running expenses will be about 40,000 dollars, so that a charge for admission will be necessary, but citizens taking the annual membership will have free admission and if sufficient members are forthcoming it is planned to admit children free. The venture is the result of hard work on the part of Mr. Carl Lietze, president of the Association, who convinced the government of the necessity for a fully-equipped aquarium in the city. "The aquarium will be comparable to San Francisco's fine project," Mr. Lietze has stated.



## OUR EXPERTS' ANSWERS TO TROPICAL AQUARIUM QUERIES

**What should I do to clear a tank of excess Infusoria?**

Unless the micro-organisms are being cultured by too much decaying plant life, uneaten fish food lying on the bottom, or excessive snails' excreta, they should soon exhaust their food supply and die away of their own accord within a few days.

**Please can you tell me why fishes often rub their bodies against rockwork or other fixed objects in the aquarium?**

Fishes often rub their bodies against fixed objects without any apparent reason. But certain parasites which attach themselves to the body of a fish will cause it to rub itself against the sand or rockwork in an aquarium. A fish which has succumbed to an attack of white-spot disease will often rub its body against the plants and sides of the aquarium. If a fish is noticed to be rubbing its body very frequently against objects in the aquarium it is best to examine it closely for parasites or other unwanted bodies. Fragments of glass wool or even tiny grains of sand may adhere to the mucous coating of a fish and set up irritation.

**I am a comparative newcomer to the hobby of tropical fish-keeping, and an aquarist friend who called to see my set-up told me it is not a good policy to bury a glass heater below the surface of the sand. Please will you tell me if my friend is right in what he said?**

Your friend gave you sound advice. A glass heater buried under the compost soon becomes coated with a hard crust of gritty particles which seriously interfere with efficient radiation of heat. Then again, a buried heater does not warm the surrounding water quite so well as a heater raised (in a horizontal position) just above the surface of the sand.

**I should like to try and grow fine, strong water plants, and would appreciate your advice on what to place as a rich growing medium beneath the sand. I tried ordinary garden soil, but this soon polluted the water.**

We suggest that you obtain well-rotted leaf mould from a beech or oak wood, pick it over carefully and extract any insect cocoons, half-decayed twigs and leaf stalks, bake it in an oven for about an hour, then spread it to a depth of about half-an-inch on the bottom of the aquarium. Cover this subsoil with at least two inches of well-washed coarse sand. If you cannot obtain beech or oak leaf mould, use ordinary scalded peat.

**I have just bought an air pump to aerate the water in my tropical aquarium. How many hours a day should I give artificial aeration?**

Unless your tank is overstocked with fishes, there is no need to keep the aerator running for more than three or four hours every day. If the tank receives a good bright light (natural or artificial), and the plant life is in a healthy growing condition, the fishes should get along very well without artificial aeration during the daytime; but after nightfall, or when the aquarium is dark, air pumped into the water helps to keep the aquarium in perfect condition, and makes for healthier, more contented fishes.

## COLDWATER FISH-KEEPING QUERIES answered by A. BOARDER

**My son has made a pond about 2 ft. 8 ins. in circumference and 1 ft. 2 ins. deep. Can you advise me which water lilies to have, a red one and a white one, and what other plants? How to set and plant? Is there any special goldfish I must buy and what is their treatment? Is any special treatment necessary for the cement of the pond? Do I need water snails and where do I have to get them?**

I hate to disappoint you but the pond is far too small for any practical use. It is not big enough to grow two water lilies; one would have a job to grow in it. The pond would

*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.*

**My fighting fish has developed bulging eyes. Please will you tell me the name of the disease, and suggest a treatment?**

Your fish has probably contracted the disease known as exophthalmia or "pop-eye." To treat this disease, place the fish in a hospital tank, and gradually raise the temperature to about five degrees above normal. Now add up to five drops of ordinary household ammonia to every four gallons of water to be treated, or *pro rata*. If the fish becomes distressed while undergoing treatment, reduce the ammonia content of the water by adding fresh water heated to the same temperature as the hospital tank. After three hours, you may return the fish to its aquarium.

**I have noticed that the gills and snout of my angel fish have become suffused with bright red colour. Do you think the fish has contracted some disease?**

The red colour which has appeared around the gills and snout of your angel fish may at the most be nothing more than the result of a knock. Angel fish are very nervous, and some specimens will dash against rockwork and the sides of the aquarium and bruise themselves badly; that is, if something upsets their usual calm such as a sudden vibration in the water caused by heavy footsteps or furniture being moved in a room, or sudden switching on or off of electric light. On the other hand, if the aquarium is on the small size, and the oxygen content of the water is low, the gills of the fish will become inflamed and look as though streaked with blood. We advise you to keep a close watch on the behaviour of your fish and check up on the condition of the water. If the fish keeps mouthing the top of the water, you may find that the fish has outgrown its aquarium, or the water has become badly polluted. A certain amount of redness is frequently to be seen in the transparent region of the snout in perfectly normal and healthy fishes.

**Although I add one teaspoonful of cooking salt to my 18 ins. by 10 ins. by 10 ins. aquarium every week, my fishes do not appear to be at all well. They have gone off their food, and some of them have died within a few days of being introduced into the aquarium. Please can you tell me the cause of the trouble?**

We would say that the chief cause of your trouble lies in adding salt to the aquarium water every week. If you have been salting the water every week for any length of time, your tank must resemble a brine bath rather than a freshwater aquarium. There are a few species which do not mind a certain amount of salt in the water, as, for example, guppies, mollies, scats, puffer fish and the like. But the majority of catfish and some of the small tetras and labyrinth fishes do not flourish very well in saline conditions, and not a few would soon die if the salinity reached a strong concentration.

freeze almost solid in the winter, when any fish might be killed. A pond needs to be at least two feet deep to be fairly safe in the winter (see answer to query below). If the concrete was scrubbed round three times and well washed it should be safe. If you wish to experiment try one lily, say *Nymphaea pygmaea alba*, and set it in a pot of loam. A little *Elodea canadensis* could be added. Ordinary goldfish, two three-inch ones, could be put in but it would be safer to take them indoors for the winter. Water snails are not



essential! There is so much to know about keeping fishes successfully that my best advice to you is that you purchase my book *Coldwater Fishkeeping*, and study this. So many people start wrongly and then enquire after.

I am writing to ask if newts are detrimental to submerged pond plants. I recently started a pond and have a lot of newts in it; now the plants have died off and I am wondering if the newts are the cause. I want to add some fish, must I get rid of the newts first?

I do not think the newts were the cause of the trouble. If the plants were insecurely planted it is possible that they may have become uprooted, but this should not have killed them all. Plants should always be rooted in pots or some kind of container; it is useless to just lower them into a concrete pond. The newts will leave the pond as soon as they have finished breeding, sometimes in late June but more often a little later on. They will return to the pond to breed next year, perhaps as early as February if the weather is fairly mild. The newts will not harm the goldfish. They and their tadpoles can eat goldfish fry, however, and so you will have to take precautions with the eggs when any appear.

I have an irregularly shaped pond in the garden 5 ft. by 3 ft. by 15 ins. deep. The bottom is covered with well-rotted turves and sand. It is planted with two water lilies and a variety of oxygenating plants and contains snails and goldfish. During the winter one fish died and the water has gone very thick and green. Why is this?

I cannot say for certain why a fish died or why the water has gone a bad colour. I expect the water became foul and the lack of oxygen killed the fish. I can, however, suggest several points where you may have gone wrong. In the first place the pond is too small to be safe in the winter, especially in Scotland where you live. It is only 15 inches deep and with turves and sand in the bottom this would reduce the depth even more. This is totally inadequate as regards depth of water. The longer I am associated with outdoor ponds the more does it become apparent that any pond under two feet deep is unsafe for goldfish in a bad winter. I know that some people may get away with it for a time, but there almost invariably comes a time when a very bad spell kills the fish or at least causes them to become so weakened that they are attacked by fungus. I am certain

that three-quarters of the queries about trouble with pond fishes are caused by the shallow ponds. I have made experiments and have found that young goldfish have been killed in tanks left outside in the winter when the water has not been more than 15 inches deep, yet fish in tanks near by which were at least two feet deep have been quite safe.

The turves, placed in a comparatively small pond may have had a bad effect on the water. Once they rot they can give off foul gases. This effect may not be noticed in a large area of water but can be deadly in a small amount of water. Water usually becomes murky looking when it contains foul gases and I expect that there is something in the pond causing pollution. I would clean all out and start again. If it is possible to deepen the pond you may save yourself much trouble later on.

I would appreciate it very much if you could supply me with information as to how to breed my own supply of white worms, and explain in detail the gear required and the set-up?

I think I dealt with this some time ago but I will repeat the advice in case you have not the back number which contains the article. I use concrete boxes about 14 ins. by 8 ins. by 4 ins. These are three-parts filled with damp peat. A hole is made here and there and a few worms are put in these places. Over these I place a piece of wet brown bread. I cover the peat and bread closely with a sheet of glass and have another piece over the top of the box. The whole is kept in the dark, or the top is shaded. If you use bread and milk this tends to turn sour, and smells. Do not put too much bread in at a time, until the worms increase in numbers. When you want to catch any just place a small piece of cheese rind on top of the peat and after a time many worms will gather underneath and can be picked out easily.

#### Are sunfishes hardy enough to winter in a large pond?

I do not see why some of the sunfishes should not winter safely in your pond. It is fairly large and a natural one, therefore the dangers of high pressures from a winter's freeze up would be lessened. Some of the sunfishes come from the lakes of North America, where it gets as cold or colder than here. In any case it is well worth a trial, as a few small sunfish are not very expensive. You must realise, however, that they are almost entirely carnivorous and so could eat your other young fishes.



## BOOK

## R E V I E W

*Marine Tropicals*, by E. L. Fisher. All-Pets Books Inc., U.S.A., 1.50 dollar. (Obtainable in Britain from Bailey Brothers & Swinfen, Ltd., 46, St. Giles High Street, London, W.C.2.)

THE marine aspect of the aquarium hobby is as yet in its infancy and very little has been written to cater for those enthusiasts who wish to venture out as marine aquarists. The author of this book has been photographer, collector and writer on marine life for some years, and recently created a record by remaining 24 hours on the sea bed off Florida examining life on a reef through a full day and night cycle. This paper-covered book has 72

pages with 25 photographs and 15 drawings, and deals in turn with keeping salt water wholesome, setting up a tank, feeding, marine tropicals, invertebrates, marine plants, artificial sea water, control of disease, fish intelligence, scientific methods, collecting marine life and underwater conservation. There is a list of fish names (scientific and popular) and a bibliography of books and magazines on marine life.

Mr. Fisher mentions that one major trouble is that captive fishes just will not eat. He suggests the reason is a poor psychological environment created by the disturbing influence of other fishes, noise (tapping on the glass or a buzzing air pump), unnaturally bright lights, insufficient cover, and so on. The trouble is met by introducing a coral fish that already knows that food is floating on the surface, or a "sergeant major" which automatically feeds when introduced to a tank. He mentions that the staple diet of most coral fishes should be a good dry food in spite of popular ideas to the contrary. To keep salt water wholesome four primary considerations apply: pollution, aeration, salinity and temperature; each is discussed at length. Marine aquarists or intending aquarists will find this book very helpful because it gives a lot of information in a very straightforward and commonsense way.

Raymond Yates

THE AQUARIST



# Microscopy for the Aquarist—19 by C. E. C. COLE

WE have now dealt with and discussed the respective merits of normal transmitted light and above-stage illumination. Both are of great value—in fact, indispensable—to us, but there is a third method we can use which is considered by many microscopists to be the best of all, revealing many small aquatic creatures as organisms of breathtaking brilliance and beauty.

This method is known as "dark-field" illumination, and details of how to obtain it will be given as this article proceeds, but a little explanation and experimentation is called for first. Set up your microscope and lamp as for ordinary transmitted (substage) lighting, and switch on, preferably in a darkened room. If the air is slightly foggy or smoky, you will better be able to see the beam of light striking the mirror and being reflected upwards towards the stage.



Female *Diaptomus* as seen by transmitted light with a 2 in. objective and  $\times 10$  eyepiece. Actual size of organism:  $\frac{1}{16}$  in.

As we have no substage apparatus apart from the mirror you will notice that the area of glass slip illuminated is greater than the field of view—in other words, a proportion of light is passing outside the objective and being lost. A smaller proportion, and this is not nearly so noticeable, is reaching the cover glass of the slip at such an angle that it is being thrown back on to the objects within the field of view, or is being directed into the field by specks of dust, scratches on the glass, etc. Such light may interfere with a perfect image, cancelling out some of the detail.

If we could get rid of the central concentrated beam of light, the wayward beams alone would strike the objects in the field and render them self-luminous upon a darkened field, shining like jewels upon dark-velvet cushions.

There is special apparatus manufactured for just this purpose, but at the moment we can do without it, for we are still dealing with fields of over half-an-inch, and to my knowledge nothing is produced which will darken fields of



Antennae of male *Diaptomus*. The upper drawing shows the structure used to grip the female during mating

this size. If there is, I shall be glad to hear of it and investigate its possibilities.

We are, therefore, thrown upon our own resources. Let us assume that we are examining a group of one of the common crustaceans, say, a number of *Diaptomus*, by using a 2-inch objective. These are close relatives of *Cyclops*, often brightly coloured and with habits which well merit further study and investigation. They are easily found in numbers near the surface of ponds during November and early December.



Left: terminal setae of a copepod seen by transmitted light. Right: the same specimen as seen when examined by dark-ground illumination

Focus one or more of them and note the specially long antennae, many segmented and displaying a number of substantial hairs (in silhouette with transmitted light). Slowly turn the mirror so that the illuminated area moves away, to be followed by a greyish area, and then a still darker area. Note that as this change of background takes place the *Diaptomus* seems to switch on a light confined to itself alone, and the hitherto dark hairs, which disappeared from view in the grey area, quite suddenly become brilliant silver, each one separate and distinct.

Care must be observed when using this technique, for unless the mirror is in exactly the right position, parts of the *Diaptomus* will be invisible. Now change to the 4-inch objective. It is at once apparent, upon focusing, that the background is no longer as dark as it was when we used the higher power. Nevertheless the creatures show up quite brightly, and the hairs on the antennae gleam silver and are plainly discernible.



A single leaf of *Elodea canadensis* viewed with a 2 in. objective and a wide-field eyepiece. Actual size of the leaf:  $\frac{1}{4}$  in.

Living creatures, swimming in pond water, are particularly lovely under this kind of lighting, and the internal organs of the more transparent ones can be watched performing their normal functions. The legs of the more opaque *Daphnia* are easier to make out than with ordinary substage lighting, and this applies to a great number of other things. In fact, it was when experimenting with this dark-field technique that I noticed for the first time that a preserved specimen of a *Cypris* I had mounted in a cavity slide, and which I had considered perfectly smooth-shelled, was in fact quite hairy. This was a definite pointer to me that before finally making up one's mind regarding the structure of an organism, more than one examination, under different conditions of lighting, is essential. A further example of



this is the fact mentioned above, that unless the dark-field technique is carefully used, parts of the creatures being examined may not be revealed at all.

A combination of the two methods, however, will usually reveal all the details it is possible to see. But with semi-opaque or completely opaque organisms, overhead lighting will in most cases be best.

Before we leave the subject of dark-field illumination for the time being, there is little doubt that by using it as I have described, with 4 ins. and 2 ins. objectives, you will notice the tiniest of objects moving round in the water—mere living points of light.

These are Infusorians. Although their various shapes cannot possibly be made out because of low magnification, you can easily watch the various methods of progression. These are by no means uniform—some "specks" will move slowly in straight lines—others will make sudden leaps, more will gyrate in small circles, or turn over and over in a spiral. Movement seems aimless with some, and purposeful with others.

These first glimpses of a very large group of really microscopic organisms will undoubtedly quicken your interest in them, arousing a wish to know more about them and their lives. Later on we shall get down to studying them, but at the moment we have plenty of other material to examine.

This is the month when ponds begin to show many young stages of a variety of creatures, and there is a tremendous burst of growth among aquatic plants and algae.

Algae always repay examination, but many minute free-swimming species need very powerful lenses to reveal the details of their structure. The filamentous species (usually lumped together as "blanket weed," and considered an unmitigated nuisance by the majority of aquarists) are easily studied with the objectives we already possess. You will be surprised and probably delighted at the variety and beauty of their construction, and lowly though they are, you will look at them with an entirely new appreciation. Among their strands you will probably discover many other forms of interesting aquatic life.

## Rasbora daniconius and its Relatives

by RODNEY YORKE

**M**OST commonly encountered species of *Rasbora* in the tanks of aquarists is the harlequin, and this is understandable. Then follows the scissor-tail, and an occasional tank contains specimens of the tiny *Rasbora maculata*. This is a pity, because there are other *Rasbora*, all long lived and easy to keep. Perhaps the most attractive of those usually obtainable is *R. leptosoma*, which resembles a giant glowlight.

However, I want to write about three *Rasbora* which are very similar to each other in every way, these being *Rasbora daniconius*, *R. einthoveni* and *R. meinkeni*.

*R. daniconius* comes from the Ganges, Burma, Malaya and is found all over Ceylon. Although large in its native waters, it rarely exceeds three inches in captivity, which is a convenient size. The colours are not striking, being olive on the back with a white belly overcast with a greenish sheen. A conspicuous black line runs from the nose to the tail, and into the tail, although photographs never show this continuation. The black line is edged with fine gold, and fins are yellowish. This is a peaceful fish which gets along well in the community tank, and is always on the move; it can move like lightning when a tit-bit (such as a white worm) is dropped into the water.

They are omnivorous feeders and will live for many years. However, they are liable to get white spot if chilled, and cannot stand low temperatures, say much below 70° F. Sexing is impossible, and breeding depends on having fish of opposite sexes plus a low pH (about 5.6), very soft water and a temperature around 81° F. Axelrod and Schultz suggest the use of a Zeolite water softener for this species. In nature these are shoal fish, but many successful spawnings are recorded, the foregoing points having been considered and use made of fine-leaved spawning plants. As eggs grow fungus, methylene blue should be added; they hatch in about 24 hours. Young tend to be cannibalistic and sorting is advisable. Infusoria can be fed after three days. Meaty foods are always popular with this variety

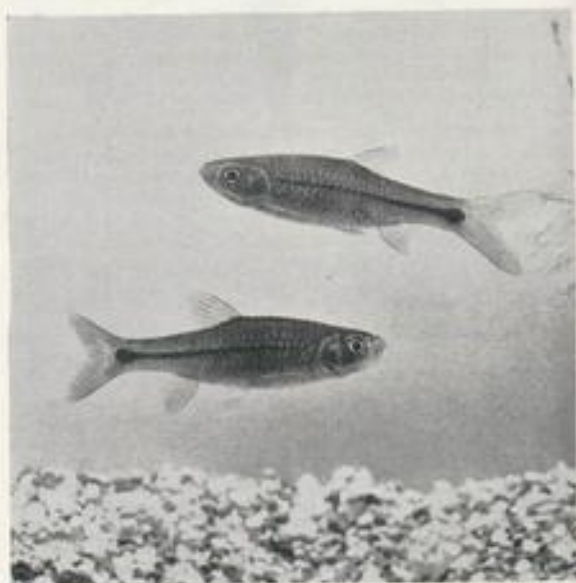


Photo:

Laurence E. Perkins

Our front cover picture this month shows two specimens of *Rasbora daniconius*

and its relations. They enjoy a well-planted tank with good swimming room, but too bright a top-light saps their subdued colour and produces a colourless fish.

*R. einthoveni* is practically identical apart from slight differences in scale counts and the violet sheen to the belly. Females in this species, however, are quite obviously plumper and larger and the black lateral line is thinner. Average aquarium size is about three inches. *R. meinkeni* is similar, but has a short dark band under the dorsal and another along the base of the anal. It is probably the hardest to breed of the three. None are high priced, and all are well worth a place in any community tank.



## our readers

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

### Portable Show Tanks

IT is some two years since we were able to function as an active club owing to falling membership and general lack of interest shown in our hobby in this area. However, with a steady increase in membership we are once again entering the competitive field.

This raised the problem of adequate equipment for staging club shows and challenge matches, as upon inspection we found our old tanks and stands were in a very poor state after prolonged storage. A great deal of discussion on this subject took place and it was decided that each member should tackle the problem in his own way and bring the results of his efforts to our meeting. One member, Mr. Beasley, suggested the combined carrying case and show tank and brought along the made-up article shown in photographs below.

We decided to make up one dozen at once, and a further dozen followed, as they proved so successful in our first show and received commendation from the judge. Details are given for the benefit of fellow aquatic clubs.

The box is 9 ins. by 6 ins. by 6 ins., soundly constructed in oak or cedar and purchased from a government surplus stores for 1s. 6d. The boxes are covered in wax when purchased and are in excellent condition, and the wax is easily removed with a scraper.

Glass cut to size costs 3s., putty about 10d., screws for



Combined carrying case and show tank described in a letter from Clapham Aquarist Society

the metal strips fitted inside the box to take cover glass 2d., rubber strip for sealing cover glass to avoid splashing when being carried 6d., oddments 6d.—making a total cost of 6s. 6d. The leather strap is supplied with the box, also hinges and metal strips to protect the edges.

The advantages that immediately come to mind over the accepted layout are as follows: (1) Show secretary's work is cut to a minimum, as he only has to ensure that stand is ready to receive boxes; members bring their entries "tanked." (2) No water is spilt to cause damage or nuisance at club rooms (this has to be considered in rented premises). (3) All tanks are of uniform size and so give each entry exactly the same show facility. (4) Any club lacking tanks can still be offered challenge matches, as the whole set-up is easily transported, and there is no fear of leaking tanks, for the tanks are glazed inside boxes which protect them.

I will be only too pleased to furnish fuller details if needed.

E. W. EVANS,  
Secretary, Clapham Aquarist Society.

### Speakers Wanted

THIS as you know is one of the smaller societies, and like a good many more these days, we are finding it a difficult job to retain members' interest and their membership. We have in the past had the few speakers that are available locally, and now feel that it would be a good idea to have someone from further afield—London or the Midlands.

We do not belong to the British Federation of Aquatic Societies, not because we do not want to, but we just cannot afford it, so we are unable to avail ourselves of their very good lists of speakers, although we do think the charges are a little on the large side.

We feel there must be someone willing to help small clubs like ourselves, who would give a talk, for their rail fare, and expenses, etc., plus a small fee, without insisting on good hotel accommodation. The accommodation we should offer would be at the home of myself or one of the committee members. I think this could be arranged to include a speaker's wife, and to make it a little more appealing, Lowestoft is a holiday resort. Have readers any ideas or suggestions on the matter which would be useful?

G. A. FRANCIS,  
Secretary, Lowestoft Aquarist Society.



### White-Spot Disease

DR. GHADIALLY has put the cat among the pigeons, as I did many years ago in confirming the findings of T. C. Roughley of Australia in his book *The Cult of the Goldfish*, published in 1933.

As a professional with over 40 tanks I have never had white spot appear in any but an isolation tank since reading Roughley's work. (No chemicals are used). So many people have shouted down the truth.

Roughley has been given little credit for his work on white spot and gill flukes published 23 years ago. White spot is not endemic as it dies at temperatures lower than 40° F. If after handling infected fishes the hands are washed properly with soap and water there would be no infestation. If there is any doubt about Dr. Ghadially's statements I should like to be the first to confirm their truth.

C. R. PARLOW, Norbiton, Surrey.

### Water Changing

IN the article on starting a tropical aquarium (*The Aquarist*, March/April) "Aquarius" instructs beginners to remove two buckets of water from the aquarium each week when removing sediment, and to refill with fresh water. As this appears contrary to the advice often given in fish-culture literature, I believe aquarists would welcome confirmation on this point.

I have always been under the impression that once the "balance" of water has been obtained it is only necessary to remove excess sediment from the sand, and this is so easily and quickly done with a hand ejector or similar appliance. As only the mulm is removed an occasional pint or two of water, to compensate for evaporation, is surely all that is required.

In any case I think "Aquarius" must have overlooked one important point—the size of the aquarium concerned. What would happen in an 18 ins. tank subjected to a two gallons change of water every week?

S. G. KNOCK, Poynings, Sussex.

"Aquarius" writes: *It is my experience and that of other aquarists that replacement of some of the water from an aquarium at intervals is a beneficial procedure, provided that the volume removed at one time is not a major part of the total. Here I admit to fault in not making it clearer that a 24 ins. by 12 ins. by 15 ins. aquarium was being discussed. "Balance" can be a mystifying term, and to deduce from it that aquarium water undergoes no progressive change in its solid content with time would be to put too strict an interpretation upon the word's application to aquarium-keeping.*

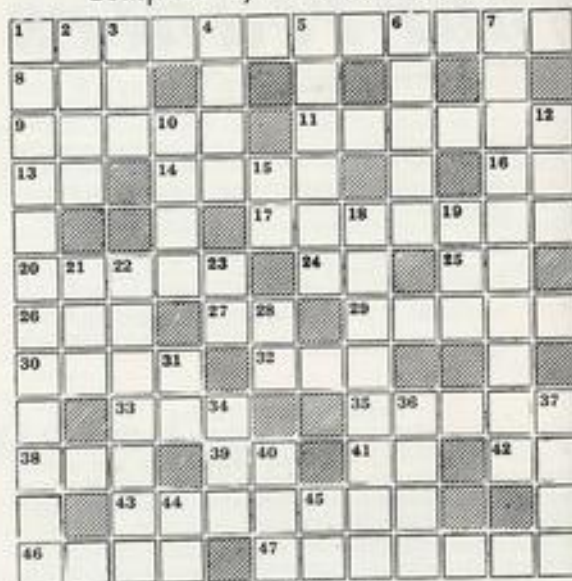
### Readers' Help to Patients

MAY I thank you for your immediate help to my appeal for books, magazines, etc., for the patients of Robroyton Hospital. Through the courtesy of your journal I would like to send the thanks of the patients to yourself, to Messrs. Spratt's Patent, Ltd., to the people who posted magazines to me, to those who personally delivered them, and to those who left no address to thank. We all—patients of Robroyton Hospital, and members of the Northern Aquarium Society and myself—thank you all most sincerely and wish you all many happy spawnings.

G. H. MEEK, Glasgow, N.I.

## The AQUARIST Crossword

Compiled by J. LAUGHLAND



### CLUES ACROSS

- Talisman as an anagram for aquarium plant (6, 6)
- This fly is a plague to cattle (3)
- Aequidens* (5)
- Push in upset and enforce statement (6)
- I'm in the mere (2)
- Parasites are usual cause of this sensation (4)
- The trade union of 17 across (1, 1)
- This household feature has been known to serve as emergency aquarium (4-3)
- The end, as 10 Down is the source, of many a fish (5)
- Symbol of the quality car (1, 1)
- See 24 (1, 1)
- Neons lose head and tail in age (3)
- But half a neon is on here (2)
- Leaves out and upsets moist (5)
- Place for eggs made by certain kinds of fish (4)
- Antelope upsets gun (3)
- Declining tide (5)
- Sporting fish ends with rout (5)
- Bag (3)
- Is the clue obvious? (2)
- "Down the Santa-trail" (2)
- Half the male is maternal (2)
- Potential frog (7)
- Kind of frame for panes of glass (4)
- Invariable question to angler (3, 4)

### CLUES DOWN

- Sexless reproduction (12)
- Lovely fabric or lovely aquarium plant (4)
- Aid upsets girl (5)
- Defence work and fish pond in earlier times (4)
- Lake plant, *advena* or *lutea* possibly (6)
- "The doctor fish" (5)
- Water cress (10)
- This streamlet would not hold brill: on the contrary (4)
- Nave of a wheel (3)
- Military punishment (1, 1)
- Sounds as if *Salmo trutta* is a flying fish (5, 3)
- Common prefix signifying three (3)
- Potential fish (3)
- Arthropods, usually winged in adult stage (7)
- Look (2)
- This is no good (1, 1)
- Wasting disease which affects fishes as well as humans (1, 1)
- Call at fish auction, for example (3)
- Do the fish that get away leer back at it? (4)
- Engine of war, or aquarium (4)
- Mineral spring (5)
- Exclamation (2)
- No turning (2)

### PICK YOUR ANSWER

- The name *affinis*, as in *Cratichneutes affinis*, means: (a) Distinctive. (b) Hard-skinned. (c) Neighbouring. (d) Timid.
- A popular name of *Aequidens pulcher* is: (a) Blue acara. (b) Brown acara. (c) Gold acara. (d) Green acara.
- Leptocacania oessana* is native to: (a) Georgia and Florida. (b) Honduras and Nicaragua. (c) Texas and Mexico. (d) Venezuela and Colombia.
- Which is the smallest of the following species? (a) *Pelmatochromis ameyensis*. (b) *Pelmatochromis arnoldi*. (c) *Pelmatochromis guentheri*. (d) *Pelmatochromis subocellus*.
- The flower of *Heteranthera graminea* is: (a) Blue. (b) Red. (c) White. (d) Yellow.
- Lobelia* was named after Matthias de P'Obel, doctor of: (a) James I. (b) Charles II. (c) George III. (d) William IV.

G. F. H.

(Solutions on page 64)



# The Heron Scare

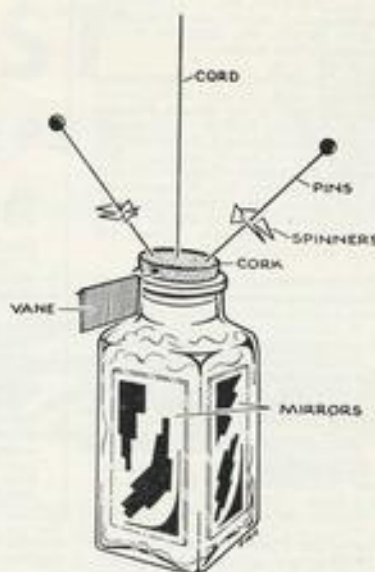
by W. H. MACEY

**A** HERONRY existed for several years within full view of my ponds, and not more than 500 yards away. Herons were often seen, and are still occasionally seen, on the banks of a stream 100 yards away. Seagulls fly overhead daily and take food from the bird table during cold weather, while owls pass night and morning during part of the year on their foraging exhibitions, yet, as far as is known, no fish has been taken. On the other hand these marauders have taken fishes from many ponds in this locality, and some of them were fitted with trip wires.

My theory for this strange behaviour on the part of these birds towards my ponds is that I am a very untidy fish-keeper, having glass bottles, jars and fish bowls always near the ponds. Inverted clear glass bottles suspended on rods three or four feet high certainly appear to protect plants from garden birds, so this alone may keep these marauders away from a pond.

However, the heron is a very cunning or intelligent creature, for it is not only an expert fisherman by day, it is also capable of fishing by night with the aid of the moon or artificial lighting. In addition, it appears to be far more scared of man than most other birds, yet it has had the audacity to take many fishes from ponds in the heart of a built-up area.

To carry out experiments with this wily creature without the risk of losing valuable fishes is rather difficult, but herons on the bank of the stream gave me a very favourable opportunity. They could be seen from my bedroom window, and I could approach the head of the stream, 200 yards away from the herons, launch my scare, and watch them through a thick bush without being seen. Several tests were carried out, always before sunrise, as a public path runs along the banks of the stream. The most effective scare was a large-size fish bowl, holding four small mirrors secured to a small wooden block. Without the mirrors giving their full effect, the herons took flight either immediately the scare came into view, or before it got within 100 yards, and when seagulls were present they also took flight either with the herons, or soon after.



As large fish bowls would need moorings, and could not be used in icy weather, the scare illustrated was tested on garden birds, and appeared to be quite successful, especially when the sun was shining. Cats also appeared to keep well away from it, but it is possible they may get used to it. In any case it would not be advisable for any bird lovers to use this scare if they want nests built in their gardens.

The scare is simply a square, small-size clear glass pickle jar with four strips of mirror fitted on the inside, and kept in position with packed cotton wool. It has a tight-fitting cork stopper, and is hung with cord to enable it to turn with the least resistance. A length of wire forced into the side of the stopper holds the V-shape vane, and this will keep the scare on the move with the lightest air current, to throw the rays of the mirrors around the pond. The vane and the spinners are made of tin foil. The latter may or may not be added, but they have the novelty of operating intermittently, and if they are placed on the wires, or on pins with their centre holes on top, they will run up and down the wire in a moderate to strong wind.

## 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.

FOUR film strips are available for hire from Peterborough and District Aquarist Society (Secretary Mrs. Y. Stockdale, 2, Home Place, Hamgate, Peterborough). These are entitled: Aquariums, (1 and 2, 30 and 23 frames); Water Plants (44 frames); Life in the Pond.

AT the May meeting of the Bridlington and District Aquarist Society, a show was held for the best female fish of any variety. Also there was an auction sale of equipment and fishes. An outing was arranged to visit the Trout Hatcheries at Melton last month.

BETHNAL Green Aquatic Society held their first social evening last month at the Society's headquarters, Bethnal Green Men's Institute. Visitors included Hornsey, Forest Gate, Tottenham and Stoke Newington Societies. The Society is planning a show to be held on 7th and 8th September next.

THE Blackburn and District Aquarists' Society have elected a new chairman, Mr. L. Richmond. This year the society is concentrating on quizzes and panel games more than lectures.

A LIVELY evening was had recently by the East London Aquarists and Pondkeepers' Association. It was provided by a quiz which was introduced by their chairman Mr. S. Moore.

THE Guildford and District Aquarists Club held a tropical table show on Wednesday, 9th May. The judge was Mr. W. L. Pearce. Most fishes were shown in square-sided jars.



On Wednesday, 13th June, Mr. J. E. Edwards will give an illustrated lecture on "Furnished Aquaria." Last month, Mr. Edwards invited members to visit his fish house.

ON Wednesday, 18th April, the **Hampstead Aquatic Society** held its second inter-club match at the Kentish Town Men's Evening Institute, Holmes Road, N.W.5. The results were: 1st, Hendon and District A.S.—10 points; 2nd, North London A.S.—8 points; 3rd, Arnold Aquarists (Wembley)—7 points; tie with Hampstead A.S.—7 points; 5th, Willesden and District A.S.—6 points; 6th, Independent A.S.—2 points. The next inter-club match will be held on 27th June. At Willesden. Classes will be for common goldfish and shubunkins.

**MEMBERS** of the **Hastings and St. Leonards Aquarist Society** competed in a series of four table shows for a silver challenge cup. This was won by Mr. T. Quickenden, the vice-chairman. Over recent months lecturers have included Mr. Walker, of Eastbourne, Mr. Edwards (on the second of his goodwill tours), Mrs. Meadows, on her own experiences in fish breeding. Also, Mr. Collins of Hastings on marine fishkeeping and Mrs. Inskip on insects and their adaptation to life under water.

A **MAY-DAY** show was held by the **Hornsey and District Aquatic Society** for characins. There was a large entry. The judges commented on the high standard of fishes staged.

**MEETINGS** of the **Mansfield and District Aquarist Society** are held once a fortnight, and aquarists in the area are invited to contact the secretary, Mr. A. Atkins, 53, Newton Street, Mansfield, Notts.

**AQUARISTS** visiting Southport are invited to visit the **Southport Aquarist Society** at any of the meetings held at St. Andrew's Hall, Park Street, Southport on the first Tuesday of each month at 8 p.m.

AN open pond competition is to be judged by the **Nottingham and District Aquarists' Society** on 24th June, with a prize of an ornamental bird bath for the winner. The society's annual outing also takes place this



## 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 2s. together with the **Aquarist's Badge Token cut from page x**, to **Aquarist's Badge, The Aquarist, The Butts, Half Acre, Brentford, Middlesex**, and please specify which type of fitting you require.

month, this year to Belle Vue Zoological Gardens at Manchester.

ON 17th April the **North of Scotland Aquarist Society** had its annual general meeting, when a new president was elected—Mr. C. Pirie. Other officers remain the same. The society has decided not to hold a show this year owing to losses incurred at the last one.

AT the meeting of the **Rochdale and District Aquarist Society** on 9th April, the guest speaker was Mr. A. Wardle of Bury Aquarist Society. He spoke on various aspects of fishkeeping from the beginner's angle and from the viewpoint of the hardened aquarist. On 7th May, Mr. H. Loder gave a talk to members.

## Aquarist's Calendar

14th-16th June: **North Staffs Aquarists' Society** second annual show, open to North Staffs area. Details and show schedules are available from show secretary Mr. L. J. Perks, 6, Radford Road, Cliffe Vale, Stoke-on-Trent.

28th-30th June: **Southampton and District Aquarists' Society** seventh annual open and competitive show at the Avenue Hall, Southampton. Schedules and entry forms can be obtained from show secretary, Mr. E. C. Goleworthy, Westways, Romsey Road, Nursling, Southampton.

7th July: **Lambeth Aquarist Society** open show, to be held at St. Luke's Church Hall, West Norwood. Show schedules are obtainable from secretary Mr. A. F. M. Bartlett, 27, Beckwith Road, London, S.E.24.

13th-14th July: **Macclesfield Aquarium Society** fifth annual show in Brocklehurst Memorial Hall, Queen Victoria Street, Macclesfield. Show secretary is Mr. H. F. Cox, 24, Brynnon Road, Macclesfield, Cheshire.

9th-11th August: **Portsmouth Aquarists' Club** fifth annual open show at the R.A. Drill Hall, Commercial Road, Portsmouth. For further details write to the show secretary, Mr. G. Elverson, 24, Bertie Road, Portsmouth.

11th August: **Romford Aquarists' Society** open show at Wycombe Hall, Romford Market Place, Romford, Essex. Schedules are available from show secretary Mr. C. E. Berkley, 37, Bridport Avenue, London Road, Romford, Essex.

22nd-25th August: **Midland Show (Midland Aquarium and Pool Society)**. Details and show schedules are available from Secretary Mr.

T. L. Dodge, 48, Dunsmore Road, Hall Green, Birmingham 28.

29th August-1st September: **Association of South London Aquarist Societies** annual show at Sutton Adult School, Sutton. Show secretary is Mr. A. Sayle. Society secretary Mr. H. J. Vosper, 25, St. Asaph Road, Brockley, London, S.E.4, will supply details.

25th August-1st September: **Weymouth and District Aquatic Society** show.

29th August-1st September: **Association of South London Aquarist Societies** show at The Adult School Hall, Benhill Avenue, Sutton, Surrey. There will be two open classes: club furnished tropical aquaria and club furnished coldwater aquaria. Full details will be available shortly.

31st August-1st September: **Walthamstow and District Aquarists' Society** exhibition of tropical and coldwater fishes at Hawthorne Road, Walthamstow, E.17. There will be no limit to the number of entries. Entry forms and further details can be obtained from show secretary Mr. D. E. Goodbody, 54, Somerset Road, Walthamstow, London, E.13.

19th-22nd September: **Peterborough and District Aquarists' Society** fourth annual open show at St. Paul's Church Hall, Lincoln Road, Peterborough. Schedules and entry forms from show manager Mrs. S. Bean, 195, Eastern Avenue, Peterborough.

19th-22nd September: **Coventry Pool and Aquarium Society** annual show at St. Margaret's Institute, Ball Hill, Coventry. Opening times, first day 7 p.m.-9 p.m., all other days 10 a.m.-9 p.m.

**THE South West Middlesex Aquarist Association** report that the teams competing for the Diana M. Charles Memorial Trophy are:—Spelthorne v. Hounslow; Slough v. Arnold (matches already staged); Feltham v. Southall (matches already staged); Byes—Greenford, Riverside, Staines, Uxbridge and West Middlesex. Slough beat Arnold 19 points to 18. Southall beat Feltham 19 points to 18.

ON 3rd May, the **Sunderland and District Aquarists' Club's** meeting took the form of "Any questions." There was a panel of three experts and a chairman. The subject was "Fish you want to breed." Questions were put to the experts by club members concerning all types of fishes and their breeding habits.

A **MEETING** was held in April by the **Middlesbrough and District Aquarist Society** together with the wildfowlers, and a table show was held so that they could see a number of tropical fishes. Mr. J. Weir gave a talk on aspects of tropical fishkeeping and tropical fish habits, and this was followed by a talk by Mr. J. Ord of the wildfowlers on the sport. This month a general discussion between members on plants and pests in aquaria, and a breeders' table show, have been arranged.

## N.W. London League

IN the notes on the above league formed by six N.W. London aquarists' societies published in our April issue it was stated that "An additional furnished aquaria class will be held yearly at the Willesden Show." This class is to be held this year at the Willesden show but not necessarily at this event in future years. The error is regretted and it is hoped that no inconvenience has been caused to the societies concerned.

## New Society

**Mansfield and District Aquarist Society.** Secretary: Mr. A. Atkins, 53, Newton Street, Mansfield, Notts.

## Secretary Changes

CHANGES of secretaries and addresses have been reported from the following societies:

**Inverness and District Aquarist Society** (Mr. J. Bain, 52, Dunain Road, Inverness); **Middlesbrough and District Aquarist Society** (Mr. J. K. Powell, 7, Coniston Avenue, Redcar, Yorks.); **South West Middlesex Aquarist Association** (Mr. A. G. Mills, 174, Uxbridge Road, Feltham, Middlesex); **Southport Aquarist Society** (Mr. R. Williams, 51, Dover Road, Birkdale).

## Crossword Solution

A	L	I	S	M	A	N	A	T	A	N	S
G	A	D	O	U	E	A					
A	C	A	R	A	P	U	N	I	S	H	
M	E	I	T	C	H	C	I	T			
O	L	B	A	T	H	T	U	B			
G	R	I	L	L	R	R	R				
E	O	N	O	N	O	M	I	T	S		
N	E	S	T	C	N	U	I				
E	E	B	B	T	R	O	U	T			
S	A	C	I	S	F	E	M	A			
I	T	A	D	P	O	L	E	N			
S	A	S	H	A	N	Y	L	U	C	K	

PICK YOUR ANSWER (Solutions)

1 (c). 2 (d). 3 (a). 4 (d). 5 (d). 6 (a).