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and Pondkeeper

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'Variety is the Spice of Life'

THIS well-known saying has been used in many contexts, and in the following article I hope to persuade you that it can easily apply to the feeding of tropical fishes. It is my belief that far too many aquarists feed their fishes on too few different kinds of food. I am sure that many people feed their fishes on only proprietary dried foods, with the occasional *Daphnia* or *Tubifex* given when available. Although not decrying these dried foods, I ask you to think how much better it would be if you could give your fishes four or five different foods a week.

Very few people will argue about live food being the best you can give them, but unfortunately this cannot be obtained regularly by most people. Last winter was particularly hard on the fish-keeper. Garden worms and *Daphnia* were virtually unobtainable and even *Tubifex* was scarce. This means that for those fishes that eat mainly live food, especially cichlids, they have had to make do on *Tubifex* and dried food. How many aquarists feed with chopped gentles? I have found that not only large fishes relish them, but the smaller mouthed ones such as cardinals thrive on the small morsels which become ripped off when the 'big fellas' dive in. When experimenting with feeding with gentles, I found that unless they were chopped first the fishes tended to ignore them. I think this may be due to the fact that they don't get any taste from the gentles until the hard skin is broken.

During the summer various other live foods can be found. Small grubs such as those found in apples and peas make an excellent meal for most fishes and green flies or black flies, a scourge to the gardener, make excellent food for even the smallest mouthed fish. Care must be taken, however, to ensure that the green fly have not been sprayed beforehand.

A variety of live foods is not the only answer and perhaps an easier way of providing an interesting and varied diet is to use a mixture of various other foods such as vegetables, fruit, fish and meat. Let me enlarge on this; several aquarists hang a shrimp in their tanks and let their fish nibble at it, and cod roe has been used on many occasions, but how many people have fed with cooked whitefish? Although I am not recommending this to be fed in large quantities as it tends to flake up and, if not all eaten, will foul the tank, a small morsel given when you happen to have it for lunch, will make a pleasant change for the fishes.

Various vegetables and fruits can be fed: lettuce and

spinach for liveboarers, especially mollies, are well known, but young fry of other species will also take these foods. Another vegetable relished by most fishes is carrot. Scraped raw carrot, apple and squashed cooked peas have all been fed to my fishes with great success.

For the majority of fishes the best food is the meatiest. Scraped cooked liver and raw heart are two excellent ways of providing this necessary item on the menu.

The yellow of a hard-boiled egg has been used for fry food for many years, but the white, chopped up finely, makes an excellent meal for adult fishes. Several aquarists make up their own dried food, using various mixes, but next time you make some up, try adding a small amount of crushed dog-meat block. This dehydrated meat food gives extra flavour and goodness to any mix of dried food.

Although the above list is not meant to be complete, I hope it will give you some new ideas for different foods, so that your fishes will benefit by a variety of foods.

Mike Thomas

The Swordtail Characin

by

JAS. STOTT

THERE are some interesting species in the characin group, one of which is the swordtail characin, *Corynopoma riisei*, sometimes called by the alternative popular name paddlefin, because of the long, bony extension from the gill cover of the males. The extreme end of this is flattened to form a tiny, shallow spoon, which is used in the breeding procedure.

The females do not possess this particular feature; their gill plates are the usual shape and so are the fins. The male also has an extremely attractive, large dorsal fin swept well back over the caudal base and an anal fin that is fairly broad to balance. There is an elongation of the lower lobe of the tail or caudal fin that beautifully matches the extension of the middle rays in the large dorsal fin.

They are not colourful fish, mainly silvery grey with reflected metallic sheen, but the male has a band of greenish blue stretching from the caudal base to the gill cover on each side. The fins in both sexes are transparent except for the extended lower rays in the tail fin of the male, and these appear considerably darker. Despite this lack of colour they are attractive in a quiet way and with their interesting and challenging breeding habits are worth a trial.

Appearing to be peaceful in disposition, they can be included in a community collection and will thrive on a mixed diet of good quality dried food with the addition of live food three or four times a week, although an increase in live foods, especially *Daphnia*, is called for to get the fish into breeding condition. The actual breeding procedure is interesting and the male uses the spoon-ended extension from the gill cover in the process.

When ready for breeding the male courts the female in a typical characin manner, swimming around her and showing off his extended finnage. At first she appears to be quite fascinated, then seems to lose all interest in his activities. Later, however, she becomes almost aggressive towards him, darting at him making what appear to be vicious attacks. The male circles around her, keeping a safe distance, all the time extending the spoon-like appendage towards the female. Eventually she bites at this and it is thought that when so doing receives milt from the male into her mouth. During the courtship milt discharged from the vent of the male is picked up and adheres to the spoon. Once the female has got some of the milt into her mouth egg-laying is stimulated and the female selects a suitable broad-leaved plant such as *Cryptocoryne* or the Amazon swordplant and deposits her eggs on to a leaf, after first placing the milt on the leaf from her mouth. This process is repeated with other leaves until some hundred or so eggs are deposited. In between the periods of egg-laying she appears to collect further supplies of milt from the male.

After the spawning the female will guard the eggs and also the young when they hatch, some 36 hours later at a water temperature of around 78° to 80°F (25-27°C). The fry usually become free-swimming in about 3 days, when Infusoria feeding should begin.

When setting up a breeding tank for *Corynopoma riisei* it is well to remember the need for broad-leaved plants, so the plants used should include some Amazon swordplants and the broader-leaved *Cryptocoryne*. The water should be just slightly on the acid side of neutral with a temperature of around 80°F (27°C). Allow the tank to establish itself for about a fortnight before introducing the breeding pair and during this period condition the adults separately on live foods; the best appear to be finely chopped earthworms and live *Daphnia*.

Jack Dempsey Cichlid *(Cichlasoma biocellatum)*

by A. JENNO

Photo: Lawrence E. Perkins

Jack Dempsey cichlid

THESE notes are from observations taken during a recent spawning of *Cichlasoma biocellatum* and may interest other aquarists because the procedure varies from the usual text-book pattern.

When I first obtained the fish there were four of them; three were about 2 inches long and the other, probably stunted, was only about 1 inch long. There appeared to be two males and one female, the smallest specimen being unsexable.

The fish were placed in an aquarium 24 in. by 18 in. by 12 in. The base of the aquarium was left bare, but several glass beakers containing *Cryptocoryne* plants set in aquarium gravel were included to give cover should the fish quarrel amongst themselves. Water used was matured tap water having a total hardness of 250 parts per million as calcium carbonate and of pH 7.4. Temperature was maintained between 75° and 80°F (24-27°C). Aeration was provided.

The fish were fed heavily with earthworms. It was found that any worm up to 2 inches in length would be quite easily taken whole by the three big fishes. Larger worms were chopped. The fish's appetites seemed to be virtually inexhaustible. At one time when I had far more worms than I thought necessary they were fed anything from six to ten 2-inch worms each a day and still they came back for more.

After 3 weeks of heavy feeding I had one male who was about 3½ inches long, a male and female about 3 inches long and the small stunted specimen.

The largest male and the female were now seen to be swimming together almost all of the time and this male would drive off either of the other fish if they approached the female. The female seemed to be filling up with spawn and her body colour was darker than usual. The male would occasionally spread his fins and show off to the female, but other than this none of the more famous cichlid courting habits were seen.

At this point I decided to remove the other two fish and at the same time two small flower pots were placed in the aquarium for the fish to spawn on.

Heavy feeding with earthworms was continued and the fish soon assumed their full breeding colours. The body of the female was black with a few brown patches on the back and a large blue area just beneath the gills. The male was not so darkly coloured but the blue and green spangles on his body and fins were really brilliant.

On arriving home one evening shortly afterwards I saw that the breeding tubes of both fish were visible and that they were busily cleaning one of the flower pots.

Early the next morning they spawned. The actual spawning was not seen, but there were about 400 eggs in a tightly packed mass on the side of the pot. The female now spent most of her time hovering over the eggs, fanning them with her pectoral fins.

During the 4 days the eggs took to hatch, I did not once see the male do anything towards helping with their care. If he did occasionally approach them in his wanderings round the tank he was politely driven off by the female, and the only time he showed any interest at all was when I was very close to the glass looking at the eggs. He would then take up a position between me and the eggs as if guarding them from possible attack.

On the evening of the third day the female started to clean the gravel in the largest of the glass beakers, which was about 6 inches in diameter and 8 inches high, but only half-full of gravel in which was set a large *Cryptocoryne*. She tried several times to uproot the plant but was unsuccessful.

The next morning the eggs were gone from the flower pot and the female was now hovering over the gravel in the beaker fanning with her pectorals. On close inspection I saw a tight mass of fry wriggling in the gravel. The female would occasionally pick up one or more in her mouth and after chewing them round several times, spit them back to the gravel.

During the 4 days hatching period only three eggs turned white. This occurred on the second day and it was assumed that these were infertile.

The development of the fry from hatching to free-swimming took 4 days and for the whole of this time the female took all responsibility for their upbringing. Most of the worms placed in the tank as food were eaten by the male as the female was very reluctant to leave the fry. The extent to which the female attended to them was quite fascinating to watch. Each evening she would clean out one of the smaller glass beakers in the tank and then move all the fry into it. This involved many trips with two or three fry in her mouth each time. She would see that they were settled properly and then proceed to clean out the large beaker. By the next morning the fry would all be back in the large beaker.

When the fry became free-swimming the female kept them in the large beaker. This entailed quite an amount of hard work for her as they were obviously keen to get out. I

did notice, however, that when I got very close to the tank they would all dive into a tight bunch in the gravel, but whether on their own accord or on a signal from the female I could not tell.

On the fifth day after hatching all the fry were free-swimming, and so I decided to remove the parents. I waited until the female left the fry and then dropped a large net over the top of the beaker to prevent her re-entering. I was then able to catch the parents carefully without alarming them too much, a point I consider important with large fish.

Both parents maintained their breeding colours for the whole of the time they were with the eggs and the young. The male was 4 inches long when I removed him and the female 3 inches, the male having continued to feed well, while the female had not eaten so much because of the attention she gave the fry.

When the parents had been removed the fry left the beaker and feeding was started with fine dry food and micro worms.

Several lessons have been learned from this spawning. For good results and good parental care, cichlids must be well fed, preferably with earthworms. They should not be unduly disturbed and should be introduced to the aquarium before they are ready to spawn. If the base of the tank is left bare I think that this gives the fish every opportunity to eat all the food put in the tank, especially where feeding fry is concerned, as the food size is so small that much would be lost in the gravel and might possibly pollute the water.

The main point about this particular spawning that interested me, however, was the use of the glass beakers by the female as containers for the fry. This was an obvious substitute for the pits normally dug by cichlids in the aquarium floor, but seemed to work better because the vertical sides of the beakers made it easier for the female to keep the fry together and hence to care for them properly. This was proved by her hatching and raising the whole spawning without, as far as I could see, any losses bar the three infertile eggs already mentioned.

Vancouver's Public Aquarium

Entrance turnstiles to the Aquarium

by MICHAEL LORANT

VANCOUVER'S Public Aquarium in British Columbia is among the most advanced and best equipped in the world. Built with government funds after 5 years of planning, it is operated by the Vancouver Public Aquarium Association, a non-profit-making society, organised expressly to construct and manage the affairs of the Aquarium.

Before the Aquarium was actually built a technical committee consisting of University biologists, oceanographers, aquarists, engineers and architects worked along with the designing architect. A group of them toured other aquariums in North America and elsewhere and discussed pipe materials, pumps, circulation, lighting and many other features with the staffs of these institutions.

The Aquarium, which has proved to be very popular with the public, has a tropical saltwater section, tropical freshwater section, cold freshwater and cold saltwater sections.

There is no metal at all in any of the systems. Pipes are made of plastic, hard rubber or compressed asbestos and concrete, and all pumps are lined with hard rubber. The tropical saltwater section consists of a closed system involving five concrete tanks, a sand and gravel filter and a heated reservoir. There are about 30 small tanks in the

tropical freshwater section, each with its own filter and heater.

The cold freshwater section has water continuously pumped through it and its temperature is kept low to meet the requirements of the numerous species of trout and salmon, found in this region, that are displayed.

The cold saltwater system is the largest and most complicated part of the Aquarium. The building stands at an elevation of 135 feet, about ½ of a mile from the sea-shore, and its intake pipe extends that distance plus another 100 feet out into the water. Sea water is pumped intermittently but automatically from its source and passes through a large sand and gravel filter into three 48,000 gallon reservoirs beneath the basement floor of the Aquarium. Three pumps constantly draw this water from the reservoirs and circulate it through the fish tanks. Plumbing is so arranged to permit alternative types of circulation: sea water can be directed through the filters or by-pass them. It can be recirculated indefinitely from reservoirs to fish tanks and back, or can pass once through the system and be replenished from the sea. This is useful because during periods of river flooding and great rainfall the surface of the sea becomes very diluted and the saltier pre-flood water can be conserved.

In the lobby of the Aquarium is a book counter where biological works, from children's stories through adult natural history studies to advanced texts on zoology, are displayed. At the back of the lobby, illuminated by a great skylight, is a tropical pool surrounded with palms and broad-leafed plants and inhabited by turtles and alligators.

Behind the scenes is a modern laboratory together with four smaller research rooms. These are equipped with running fresh and saltwater, and can be used by any qualified marine scientist and hobby aquarist who makes application to the Vancouver Public Aquarium Association. At the present time two specific studies are being undertaken in the laboratory. The first is a comparative investigation of the metabolism of flatfishes, its object being the elucidation of the role of the thyroid gland in migratory and non-migratory species. The second is a study of inter-specific competition among closely related inter-tidal fishes of the family Cottidae.

The staff consists of eight permanent and six part-time members, including a professional ichthyologist as curator, a biologist who collects local aquatic organisms and supervises displays, and a biologist in charge of feeding and pathology.

Green sea turtles at the Aquarium were sent to Vancouver from the Waikiki Aquarium

Breeding the Leopard Danio (*Brachydanio frankei*)

ON 14th March I obtained a trio (two males, one female) of a new danio. They look a cross between a spotted and zebra danio and had a pearly sheen all over the body. They are peaceful fish and will make a good community species; happy in any water and temperature, although now the warmer weather is with us I have not had a chance to find their lowest temperature range.

I separated the males and fed them all on white worms for 2 days, by which time the female was bulging with eggs. I set up a 24in. by 8in. by 8in. tank, half-filled with fresh tap water and at a temperature of 80° F (27° C). Water was 18° German hardness and pH 7.4.

I then put a wire-mesh trap across the bottom, and on the evening of the 16th put the danios in. On the following morning they started spawning in the typical danio manner, and by mid-day had finished and were trying to get at the eggs under the trap. I removed the parents and added a small amount of methylene blue to stop any growth of fungus, and the tank was left in darkness.

The fry were seen on the 21st hanging to the sides of the tank, and were free-swimming on the 23rd. I estimated there were about 50 fry to be seen, and started feeding them on *Euglena*, this being a pure culture of the smallest organisms as the fry were very small. They grew rapidly and by the 29th were able to take newly-hatched brine shrimps and micro worms. At this stage the fry were noticed to have a stripe of silver down the lateral line, which is not on the parents, and this slowly faded as they grew. There must be a reason for this, as all the danios seem to have it; I can only think that it might have something to do with them swimming in shoals and enables them to see the others and keep together, although it would also show them to the many natural enemies.

On the 10th April they were taking Grindal worms and were still growing quickly, and by the 18th were taking white worms and were sexable.

I now look forward to finding out more about their habits and nature. These danios should soon be seen in the tanks of your dealers and I wish you every success in breeding them.

Ken Hall

Society on the Sea-Shore

by

R. DWYER

At about the extreme range of the tide, five members of Lewisham N.H.S. foregather to examine and discuss the habitat of dahlia anemones. Mr. H. J. Vosper points out two specimens well camouflaged by a coating of sand and shell debris. Members new to the collection of sea-shore creatures are urged to bring in anything or to call attention to strange objects and by this means rapidly learn to identify the more common species. They are also shown how to identify particular creatures and to set up flag markers at the upper and lower find sites and thus to learn how different creatures tend to remain within certain limiting ranges

CREATURES of the sea-shore inhabit "zones", the perpendicular range of which are dependent upon the period of tolerated exposure to the atmosphere of the animal concerned. The rise and fall of the tides governs the exposure and in consequence any extremely low tides tend to reveal animals that are normally unexposed or visible for but short periods at the turn of the tide. Fairly extreme tidal ranges ("springs") occur at about the new or full moons, when the lunar and solar attractions of the waters act more or less closely together; at the spring and autumnal equinoxes there are especial conditions, and it is at these periods that naturalists interested in marine biology congregate on the sea-shore.

A favourite spot for members of Lewisham Natural History Society (of S.E. London) is on the Sussex coast, at Black Rock near Brighton, where a flattened area of chalk is exposed at low tide and on this are many runnels and pools which make collecting easy and profitable, ease of access to and from London also being an important factor.

The aim is to reach the beach some 1½ hours before extreme low tide and thus to follow the receding waters until the turn, after which the collecting jars and tanks are carried up above high-tide level so that the specimens can be examined and photographed.

The visit on the occasion of the vernal (spring) equinox takes place on a Sunday nearest to that especial low tide, and in 1962 this resulted in a convoy of vehicles leaving London at 4.0 a.m. to be on the beach at 6.0 a.m. This year (1963) the low tide on the suitable Sunday (31st March) was at about 9.0 a.m. (G.M.T.), and the Society travelled down by coach, leaving at 5.00 a.m. (G.M.T.).

These early morning trips are fairly well attended and a favourable aspect is that even such a well-frequented spot as Brighton is forsaken by most sight-seeing ramblers at such a time of day and the naturalists can work undisturbed.

As well as tanks, nets and photographic equipment, the group also takes recording apparatus and a taped commentary relating to finds and conditions is then maintained from year to year.

A long-spined sea-scorpion warily eyes its captors before darting for cover in the shadow of a rock placed in the photographic tank. This fish, less common than the blennies on our coasts, varies greatly in colour (metallic greens, blues etc.) and gets its name from long spines on the gill cover, but it is not poisonous, as its name perhaps implies

Soft or Hard?

by E. D. BUMSTEAD

MOST authorities dismiss water conditions, that is reaction (pH) and hardness, as too advanced for beginners' consideration but as an absolute necessity for that of breeders. This attitude is probably quite right, but the idea of being an aquarist is to keep fishes in the best possible health, and this is breeding condition. Every species requires different water conditions to achieve perfect health, but a general idea of the quality of the water can be obtained by a look at the general geology of the area from which the fishes are obtained.

The main areas of origin for our fishes are the Amazon Basin, Central America, Africa, India and South East Asia. The major rivers rise in mountains which may contain limestone and then run over hard and mainly non-calcareous Pre-Cambrian rocks. This journey takes the river, in many cases, through areas in which there is excess of vegetable decay and, due to this, the water is slightly acid and soft.

These are the conditions we must try to create, but to achieve ideal conditions for all species would take a fantastic amount of work and is unnecessary for general purposes. Soft, slightly acid water (pH 6.6-7.0) will also cut down the rate of growth of many minor organisms, such as algae. Even so, they are not good enough for certain fishes and I think here particularly of mollies and swordtails, which require a salty alkaline water. At this pH the plants will grow, the indigenous ones better probably than those which are foreign. The problem is not so much obtaining this water as keeping it.

Rain Water

Rain water is soft and acid. On its journey it can only dissolve gas and the main ones available in the atmosphere are oxygen, nitrogen and carbon dioxide. It is the carbon dioxide that makes rain acid. This is true as long as you do not live in Birmingham, London, Manchester or any other city. In these places the atmosphere is full of products of our age, soot, sulphuric acid and dust. This is the cause of the exterior deterioration of the Houses of Parliament. So town-dwellers have to nip out and buy a water softener, and then with the aid of a pH kit, add water which has stood over peat until the required reading is reached (about pH 6.8 for general use). Now let's put the water in the tank. No! Wait! Let's just look at the rocks. Do they contain any calcium or magnesium carbonate or sulphate? Has the gravel any shell fragments? It almost certainly has and these shell fragments are calcium carbonate (calcite). These are the very things that cause hardness in water and which also make the water alkaline.

Let's take up with our rain again, but not catch it. Suppose it is falling on the Pennines. This rugged backbone of England happens, in the main, to be made of calcium carbonate and many of the rivers which rise there contain water that is hard and alkaline.

Hardness in water is divided into two types—permanent and temporary, and both are caused by the salts of the same metals. Temporary hardness is caused by calcium and magnesium carbonates dissolving in water that contains carbon dioxide, to form the bicarbonates. These can be removed by boiling the water or by adding a calculated amount of sodium carbonate (washing soda). Permanent hardness is caused by the dissolving of the sulphates of magnesium and calcium. These and the carbonates are removed by passing the water through a water softener, in which sodium ions are exchanged for the calcium and magnesium ions.

Hard water would be obtained if acid water was put in a tank without making very sure that calcite had been banished. Neither magnesium carbonate nor the sulphates of the two metals are one-tenth as common as calcite, so I will not deal with them here.

Grit and Rocks

Going back to the grit—does it contain any shell fragments? How can these be removed? I suggest that the method outlined by D. J. Kirk (*The Aquarist*, June 1961) is used, but after the acid treatment wash with soft water, then with a solution of sodium bicarbonate until effervescence ceases, and then again with soft water. The gravel will now be clean, carbonate-free and neutral. Some people say that this treatment gives gravel which is too clean, that is, it removes all the minerals needed for plant growth. This may be true, but the fault is easily overcome by placing a layer of peat below the grit. Its slow break-down gives all the necessary elements, including the trace elements, which the plants need, and it cannot make the water alkaline or hard. Any other deficiencies in plant foods will soon be made up by the fishes.

The next thing to consider is the rocks. The geologist divides rocks into three main groups. These are igneous, sedimentary and metamorphic, and I shall take them in this order.

Igneous rocks are formed from cooling magma, either at the surface as lava flows or below the surfaces as dykes and other structures. Magma is a molten mass of metallic silicates, mainly potassium, calcium, iron and magnesium, and leaving in some cases free silica as quartz. The composition of magma varies and gives different rocks. When magma is cooled it crystallises, the various silicates separating to give different colours. The ferro-magnesium silicates are black, brown or green. The potasso-calcium silicates are white, pink or fawn. The quartz is usually colourless, glass-like, but occasionally, like the others, can be any colour due to traces of other minerals.

For the purpose of the aquarium, nothing could be better than the granites. We have all seen this king of building stones in our large towns. They are hard, insoluble and attractive. The granites are composed of all the minerals mentioned above and have a speckled appearance. Each crystal is up to ¼ in. across; grabbo is another in which the crystal size is the same, but in this quartz is missing and it has only two colours, usually black and white, with the black predominant.

When the crystal size is so small that it can just be seen with the naked eye, they are called dyke or sill rocks; these usually have the same minerals in them as gabbro, but can be granite-like.

When it is necessary to use a lens to see the grains, the rock is a lava. Basalt is the most common. These are dark

rocks and are usually very heavy. Those who have been to Fingal's Cave or the Giant's Causeway, where it is found in hexagonal columns, will recognise it easily.

All these rocks have a limited distribution in Great Britain and are found always in the west.

Having dealt with the igneous rocks, we come to the largest group of rocks, the sedimentary rock, and I include here the calcareous rocks, as they play an important part. The characteristic of sedimentary rocks is that they are laid down in beds, under water, one on the other. The first may be a sandstone, after that a clay, and so on.

These rocks are produced by the weathering of pre-existing rocks and the material they contain depends on the original rocks and also the amount of travelling the grains undertake. Certain minerals are very easily reduced to clay size whereas others, such as quartz, are very stable.

The beaches around our coasts in time will become sandstone. This is caused by the cementing of the individual grains of the sand together. The most common cements are calcite, silica and iron minerals.

This introduces us to the limestones. These are produced from pre-existing limestones and from the shells of marine animals. Animals like the mussel and winkle have shells of calcite and so do the snails that can be used in the tank. Certain algae and the corals also produce it. When these die, the shells and the broken pieces become limestones and also produce the cements for the other rocks.

What are Limestones?

A question now arises. What really are limestones? According to the geologist they are rocks that contain 50 per cent or more of calcite. This last statement implies that there is a continuous series of rocks which can contain at one end no calcite and at the other end can be all calcite. Unfortunately, this is very true. We can take a sandstone and generally find that it contains a cement of calcite. As it has already been decided that calcite must go (some may have given up hope of achieving this banishment) a way must be devised of testing rocks to find out if they contain any calcite. The best way is to put a few drops of dilute hydrochloric acid (1 part of acid : 12 parts of water) on the rock, when it will effervesce if calcite is present; but remember, the less calcite the less effervescence. Only a small amount is necessary to harden and neutralise the water. Calcite is not very soluble, only 0.0014 gram dissolves in 100 grams of water at 77°F (25°C) compared with 35.7 grams of ordinary salt in 100 grams of water at the same temperature. However, if the water has a reaction of less than pH 7 and contains carbon dioxide, the amount can be much greater. This means that only the smallest amount of calcite will make the water hard: 0.23 gram of calcite, a small chip of shell in a gallon of water, will give 5 degrees of hardness (Clark's scale).

However, limestones do give us one of the best rocks for the aquarium, because in them are found black nodular lumps which are transparent when very thin. These are chert, or flint, silica rocks formed from the skeleton of sponges that once lived in the ancient seas. They are harder than steel but, because of their bad neighbours, it is as well to wash them in the same way as the grit, unless they are taken from a river.

The last class of rocks we consider are the metamorphic. These rocks were once one of the other classes, but have somehow been changed. They contain the hard-banded rocks, the slates and marbles. The first two are very good for the aquarium, but the last is only limestone in a new guise, so do not forget the acid test.

Beware also of rocks that have veins running through

Please turn to page 90

Pimelodella gracilis

THIS rather striking catfish is native to South America, from the Orinoco and Amazon to La Plata. Like most of its kind it is a bottom-dweller and, though it occasionally ventures into the middle levels of the water after descending food, it is seldom seen, even for a moment, at or near the surface.

It will eat almost anything and, for that reason, combined with the fact that it feeds a lot after dark, it ranks among the most praiseworthy scavengers. But be that as it may, there is no question that it lives longest—upwards of 5 years—and grows fastest when it is given an almost exclusive diet of lean meat or whole or chopped worms (red or white).

With plenty of room to swim around in *Pimelodella gracilis* can reach a length exceeding 6 in. in half as many years and, at this size, and because of its great appetite and wide mouth, is better kept out of the community tank housing diminutive fishes. In its smaller sizes, however, it will not swallow anything larger than fry.

Although by inclination *P. gracilis* is a frequenter of shady places, it will swim boldly into view, whatever the quality of the light, the instant food is dropped into its aquarium; for its sense of smell and presumably sensitivity to vibrations in the water are highly developed. Here it may be mentioned that its habit of mouthing the compost in search of every scrap of edible matter makes it invaluable for keeping down carpeting algal growths.

The smooth and scaleless body is a sort of olivaceous grey, silvery in parts, and overlaid here and there with a moonlight blue to greenish sheen. The underparts are white. A variable dark line, broadening posteriorly, extends from the gill covers to the root of the tail. The rather high dorsal fin sometimes shows dark markings anteriorly. In general the rest of the fins (what appears to be a supplementary dorsal fin on the back is in reality a well developed adipose appendage) are colourless. There are six barbels. The two adorning the upper lip are about half as long as the body itself and, though normally carried in a forward-pointing position, can, like the lower barbels, be moved in every direction.

P. gracilis is not faddy about the sort of water it is kept in so long as it is not excessively hard (that is, for fish-keeping) and has a temperature above 66°F (19°C), which is the minimum for a healthy existance. Both sexes resemble each other in coloration and shape of fins, but it is reasonable to assume that specimens with longer, fuller and more round bodies are females.

Although its history as an aquarium fish can be traced back to the 1860s, it has never been bred in captivity.

Jack Hems

EXOTIC GOLDFISH

What is a Shubunkin?

by C. E. C. COLE

THE word 'exotic' means introduced from a foreign country. Taken literally therefore all goldfish are exotic, but in the minds of most people, however wrong they may be, exotic conjures up a picture of something unusual, uncommon, not necessarily beautiful, but different, and it is in that sense that I use the word to describe all goldfish other than the common goldfish.

One of the most easily obtainable exotics is the shubunkin. This fish is frequently seen in pet shops, but specimens so obtained bear little resemblance to the beauties exhibited by specialists in their production. Of this, more later!

The most striking thing about shubunkins is the fact that you can see right through many of their scales into the body walls. Many of them have eyes that are black and their opercula are completely transparent. Other specimens may have one gill cover shiny and patches of shiny scales all over the body, and their eyes are like those of the common goldfish.

Yet if a male shubunkin is mated with a female shubunkin many of the fry are exactly like common goldfish, with no transparent scales anywhere on the head or body. This is most puzzling and frustrating to the average amateur anxious to specialise in the creatures. Is there anything he can do about it?

Yes, indeed, there is—he can produce 100 per cent shubunkins by not mating them at all! A seemingly crazy statement, but with a perfect explanation. What follows is applicable to nearly all goldfish.

Firstly, why has a goldfish the burnished metallic lustre that is its chief appeal? Dissection shows that in the skin above the scales intense production of colour pigment imparts the colour we know so well. Then comes the scales, like sheets of rippled glass, and beneath the scales another intense layer of a substance called guanin, which is a waste product, crystalline and capable of reflecting light.

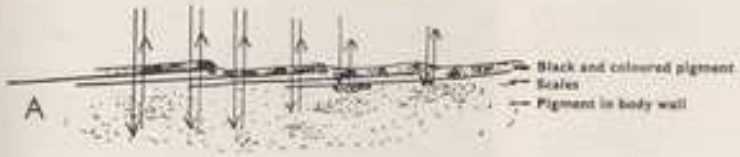
Shubunkin goldfish

Under the scales it acts like the silvering to a mirror, and in conjunction with small quantities above the scales gives the fish its polished appearance.

From the surface of the fish to quite deep in its body walls black pigment is also present. In the 'metallic' fish the pigment below the scales is obscured from view by the layers of colour and reflective substance.

Somewhere in the history of the fish mutations occurred that prevented some of them from manufacturing guanin and depositing it beneath and above the scales. So the 'mirrors' now had no backing and acted like pieces of plain glass. The result was a somewhat unattractive fish with an all-over dull appearance—a 'matt' fish. The absence of guanin not only altered its appearance, it seemed to make it less resistant to ills and chills, as though the guanin had some protective value.

Then suddenly the shubunkin manifested itself, possessing



A. Diagram of the layers above and below the scales in a shubunkin. Absence of guanin allows penetration by light rays (indicated by arrows)

B. Diagram of the layers above and below the scales of a common goldfish. The presence of intense colour and quantities of guanin reflect light rays from the fish surface

colour pigment, a degree of reflective tissue sufficient to give it a mother of pearl or nacreous appearance and the black pigment showing as slatey blue or intense blue according to the depth within the body walls. It is a most attractive fish that scored an instant hit with observers. Small wonder they tried to breed more of them, trying and trying again to get a 'true-breeding' line, but never successfully.

Goldfish Crosses

When the Goldfish Society of Great Britain was founded it was the late Dr. R. J. Affleck who did research with shubunkins and encouraged other members to do likewise.

He proved conclusively that the matt fish completely without guanin, when mated with a metallic fish possessing its full complement of the material, produced fish of only one kind—nacreous. So two entirely different scale groups, when mated produce a very desirable third group that is like neither parent. The early objections of specialist breeders who feared they would lose the lovely colours of their fish were quieted when the offspring of such crosses revealed that they, too, could show colour in plenty and of the right shade.

Dr. Affleck further worked out and proved the probable percentages of each group that would result if the following crosses were made.

Metallic × metallic —100 metallic
Metallic × matt —100 nacreous
Matt × matt —100 matt
Metallic × nacreous —50 metallic, 50 nacreous
Matt × nacreous —50 matt, 50 nacreous
Nacreous × nacreous—50 nacreous, 25 metallic, 25 matt.

Now then! Suppose you have a pair of very good nacreous fish, but no metallic or matt fish. You don't wish to buy other stock—you are satisfied with what you have. But you do want to breed all shubunkins.

Well, you just can't have them, until you have made one final mating nacreous with nacreous. If you use the stripping method I so strongly advocate, you have all the raw material you will need for dozens of crosses—once you have raised them. Select the best of the matts and the metallics and give them the best possible treatment—they are V.I.P's, after all. Once they mature, you are well away!

Selection

If, through unforeseen circumstances you lose your breeding fish—and I have done this on several occasions from the attentions of cats, children, gulls or herons, the younger fish in indoor aquaria will provide you with a fresh stock—in time. Always select those that promise to provide you with progeny nearest to your ideal, whatever that is! Never breed from fish that are nothing like your target, unless out of curiosity.

At the beginning of this article I mentioned that the shubunkin is one of the most easily obtainable of the exotics.

There are many others, for there is no known fish as liable to variation as the goldfish, and almost if not all the variations have at one time or another been crossed with each other either deliberately or by accident.

Various groups of people in this country have formed specialist societies, and many members have spent half their lives line-breeding certain variations in an endeavour to improve their particular fancies.

So great are the differences between the more advanced variations and the wild-type common goldfish that strangers to the cult find it very hard to believe they are one and the same species. Even those who own them sometimes persuade themselves that they are in no way related, that a separate species has in fact been created.

Fig. 1

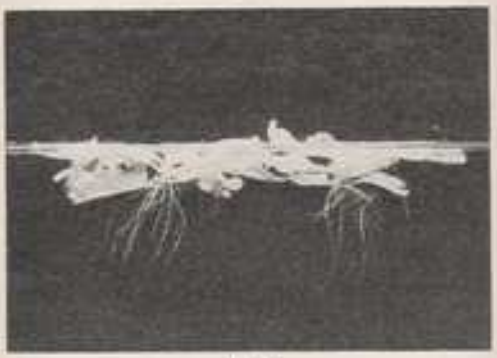


Fig. 2

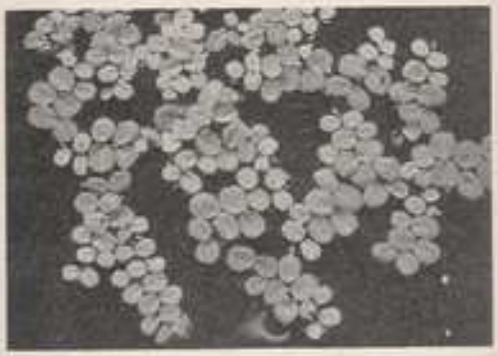


Fig. 3

Aquatic Plants

by C. D. SCULTHORPE

Photographs by the author

IT is not perhaps generally realised how useful free-floating plants are in aquaria and what a considerable variety of such plants is available for both tropical and coldwater aquaria and for garden pools. In habit some floating species are small and profusely branched and create a dense colony of vegetation on or just beneath the surface, whereas others have prominent aerial foliage, often with organs modified for buoyancy, and immense submerged root systems. They are, of course, decorative, but in addition they valuably reduce the intensity of close artificial lights and they may be used in masses for the spawning of numerous fishes.

Little may be said of the cultivation of free-floating species, not because such practical aspects of their growth are unimportant but because less is known of the factors influencing their development than that of rooted species. It has, however, been known for some time that they absorb most of their mineral requirements in solution from the surrounding water, and the higher the concentration of dissolved salts the more vigorous is their growth. The duckweeds, for example, are always to be found particularly in natural still waters containing a high concentration of nitrates and dissolved organic substances. The profuse root systems of such genera as *Eichhornia* and *Pistia* are functional and these plants have been found to grow much more vigorously in shallow water with their roots penetrating the bottom mud and presumably absorbing nutrients from it.

Fig. 4

Fig. 5

Heat from Lamps

Many of the free-floating species occurring just beneath the surface tolerate a wide range of water temperatures. Tropical species with aerial foliage are quickly scorched by the heat from overhead artificial lights, as in an aquarium hood; they tolerate such lights for longer periods if the lamps are separated from them by a glass cover and if the air around the foliage is reasonably humid. There is no doubt that species of this type are cultivated most successfully in diffuse light and constantly humid air, such as occur above a heated pool. Those aquarists interested in these plants for their own sake, rather than as adjuncts to a community aquarium, may easily construct a substitute by fixing polythene sheet over a tall framework of wire fixed above a small tank.

The only serious disadvantage created by free-floating species in aquaria or pools is their occasionally embarrassing abundance, brought about by rapid vegetative propagation and fragmentation. The multiplication of some

Fig. 1. Aerial view of several 2 weeks old plantlets and three 6 weeks old plants of Ceratopteris cornuta; the older plants are themselves beginning to produce tiny plants at the margins of the leaves. This species generally survives only in warmer water, at temperatures above about 60-65°F (15-18°C); mature rosettes up to 12 in. or more in diameter, rich green in colour, are formed. Young plants eventually break free and develop rapidly

Fig. 2. Side view of two specimens of Ceratopteris cornuta showing the leaves at the water surface and the short compact root stocks, from which hang the branched adventitious roots

Fig. 3. Aerial view of another floating fern, Salvinia auriculata. Floating leaflets occur in pairs along the slender brittle stem; each leaflet is pale green and covered with curious white looped hairs which repel water; underside of the leaflet is covered with brownish hairs. Leaflets vary from ½ in. to as much as 2 in. long in different conditions, the plants often becoming depauperate for no apparent reason. Suited only to warmer water

Fig. 4. Salvinia oblongifolia has, as its name describes, more oblong leaves which sometimes reach a length of 3-3½ in.; the plant is otherwise similar to S. auriculata (Fig. 3)

Fig. 5. Side view of specimens of Salvinia auriculata, showing the upper leaflets resting on the surface and the feathery, much divided submerged leaflets hanging from the stem

Fig. 6. Side view of a dense floating colony of crystalwort, Riccia fluitans, a very small plant body bearing no stems, roots or leaves and consisting only of a slender dichotomously branching thallus, bright green in colour. It multiplies rapidly by growth and fragmentation, forming tangled masses of vegetation beneath the surface, and appears to survive equally well in warm or cold water

species has often been and continues to be a serious economic problem in many warmer parts of the world, as I recalled in some detail in the article 'Invasion by Aquatic Plants' (in *The Aquarist*, May, 1960). Aquarists could undoubtedly assist the study of possible control measures by offering information about the survival of floating plants under the particular conditions of light, temperature, acidity and humidity prevalent in their own tanks or pools.

Fig. 7. Aerial view of a colony of water lettuce, Pistia stratiotes. This is a stoloniferous tropical species with buoyant, air-filled foliage. Leaves are rounded in young plants, spatulate in mature ones, pale green in colour, covered with minute hairs which repel drops of water; a tuft of much-branched white roots hangs from each rosette. Its aerial inflorescence is rather inconspicuous, with minute blooms. A useful and decorative plant but is easily scorched by artificial lights

Fig. 8. Side view of the water hyacinth or devil's lilac, Eichornia crassipes. Leaves are produced in a compact rosette, up to 18 in. or more in diameter, from a stout root stock; young plants are formed at the nodes of succulent stolons running just beneath the surface. Each leaf stalk is swollen with air-filled tissue which gives buoyancy; the swellings are much reduced or absent in plants in very shallow water or stranded at the margins of a pool. The 'sail-like' attitude of the leaf blade aids spread of the plant by wind. In humid air under good light the aerial spike of violet-blue flowers with yellow markings is often produced. Profusely branched, white to purplish-black roots with very conspicuous root-caps hang in the water. This species is not hardy and is really suited best to warm water; it does not tolerate acid water less than about pH 4.5-5.0

Soft or Hard?

continued from page 86

them. These veins can be four types: quartz, calcite, metalliferous and A.O.V. I strongly advise against the inclusion of any veined rocks as the last three can be dangerous, even though the rocks are very attractive. However, quartz cannot be scratched with steel and does not effervesce with acid, so provided that there is nothing else in the quartz (quartz is often associated with metals) a rock so veined might be used.

To sum up—the waters from which tropical fishes are obtained are probably soft and acid, and hardness is caused in the main by calcite, which will also neutralise the acid water. In the tank the main sources of calcite are shell fragments in the grit and sedimentary rocks, which can be tested with hydrochloric acid.

If soft alkaline or soft acid water is required, no calcite must be present. If hard water is wanted, use any rocks, including the limestones, when the water will become saturated with calcite, giving 14 degrees of hardness (Clark's scale).

Rearing Young Terrapins

by DAVID LASKEY

IN *The Aquarist* (November 1962, page 151) Lake Turtle and Amboina Box Tortoise) Robert Bustard has hinted at the difficulty of rearing hatchling American terrapins, which are freely obtainable in this country during the spring and summer. Readers may be interested to hear of my experience of raising a hatchling red-eared turtle (the elegant terrapin, *Pseudemys scripta elegans*) from the size of half-a-crown to a length of 4 in. in 2½ years. This terrapin is distinguishable by the red or orange stripe behind the eye, and in my specimens the carapace was green with black markings, the plastron yellow with black markings, and the skin green with yellow and black stripes.

Acceptable Foods

I found that considerable patience was needed to find an acceptable food; finally the two terrapins ate well on scraped raw beef, very small pieces of raw cod and herring, and the stems of common pondweed (*Potamogeton*). They refused *Tubifex* worms, commercial dried 'turtle food', and also the doses of fish-liver oil and powdered cuttlefish bone recommended in the textbooks, but later did well and increased rapidly in size on a diet of tadpoles. These have the advantage of providing all the right food elements and plenty of exercise and amusement for the reptiles in stalking them. I have a large supply of tadpoles, having natural running water in the garden; after they lose their tails and turn into small frogs I feel an unscientific squeamishness about feeding them to hungry terrapins! This same spring water is used for the terrapin tank, and it may be of interest that it has a high acid content, from heavy clay soil. The rapid growth was, of course, accompanied by regular moulting of the skin and flaking of the sections of the carapace.

Despite the easy assurance of some dealers that terrapins of this kind will thrive at "average living-room temperature", I found that my specimens ate only with reluctance and spasmodically until heated water (average 75°F; 24°C) was supplied, with the usual thermostat and heater. Adequate dry land for exercise seems to be an absolute necessity; natural sunlight appears to give great pleasure and is certain to be beneficial, provided that it is not too much filtered by dirty or dusty glass.

The reptiles were first installed in a small fish tank (12 in. by 8 in. by 8 in.) with 3-4 inches of water and flat rocks on to which they could easily crawl. The tank was placed in a south-facing window and no artificial light was used.

Living Accommodation

It was impossible to create a balanced tank, as one can do with fish, because of food pollution. They preferred to take their food in the water, carrying off scraps of meat placed on the rocks into the water to eat. This habit made it imperative that a change of water was made after each feed (once a day), since raw meat and fish are not conducive to clean water. There are other ways of solving this problem—keeping a separate tank for feeding (which has the disadvantage that the terrapins are handled excessively, and this water must be at the same temperature as the main tank) or alternatively using a larger tank which can be aerated. I did not attempt the last-named on grounds of expense, but I am assured that terrapins in an aerated tank do not need to be cleaned out.

After about 12 months, the terrapins outgrew their tank, and to provide half swimming space and half walking space, they were transferred to a larger tank (30 in. by 12 in. by 10 in.), used as a vivarium with gravel and rocks at the bottom to a depth of 4 inches. Into this layer a removable plastic swimming tank measuring 4 in. by 9 in. by 12 in. (actually a food container without its lid) was sunk. In this was placed the heater and thermostat and a sloping rock to assist the reptiles to climb out. In the gravel was placed a pot containing a small plant—a peperomia of similar colouring to the terrapins. They enjoyed walking about, sitting on each other's backs (a habit with terrapins), basking in the sun with legs stretched out voluptuously, and climbing on top of the plant and nestling in the leaves. A sheet of glass was placed over the end of the tank holding the plastic container to minimise heat loss from the water.

After 6 months in these quarters, one of them produced the male characteristics—thick tail and long claws, and I concluded that I had a true pair. In the spring, when the reptiles were assumed to be about 18 months old, I saw the beginnings of mating activity. The male pursued the female round the swimming tank, manoeuvred her into a corner so that he faced her, and brought his front legs round alongside his head (as one about to dive) and fluttered his claws over her head and face. This was not, unfortunately, appreciated by the female, and my visions of breeding elegant terrapins in this country were brought to an end by her death. The symptoms were loss of appetite and swelling of the feet. It may be significant that death occurred presumably at maturity, and the carapace of the female seemed to be slightly deformed, so perhaps some congenital defect was the prime cause. Two remedies were suggested for the condition: terramycin in the water, and painting the affected parts with red ink. The first had no effect, and the second I dared not try!

I am now considering larger quarters for the surviving terrapin, since it needs to swim more freely and is now 4 in. long. These American terrapins are supposed to be hardy in this country in the summer months, but in our unpredictable climate it is probably better to keep them without hibernation under such controlled conditions as I have described. Since I had no knowledge or experience of terrapins until I bought my two specimens, there seems to be no reason why more of these beautiful and interesting creatures should not survive, provided that patience and care are exercised, and that active, bright-eyed youngsters are chosen at the dealers and given adequate quarters and the right food.

Cacti in the Fish House

DO not prick out cactus seedlings too soon, as whilst the cotyledon, or food-bag, is still present the root is very fine and its junction with the plant is very delicate and easily broken. Wait until the food-bag is absorbed and then there should be a strong healthy root which can stand moving. The soil into which the seedlings are pricked out can be John Innes seed compost, as for seed sowing, plus 1½ ounces of hoof and horn grist and ½ ounce of sulphate of potash, to each bushel.

Introducing the Fishes

by A. BOARDER

A COLDWATER aquarium set up about a month ago should now be in good condition with the water plants making active growth. The water should be clear and without any bad smell. If the water is not clear it can be changed very carefully, so that nothing much is disturbed.

The question of which kinds of fishes are to be introduced must now be considered. I realise that this is mostly an individual taste but there are points about the various types which should be considered at the very beginning. It is no use spending money on types that prove unsatisfactory, so that you have to start all over again. Perhaps your favourite fishes are not ideally suited to a coldwater tank in the house. I will try to give most of the advantages and faults of the kinds often kept and then leave you to decide which to have. In the first place do let me dissuade aquarists from trying to keep several different kinds of fishes in one tank. There is nothing clever in this, and unless the tank is a very large one there is likely to be failure before long.

I think that most people would agree that some variety of goldfish is almost an essential. The common goldfish is no doubt the one most often kept, probably because it is usually more readily available and cheap. As long as small ones are kept there is little wrong with this choice and I would go so far as to say that for anyone making a beginning with fishkeeping, the common goldfish is the one with which to commence. The main faults I have to find with them is that they are often inclined to root out some of the water plants and disturb the bottom of the tank. They also grow fairly quickly and could soon become too large for the medium-sized tank. A more handsome goldfish variety is the shubunkin, either the Bristol or the London. These are more prettily coloured but have the same possibilities of fairly fast growing and disturbing the base. The comet I consider to be too fast a swimmer for the average tank; although a handsome fish when in a large tank, it is of a type which delights in fast swimming. The fantail has all the good qualities for a tank fish and very few of the faults. I may be prejudiced, as I have been keeping these in tanks for very many years, but I have yet to find any fault with them. They are handsome, do not rush about like some other varieties, do not disturb the plants, they move around in a graceful manner, are very hardy and no trouble to feed or keep in good health. Also they do not grow as large or as fast as the common goldfish.

The veiltail I do not recommend for the beginner. It is a very handsome fish, especially when not too large, but it has a bad fault of resting on the bottom of the tank with its large fins partially folded, so that it hides much of its beauty for most of the time. The flowing finnage is liable to show fin congestion, which makes this variety a rather difficult one to keep for the beginner. If any of these are kept I suggest that the tank should be not less than 30 in. long and 18 in. high. The oranda is also a fish for the experienced aquarist and much of what I have said about the veiltail applies to this fish. The moor can be used, but if so I would recommend the fantail moor in preference to the veiltail moor. The former will move about better in the tank and not be as liable to develop any disorders in the tail.

The lionhead is quite a good fish for a tank but being more expensive to obtain it is hardly the fish for a beginner. The same may be said for the other fancy varieties, the celestial, bubble-eye etc.

Other coldwater fishes include the golden orfe, hi-goi carp, golden tench, rudd, roach, bleak and dace. The golden orfe is one of the finest fishes for the outdoor pond, especially if this is fairly big or has a waterfall or fountain, but this fish is not ideal for the tank. It is essentially a river fish, fast swimming and quick growing. It is not fair to try to keep these fish in a fairly small tank. As very young ones, no more than 3 inches in length overall, they may be all right as long as the tank water is kept quite pure, but once these fish grow larger they should be placed in an outdoor pond.

Tench, either green or golden, may be kept in the tank when small. I usually have a young one in my tanks with the fantails, and I have never found them interfering in any way with these. I do not believe in keeping tench in a tank once they reach 4 inches long overall. They can then be placed in the pond and a young one used to replace it. Rudd are also very nice for a fair-sized tank whilst they are small, but again once they grow to a size of near 4 inches the small tank is no place for them. I have never been very satisfied with the roach as an aquarium fish. Many aquarists find that even in a pond they are liable to contract fungus disease, and the rudd is therefore much to be preferred. Bleak could be kept when quite small, but these, like dace, are river fish and like moving waters. They can be kept in a good sized pond, but are better left out of the indoor tank.

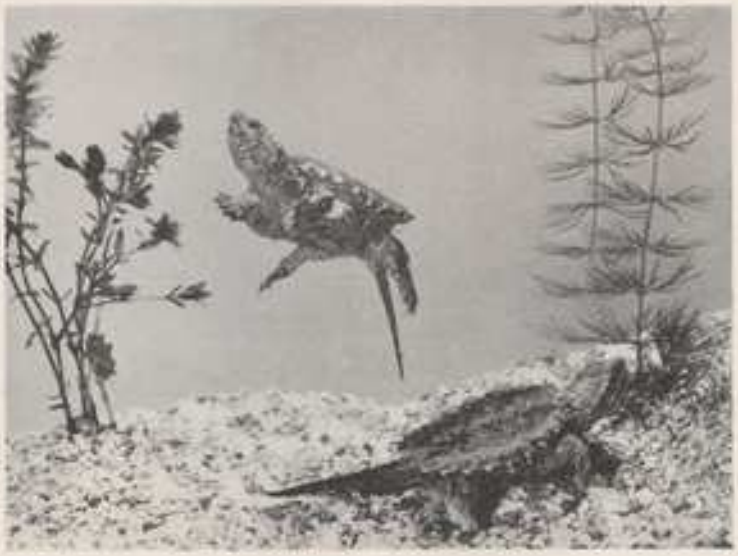
The hi-goi and other carp are fish that are very suitable for a large pond but not for the indoor tank, as they can grow very large in a short time. Other freshwater fishes such as trout, gudgeon, miller's thumb and ruffe are not very suitable, and although I have kept these kinds for a time, I do not consider that they are the ideal kinds for the set-up tank. In a large tank two or three small perch can look very handsome, and will thrive with plenty of garden worms or small fishes as food. However, they must not be kept with other small fishes or they may be tempted to make a meal of them. The pike is only suitable for a large tank, if the fish is only a young one, but I do not think this a good fish for the beginner; the feeding problem may be too much for anyone without experience.

Foreign fishes such as freshwater bass or sunfish are very handsome but mostly are not too easy to feed, as they prefer a live diet more like that of the perch.

Remember, do not try to keep too many fish in your tank and not too many kinds. It is far easier to keep a few fish in a very healthy condition than to keep alive in misery too many in the tank. The golden rule for the tank is an inch of fish (not counting the tail) to each 24 square inches of surface area.

My next article will deal with the maintenance of the tank.

Snapper Terrapins



by ROBERT BUSTARD, B.Sc.

Photographs by the author

SNAPPER terrapins are abundant in North America from Canada to Florida and from the Rockies to the Eastern States. They are unusual among chelonians in that they do not rely on a strong protective shell for their defence but are actively aggressive animals—or least they appear so when disturbed. They possess large heads armed with sharp jaws, which, like the limbs and long tail, cannot be completely retracted within the shell. The carapace or upper shell is rough in baby specimens of both species but more so in the alligator snapper, and the plastron is reduced. The common snapper (*Chelydra serpentina*) attains a weight of about 60 pounds but the alligator snapper (*Macrochelys temminckii*) is gigantic, and specimens of 200 pounds are on record. It ranks as one of the largest of the world's freshwater chelonians.

Photographs on this page are of the common snappers (Chelydra serpentina)

Snapper terrapins, on hatching, have a carapace length of scarcely 2 inches and specimens of this size are readily obtainable. They make most unusual aquarium inmates and have the advantage that they are really hardy and can be reared by the average amateur, unlike many of the beautifully marked but delicate 'painted' terrapins. In this connection the common snapper is much the hardier and hibernates regularly over much of its range. It has also been seen walking over the ice of frozen ponds and moving about below the ice. The alligator snapper is restricted to the south-eastern United States, especially the Mississippi drainage area, and as a result it is accustomed to warmer conditions.

In captivity they are very largely aquatic and I have always kept my specimens of both species in an aquarium with a small wooden raft, on to which they can climb when they wish to leave the water. Up to four baby specimens can be accommodated in a 24 in. by 12 in. by 12 in. aquarium, which should have a layer of compost and hardy plants such as *Elodea* that will survive a certain amount of rough treatment. In my experience even baby specimens are almost entirely carnivorous, so that plants

Alligator snapper terrapins (*Macrochelys temminckii*)

are unlikely to be eaten, but they will crawl through and over them. A water depth of 6 inches is adequate.

The amount of food required depends on the temperature at which they are kept. It is perhaps safest not to hibernate hatchlings but 2-year-old specimens of the common snapper can certainly be hibernated in a cool outhouse provided that their tank cannot become frozen solid. Before hibernation they must be well fed so that they can build up fat reserves for the winter, and specimens that are not in excellent condition should never be allowed to hibernate. This applies to all species of reptiles and amphibians.

During the active season they may be fed on live food such as earthworms or tadpoles or on strips of raw meat or fish. My specimens were fed almost exclusively on earthworms because these are the cleanest food to give. Strips of raw meat tend to flake in the water and this flaking is even more pronounced with fish. Such fragments decay and foul the water. The frequency of cleaning out the tank will depend on temperature and feeding. If they are kept really warm they will be more active, require more food and will foul the water more quickly. They will also grow more rapidly. Taking these factors into consideration I have kept my alligator snapper terrapins active throughout the year at temperatures of approximately 60-68° F (15-20° C). The common snappers have lived at room temperature (50-60° F; 10-15° C) and all but hatchlings have been hibernated during the winter.

Snapper terrapins are thought of as large and sluggish. While this is true for large specimens it is not the case with hatchlings, as the accompanying photographs show. My specimens have always been quite active, especially when they were fed, which was done on alternate days. Certainly most of the time they rest on or walk about the bottom although they can swim freely when they so desire. The long tail is most conspicuous in baby specimens, and the carapace of baby common snappers is wrinkled whereas the alligator snapper's carapace has three strong keels, which persist even in large specimens.

At room temperature growth is slow and the juvenile antics will persist for some time. Indeed the collector will be able to house his specimens for many years, as when they grow they become less active and consequently require less space. The only precaution is that these terrapins should be kept away from other species that they might attack. Both the common and alligator snappers can be housed together, however, at about 60° F (15° C). The price of baby specimens is likely to be about 10s. to 15s. each.

OUR EXPERTS' ANSWERS TO TROPICAL AQUARIUM QUERIES

Please tell me how to prepare a culture of Infusoria and feed it to fry.

To roughly a pint of water add a closed handful of wilted lettuce leaves, or one over-ripe banana skin, and keep it in a warmish, not overlighted place for about 5 days. At the end of that time the water should contain plenty of the minute creatures drifting about in what look like greyish-white clouds. The drip method of feeding Infusoria to fry is undoubtedly the best. The culture should be strained through fine nylon into a clean jar of water floated in the aquarium to equalise the temperatures. Then, with this rested on top of the aquarium to retard loss of heat, a pinched-down siphon is brought into operation to convey the Infusoria to the fry.

Would an 18 in. by 8 in. by 9 in. aquarium maintained at 78°F (26°C) prove satisfactory for a breeding pair of black mollies? I have been told that mollies flourish best on a mainly herbivorous diet. Is this true?

Mollies like plenty of swimming space in well-oxygenated water, so the aquarium to breed them in should be as large as possible—at least 2 ft. long. That they need lots of greenstuff in their diet is perfectly true. Their natural green food is mossy algae, but in the absence of this in the aquarium, cooked table greens such as spinach, turnip tops, cabbage and so forth will do. They will also eat fine-chopped raw lettuce and the small types of duckweed. The addition of about one teaspoonful of evaporated sea salt to every gallon of water in their tank is recommended. But once salt is introduced, do not add any more. The temperature you mentioned is about right.

What thickness of glass will I need to glaze a frame measuring 3 ft. by 2 ft. by 2 ft.?

You will need ¼ in. polished plate.

How can I feed aquarium plants such as tropical lilies and spatterdocks without injuring the fish?

Make up small pellets of soft yellow clay, enriched with a few specks of bonemeal, and push these into the sand around the plants' roots.

Is it possible to use batteries in place of mains current for tank heating? I am worried about possible power cuts next winter. My tank holds about 20 gallons of water.

A battery-operated heating system would not be worth the outlay on equipment. Among other things, you would need an expensive storage battery, a trickle charger to charge it, specially wired heaters and so forth. As power cuts in this country are not usually of long duration, it is cheaper and far easier to maintain heat in an aquarium by lagging the back, bottom and ends with some insulating material such as asbestos wool, granulated peat, aluminium foil and so on, masked by flush-fitting, painted hardboard panels.

I have owned a pair of Australian rainbow fish for several days and all they do is to keep near the top of the aquarium and chase each other around. Is this behaviour quite normal, or is there something wrong with the fish?

Australian rainbow fish are playful but not offensive. In short, they will neither harm each other nor companion fishes. They swim in the middle and upper levels of the water and seldom descend to the bottom.

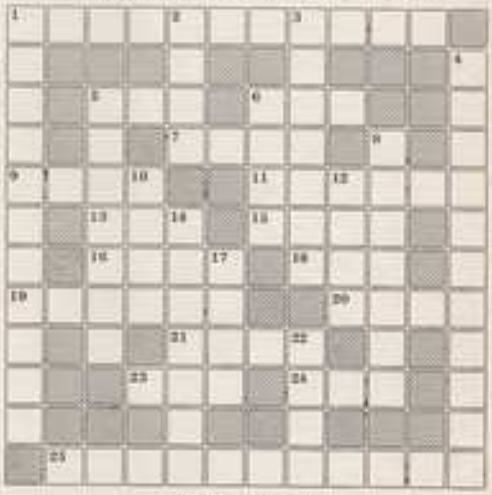
Is it true that shallow water is preferred by pearl gouramies in ripe breeding condition and does it, generally speaking, ensure healthier and faster-growing fry?

Yes, the pearl gourami spawns more freely in water not above 6 in. deep, and the tiny fry grow faster and stronger when there's less pressure from above.

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.

The AQUARIST Crossword

Compiled by M. W. SAUNDERS



CLUES ACROSS

1. Second cousin to a chisel jaw? (7, 4)
5. Sounds like a cuppa on the golf course (5)
6. A user and a crazy mixed-up ant (3)
7. For this you need a pair (4)
9. An event, mostly on the flat (4)
11. These are found by the sea (6)
13. As in a thermostat, for example (3)
15. A broken-up nest is being despatched (4)
16. Study closely a mature opening in the skin (4)
18. Regret taking the French road (3)
19. Pressed by myself, Ron and Ed (6)
20. Aeration might help to prevent it (4)
21. Eager to go gay merely (4)
23. Devoured from the plate (3)
24. A girl from a valley (3)
25. Fish family part noted for its spiny-eyed appearance (8, 3)

CLUES DOWN

1. Common name for the Atherinidae group (11)
2. Regains (4)
3. Type of fin also found on a chicken (7)
4. Shooting up? No, quite the reverse—or is it? (3, 4)
5. X marks it in white when on a diseased fish (3, 4)
6. Loch the monster in (4)
8. Scientifically, the brine shrimp (7)
10. Common name for *Hyphessobrycon innesi* (4)
12. The burden is on us (4)
14. Gives something to cure the disease (7)
17. Rim or the ledge mostly (4)
22. Of which swimming is an important part (4)

Solution on page 97

News from AQUARISTS' SOCIETIES

Monthly reports from Secretaries of aquarists' societies for inclusion on this page should reach the Editor by the 15th of the month preceding the month of publication.

THE Annual General Meeting of the **Smethwick and District A.S.** was held last month and the officers elected were as follows:—Chairman, D. H. Edmunds; Chairman-Elect, J. Nickles; Secretary, R. F. Biddle, 6, Gilbert Road, Smethwick, 40; Treasurer, A. M. Palmer; Show Secretary, G. Harman; Press Secretary, C. Bird.

In his report, the Chairman pointed out that the past year had been satisfactory, but there was room for improvement. The Society had welcomed new members, but it would be an advantage to get more and they can be assured of a warm welcome.

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AT the annual meeting of **Ilford and District Aquarists' and Pondkeepers' Society**, Mr. Vic Price relinquished the post of secretary which he has held for seven years. He was elected president and will also serve as assistant secretary.

Officers elected were: president, Mr. V. Price; vice-presidents, Mr. E. Atkins, Mr. J. Charter, Mr. L. Jarvis, Mr. J. Nott; chairman, Mr. A. Stebbings; vice-chairman, Mr. L. Smith; secretary, Mr. R. Rush; asst. secretary, Mr. V. Price; show secretary, Mr. H. Berger; Press and social secretary, Mr. L. Smith; librarian, Mr. K. Ellis; auditors, Mr. Bryden, Mr. Shadrach.

*   *   *

THE results of the **Newcastle Guppy and Livebearer Society** Show were as follows: Furnished jar class: 1, Mr. W. Falkous; 2, Mr. J. Reed; 3, Mr. R. Coulson. A.V. Male Guppy: 1, Mr. W. Cummings; 2 and 3, Mr. J. Reed. Female Guppies: 1 and 2, Mr. W. Cummings. A.V. Molly: 1, Mr. W. Cummings; 2 and 3, Mr. G. Oliver. Platy and Sword-tail class: 1 (Red Platy), Mr. W. Falkous; 2 (Red Swordtail), Mr. G. Oliver; 3 (Yellow Wagtail Platy), Mr. W. Falkous. The Best Fish in Show was won by Mr. W. Cummings with a Male Veiltail Guppy. A Plaque was awarded to Mr. J. Reed (57 points), a Gold Medal to Mr. W. Cummings (53 points) and a Silver Medal to Mr. W. Falkous (21 points). Visitors and prospective new members are invited to attend the meetings which are held fortnightly at the Blue Bell Hotel, Shields Road, Byker, Newcastle-on-Tyne. Further particulars are obtainable from The Secretary, Mr. [illegible], [illegible] West Farm Avenue, Longbenton, Newcastle-on-Tyne, 12.

*   *   *

RECENTLY the **Thurrock Aquarist Club** of Grays, held their Annual Show in conjunction with the Proctor & Gamble family day. Although the number of entries was down on last year, the fish entered in all 13 classes were of a high standard. The prize for the best fish in the show went to Mr. K. J. Pearl with an Egg-laying Tooth-Carp (Aphyosemion [illegible]) and the other results were as follows:—Livebearers other than a Guppy: 1 and 2, Mr. K. J. Pearl; 3, Mr. R. Nichols. Barbs: 1, Mr. P. Sowells; 2 and 3, Mr. G. Prescot. Characins: 1, Mr. R. Nichols; 2 and 3, Mr. P. Sowells. Fighters: 1, Mr. P. Sowells; 2 and 3, Mr. R. Nichols. A.O.V. Labyrinth: 1, Mr. S. Wellman; 2, Mr. K. J. Pearl; 3, Mr. R. Nichols. Guppy: 1, 2 and 3, Mr. P. Sowells. Danios, Rasboras, Minnows: 1 and 2, Mr. K. J. Pearl; 3, Mr. R. Nichols. Catfish: 1, Mr. P. Sowells; 2, Mr. K. J. Pearl; 3, Mr. S. Wellman. Cichlids: 1 and 2, Mr. R. Nichols. E.L.T.C.: 1 and 2, Mr. K. J. Pearl. Fancy Goldfish: 1, Mr. R. Nichols; 2 and 3, Mr. P. Sowells. Goldfish: 1 and 2, Mr. P. Sowells; 3, Mr. R. Nichols. Miniature Furnished Aquaria: 1, Mrs. R. Nichols; 2, Mr. P. Sowells; 3, Mr. R. Nichols.

During Whitsun week the Freelance Aquarist Society made their second appearance as exhibitors at the Lewisham Hobbies and Handicrafts Exhibition held at Catford. This year's theme was furnished aquaria in the living room, with a tank set in a chimney breast above a fireplace. In addition eight small breeding tanks were on show, depicting various methods of spawning and the media used. On a table were many magazines and books available for the aquarist, together with trophies won by Society members. New members are welcome and can obtain particulars from Mr. R. A. Thomas, 94 Beecroft Road, Crofton Park, London, S.E.4.

THE table show results of the **Nelson A.S.** for livebearers were as follows:— Swordtails: 1, Mr. Dickson; 2 and 3, Mr. Richards. Mollies: 1, Mr. J. Rhodes; 2, Mrs. Crick; 3, Mr. T. Scott. Platies: 1, Mr. R. Singleton; 2 and 3, Mr. J. Rhodes. Guppies: 1, 2 and 3, Mr. Singleton.

*   *   *

AT the monthly meeting of the **Belle Vue (Manchester) A.S.** the main item on the agenda was a bring and buy sale which was well supported by members. The next monthly meeting will be held on Wednesday, 7th August, at 7.45 p.m. in the Palm Court Restaurant, Belle Vue Gardens.

*   *   *

AT the June assembly of the **Guest Keen & Nettlefold's Pond and Aquarium Society** an Inter-Society Table show was held against Dudley A.S. which Dudley won by 11 points to 6. The result of the table show for Characins was as follows:— 1 and 3, T. Lowe; 2, C. Richards. Whilst the judging was taking place Mr. Harry Williams (Wolverhampton) gave a talk on some new fish which he had brought along, and afterwards members asked questions.

*   *   *

RECENTLY **Tipton and District A.S.** entertained the members of G.K.N.P. & A.S. Darlaston to a challenge table show and quiz. The result of the Quiz ended in a draw, both teams scoring 11 points each, and Tipton were winners of the Table Show. Results: Characins: 1, W. Davison, Tipton; 2 and 3, R. Cook, Tipton. Anabantids: 1, G. Gedd, Tipton; 2 and 3, W. Davison, Tipton. Livebearers: 1, W. Davison, Tipton; 2, G. Harding, Tipton; 3, E. Hyde, G.K.N. The Best Fish in Show was W. Davison's Bleeding Heart Tetra.

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THE **Bedford and District A.S.** held their Coldwater Table Show recently. There were two classes and these were for A.V. Goldfish and A.V. British Freshwater. The results were as follows:— A.V. Goldfish: 1, J. Burke; 2, D. Angel; 3, Mrs. D. Bell. A.V. British Freshwater: 1 (equal), R. McMurray and B. Smith; 3, B. Smith. As a result of this show the Georgeson Trophy for the highest pointed coldwater fish goes to J. Burke. The new Secretary is Mr. K. Satterthwaite, 24, Bowallan Drive, Bedford.

*   *   *

RECENT activities of the **Newport A.S.** have included a visit by several members to Bristol for the Keynsham Annual Open Show, where award cards were won by Messrs. G. James and J. Burgess. A number of members also attended the annual open show of the F.G.B.S. held in Newport, and two members also belonging to the F.G.B.S. won awards, namely Mr. Ralph Harris and Mr. John Burgess.

Club meetings have included a talk by Mr. Colin Salmon on "Pondlife with relation to indoor aquaria," profusely illustrated by the use of a microscope and locally obtained specimens, both harmful and beneficial. The result of a table show for any variety was as follows: 1, Mr. M. Roach; 2, Mr. G. James; 3 and 4, Mr. K. Edwards. The inter-club show with Llantwit Major, Barry and Pontypool societies will take place on Saturday, 7th September, at the Shaftesbury Street Methodist Church Hall. The Show Secretary is Mr. Colin Lewis, 99, Henry Street, Newport. Visitors will be made very welcome and all information can be obtained from Mr. Lewis.

*   *   *

THE second annual open show of the **Peterlee and District A.S.** was held recently and there were approximately 300 fish on show from Middlesbrough, Sunderland, Tyneside, West Hartlepool, Newcastle Guppy, Yorkshire Fed. Societies and many unattached aquarists. The results were as follows:

Furnished Aquaria: 1, A. Bailey (Sunderland); 2, and [illegible], J. Hunt (Tyneside). A.V. Fighter: 1 and 3, W. Carnell (Yorkshire Fed.); 2, J. Hunt (Tyneside). A.O.V. Labyrinth: 1 and 3, J. G. Reed (Newcastle Guppy Assn.); 2, R. Atherton (Peterlee). A.V. Dwarf Cichlid: 1, T. Harley (Peterlee); 2, E. Mothersill (Peterlee); 3, D. Lancaster (Middlesbrough). A.O.V. Cichlid: 1, G. Corkin (Sunderland); 2, R. Atherton (Peterlee); 3, J. Hunt (Tyneside). A.V. Guppy: 1, J. Hewitson (Peterlee); 2 and

S. E. Mothersill (Peterlee); A.O.V. Livebearer: 1, E. Mothersill (Peterlee); 2 and 3, J. G. Herring (Peterlee). A.V. Barb or Shark: 1, N. W. Jones (Peterlee); 2, A. Thomas (Sunderland); 3, D. G. Bell (Tyneside). A.V. Rasbora or Danio: 1 and 2, C. Simpson (Peterlee); 3, Mrs. D. Atkinson (Middlesbrough). A.V. Characin: 1, D. G. Bell (Tyneside); 2, J. Hunt (Tyneside); 3, R. Atherton (Peterlee). A.V. Corydoras: 1, J. G. Herring (Peterlee); 2, A. Thomas (Sunderland); 3, P. Harrison (Peterlee). A.O.V. Catfish or Loach: 1, A. Thomas (Sunderland); 2, N. W. Jones (Peterlee); 3, D. G. Bell (Tyneside). A.V. Coldwater Fish: 1, M. G. Watson (Peterlee); 2 and 3, Mr. Coulson (Middlesbrough). A.O.V. Egglayer: 1 and 2, N. W. Jones (Peterlee); 3, Mrs. N. Mason (Middlesbrough). Breeding Pairs Livebearers: 1, J. Hewitson (Peterlee); 2, J. G. Read (Newcastle Guppy Assn.); 3, J. Robinson (Peterlee). Breeding Pairs (Eggscatters): 1, J. G. Read (Newcastle Guppy Assn.); 2, J. Hewlop (Peterlee); 3, J. Hewitson (Peterlee). Breeders Class (4 fish): 1, D. G. Bell (Tyneside); 2 and 3, D. Porter (Peterlee). Best Club Stand: 1, Peterlee; 2, Sunderland; 3, Tynside. Best Fish in Show: N. W. Jones (Peterlee).

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A TABLE Show was held recently by the **Stourbridge and District A.S.** and the results were as follow:— Characins: 1, 2 and 3, Mr. J. Nelson. Livebearers: 1, Mr. R. Brown; 2 and 3, Mrs. V. Clinton. The Best Fish in Show award went to Mr. J. Nelson. Hon. Secretary of Stourbridge is Mrs. V. H. Clinton, 44, Dunstall Road, Hanbury, Halesowen, Worcs.

* * *

NEW SOCIETY

WE have been informed that a new society has been formed at Weston-super-Mare. The Hon. Secretary is Mr. J. R. Evans, 6, Victoria Quadrant, Weston-Super-Mare, Somerset, and new members will be welcomed.

* * *

NEWS from **Bradford and District A.S.** includes results of the Table Show which was won by Mr. G. Hobson, Mr. C. Hobsworth filling the second and third places. In the Novice A.V. section Mr. H. Greenwood was first, Mr. A. V. Ford being second and Mr. A. Holmes third. The latest date given for the Members Show is Tuesday, 10th September. Forthcoming trips include a visit to Whitby on the 8th September combined with a Table Show challenge from Staithes Society.

* * *

THE **Willesden and District A.S.** were at home to the four other clubs competing for the North West London group shield. This was the first in a series of meetings to be held this year. Riverside, of Hammersmith, scored a runaway victory, and Willesden finished third. Show results were: Any variety, female guppy: 1, Mr. E. Dayner (Riverside). Any variety, male guppy: 1, Mr. Byfield (Independent). Egg-laying toothcarps and any other variety egg-layers: Mr. Cleveland (Riverside). Best fish in the show, black shark (Mr. Cleveland).

Final results and placings: 1, Riverside, 43 points; 2, Independent, 14 points; 3, Willesden, 6 points; 4, Hampstead, 4 points; 5, Hendon, 3 points.

THE results of the table show of the **Willesden and District A.S.** were as follow:— Danios, Rasboras and W.C.M.M. Class: 1 and 3, Mr. W. Hobbs; 2, Mr. K. Hobley; 4, Mr. R. Sherwin. Corydoras Catfish Class: 1, Mr. W. Hobbs; 2, Mr. R. Sherwin. Mollie Class: 1 and 3, Mr. R. Sullivan; 2, Mr. Sherwin; 4, Miss Ing.

* * *

THERE was a total of 180 entries at the annual show of the **Basingstoke and District A.S.** and the quality of the exhibits was very high with keen competition.

Best Fish in the Show was exhibited by V. P. Verney of the Basingstoke Club, and this fish—a Black Widow Characin—was awarded the Ryan Cup. The most successful exhibitor at the Show was the team of C. D. Roberts and Miss P. Vears of Fleet, who were awarded the "Waverly Edmonds-Bill Locke Rowers" Memorial Trophy, for their total of 15 points. Full results were as follows: A.V. Minnow: 1, C. D. Roberts. A.V. Danio: 1 and 2, M. Nicholson; 3, R. Forest-Jones. A.V. Rasbora: 1, L. W. Jordan; 2, R. Forest-Jones and E. C. R. Knight. A.V. Tanichthys: 1, R. A. Dove. A.V. Characin: 1 and 3, V. P. Verney; 2, V. J. West. A.V. Platy: 1 and 3, R. Forest-Jones; 2, A. Weller. A.V. Guppy: 1, R. A. Dove; 2, C. D. Roberts; 3, V. J. West. A.V. Cichlid: 1 and 3, L. W. Jordan; 2, L. A. Timms. A.V. Barb: 1, A. P. Wilkinson; 2, G. S. Howard; 3, R. A. Dove. A.V. Corydoras: 1 and 3, M. Nicholson; 2, R. W. Tyrer. A.V. Swordtail: 1, V. J. West; 2, M. Nicholson; 3, C. Droue. A.V. Mollienisia: 1, Miss B. Hancock; 2, S. Pearce; 3, J. Stilwell. A.V. Anabantid: 1, M. Nicholson; 2, V. J. West; 3, V. P. Verney. A.O.V. Tropical Fish: 1 and 2, L. A. Timms; 3, E. C. R. Knight. Fighters: 1, B. Hailstone. Breeders Class—Livebearers: 1, C. D. Roberts; 2, Mrs. N. Jordan; 3, L. W. Jordan. Breeders Class—Egglayers: 1, R. A. Dove; 2 and 3, C. D. Roberts. Common Goldfish: 1, C. Droue; 2, T. M. W. Invey; 3, Miss W. Ryder. Fancy Goldfish: 1, 2 and 3, L. L. Searle. Shubunkins: 1 and 2, Miss W. G. Ryder; 3, L. L. Searle. A.O.V. Pond or River Fish: 1 and 2, W. T. Ryder; 3, L. L. Searle. Furnished Aquaria: 1, Mrs. W. Verney; 2, Miss Pam Vears. The Basingstoke A.S. meets every second and fourth Fridays of each month at the Victoria Inn, Brook Street, Basingstoke.

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RECENT events in the **York and District A.S.** programme have been a lecture by Mr. P. Reynolds of Leeds on "Diseases and what to look for when purchasing fish," and also a trip to the trout hatcheries at Driffield, with the afternoon spent at Bridlington, and the evening at Mr. E. Foster's fish house at Beverley.

AQUARIST CALENDAR

28th-31st August: Midland Open Aquatic Show, Princes Hall, Bingley Hall, Birmingham. Full details from Mr. J. Edwards, 6 Amy Terrace, Oaks St., Ladywood, Birmingham, 16.

30th-31st August: Bristol Tropical Fish Club Annual Open Show, Congregational Church Hall, Newton Street, Stapleton Road, Bristol. Schedules obtainable from Mr. J. D. Brown, 76, Pearl Street, Bedminster, Bristol, 3.

6th-7th September: Bethnal Green A.S. Annual Show. Show Schedules available soon.

7th September: Blackburn & District A.S. Annual Show. Schedules obtainable from Mr. G. Smith, 773 Whalley New Road, Blackburn.

7th September: Wycombe A.S. Particulars and schedules from Show Secretary, D. Chadboon, Pinecroft, Marlow Hill, High Wycombe, Bucks.

14th-15th September: Willesden and District A.S. Annual Show at Roundwood Park. Details from Mr. R. Sullivan, 130, Barry Road, Stonebridge Park, London, N.W.10.

14th September: East London Aquarists and Pondkeepers Association. Closed Annual Show to be held at Ripple School, Ripple Road, Barking, Essex. Open Classes for Breeders and Furnished Aquaria. Schedules from Mr. W. Dunnage, Show Secretary, 91, Boundary Road, Barking, Essex.

15th September: Nottingham & District A.S. Open Show at Drill Hall, Derby Road, Nottingham. Apply to Show Secretary, Mr. A. Lindley, 65, Selgrave Street, Ilkeston, Notts.

15th-21st September: Leeds & District A.S. Annual Open Show. Details from R. Moss, 19 Hilton Road, Harehills, Leeds 8.

20th-21st September: Bristol A.S. Open Show and Exhibition for Coldwater and Tropical Fish, Bishopston Parish Hall, Gloucester Road, Bristol, 7. Schedules obtainable from Mr. L. Dunstan, 11, Sandylease, Westbury-on-Tyrn, Bristol.

27th-28th September: Three Counties Show, Gas Social Club, Gasworks Road, Reading. Schedules from Mr. C. Masters, 12, Patrick Road, Caversham, Reading.

28th September: First Annual Dinner of the British Ichthyological Society in Glasgow. Information from the Secretary General.

29th September: Kingston and District A.S. Inter-Club Show.

29th September: Blackpool and Fylde A.S. Open Show at 67 Station Road, Blackpool.

Crossword Solution

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THERMOSTATS

Es Es Major Submersible	10 0
Es Es Minor	10 0
Es Es Sentinel Outside Control	26 6
Comet 250 watts	10 0
Comet 250 watts with neon	12 6
Comet 500 watts	15 0
Constar Outside Fitting	33 0
Prockter Outside Fitting	36 0

AIR PUMPS Vibrators A.C. only

Fairy	£1 7 6
Montrose Minor	£1 1 0
Montrose Major	£1 4 0
Es Es Model D	£2 7 6
Prockter	£3 5 0
Zoobako	£2 6 0
Silenta	£2 15 0
Kena Air Pump	£2 2 0
Junior Zoobako	£1 17 6
Quiko Pump	£1 2 0

PISTON PUMPS

Hy-Flo Junior	£5 7 6
Hy-Flo "A"	£6 10 0
Hy-Flo "B"	£8 5 0
Hy-Flo "C"	£13 10 0
Stokes Garden Fountain	£7 19 6

PUMP SPARE PARTS

Fairy Diaphragms, 1/3; Fairy Air Chamber, 1/9; Prockter Diaphragms, 1/6.

Uno Popular	10 0
Uno Popular (Glow-light)	12 6
Uno (submersible	15 0
Uno Outside Control	18 0

THERMOMETERS

Dumpy Compass	6 6
Comet Plastic Back (mercury)	4 6
Floating (spirit)	2 6
Perspex Aqu.	5 6
Stick on (spirit)	5 0

POST!!!

ALL PARTS OF THE U.K.

ALL PARTS OF THE WORLD

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WATER PLANT NURSERIES AND FISH HATCHERIES—Phone: SHIRLEY 130

Stratford Road, Monkspath, Shirley, Solihull, Warwickshire

SPECIAL FOR AUGUST/SEPTEMBER

HIGOI

(JAPANESE GOLDEN CARP)

2000 Specimen Fishes in 20 Colour Combinations from 2" to 20" in Size

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ADULT BREEDING PAIR (18") RED, WHITE AND BLUE	£70
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VARIOUS COLOURS WITH MIRROR SCALES AS IN MIRROR CARP from ... ... 40/- —	100/- each
SELECTED MARKINGS IN ALL COLOUR COMBINATIONS	60/- each

PLEASE NOTE—All enquiries requiring a reply MUST be accompanied by S.A.E. Our premises are situated on the main Stratford-Birmingham road, 8 miles from Birmingham, Midland "Red" Bus No. 150 from Bull Ring, Birmingham, passes the door, alight at "The Crown," Monkspath.

HOURS OF BUSINESS—
Weekdays 10 a.m.—6 p.m. Summer, 10 a.m.—5 p.m. Winter. Sundays 10 a.m.—12.30 p.m. (Also Sunday Afternoons June-July Only)
CLOSED ALL DAY EVERY MONDAY

TERMS OF BUSINESS—Cash with order please. Fish sent by rail. Tropical minimum order £5, insulated container and carriage 10/-. Cold water minimum order £1 plus 10/- can and carriage. Plants by post (minimum order 10/-) please add 1/6 post and packing.

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