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MAY, 1960

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VOL. XXV No. 2 1960

Editorial

IN "Aquarist's Notebook" this month Raymond Yates has something to say about crocodiles and alligators as pets. Alligators when small are so popular for the home aquarium in America that the demand has been outreaching supply. British Guiana is reported to be exporting these reptiles to supplement numbers from Peru and Colombia. One animal dealer despatches over 8,000 baby alligators each month. A story we were told some time ago illustrates the state of things at the receiving end, although something must be allowed here for some over-enthusiasm on the part of the story-teller. A sewerman reported having been bitten by a large alligator during his duties beneath the streets of New York, and, it was said, despite some initial scepticism on the part of the authorities, search revealed several of the animals thriving in the warmth of the sewers. The explanation given was that many owners of small alligators, finding that these pets are unsuitable for ordinary aquaria, had disposed of them by flushing them down toilets into the sewers. We do not believe that these reptiles could live and grow under sewer conditions, but we are sure that the young alligators offered for sale in such large numbers do not live long with those who buy them as some kind of novelty toy.

SOME important points about the way to manage an aquarists' society successfully are discussed by Bob Calrow of Hendon Aquatic Society in this issue (page 43). A complaint frequently made by societies is that difficulty is experienced in obtaining speakers for meetings. We have spoken about this with several well-known lecturers, who have explained regretfully that some societies offer them fees that are inadequate to cover the expenses and inconvenience of going to a meeting out of the lecturer's home area. This is a matter that societies should consider carefully. Society finance is always tricky but member subscriptions are often ridiculously small by present-day values and could be raised substantially to provide the means to obtain the services of first-class lecturers. Interesting meetings promote better attendances and bigger membership.

SCHOOLING FISH

What stimuli underlie this highly organised behaviour?

by EVELYN SHAW

TO watch the actions of great schools of fish in which the movements of the individual fishes are lost in the synchronous movements of the whole—like some huge, single animal—is to wonder about this pattern of behaviour, so different from that of other socially organised vertebrate groups. In a school, all the fish seem to behave alike and each school—whether mackerel, herring, tuna, or small shiners—resembles other schools in shape and form.

Of the many features schools have in common, the most surprising, perhaps, is the absence of a continual leader. A school may swerve to the right or to the left, fan out from the centre, or change direction entirely. Each time, a different group of fish heads the school. As these movements of the school as a whole are made, there is also constant movement *within* the school—as each fish maintains its distance from the other fishes. The precision of orientation that is shown by fish as they swim in a school is rarely found anywhere else in the animal kingdom.

Schools may be composed of small, medium-sized or large fish, but rarely are the sizes mixed—possibly because all the fish must travel in the same direction at the same rate of speed. The demands that such highly integrated behaviour places on an individual fish are great. Each fish in the school must respond quickly and precisely to its fellow schoolers—and to environmental changes—in order to maintain the unified orientation of the whole.

Such elaborate response and counter-response in schooling behaviour presents many questions to the investigator. For example: what stimuli do the fish require to maintain their positional relationships? Do temperature, light, chemical substances, turbidity of the water, sunlight, clouds and the like influence the structure of the school and the direction the school will take? One experimenter, C. M. Breder, has shown that the small schooling fish *Jenkinsia* will recognise a temperature change of as little as one-half degree. Certain temperature gradients act as obstacles and *Jenkinsia* could not be forced to pass these temperature barriers. In contrast, other fish seem to be totally unaware of differences in the water temperature as they swim from one place to another.

Another important factor is the response of fish to light. These responses are highly variable when measured quantitatively, but most schooling fish are light-positive; that is, they are attracted to light. If there is very little light, as is the natural condition at night, schools tend to disperse —and do not form until light intensity increases with the coming of morning. Overcast days seem to affect schools by disrupting orientation. We have found that on clear, sunlit days the tightness and orientation of a school is enhanced. These observations present numerous possibilities of combinations of various factors, for, without any doubt, schools of fish are influenced by their environment. But we want to know more about these influences and how they are mediated.

A school is made up of many individuals: it is possible that the observed responses in a school are simply a summation of individual reactions. If we may make this assumption, the schooling response can then be divided into

Illumination affects the schooling of ocare. Here, a group schools under combined incandescent and fluorescent light

Dispersal takes place in a few seconds after fluorescent light is turned off. The school is now completely broken up

Grouping begins again when light is restored, stressing the importance of adequate light in fish-to-fish response

two intimately related categories—the response of the entire school and the response of the individual.

The next question arises: how constant is individual behaviour, and how strongly developed is the response to species mates? It seems highly unlikely that a fish "knows" that another fish is like itself. What it *does* "know" is that it has been surrounded, during growth, by fishes that have recognisable characteristics; it would thus tend to remain with those fish with which it has become most familiar.

Since schooling fish tend to spawn in different places and at different times of the year, the chances of young fishes schooling with other than their own species are reduced. Even if they drift in the tides as plankton, they tend to be carried along together by the tidal action. Therefore we generally find one species type in each school formation. We cannot justifiably say that fish of the same species seek one another, but we can assume that their coming together in schools is the logical result of a number of environmental conditions and circumstances.

To return to several questions posed earlier by this unique form of behaviour: what are the stimuli that fish require to maintain their positional relationship in the school?

Vision, we know, is very important. Albert Parr, in 1927, postulated an approach to the means by which visual stimulus operates in allowing fish to maintain certain distances from each other. For example, if two are swimming side by side, they may be attracted to one another and steadily swim closer and closer. However, when they are too close, the attracting stimulus may become a repellent. Therefore, they swim side by side under the influence of opposing, antagonistic stimuli—one tending to bring them closer together and the other tending to push them apart. An individual swimming between two companions, Parr postulates, will be visually stimulated, will perceive each companion, and will receive antagonistic stimuli on each side, resulting in the maintenance of certain distances from his companions. The distances observed in schooling formations may be a cumulative result of these antagonistic stimuli, occurring simultaneously in individuals throughout the school.

This is, of course, a hypothesis. As we observe the schools, we note that there is always variation in behaviour. One cannot expect mathematical precision in actively swimming fishes. Although we do not yet know the "how" of visual stimuli, they have been clearly established as important. A number of investigators have eliminated visual stimuli by blinding fish, covering their eyes and so forth. By thus preventing visual stimulus, they eliminated the schooling response.

One of the most fruitful approaches to problems in behavioural research has been to study the period in which the development of some element of behaviour occurs—to learn when and how behavioural patterns appear. The analysis of schooling behaviour in which we are now engaged has followed this approach. We began with observations on the first development of schooling. *Menidia*, the common silverside fish (also called whitebait, spearing or shiner), has proved to be a satisfactory experimental animal for some of our studies. *Menidia* is small—the adults reach a maximum length of 4 to 6 inches. It lives in shallow water, where it is easily observed and easily collected by seining. The adults spawn from May to July, depositing their eggs on the soft, grassy, underwater banks of seashores. The eggs, which develop without parental care, hatch in about a week. The newly hatched larvae, 5 mm. long, drift with the tides, where they can be found randomly distributed among the plankton.

When the *Menidia* young have grown to 12 or 15 mm. in length, they are no longer found with the plankton, but have formed into schooling groups, swimming in shallow waters. At some time during their growth from the larval, 5 mm. length to their greater size, the fry develop the specific behaviour patterns they show in their schooling.

In order to study this crucial period of their life it was necessary to rear young *Menidia* under laboratory conditions. After much trial and error, ways were found to do this successfully, thus permitting us to make observations on the development of the schooling response.

It had long been believed that schooling commences at the time of a fish's hatching. Our first, rather startling, observation was that schools did *not* form at that time. In fact, schooling did not begin until the fry had been swimming freely for 3 to 4 weeks, the time required to grow from their initial 5 mm. length to the 12 mm. size. Just after hatching, the fry showed no apparent response to their fellows. As they grew older and larger (some to 7 mm. in

Re-schooling is completed. Experiment will lead to tests of various aspects of light factors on schooling behaviour

Early phases of schooling behaviour of fishes shown here in Menidia, the silversides. Newly hatched (left) no fish shows any response to others. Sporadic approaches to other fish in the group begin as the Menidia fry grow larger. Occasionally, they line up in twos or threes for a few seconds only (centre). Precise schooling begins after the fish have been swimming freely more than 4 weeks (right). The Menidia fry have now grown to 16 mm. long

length), they swam toward each other sporadically, but not in an orientated fashion. At 9 to 11 mm. in length, they approached and occasionally lined up in twos, threes or fours for several seconds, but they still did not achieve parallel orientation. However, when they had at last attained a length of about 12 mm., they began to school continuously.

These first schools were loosely structured: the fish did not maintain their parallel orientation consistently and did not always swim at equal speeds. But, by the time a length of 16 mm. was attained, the fish formed tightly interwoven schools, maintaining parallel courses and a constant speed of swimming.

From these preliminary observations we learned two important facts. First, schooling in *Menidia* does *not* appear immediately after hatching but develops gradually, following a characteristic pattern of approach and orientation. Second, fish-to-fish orientation, once schooling has begun, becomes increasingly precise as the fish grow more mature.

The latter fact suggested to us that schooling orientation may require some orientative experience. To test this possibility, 400 fish were reared as individuals in physical and visual isolation. This was done by placing each embryo, before its eyes appeared, into an individual bowl. A coat of wax inside each bowl made it impossible for the embryo, as it developed, either to see out or to see its own reflection in the glass.

Of the 400 fish raised in isolation, only four reached schooling age. When these four were placed with schooling fish of the same age, they joined the group. However, while these formerly isolated fish schooled, they were unable *initially* to maintain their positions in the school and frequently bumped into the other unisolated schooling fish.

Yet, after a few hours, we could no longer distinguish the isolated four from the other fish in the school by their behaviour. Does this result mean that precision in schooling orientation is, to some extent, learned by experience? Such seems to be a reasonable conclusion even though this observation involved only four fish.

We now knew some facts about the development of schooling in *Menidia*. However, with this fish, we were restricted to study during the summer months. In searching for an experimental animal that could be studied in the laboratory all year round, we selected the cichlid fishes—for, in these species, the young school although the adults do not. One kind of cichlid in particular, the blue acara (*Aequidens latifrons*), is hardy and easy to raise. Their young school, in many instances, soon after they are freely swimming.

We reared acaras individually from the embryonic stage, in physical and visual isolation, until they were swimming freely. We placed these isolated acaras among schooling young of the same age. After 15 or 20 minutes, they joined the schooling group.

In another series of tests, these isolated fish—when placed only with one another—never formed into a school. At most, they joined in small groups after being together in the same tank for at least 24 hours. This test reinforced our observation that behaviour is strongly influenced by the conditions under which the animals are reared and by the situation in which an animal is placed. The type of behaviour elicited in a fish may very well depend on the behaviour of its broodmates.

In a further effort to evaluate visual stimuli in the phenomenon of attraction, we carried out some experiments with both silversides and acara. The experiments were arranged as follows: a small, rectangular aquarium was separated into three vertical compartments by two glass plates. The centre compartment contained the test fish. The compartments at either end remained empty until one (or more than one) fish was placed in one end or the other.

Observation is made of the schooling behaviour of acara fry in a ring-shaped aquarium with an overhead circular fluorescent light

Because the fishes were physically separated by the glass plates, the effect on our test fish of the presence of other fish was not influenced by any chemical, tactile or vibratory stimuli.

Neither silversides nor acara, in the test compartment, approached a *single* fish behind the glass plate in an end compartment. However, when two or more fish were put into the end compartment, young acara in the centre would approach and orientate.

This experiment has yet to be run with test silversides to see if they, too, will orientate to a greater mass of fish. Since two freely swimming silversides will orientate and school, however, it seems strange that the test silversides would not approach a single fish. It appears likely, from our preliminary study, that visual stimuli are not the *only* important ones in bringing two fish together and that other factors also operate in schooling.

Light plays a very important role in the formation of schools. In one series of observations, it was found that light could influence both the formation and the break-up of a school. For example, when we turned on our overhead laboratory light at night, we would find silversides scattered throughout the aquarium. Within a few seconds, they became active and, within 5 minutes, they formed into well-integrated schools.

Different types of light also had different effects on the development of schooling in silversides. Those fish that were raised under cold fluorescent lights schooled earlier than fish reared under incandescent lamps. Among the former group moreover, the schooling orientation was more precise than among the latter.

In another series of experiments, it was found that acara also respond directly to different conditions of illumination. This was demonstrated when acaras were placed in a special apparatus—a doughnut-shaped tank, with a channel 3 inches in width, filled with water and its bottom lined with gravel. Above the channel, at a distance of 12 inches, was a circular, 32-watt, cold fluorescent light. The ceiling of the room housing this apparatus carried 300 watts of incandescent light. This ceiling light was kept on throughout the experiment, so that the channel was never in the dark.

When placed in the channel with the fluorescent light on, the acaras schooled immediately. When the fluorescent light was turned off, the school dispersed despite continued illumination from the ceiling light. By turning the fluorescent light on again, we could cause the school to re-form.

This has been a tantalising observation. It will lead us into explanations of light intensity, wavelength, polarisation and the like—and the effect of these factors on schooling behaviour. What characteristic of the light is responsible for this remarkable effect? Does it alter the appearance of the fish in their response to other fish? These are only a few of the problems to be explored.

In this brief review of our recent experiments, we have presented only a few of the many questions facing the student of schooling among fish. We hope some day that our investigations—as well as the work of others—will help to answer some of the questions raised by this intriguing example of highly organised social behaviour.

Dr. Shaw, a research associate in the Department of Animal Behaviour at the American Museum, has carried out her studies of fish at marine research stations in the Caribbean area. This article first appeared in *Natural History*, the journal of the American Museum of Natural History.

SWIM BLADDER TROUBLE

by A. BOARDER

MANY of the fancy goldfish are subject to swim-bladder trouble and they are often the short-bodied types such as veiltails and orandas. Fantails and moors also suffer but perhaps not in such numbers. Not that it is only these types of fish which are attacked by this trouble, as common goldfish and shubunkins can have the same attacks. However, it is most often found in the very short, thick-bodied fish and the reason is not far to seek. The internal organs of such fish are constricted so much that there is not much room for the intestines to work normally and the swim bladder is also constricted. This is the main cause of the trouble as the swim bladder is in almost two separate sections with a narrow neck joining the two. The balance of the fish in the water is controlled largely by the adjustment of the contents of these bladders.

The effectiveness of the action of the swim bladder can be disturbed by several factors. One of the most frequent causes is that the fish receives a sudden chill and this prevents the swim bladder from functioning properly. This has been stated so often that many aquarists think that this is the only reason for the trouble. There is another reason, perhaps connected somewhat with the colder weather, and that is the amount of food which is given at this period. Fish can digest their food fairly quickly in warm water but as the water loses its heat then they become more sluggish and their whole body metabolism slows down. This means that any food taken will remain in the intestines and so clog things up. The swim bladder, being already constricted in these short-bodied fish, is then further cramped and so the fish loses its balance.

What can be done then to alleviate the trouble and effect a cure? The possibility of a cure depends on several factors. If a very young fish gets this trouble it is often harder to effect a cure than if the fish is an adult one. The trouble is probably that the young fish has been bred from parents with a tendency to be subject to swim-bladder derangement. This is where the bad practice of patching up ailing fish for breeding purposes encourages trouble with the offspring. Only the healthiest of fish should ever be used for breeding.

An adult fish that suddenly loses balance, stands on its head, swims upside down or lies on the bottom will usually respond to treatment and may be little the worse for it. The best plan is to stop all food immediately. Let that which is already in the fish have a chance of being digested and voided. Do not worry that the fish might die. Any variety of goldfish would live for weeks without food and so a few days without food will do more good than harm.

It is often said that one of the cures is to place the fish in warmer water. I have nothing against that since as the water is warmer so the activity of the digestive organs of the fish is quickened and the food in it is voided. Another remedy suggested is to place the fish in shallow water. Again we can see the sense of this procedure as shallow water is always likely to contain more oxygen than deeper water. The extra oxygen assists the fish to digest the food again and so we have the ideal conditions for a cure.

In short try to prevent this from happening by reducing the dried food once the water cools down, and if a fish is attacked then treat as described above: no food and shallower and warmer water. After a cure give mainly live food for a week or two. I see no reason why an adult fish that is suddenly attacked by swim-bladder trouble should not be used for breeding if it responds fairly quickly to treatment, but do not use a young fish which shows a propensity to develop the trouble as it has probably inherited the weakness.

South African Girdle-Tailed Lizards

by ROBERT BUSTARD

(Photographs by the author)

SOUTH Africa is the home of an interesting though small family of very spiny lizards. These are found in rocky and semi-desert areas. As will be seen from the photographs, certain species are much more heavily armoured than others, and so are less active and unable to move with the speed and agility of the lightly armoured species. The largest of these lizards is about 12 inches in total length, the average being some 6 to 7 inches. They feed on insects. They produce living young, usually two in number but sometimes only one and these are about half the size of the parents.

The commonest species, known scientifically as *Cordylus cordylus*, exists in two colour forms which themselves are variable. One is often referred to as the red girdle-tailed lizard, since the colour is frequently red or red-brown; sometimes it is yellow-brown. The other, the black girdle-tailed lizard, is jet black. These small lizards are very active and common in rocky areas. The upper surface is covered with heavily armoured scales and the tail especially is very spiny, being covered with whorls of spines.

Another species, known as the armadillo girdle-tailed lizard (see illustration), is very well protected by armoured scales and the tail is exceptionally spiny. In this species the armour-plated scales and spines are seen to their best. The coloration is an attractive yellow-brown or almost orange colour, and the sight of this 6 or 7 inch lizard walking around in the sand reminds one of a miniature prehistoric monster!

All these lizards have a weak link in their defences, and the armadillo girdle-tailed lizard, at least, is very conscious of its soft belly, and has devised an interesting behaviour to protect this region. It also serves as protection against snakes which might try to eat it. Let us watch one of these lizards and see what happens.

The armadillo lizard is slowly walking about looking for insects and basking in the sun when suddenly it sees a small snake approaching. It has no chance of reaching the safe retreat in the large rock, some yards away, which has been its home for its 5 years of life. However, the idea of making a bolt for it never occurs to the armoured lizard. It merely curls up into a ball and grasps the end of its tail in its mouth. In this manner it is protecting its soft underside against attack but is also posing a very difficult problem for the 3 feet snake that would like to make a meal of the lizard. This snake is in the habit of pouncing on small lizards unawares and holding them in its coils to prevent them escaping. While they struggle in vain to escape it squeezes them to death, and when they no longer move it loosens the coils, searches for the head and swallows the lizard whole, head first.

The black zonure (Cordylus cordylus niger), an agile species found in rocky areas. This armoured lizard has a spiny tail

The red-brown zonure (Cordylus cordylus rubra), a species differing from the black zonure only in colour

However, the snake sees the armadillo girdle-tailed lizard lying motionless on the sand. It stops, and while we watch, it flicks its tongue in and out, touching the lizard in the process. (Despite popular belief the tongue of the snake is never used for poisoning anything, that is done by the fangs and in this case the snake is harmless.) In all snakes the tongue is a sensory organ used for taste, smell and for feeling strange objects. Since our lizard has remained still the snake is not excited to constrict it, and woe betide the snake which tries to squeeze one of these prickly lizards, and it therefore passes on to the next process in feeding, namely swallowing. It is important for the reader to appreciate that snakes and other reptiles do not think in such circumstances but carry out the required actions by instinct. Instinctively, the snake looks for the head of the lizard as it always swallows its prey head first. Had our lizard not curled up into a closed ring or ball, but merely lain still, the snake would now start swallowing it head first. It would be a prickly meal and indeed it might well choke the snake, in which case both would die in the process.

Our armadillo girdle-tailed lizard remains still, this has often happened before, and he "knows" that he is safe against the small lizard-eating snakes. Meanwhile the

snake searches for the head and, having found it, tries to engulf it. Snakes never chew their food but swallow it whole and secrete saliva abundantly to ease the process of swallowing. The snake makes no progress since the lizard is holding its tail firmly in its mouth and it cannot swallow the head with the tail sticking out of the right side of the mouth. The snake may stop to re-examine the situation, the tongue carefully examining all over the lizard, but in vain it searches for a starting place. The lizard has formed a closed ring in which there is neither beginning nor end.

Here the snake's instinctive behaviour breaks down. There is no answer to this problem and although it may take some time for the hopelessness of the situation to reach its tiny brain, eventually it gives up and continues its hunt for food elsewhere. After a short time our armadillo girdle-tailed lizard slowly uncoils and looks around. All is safe, so it leisurely makes its way back to its favourite boulder, stopping on the way to catch a beetle and pounce on a couple of flies.

Unfortunately I am unable to show a photograph of this, since my specimens are so tame that they will no longer coil up when handled. The great girdle-tailed lizard uses its tail like a spiked club, striking with it at its enemies. This 12 inch lizard also uses it as a defensive barrier when hiding in cracks in the rocks, as do all of these girdle-tailed lizards. The appearance of these interesting little lizards is well illustrated in the accompanying photographs of specimens in my collection.

Throughout the animal kingdom these fascinating adaptations in behaviour to protect the species constantly occur in different forms. The ways in which Mother Nature takes care of her creatures, and protects them from their enemies, are marvellous. In wild life there is a continual struggle for existence and only those that are adapted to meet this survive to produce future generations.

Most spiny of the armoured lizards is the armadillo girdled zonure (Cordylus cataphractus), and this species shows the protective behaviour of coiling with tail in mouth when it is molested

Herpetologist's Notebook

THIS month's article on zonures may make several collectors wish to keep these delightful little lizards, so perhaps a few remarks on their maintenance would not be out of place.

Cordylus cordylus (both the red form *C. c. rubra*, and the black sub-species *C. c. niger*) live well in company with the armadillo girdled zonure (*Cordylus cataphractus*). All these lizards are of a similar size—6 to 7 inches.

I keep mine in a vivarium with a floor area of 24 in. by 24 in. This is covered with sand, and stones are set round the sides of the vivarium to provide hiding places and basking sites. Suitable cacti and succulents, grown in small pots hidden by the surrounding sand and rocks, greatly add to the appearance of the set-up. A small dish of drinking water is provided. The vivarium should otherwise be dry (I remove the vegetation to water it) and a temperature of 70° to 80°F is suitable.

Zonures (or girdle-tailed lizards) are insectivorous and will accept bluebottles, gentles and mealworms as well as spiders, caterpillars etc. They become very tame and will soon accept food from the fingers. Like all semi-tropical lizards they do not hibernate.

The above-mentioned species are specially recommended. Prices are very variable indeed. The closely related crag lizard (*Pseudocordylus microlepidotus*), which grows to 12 inches and will accept raw meat, is also an ideal vivarium inmate. This lizard should, however, be kept alone or with other lizards of a suitable size. The blue-speckled zonure (*Cordylus coeruleopunctatus*) is much sought after by collectors; it has some sky-blue scales and an orange throat. It does well in close confinement.

I do not recommend *Cordylus polyzonus*, which has been quite often available in late years. This species tends to be very nervous and certainly does not get enough food in a community vivarium.

Zonures frequently breed in captivity and gravid females are commonly imported (unwittingly). It is not unusual therefore for the collector to be presented with a family. The young, usually two in number, are about half the length of the parents and feed on small mealworms, flies and gentles. For further details see: Bustard, R., *British Journal of Herpetology*, vol. 2, no. 1, December 1955, pp. 8-9. Bustard, R., *British Journal of Herpetology*, vol. 2, no. 4, July 1957, p. 71.

I have found that zonures do well in company with skinks of a suitable size and nature. The following South African skinks are usually available and do well in the vivarium: three-striped skink (*Mabuia capensis*); speckled skink (*Mabuia homalocephala*).

May and June are good months for purchasing tortoises —common varieties such as *Testudo graeca* and *Testudo ibera*, for outdoor life. The weather is usually favourable at this time and it allows them some months to settle in and feed before their first hibernation.

I strongly advocate purchasing tortoises from a reputable reptile importer who buys quality and not quantity, and although such a tortoise will cost more (the price will not exceed about 10s.) it is definitely worthwhile. Should the collector wish to select a tortoise himself from the local pet store (and I emphasise that this is not good policy for beginners) then he should select a medium to large specimen as these are much hardier than their small and rather cute counterparts. When lifted up, or when the shell is tapped suddenly, the tortoise should retract into its shell. However, in a pet shop away from the sunshine, they tend to be rather sluggish. The eyes should be clear, and they and the nose should be free from discharge, and the soft parts should be examined to see that there are no wounds or adhering ticks.

R. B.

The Garden Pond in May—*by* ASTILBES

IF you expect the fishes in your pond to breed, then this month it may be necessary for you to feed them well so that they may come into breeding condition. It is a natural function for the fishes to breed but they will only do so if they are in good condition.

Take note of the number of fishes in the pond, its size and the amount of growing water plants therein. A pond in good condition will always hold plenty of natural food but if there are too many fishes then the food will not go round and must be supplemented. It may be thought that it is difficult for anyone but an expert to know if there is sufficient food in the pond. It is a simple matter to find this out. One or two small pieces of dry brown-bread crust can be thrown into the pond, and if the fishes are hungry they will very soon be at the surface biting at the food. If the fishes are already well fed they are not likely to show much interest and further food should not be offered. In ponds where there are too many fishes they will almost fight for the food and push each other around in an effort to get something to eat.

In any case a few broken earthworms can be offered, especially if it is possible to see the fishes or to be able to put the food where it can be seen. It is always well to give food in the same place each time so that if the fishes are ready for food they will congregate there as soon as the pondkeeper appears. Although fishes need a fair amount of food to keep them healthy and growing they need a little more if they are developing eggs or milt. Not that the actual condition of the fishes is the only thing to watch, as the condition of the water has a very important bearing on whether the fishes are likely to breed or not. Several factors influence the tendency for the fishes to spawn but one essential is that the water must be well oxygenated and pure. It is very unusual for fishes to spawn in foul unhealthy water.

Any frog spawn found in the pond can be removed to hatch out in safety so that the tadpoles can be used for feeding the fishes when they have grown to a good size. Do not worry if the pond water turns green once the sun gains power, this is quite a natural proceeding and the green water will be useful to assist in feeding the fry later on. The water will contain many small forms of live food in the shape of Infusoria, and together with the green algae will make an excellent first food for newly free-swimming fry.

Although it is possible to breed and rear many fishes in the actual pond it is certain that in many ponds no fry live to grow on as they are eaten by their parents either as eggs or small fry. If the pond is very heavily planted it is possible to get plenty of fry to survive. Netting and partitions can be used but it must be remembered that it is not only necessary to have netting to keep out the large fish from the enclosure but also that the netting must be sufficiently fine to make sure that the small fry cannot get through to the larger fish.

By far the safer way is to take out the eggs and hatch them in safety away from the parent fish. Once the fish lay their eggs they lose all interest in them except to eat them avidly if hungry. If small bunches of plants are tied near the side of the pond (a shallow part is preferable), the fish will spawn there and then the bunches can be removed quite easily and the eggs hatched out in a separate container. This is not only a safer way but it is also more interesting, as the development of the embryo can be watched and the growth of the fry examined.

If the pond water starts to become too green so that the fishes cannot be seen it will be necessary to cut down the amount of sunlight reaching the water. This can be done by covering the surface with duck weed, which will grow and spread, quickly shading out the sun. Later on as much of it as is unwanted can be flushed off with a hose or netted out.

Photo: W. J. Howes

Shade and security for young fry are provided in this formal pond by two thick clumps of rushes and bog plants

GREEN WATER
by W. J. CHRISTIAN

THE time of the year will soon be upon us when many pondkeepers will once again be confronted with the old problem of green water. The explanation that comes to mind is excess of strong light. This may be true but there is another greater cause, combined with light.

My observations over many years confirm that a dry food with a high content of vegetable matter will produce green water. To confirm this let us take two identical ponds and feed fish in only one of them. It will be found that any excess, no matter how small, will make the pond green, whilst the other pond remains clear and bright.

This condition is brought about by the fact that any uneaten food, particularly of the type mentioned, starts to decay, forming infusorians which in the presence of strong light turn green.

To prove this, any aquarist has only to set up an aquarium and furnish it in the usual manner to get a correct balance, and then to overfeed. If sufficient strong light is allowed to play on the water, the uneaten food, once a grey colour, becomes green.

There is one other factor which could produce similar conditions. This is where a pond has sides built up with clay, which is a fine silt. In this case the rain washes this matter into the pond and, being of a very fine texture, it remains suspended. In time, light playing on the water allows these particles to collect algae from the water, giving it a green look. Fish of good size stirring about the bottom of a pond which contains much of the type of soil I have mentioned could bring about the same conditions.

Now comes the question of how to cure it. Frankly there is no easy way. In fact about the only simple remedy is potassium permanganate, added until the water takes on a pink appearance. This chemical is bought in crystal form and should be dissolved in a separate vessel of water before it is tipped into the pond. Never throw in the crystals.

AQUARIST'S Notebook——

by

RAYMOND YATES

ALTHOUGH quite a few aquarists indulge themselves also in the vivarium hobby they restrict themselves to the easier-to-keep frogs, toads, newts and snakes. Young crocodiles and alligators are rarely seen. Quite apart from the difficulty of obtaining small specimens and the rather high price for a "baby," the fact is that many of these imported youngsters cannot stand the rigours of the English weather or the ill-treatment afforded them by inexperienced owners.

I doubt if young crocodiles are ever available, but small specimens of the Mississippi alligator and caiman, about 12 inches long, are available. The former makes the better pet and can become quite tame and will even eat out of the hand. Caimans are almost always nasty and vicious and thoroughly bad-tempered. Children do not take really kindly to these creatures as pets, because they want movement, evidence of animation, and insist on having it. Caimans can retaliate, too, and the lightning-like speed at which they can turn round and snap at a disturbing finger has to be seen to be believed.

Plenty of sunshine (real or artificial) is essential, also a roomy tank with a pebbly beach and a temperature of at least 75 F for both the water and the air. Feeding is sometimes disappointing but one cannot go far wrong with live fishes, tiny frogs, pieces of raw meat or of fish. Insects and worms may be accepted but live fishes or raw meat must be the staple diet. Baby alligators are very clumsy and lack the dangerous grace of their elders which is so fascinating in films.

Some interesting data on the crocodile is given in *No Tears for the Crocodile*, by Paul Potoas (Hutchinson). The clutch of up to 80 eggs in a nest stay buried for over 70 days under 12 inches of sand. Each egg is a little larger than a goose egg and has both ends of equal size and slightly squared. At birth the baby crocodile is 5 inches long and snaps immediately at anything. They grow about 5 feet in their first 5 years, rather faster in their first 3 years. After reaching a length of 6 feet growth is retarded to a mere inch a year, so a 14 footer is about 100 years old. It is suggested that the crocodile can, on occasion, remain submerged for 25 to 30 minutes if necessary. The great age reached by these creatures could be due to sedentary life but tooth replacement helps. Most carnivores die when teeth and claws wear out, but crocodile teeth are all replaced by further teeth as needed. Nowadays man is the crocodile's only enemy, but the heavy armouring suggests that in the dim past its forebears must have been preyed upon. The crocodile swallows meals entirely, as it is unable to chew.

* * *

On all sides one hears the cry "Let us have new importations," but where are these to come from? The answer is, of course, Africa. The dark continent probably contains many wonderful fishes which would be eminently suitable for the tanks of hobbyists, but they are not easy to find in any numbers, or to transport. Native labour is usually not very interested in such tiny catches and national frontiers cause difficulties. Then again Africa seems to go in for big fishes, beautiful but too large for our average tanks. Lake Nyasa was first discovered by the Portuguese in 1616 and it was not until 250 years later that Livingstone came across it. This wonderful sheet of water (the title means "broad water") is up to 2,300 feet deep and is known to contain 220 species, of which 194 are found nowhere else in the world.

* * *

Hobbyists are rarely a nuisance to others as a result of their hobby (wives excluded), and perhaps the only real source of annoyance would be the sound of a noisy pump or a leak through the floor of the flat above. A case in U.S.A. shows other pets can cause trouble. A cat fancier was fined the equivalent of £35 because he shot a boxer dog which had killed his cat. The owner of the boxer was fined £66 for assaulting the cat owner. The latter contended he was only making a citizen's arrest of the cat fancier, who said he was only engaged in target practice when charged with discharging fire-arms in a residential area. The dog owner was also charged with keeping a vicious dog. If you keep fish this sort of thing just doesn't happen. The tale is also told of the wife who complained that her husband had left her for his pet chihuahua dog. "I used to enjoy holding hands with him whilst watching T.V.," she remarked, "but now he holds the dog's paw instead." Wives will see from this that there is something to be said for fish-keeping after all.

* * *

Far too few clubs really cater in any worthwhile way for their junior members. One club in the North, however, has run a special table show for juniors open to all members and their friends (a cunning effort to get new members) under 18 years of age. Fourteen different classes made it possible for almost any junior to enter his fishes. Entries did not need to be fully grown although this was preferable, as points were also awarded for colour, body shape, finnage, condition and deportment. Prize cards were awarded for each class as well as 6s. 6d. boxes of a well-known fish food. This provided the juniors with a splendid opportunity to show their seniors what a table show should be. The classes were: guppies, mollies, platys, swordtails, barbs, characins, danios, rasboras, gouramies, fighters, cichlids, catfish, a.o.v. tropical and coldwater fishes.

* * *

A member of the Blackpool Society has designed a new type of tank made from polythene. The tank has a detachable glass viewing panel in the front, the other sides and the base being made of medium-grade polythene and designed to stack inside one another for ease of carriage and storage. Such a tank would be ideal for show purposes as it is virtually leak-proof, unbreakable, light in weight, space-conserving, easy to clean and unlikely to deteriorate. It ought to be cheaper, also. A prototype has been made and tested and found satisfactory. It is hoped that the designer will be able to interest a manufacturer in the project so that production can start. This is the difficulty at the moment as it would not be financially worthwhile having a cast made for less than 1,000 tanks.

* * *

The Liverpool club has been advising members to have a thorough spring cleaning, not of their homes, but of their tanks and the contents thereof. Thin out the plants, clear out that gravel, give away those odd fishes which have survivied all their relations, check your wiring, clean up the electrical equipment and your tubing. Look through your spare tanks and spare gear. Don't hoard what you will never want or need. A brilliant suggestion and a new one which Liverpool put forward is that if only that old spare room is cleared out of its fishy impedimentia the aquarist concerned will be able to take in boarders. How to get rid: don't leave for the dustman . . . he isn't a fish fan. Take them down to the club auction and make others happy while

helping the club and yourself. Personally I have loads of aquatic junk which I know perfectly well I'll never use, but it stays—just too lazy to bother I suppose; I have the room to store it, too!

* * *

Some time ago I mentioned that although almost all the countries of the world had something to offer our hobby, two, Chile and New Zealand, did not seem to have any fishes of their own to put on record. The leading New Zealand Aquarium magazine mentioned this in a recent editorial and made the interesting point that native fishes more or less disappeared with the introduction of the trout to New Zealand waters. Trout are predators and are never averse to a fishy meal. In recent weeks many thousands of trout eggs have been flown out to Otago from British fish farms and we can take it that the trout is going to stay. Talking of trout, some hundreds were lost a short time ago when an unknown person opened a sluice which drained a lake near Catterick, Yorks. It is thought that perhaps a few of the fish may have reached the river Swale. We grumble about damage to ponds in our gardens but this is sabotage on a big scale.

* * *

I remember long ago writing that cardinal tetras are much more community-minded than neons and do not fight and bicker. This was probably true for this variety as a whole. They are a more sedate fish and do seem to get along much better together than their neon cousins. However, there is always the exception to any rule and my cardinals recently proved to be just this. After having had a blameless existence for upwards of 2 years in a large community tank trouble started. It was obvious that the happy days of peaceful coexistence were over. I never saw such bickering, but I took no action. Later I found one of the shoal always hiding and apparently having lost all his blue-green colour. However, this returned in electric light so my fears of some neon-type of disease were groundless. The bickering became worse but I took no action until one evening I returned home to find all the cardinals, except two, dead on the bottom. There was no other explanation but that all had been done to death by their own kind. The two survivors still put on a fighter act but mostly live at opposite ends of the 4 ft. tank. And yet a week or two ago it was all one happy family who went everywhere in full fleet formation. Can any reader suggest what happened from a similar experience with cardinals? Normally they seem to be fish which are never off colour and enjoy excellent health. It is interesting that after death, days after, the red coloration does not fade although the blue does.

* * *

I have suggested chemical treatments for *Hydra* which are efficient. A suggested new method of getting rid of these pests is to introduce the giant pond snail into the affected tank. This is the very big snail (*Limnoea stagnalis*), which is found almost everywhere in stagnant water. I have not tried this out myself, although it may be quite effective, for the simple reason that the plants would undoubtedly suffer, the snail droppings are enormous and it would be hard to get rid of the baby snails later on. For those who are unaware of the chemical method all that is necessary is to add ammonium sulphate to the tank in the proportion of 5 grains to the gallon, leaving the fishes and plants in. After about 4 days the *Hydra* just fade away. Ammonium sulphate can be obtained pure from any chemist for a few coppers; for goodness' sake don't use the garden fertiliser kind.

* * *

Looking through an American aquarium magazine dated 1933 I was surprised to find a long article, with coloured plate, describing the "new discovery," the brick-red swordtail. How times change—then a much sought-after novelty, now an unwanted curse. In the same issue I was interested to see aeroplane fish offered for sale in pairs. These turned out to be the well-known freshwater sole, which has recently appeared again in some shops as a "new" aquatic find. Frankly, turning the pages of this 27-years-old issue one did not feel so far back in the hobby. Most of the current fishes, plants, gadgets and remedies were lavishly advertised then as now, with perhaps the observation that advertising then seemed more interesting and less formal than to-day. What will hobbyists think of us in 1987? Doing a Mother Shipton, I very much doubt if the current rage will then be Robin Hood fish, red-hatted cardinals or Pancake sharks. No, a dip into the advertisements for 1987 will probably reveal such claims as "real jet-black mollies," "spawning pairs of discus," "blood-red swordtails" and perhaps "brilliant red, blue and green fighters, extra large, peaceful strains only."

* * *

The news that a golden pike weighing 4 lb. has been caught recently at Goring-on-Thames is interesting. Some fishes have a tendency to this colour change (golden varieties of rudd, tench, carp, ide etc.) and an addition to the list would be welcome, although pike are rarely kept in aquaria.

TRADERS' CODE

A "CODE of behaviour" for dealers in the pet trade has been prepared by the Pet Trade Association, the main features of which are given here.

The Executive Council of the Pet Trade Association recommends that those in charge of Pet Shops should replace livestock returned to them by a customer if the following conditions apply:

(A) **Birds and** (B) **fishes**

1. If the bird or fish possessed a deformity which was not noticed at the time of sale.
2. If the bird or fish proved subsequently to be of a different sex from the sex the vendee claimed it to be when sold.
3. If the bird died within 24 hours (does not apply to fishes).
4. If it could be demonstrated beyond reasonable doubt that the bird or fish was diseased when sold.
5. If it could be demonstrated beyond reasonable doubt that the bird or fish possessed the germs or virus of a disease when sold, albeit the bird or fish showed no symptoms when sold.

(C) **Other vertebrate livestock**

Conditions in A and B 1-3 and 5 apply and also if the purchaser produces a veterinary certificate stating that the animal was diseased when sold.

The Council recommends that livestock should not be replaced if:

1. It could be proved beyond reasonable doubt that neglect or ignorance on the part of the purchaser was responsible; 2. It were obvious that the death or disease could in no circumstances be even remotely attributable to the vendor. Nevertheless, it should be borne in mind that circumstances might arise wherein even these two recommendations might be mitigated.

Persons in charge of Pet Shops should remember at all times that the good relationship and trust between the Public and the Pet Shop is the most valuable asset they possess—and act accordingly.

* * *

CHANGE of address of the manufacturers of Hy-Flo pumps and accessories took place on 21st March. The new address is Medcalf Bros., Cranborne Road, Potters Bar, Middlesex (telephone Potters Bar 6925).

Breeding the Bumble-Bee Fish

by R. E. MACDONALD

THERE is no doubt that the bumble-bee fish (*Brachygobius doriae*) is the most popular of the gobies. The brilliant yellow and dark vertical bars that mark its body add definite charm and interest to the aquarium. It is one of the smallest of the Gobiidae family, growing to about only 1½ inches, and its tolerable nature makes it suitable for introduction to the community tank.

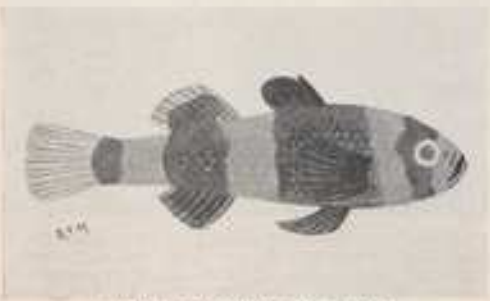
Occasionally, in the past, the bumble-bee fish has been confused with *Brachygobius xanthozonus*, as the colouring and markings of these two fishes are similar, but *B. doriae* has three black girdles or bars whereas *B. xanthozonus* has eight black girdles. Another method of distinguishing which is which of these two fishes is by taking a scale count. *B. doriae* has from 27 to 30 scale rows and *B. xanthozonus* has 50 scale rows.

The scale count is taken by counting the scales, in a single line, from the upper edge of the operculum (i.e. the fish's gill-cover) to the base of the caudal fin rays, as shown in the diagram. This is an extremely good method to adopt when identifying fishes, as the number of scales, regardless of age, remains the same throughout the life of each fish. If a scale is lost, perhaps through an accident or fighting, a new one will always grow in its place.

Although breeding the bumble-bee fish presents no real problem, as it spawns fairly readily, it is important to stress that *B. doriae* requires a considerable amount of conditioning on chopped earthworm, white worms and brine shrimp to bring it into the necessary condition before spawning will take place. It will also become increasingly obvious during the period that the aquarist keeps this particular species from Borneo, that *B. doriae* apparently thinks more of its stomach than it does of love-making. Where breeding is concerned, the bumble-bee fish should be pampered and its gourmand tendencies tolerated.

A good size tank with a capacity of about 15 gallons (about 24 in. by 15 in. by 15 in.) is needed for breeding purposes, and should contain a well-sanded bottom and an empty flowerpot. The flowerpot should be placed on its side in the tank with the water just covering it so that there is water to a depth of about 4 to 5 inches.

Although the bumble-bee fish has a temperature range of 72° to 86°F, a steady temperature of 76°F will be found to be the most desirable for breeding and egg-hatching purposes. The pH of the water should be kept at 6.8, which is considered as the most suitable for the majority of tropical fishes.



Bumble-bee fish (Brachygobius doriae)

This diagram demonstrates how the scale count (a feature often used for the exact identification of a species) is taken

When the breeding tank has been set up, a pair of bumble-bee fish can be placed together and prepared for spawning.

When breeding starts, the female will enter the flowerpot and lay a string of eggs on its upper surface inside. To do this the female will have to roll over and gain an upside-down position. The male will follow her and fertilise the eggs. Once spawning has taken place the female can be removed from the tank and the male will take over the care of the eggs by adopting a similar upside-down position underneath the eggs in the flowerpot and will begin to fan the eggs with his pectoral fins. The most probable reason for this fanning action by the male is to circulate the water over the eggs to keep them relatively free of fungus, to which the eggs of this species are very susceptible.

This egg-washing process is found in quite a number of different species of tropical fishes, particularly in the Cichlidae. Mouthbreeders, e.g. the black-chinned mouthbreeder (*Tilapia macrocephala*), the Mozambique mouthbreeder (*Tilapia mossambica*) or the well-known Egyptian mouthbreeder (*Haplochromis strigigena*), to name but a few, show the same behaviour. The "chewing" action of the jaws that the mouthbreeders adopt while incubating the eggs in their mouths causes moving water to wash away any fungus spores that could attach themselves to the eggs and so destroy them. It also washes away any natural sediment that may be deposited on the spawn and promote a bacterial infection. The bumble-bee fish obviously uses a similar method of egg washing for the same reasons. To assist the male in protecting the eggs, 2 drops of a 5 per cent. solution of methylene blue can be added to the water in the breeding tank.

It is worth mentioning at this point that this form of egg washing can be artificially reproduced by allowing a stream of bubbles from an aerator to pass over the eggs.

During the incubation period the male will not attempt to interfere with the eggs, but once the eggs have hatched he should be removed from the tank as he will more than probably begin to show cannibalistic tendencies.

With the water temperature at 76°F, the eggs will hatch out in 5 days, when the fry should be fed with Infusoria and small-grained foods. The fry appear to be quite hardy provided that they are well looked after during their early stages of life.

INVASION BY AQ

by C. D. SCU

(Photographs

Surface view of a group of water hyacinths (Eichornia crassipes). The large parent rosette has produced three young plants, the stout, connecting stolon being clearly visible with the most mature of these. Note also the dilated petioles and the main roots with their dense rows of lateral roots

FOR countless centuries many species of plants have spread from their native countries to foreign lands. Two biological features of this process are distinguishable: firstly, dispersal by wind, water, animals or man, and secondly the establishment of the species once it has been introduced. The scanty records create a difficulty in tracing the early existence of introduced species. Attention only seems to be paid to the plant when its abundance hinders agriculture, trade or sport. This is particularly true of aquatic plants whose relentless invasions hinder trade along inland waterways and rivers of every continent. In England the use of waterways has decreased but now the introduction of plants apparently endangers sporting interests and still provokes fierce controversy. Of course, not all introduced plants flourish, and several native species are now extinct or are slowly disappearing. A survey of these plants in any part of the world reveals an unstable, ever-changing freshwater flora.

One of the most troublesome aquatic plants is *Eichornia crassipes* Solms., the water hyacinth, which, with its related species *E. azurea* Kunth., is native to the water meadows of Pernambuco and other parts of Brazil. Dedicated to the German J. A. F. Eichhorn, both these amphibious species belong to the family Pontederiaceae, and both form floating rosettes of rich green leaves. *E. azurea* is distinguished by its sessile, pale-blue flowers and erect oval leaves. The youngest leaf of *E. crassipes* has a long succulent petiole and tiny circular blade; the relative sizes of petiole and blade change in succeeding leaves until the mature spreading form is reached. Each leaf, with its swollen, air-filled petiole, develops from within the shaggy, transparent sheath of the preceding one. Young plants arise from the axils of leaves and grow away from the parent rosette on the ends of thick, but brittle, stolons. Both parent and young have profuse roots hanging from their rosettes; each root has a prominent, dark root-cap and in a bright light develops a purple pigment. Dense rows of lateral roots grow out as each main root matures; that these are true roots, and not root-hairs, is shown by their individual caps. *E. crassipes* produces a short-lived, aerial spike of large clawed flowers which are silky in texture, and violet-blue in colour, speckled with yellow.

As an aquarium plant *E. crassipes* is of limited use as it will not flourish in artificial light, but in the diffuse light and humid atmosphere of the tropical or greenhouse pool it quickly spreads and flowers. Its interesting roots provide an excellent spawning mop and shelter for fry. In a hot summer it will thrive in the garden pool but should be removed in early autumn to a bowl containing damp soil mixed with peat moss. In this compost, the leaves lose their swollen petioles, which normally float the plant high on the water and cause it to be easily moved by wind.

Eichornia crassipes was introduced to the Old World about 1829 and by 1886 in Java it had become a troublesome weed. Taken from there to Singapore, it was cultivated by the Chinese, who sold its flowers in bunches on the streets. About 1890 it was introduced quite accidentally to Florida, in the St. John's River, whose sluggish current allowed the plant to colonise the shallow margins. Several years later colonies from 25 to 200 feet wide extended each side of the river for a distance of 200 miles. The summer of 1896 was

Sleep movements in Pistia stratiotes, the African water lettuce. The leaves are here in their erect, night position, and their ribbed, mat undersides are visible. The smooth, mat appearance is caused by the dense covering of minute, depressed, water-repellent hairs. The parent is forming a young rosette at its side

AQUATIC PLANTS

D. SCULTHORPE

(Photographs by the author)

stormy and very strong winds swept the plants upstream from Lake George, blocking the river for 25 miles. Boat propellers failed to penetrate the mass and logs could not be floated down the river, the estimated annual loss to the local lumber industry being 55,000 dollars.

Though it flourished similarly in Australia and Cambodia, the plant was little noticed until last year the *Manchester Guardian* reported its rapid spread over the African continent and the danger of its reaching the headwaters of the Nile. On the 14th August, 1959, the B.B.C. Television programme "Tonight" featured a film report which showed that the fears of the river traders had been realised. Though it has not reached the Nile Delta, the devil's lilac—the more appropriate of its two popular names—was then 25 miles from Khartoum, and, aided by the current, was creeping down river every day. Unsuspecting boatmen on shore returned to find their anchored crafts surrounded or even smothered by the green vegetation.

The behaviour of *Eichornia* at first in Brazil, Florida, Australia and the Far East, and now in Africa, has been paralleled throughout by that of the African water lettuce, *Pistia stratiotes* Hook. Just over 70 per cent. of the volume of the spatulate, sessile, pale-green leaves is air, and both upper and lower surfaces are covered with curious, water-repellent hairs analogous to those of *Salvinia* species. The leaves "sleep" at night, moving upwards from the horizontal day position. On each leaf of *Pistia* and *Eichornia* is an apical pore through which drops of water are actively secreted in the early morning and evening. *Pistia* is an exceptional member of the Araceae and its unusual structure helps to relate the duckweeds of the Lemnaceae to the true aroids.

In Madagascar, *Pistia* inhabits the rice fields; in Africa itself it is a plant of ponds and river backwaters. The spread

Surface view of the same specimen of Pistia stratiotes as that in the other photograph, a week later. The young plant has now formed roots and has been pushed away from the parent by a stolon similar to that of Eichornia. Note that the spatulate leaves are now in the spreading, day position

The profuse roots of Pistia stratiotes, white to brown in colour, are shown here. They are as useful as those of Eichornia in providing natural spawning mops and shelter for fry

of *Pistia* and *Eichornia* is entirely due to the proliferation of young rosettes and the entangling of the stolons and roots. From the small creeks they colonise the shallow edges of the river and gradually advance towards the centre. The outermost rosettes may occasionally be broken off by the current, which carries them away to start a new colony in another habitat. Eventually the whole surface is covered with a network of plants under which the river now flows. *Pistia* constitutes a serious hindrance on the rivers of equatorial Africa, such as the Ogowe, which empties into the Gulf of Guinea near Cape Lopez, and the tributaries of the Congo and the rivers of the French Cameroons. What other means of dispersal are there? *Pistia* may well reach isolated, stagnant waters by its minute seeds, which develop within berries easily picked up from damp shores by wading birds. In the Far East, enormous quantities of *Pistia*, *Eichornia* and various species of *Azolla* and *Lemna* cultivated in artificial ponds for use as pig food become dispersed by careless handling. The sudd, or floating masses of vegetation characteristic of rivers in open, flat country, for example the Nile and Ganges, contains plants other than *Pistia* and *Eichornia*. *Ceratopteris thalictroides* Hook., the Indian fern, *Trapa natans* L., the water chestnut, *Aldrovanda vesiculosa* L., a tropical bladderwort, and various species of *Azolla*, *Lemna* and *Nymphaea* also occur. Such masses of vegetation are easily moved by wind, once they have been ripped loose. Currents, swollen by torrential rains, tear away the vegetation, carrying it not only down the river but also over the flood plains. In this way species are quickly distributed over large tracts of country.

Two of the smallest species of *Azolla*, *A. caroliniana* Willd. and *A. filiculoides* Lam., both known as fairy moss, have spread all over the world during the last 80 years. Both species appeared in Europe from their origin in the U.S.A., central America and Brazil via botanic gardens, *A. caroliniana* reaching France in 1879, England in 1883 and Italy in 1886. It is rare in England, having been confused with *A. filiculoides*. The species are identical to the naked eye with their radiating rows of overlapping

scales, the upper, aerial lobes of which are pale green and the lower, submerged lobes colourless. In a hot, brilliant summer sun the older parts of the plant assume a dull red or purplish hue, and the young tips become bright pink. Both species produce spores within globular sporocarps, but *A. caroliniana* has never been found to do this in England. Undoubtedly, the spreading of both species is by fragmentation, every bit of the plant body being capable of renewed growth. Both species are covered with minute, water-repellent hairs which are one-celled in *A. filiculoides* and two-celled in *A. caroliniana*.

A. filiculoides was introduced into France in 1879 and 1880 by a botanist named Roze, who threw quantities of it into ditches near Bordeaux, from where it has now spread here and there over the South of France. It is said to have been put in a ditch at Horning Ferry in Norfolk about 1888 by a schoolteacher who somehow procured it from Glasgow. Natives of the nearby village of Ranworth had certainly known it to be there since 1896. It was dispersed along the Bure, Ant and Thurne rivers and all over the Norfolk Broads by the heavy floods of 1912. About that time it was recorded from Queenstown Junction, County Cork. Now naturalised all over southern and eastern England it is probably spread by water fowl, to whose plumage it strongly adheres. In very mild habitats in the south it may grow through the winter; elsewhere it passes the winter as sporocarps, and the failure of *A. caroliniana* to produce these resistant bodies may well be one reason for its severe depletion in hard frosts and for its consequent rarity in this country. In the north and west *A. filiculoides* occurs sparingly in disused canals, particularly where the water is accidentally heated by local industry. Often mixed in dealers' cultures, both species thrive in aquaria; in outdoor pools the plants look better, especially in late summer, but must be watched lest their growth becomes too vigorous.

The most notorious water plant to spread through the British Isles was *Elodea canadensis* Michx. (or *Anacharis canadensis* Planch. or *Anacharis alsinastrum* Bab.), variously known as Canadian pondweed, water thyme and Babington's curse. It passes the winter as spindle-shaped clusters

The radiating fronds of Azolla filiculoides

These mature, autumn fronds of Azolla filiculoides are over an inch in diameter

of leaves which germinate while attached to the dying parent plant. Indigenous to North America, *E. canadensis* was recorded from Ireland in 1836 and seems to have appeared first in Great Britain in a pool at Duns Castle, Berwick, in 1842, from where it escaped to the River Whitadder. It was probably introduced to England several times with American timber and with importations of aquatic plants such as *Nymphaea* and *Aponogeton* species. By 1847 it had appeared at the Leicestershire village of Foxton, not far from Market Harborough. In 1847 the curator of the Cambridge University Botanic Garden obtained specimens from Professor Babington and, accidentally or otherwise, introduced them into a tributary of the Cam in the following year. In the next 4 years the species choked the river, raising its average level 4 inches, and severely hampering rowing, swimming, fishing and barge traffic. From the River Cam it spread all over the fens, blocking dykes and hindering drainage. First recorded from Burton-on-Trent in 1849, it had almost blocked the river there only 2 years later. The invasion continued and the species eventually reached France and Belgium in 1860, Holland by 1861 and Denmark, Sweden, Germany, Hungary and Russia in later years. In England it had reached the River Severn in 1852, the Bristol Avon in 1856, the Rive Weaver in 1859, the River Ribble in 1866, the West Country in the 1870's and the Lake District in the 1880's.

Despite the many inspections made in various places, and the investigations of a Government adviser sent to examine the situation in the fen districts, no measures of eradication or prevention were found. The active phase of growth seemed to persist for only 5 to 7 years, and by 1883 its maximum abundance had passed. In the Proceedings of the Linnaean Society of London for 1912 are given details of a country-wide enquiry amongst natural-history societies into the state of *Elodea canadensis* in 1909. The plant had settled down in river and pond communities and had even disappeared from several earlier habitats. Its temporary dominance had ended.

Until 1879 only female plants, with their tiny, greenish-violet flowers borne to the surface on thread-like stalks,

had been found. In that year a certain D. Douglas discovered male flowers near Edinburgh and described and drew them in an article "Notes on Water Thyme (*Anacharis alsinastrum* Bab.)" published in volume XVI of *Science Gossip* in 1880. From this record the male plant must have occurred in these islands, but it is doubtful that it has been found since. Consequently all the material of this species in our fresh waters has been regarded as female by some writers and therefore as the single plant body derived from one fertilised egg. This is doubtful since the plant seems to have been introduced independently to several places. Nevertheless, the dispersal and abundance attained from these few introductions emphasise the overwhelming success of vegetative reproduction and perennation.

It is interesting that *Enhydrias angustiperala* Ridl., a plant similar to *Elodea canadensis* and belonging to the same family, the Hydrocharitaceae, was discovered in the man-made lake of the Singapore Botanic Gardens. The vegetative reproduction of the plant necessitated the removal of enormous masses weighing tons each year. The species was also found in Thailand, Malaya, Borneo and Cambodia.

Acorus calamus L., the sweet flag, is an introduced plant of pond, river and canal margins; the related species *A. graminous* Ait., the dwarf rush, and *A. pusillus* Sieb., the Japanese rush, are familiar aquarium plants. *A. calamus* seems to have originated in Siberia, and it was brought to Poland by the Tartars, sometime in the thirteenth century, for the drug which could be extracted from it to treat eye diseases. Abundant in Germany by 1588, it was naturalised in England by 1660. Its smooth leaves reach a height of 3 feet and may be crushed and used for their tangerine flavour, though true tangerines probably make considerably more pleasant eating. The tight, yellow flowers are formed almost everywhere the plant grows, but fruits are rarely produced and are unknown in Britain. Growth and division of the rhizome, and drifting to new habitats, have spread the species throughout southern England.

One of the most beautiful native water plants, which used to be in the gentian family but is now separated in the Menyanthaceae because of its aquatic habit, is *Nymphoides peltatum* (Gmel.) O. Kuntze, the fringed water lily, previously known as *Limnanthemum nymphaeoides* (L.) Link., and as *Villarsia nymphaeoides* Vent. Its shining green leaves resemble, as the plant's name suggests, those of a water lily in their rounded shape, cordate base and floating habit. They have a sinuous edge and marginal, bluish-brown mottling. The creeping rhizome also floats, producing short-petioled leaves and long unbranched roots from the nodes. Clusters of two to five flowers appear in the axils of leaves at the end of a floating stem. Thus soluble organic compounds synthesised in the leaves have to travel a very much shorter distance to the developing fruits than in typical water lilies of genera *Nymphaea* and *Nuphar*, whose leaves and flowers grow independently from the rhizome on the substratum. The five bright-yellow petals of the flower of *Nymphoides peltatum* have beautifully fringed, marginal lobes. Though uncommon, the plant rapidly spreads when put in pools and ornamental lakes.

A native species that has already become extinct is *Trapa natans* L., the water chestnut. Popularly thought of as an oriental species it occurs in eastern Europe and Africa as well as the Far East. Rarely in commercial supply, it is worth looking out for and cultivating in aquaria. The dark-brown horned nut germinates in spring and the emerging hypocotyl bears the rudimentary shoots and root. The root does not respond to the pull of gravity and grows upwards at an angle; many lateral roots later grow down into the compost. Of the two shoots, one is dormant and the other produces narrow leaves, which soon die and are replaced by adventitious roots possessing chlorophyll. On reaching the surface the shoot produces a mosaic of triangular, serrated, green leaves which have dilated petioles analogous to those of *Eichornia*.

A few years ago a nut of *Trapa natans* was found in debris cast up on the shore of Loch Ceanna' Bhaigh on South Uist in the Outer Hebrides. Peat from the crannies of its surface was examined for pollen grains and compared with samples from peat deposits a mile to the south-east and 2 miles to the north-east. The results of this investigation confirmed what had long been suspected; that *Trapa natans* was a member of our flora after the Ice Age. Remains of the species have also been found in Norwegian and Danish post-glacial peats which are beyond the present limit of distribution.

The stoloniferous habit of *Eichornia* and *Pistia* provides a successful mode of reproduction and of dispersal under

Other constituents of the 'sudd' besides Eichornia and Pistia are Salvinia brazilensis (left) and Ceratopteris cornuta (right)

tropical climates. Plants introduced to this country, however, must be able to overwinter if they are to spread. *Elodea canadensis* was equipped for this, perennating by winter buds; the two species of *Azolla* were introduced slightly after *Elodea* and yet have shown nothing like the same abundance. *A. caroliniana* is probably restricted by its inability to develop resistant sporocarps, which help *A. filiculoides* to pass the winter. *Nymphoides peltatum* is comparatively rare although apparently possessing great vigour. Dispersal may not be easily accomplished since its ripe fruits soon sink and pieces of its foliage are usually too large to be accidentally carried from place to place by birds. The introduction of rare plants by naturalists seems to be harmless, as so few of them survive in our climate. Indeed the re-introduction of several disappearing species might avert their otherwise inevitable extinction.

Microscopy for the Aquarist—54

by C. E. C. COLE

FOR temporary preparations of *Daphnia* we have a choice of several water-soluble chemicals and dyes, all of which work extremely well.

Leisurely examination is always better than hasty glances, but for those aquarists who are in a hurry I suggest the following methods. Good results are obtained, but in a matter of an hour or two the specimens so treated will be almost unrecognisable, due to distortion and shrinkage.

Many species of *Daphnia* have semi-opaque carapaces. To make these almost completely transparent we have to raise their refractive indices to something little short of that of glass. Both glycerine and lacto-phenol are eminently suitable for this purpose. Therefore place your specimens in a drop or two of either of these substances, focus with, say, a ½ in. objective and × 5 eyepiece, and watch closely. In 2 or 3 minutes the carapace becomes very transparent. A minute or two longer and it begins to shrink, as does the body of the *Daphnia*, which is forced forward and out of the opening in the front of the carapace. The legs are still largely indefinable, however, being all bunched up together, and the clawed end of the abdomen is hidden among them.

To see further detail it will be necessary to tease these apart. This is best done with the help of a couple of fine needles, mounted in wooden handles about 6 inches long.

Switch to a lower power (a 1½ in. or 2 in.). This will give you room in which to work. Place the point of one needle on to the carapace and the point of the second needle on to the body of the *Daphnia*. Then draw the carapace away. You can do this without looking through the objective if your eyes are good enough, but it is better if you can train yourself to work through the objective. The most difficult thing is to remember that all your actions are reversed through the microscope. So if the carapace is to the right in your field of view, you use the left needle and pull to the left to remove it. Or if it shows to the top of the field of view, you pull down. Only practice will make you adept at this sort of rough dissection.

After removal of the carapace the legs can be more easily teased apart.

There is plenty of contrast when such a newly killed specimen is used, but many of the small details can still be missed unless extreme care is used in focusing. It is impossible to see the details shown in my sketches (published with last month's article) without recourse to staining with one or other of several chemicals or dyes.

Dilute tincture of iodine can be used to reveal tiny hairs. A drop of tincture can be added to a little distilled water in a cavity slip, and the specimen placed therein. In a few minutes the iodine begins to reveal great detail.

Better, in my opinion, is Cotton Blue, used in the following manner. Select a moulted carapace, and place upon the cavity slip in a drop of distilled water. Focus and note how transparent it already is. Many parts—the complete outside skeleton is moulted inside the shell—are almost invisible.

Instead of introducing transparency here is a case when we must aim at contrast. Place a minute drop of Cotton Blue in the distilled water, which will assume a rich blue colour. Stirring with the point of a needle will hasten diffusion of the stain.

Photo: W. J. Howes

Collectors of freshwater animals can obtain many specimens by raking out a mass of plants from a natural pond or stream

As the moult is reached its outline becomes rapidly more apparent—the swimming antennae, the grinding surface of the "jaws"—the legs—the clawed abdominal extremity, and finally the minute hairs with which most parts are covered. All eventually assume a beautiful shade of blue. The carapace can be teased apart from the rest of the moult in the manner outlined above.

By now you may have noticed that you have not obtained the head shield. This is quite usual, and before I witnessed an actual moult I began to think that perhaps it wasn't moulted at all.

But I was wrong—it does come off with each moult, but separately, like a vizor—and what a sight it is to see the single large eye almost pulled from its socket before snapping back into the new carapace. It looks most uncomfortable, to say the least!

If the moult you are examining is that of a male *Daphnia*, take particular note of the details of the first and second pairs of legs, and also of the "fringe" on the open front edge of the carapace. This latter never appears on a female carapace, and, in my opinion, is an aid to the male during courtship, as are the hooked portions of the legs.

Has the Tide Turned?—*by* BOB CALROW

SHORTLY after the last war, most of the people of this island, not yet being preoccupied with the nightly grind of cowboy gun battles and parlour games, turned their eyes to the pleasant problem of making £75,000, or thereabouts, in as short a time as possible. As it now appears that most of us were thinking the same thoughts at the same time, it is small wonder that the range was narrowed down to two simple and attractive methods in the province of the ordinary man in the street.

One simple task was to draw eight circles against certain football games with the reassurance that, at the commencement of the game, one was on a winning bet anyway, and only the failure of trained athletes to keep the ball out of the net could possibly alter what had started out anyway, to be eight draws; frequently, however, the aforementioned athletes could and did spoil it. Another possibility, of equal appeal to you and me, was to breed tropical fishes; this was, as I say, coupled with the mass desire to drive up to the boss in the gold-plated Daimler and tell him to "go blow a bubble-nest."

After all, clubs were springing up all over the country, practically every street had at least one well-lit tank to be seen in the front window, and the man of the house found it as urgent to get his tank and fishes (and water weeds to keep it clean) as his father had found it 50 years ago to chase out to get an aspidistra.

It was therefore no wonder that everybody was hearing of this hobby. Thousands joined clubs, memberships soared, shops opened in every district to dispense tropical fishes, shows were held simultaneously all over the country and prize-card printers were second only to the national Sunday papers with their output. It was all very exciting, and very, very false. The pre-war aquarist sages shook their heads and said it couldn't last; the hopefuls carried their cans of green swords from shop to shop muttering "it's the pH." The sages lectured and judged, and the hopefuls advertised their tanks (with the weeds that keep it clean) in the local papers and bought one of those magic scoops of plastic, which, fixed on the water cap of your car bonnet, kept the car free forever from mud and winged live food.

During those halcyon days the Hendon and District Aquatic Society was born, and with meeting attendances

Hendon A.S. show secretary demonstrates some of the club's trophies to Mr. R. O. B. List (left) of the F.B.A.S.

Photos: B. Calrow

Break for tea at a Hendon A.S. meeting — a chance for aquarist to meet aquarist and talk fish

regularly in the eighties, it was not difficult to afford shows and social events, travelling visits to provincial shows and, at one time, the ability to compete in three separate open shows hundreds of miles apart at the same time. We were very lucky at that time to have at the helm of the society die-hard aquarists, and under the leadership first of Fred Riddle and Roy Skipper, it was possible to make one or two decisions, which have proved over the lean days to have the greatest possible effect on the survival of the Society.

Firstly it is essential to meet weekly, and this is the main fact from which the camaraderie of membership is built. After 10 years it is a matter of complete habit to turn up to meetings, and club members should take it upon themselves to attend regardless, and not look for the ever-obvious excuse just to miss it for one week. During this last winter, with the heaviest fog possible to encounter, with not a bus running in North London, our attendance was good, with many of the members starting out a little earlier and walking long distances to the club.

Another important decision which paid off was the insistence in the past that it was no use whatsoever holding a fish-club meeting if there was no possibility of using water; and my advice to any club is, no matter how comfortable you may be in your meeting place in the local pub or church hall, if you can't use water and occasionally show fishes, move on, if you want to survive.

Hendon have moved four times because of this last-mentioned fact, and now we are comfortably situated in a hall with all the facilities we need, and with the stock and stands belonging to the Society.

However, let us not dwell on the whys and wherefores, but be pleased to say that we have arrived to-day with the hobby on a regular steady keel and a membership as good as ever. At the annual general meeting held recently practically everybody in the hall offered their services, and up to 20 names went into the ballot for committee offices.

It was the most encouraging night since the club started to see every member fighting to get in on the chores that have been for a long time the task of a regular few. The Society have been able to give services such as slide shows and talks to many other clubs, and at the moment it is one officer's sole task to be services secretary to the requests received. Tapes and slides have been sent to Scotland, Holland and the U.S.A.

It was no wonder to the committee then, that at the first

meeting of this year, plans were already handed in to run the most sensational annual congress ever. Our member in America, Lloyd Bell, is to present a screen show later this year at Hendon. All who attended the Hendon Congress last year will be aware of the necessity to book early for this annual feature, and arrangements have already been made to accommodate a greater crowd than ever before. Lloyd Bell is on the board of the San Francisco Aquarium Society and has been drawing up a judging and show plan for America, on the lines of those which he experienced over here. He intends to show at the Hendon Congress much of the brine-shrimp processing which is so popular over there, and which is the backbone of the solution to the American fish-keeper's food problem. He also wants you to see the famous Steinhart Aquarium. These films, along with films of collecting expeditions which he has undertaken in Mexico and Columbia, should make this year's Hendon Congress well up to and beyond standard.

Hendon has also considered deeply the falling off of open shows, something that has to be admitted by us all. In order to see if a new approach is the answer, this society will hold an open show early this summer. There will be no endless rows of single entries, but clubs will be free to make a club effort on the space and stands that will be allocated to them. This show will be on similar lines to that organised by the Federation of Northern Aquarium Societies over the past few years. We think it will be the answer to the already dying open shows. No effort will be spared to assist all the clubs who wish to take part, and secretaries should now write in for the available space.

So much for the present, and with the happy prospect of the year being a success, we should now look back to the beginning of this story, where we saw how thousands joined the hobby and stayed for a time. Will it ever be the same again? It is very doubtful. Indeed it is much better now that the hobby has shaken down to real aquarists, and it appears that we are, on balance with the situation before the war, a much stronger band for the experience. We are encouraging all members to keep fishes, and more fishes.

It is the aim of this club, and this we have deliberated coldly for a long time on the committee, that the emphasis must be to get members keeping more fishes, and to afford them the opportunity to show them more frequently. And here is a total difference: one hears no longer of the club member trying to breed fish for what they will bring in cash, but solely for their own fun and enlightenment. That surely is the whole point.

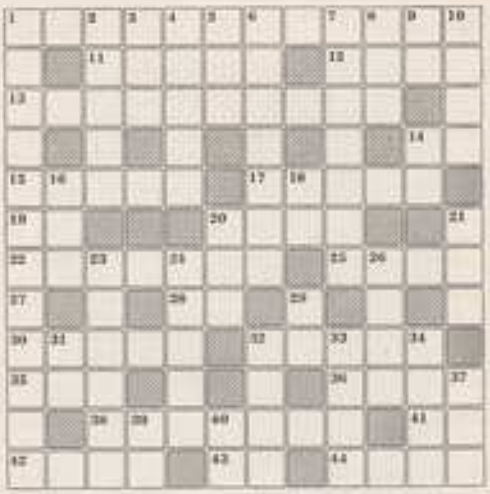
We shall be pleased to have anyone who will join us in in this pursuit, and feel more certain than at any time over the past few years, that the hobby has at long last reached a happy phase, and that as a steady rewarding pastime it is safer than it was before, with, incidentally, the same old original magazine, that has been with us during all the days mentioned, as the sole and only periodical at our side.

Manual of Water Plants

THE need for a book about aquarium plants has been evident for a long time, and the recent production and publication by Shirley Aquatics Ltd. of *A Manual of Aquarium Plants* is a welcome venture. In this book the plants are presented in alphabetical order by their generic names, with brief descriptive notes for each, and there are numerous drawings of individual species. The publishers have restricted the species listed "to those grown by us" but the list remains an impressive and important one. There is also included a page of notes on "Decorative Aquaria." The *Manual* has 64 pages of art paper, with a stiff-paper cover, and is obtainable from Shirley Aquatics Ltd., price **7s. 6d.** post paid.

The AQUARIST Crossword

Compiled by J. LAUGHLAND



CLUES ACROSS

1. Cobra *lalia* (alternative spelling) (5, 7)
11. Stomach trouble upsets most of the calicoes (5)
12. Offside! Beware of them, Caesar! (4)
13. Family of air-breathing fishes (10)
14. So the sardine's head returns (2)
15. Metal part of the usual aquarium (5)
17. *Hydra* or jelly-fish, for example (5)
19. Heart of the sandal fin is first class (1, 1)
20. Artificial bait (4)
22. Dusky aquarium favourites (7)
25. Flowering bog plant (4)
28. Dan comes back without her tail (2)
30. Striped tropical-tank fish (5)
32. Polyp often found in aquaria (5)
35. Poem for musical setting (5)
36. Slippery fishes (4)
38. Looking like the lionhead? (5)
41. Name of Chinese and Italian rivers (2)
42. Frame for glass and name of a fish (4)
43. Alternative (2)
44. Fish house and *Hydra*, for example (4)

CLUES DOWN

1. Small female fighters? No, plants (5, 7)
2. Cichlid (5)
3. Stool (3)
4. *Hyphessobrycon flammeus* or an old love (5)
5. Fish trap, perhaps (3)
6. Sup cook (anagram) (7)
7. Poecilia that is X-ray fish (5)
8. Sad in a way, but you'll find some on the end pages (3)
9. Objective case of I; get me? (2)
10. English river (4)
14. Pa goes up for the Welsh son (2)
16. S. American river whence comes famous tetra (5)
18. Otherwise (2)
20. Nearly a leak (3)
21. River swum by Young Leichhardt (3)
23. Bella's the tickets (5)
24. Perfect stage of an insect (5)
26. This kind of fish is far from common (4)
29. Belonging to me (2)
31. His decision is final (2)
32. This aquatic grass is dainty and decorative (4)
33. Not shallow (4)
34. European mountain sport friends (4)
37. Soak (3)
39. What? in another and vulgar way (2)
40. Take it up to catch us. No? (2)

(Solution on page 40)

our readers write

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

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

Dangers of Shellfish as Live Food

I AM writing with reference to one of the answers given to readers' queries on page 194 of the March issue.

In a reply to the third question on that page, regarding the advisability of using shrimps, cockles, mussels etc., taken from the sea as live food. While, of course, you are quite correct with regard to shrimps and crabs etc., I feel that you should warn your reader(s) regarding the use of mussels, winkles and similar shellfish.

In certain areas (of which this is one) the danger is more serious than others, but it is nevertheless a substantial risk anywhere. In this instance I am writing with some experience, having only in the past few weeks experienced considerable trouble, including several losses, entirely through feeding with winkles and mussels that had not been sufficiently quarantined.

The danger exists in the risk of introducing into the aquarium a snail or mollusc with miracidia or cercaria in the stage at which they are about to pass from the one host into the fish host. Unlike the well-known *Gyrodactylus*, which is monogenetic, there are about 20 other known Trematoda or "flukes," many of which have an extremely complex life cycle. Although the precise details of many of the varieties are relatively unknown, the broad pattern is basically similar, though the details of the stages may vary from one species to another.

The adult parasites live in the throats and mouths of sea birds and also freshwater birds, such as herons etc. Eggs are laid, which are discharged into the water either through the mouth or through the excreta of the bird. The eggs hatch in the water, giving rise to the first stage, called miracidium. This is a free-swimming larva of extremely small size, often covered with very fine hairs called cilia, with which it is able to propel itself through the water. The miracidia swim through the water in search of a shellfish host. This may be a snail or mussel or other shellfish, and if they find the right species within a few hours of hatching they penetrate into the liver of the animal. If they do not find a host within a certain time they perish. When they become installed in the liver of the snail, they undergo further development, which varies from simple development, to complex multiplication according to the species, and there may be three or four larval forms within the period that the snail is host. Eventually, however, the parasites are in a form when they are ready to leave the snail host which are called cercariae.

The cercariae leave the snail host and either swim through the water or float about in the hope of contacting a fish host, which like the miracidia they must do within a certain time or perish. If the cercariae contact a fish, they burrow into the skin of the fish, often the head or fins, or beneath a scale of the body. Depending upon the species of trematode, such infestation may produce skin parasites like "yellow grub" or "black spot," which are already well known. There are others that are even more serious and can often prove fatal. In these cases, also those where the infestation causes disabilities to the fish, such as off-balance swimming and partial blindness, there is a fair chance of the fish being eaten by a water bird. The parasites resist digestion in the bird's stomach, and migrate to the mouth or throat of the bird, where they attach themselves and breed, so starting the whole complex life cycle again.

In my recent case *Hemppera procaudata* was introduced into an aquarium through feeding live shellfish, which although quarantined for some time obviously were still infested. The parasite in this case was a very dangerous one, being an endoparasitic fluke about which only limited knowledge is available. In a confined space as in aquaria 100 per cent. fish infestation is almost a certainty. Other fish, however, added to the same aquarium at a later date did not become affected, as most of the parasites of this character have to pass through a further host or succession of hosts before the cycle takes them back to fish again.

Not all Trematoda are fatal to fish in themselves, although this nearly always follows in their natural conditions, as the various disabilities produced usually result in the victims becoming prey to every predator within range.

When I first had this trouble, the fishes began to scratch a great deal, rubbing themselves against the rockwork or gravel and some never progressed beyond this stage, subsequently recovering on their own. Others developed varying degrees of blindness, due to the presence of the flukes in the eye cavities. In some, even those that were totally blind, the sight was gradually restored when the flukes moved away, but some of these fish died subsequently when the flukes penetrated the brain. In the recent case of *H. procaudata*, the mouth and eye cavities were heavily infected, also the stomach and intestines. There is no specific cure, although I have had success with the "sulpha" drugs in some instances, and in fact fish that were totally blind last year for a while, are lively and healthy to-day, although others succumbed quite quickly.

The difficulty is that there are not many chemicals or medicaments that are capable of killing the parasites that are not also liable to harm the fish, and in fact in most cases any of the effective treatments against parasites are debilitating, and if you lower the constitution of the fish, its resistance to the parasites is decreased, and even if the

parasites are overcome by the treatment, so all too often are the fish!

The foregoing may sound rather terrifying, but unfortunately it is only too easy to invoke by the feeding of live shellfish. Unfortunately, many fish refuse to eat anything else, and although the obvious answer would appear to be to boil all the shellfish first, many fish refuse to eat it cooked, and there seems little doubt that much of the nutriment is lost by prolonged boiling.

The usually accepted solution is to obtain your shellfish, and maintain them in a quarantine aquarium where there are no fish, and no water birds, and obviously any that are infested will in time release their cercariae, which will shortly die through inability to find a host. It is generally accepted that the period during which the shellfish is host is between 3 and 4 weeks, but as there are so many different types of Trematoda, this would seem a sweeping generalisation.

In fact I have always quarantined my shellfish for at least a month, yet on several occasions infestation has developed as mentioned above. Two months would seem to be the really safe minimum, but unfortunately it becomes increasingly difficult to keep the shellfish for this period or longer due to feeding difficulties. Three to 4 weeks without food seems to have little effect on most marine shellfish, but beyond that time they pine away rather rapidly. All things considered it would seem that shellfish other than shrimps, crabs and the like are best avoided, unless, as in my case with one or two marine species, no other food is acceptable.

It may be put forward that the risk would be minimised in tropical aquaria due to the increase in temperature, but there is no evidence of this, for the same situation is known to occur in tropical waters under natural conditions, and even in this country the temperature in rock pools may well reach 70°F or more. Furthermore, my own last infestation took place in a tank that was maintained at 65°-75°F.

A. W. Smallwood,
Pwllheli, N. Wales.

Sensation in Fishes

I NOTE with interest the item in "Aquarist's Notebook" (March issue) where Raymond Yates reports on suggestions made by Dr. Hans Haas in his book, *We came from the Sea*, about the lateral line of fishes.

Any aquarist who has heard of the blind cave characin (*Anoptichthys jordani*), which has no eyes at all, must be well aware of this phenomenon noticed by Dr. Haas. That Dr. Haas should suggest that the lateral line has "*something* to do with this ability to sense in a way that we cannot sense" and that the lateral line *could be* the means by which fishes distinguish between different vibrations does not say much for his knowledge of anatomical ichthyology.

All fishes possess sense organs which inform them of the nature and whereabouts of the objects in their immediate and distant environment. These sense organs consist of cutaneous sense organs (or touch cells), and the lateral-line system to which Dr. Haas refers.

The cutaneous touch cells are extra-sensitive nerve endings in the dermal layer of the skin which are innervated by the fifth or trigeminal cranial nerve. The existence of these extra-sensitive touch cells explains why fishes show distress in the aquarium when touched by other fishes or with the human hand etc. It is when a fish is swimming in dark regions or by night that these touch nerves are most valuable.

The lateral-line system is formed by the presence of one or more tubes that are embedded along each side of the fish. At intervals along the body where there is a muscle segment, there exists a minute opening or pore in each scale through which a nerve passes and is connected to the lateral line tube. The lateral line is innervated by the lateral cranial nerve. This lateral line enables fishes to detect low-frequency vibrations such as the movements caused by other fishes swimming. Hence, when a fish is injured, the irregular or erratic low-frequency wave vibrations set up by its convulsions or abnormal swimming movements are communicated through the water to the prowling shark, who is immediately attracted, and to the other fishes in the vicinity.

To anyone who has studied the anatomy of fishes there is nothing unusual in the manner by which fishes can detect the presence of prey etc., while still apparently some distance away. Fishes (which includes the shark family), use their lateral line in a manner similar to the way we use our radar scanners. By constantly twisting and turning the body in the water and altering course the fish can pick up these vibrations from all directions.

I sincerely hope that somehow Dr. Haas is confronted with these few words and is somewhat enlightened. Incidentally, I have the highest regard for all of Dr. Haas' works and he remains, as always, one of my favourite authors.

R. E. Macdonald,
Welling, Kent.

Feeding Rings

WITH reference to the note on feeding rings, on page 187 of the March issue, I would add that rings can be made from a length of plastic air line. One end is pushed into the other, any crease being on the top when the ring is floating. These rings can be made of any size, to suit size of tank, number of fishes etc. Rings can also be anchored by a loop of thread to a split rubber tube or channelling on the tank frame.

E. J. Rutter,
Huntstanton, Norfolk.

Under-gravel Filtration

I AM a specialist breeder of guppies, which are as you know an extremely delicate fish, when intensively bred for the show bench. The modern show guppy has been inbred for generations and outcrosses for virility are extremely difficult as almost invariably the outcross produces non-standard finnage necessitating further inbreeding to repair the damage, so that then you are back where you started from.

I have experienced several instances of death and destruction amongst prize males when for no apparent reason 75 per cent. of a brood become sluggish, with tail-drop, and then die. This usually happens at 3 to 4 months.

I have tried many variations of feeding and salt or Epsom salts in the water, but have not found the answer.

It has been suggested by a correspondent that my use in all tanks of sub-gravel filtration may be part of the cause. This type of filtration has been questioned by several experienced aquarists, who are dubious about its effects on fishes.

I would be glad to have your views on this question as the sub-gravel filter certainly produces crystal water, but may lead to trouble in a change from anaerobic to aerobic bacterial conditions in the compost.

P. Dendy,
Evesham, Worcs.

We do not know of any findings that would support the suggestion that under-gravel filtration could be responsible for losses of fish such as described by Mr. Dendy. It should be possible to examine this matter experimentally by comparison of results from separate broods reared in tanks with and without the use of this type of filtration. We would welcome readers' comments and suggestions on this.—Editor.

News from AQUARISTS' SOCIETIES

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

AT a recent committee meeting of the Three Counties Show it was decided to hold this popular show at Reading on the 1st and 2nd of July. There will be two setting up days, prior to the show, and every effort is being made to make it a success. Schedules and rules, similar to the previous show, will soon be available from the show secretary, Mr. G. Thompson, 57, Royal Avenue, Calcot, near Reading, Berks.

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A DEMONSTRATION of aquarium glazing was given by Mr. E. W. Nicklas, of Thorpe Pet Stores, to members of the **Goole and District A.S.** at a recent meeting. Mr. Nicklas also gave some tips on cutting glass and sealing small leaks. One of these was to put a sheet of toilet paper under the gravel near the leak.

A club outing was discussed for the coming year and a table show was arranged for the next meeting.

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THIS year has started off very promisingly for the **Gloucester and Cheltenham A.S.** With the increased membership it has been found necessary to find a larger meeting room and with this end in view the club room at the Great Western Hotel, Clarence Street, Cheltenham, has been booked. From May onwards the society will meet there at 7.45 p.m. on the second Wednesday in the month and any new members or ex-members will be welcome.

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THE spring meeting of the **British Aquarists Study Society,** held at the London Zoo on 2nd April, was attended by nearly 150 members and friends. Speaker at the meeting was Mr. W. L. Mandeville, this year's president of the Society, who, in philosophical vein, introduced topics of aquatic interest "From My Notebook." He discussed the question of how often to change the aquarium water and said that to speak of a "mature" aquarium water is meaningless. "Conditioning" of water was a process that the speaker thought was important, and he described in detail his experiments with water treated with silver ions in attempts to control growth of algae and micro-organisms including the white-spot-disease parasite. Aeration and the conditioning of fishes for breeding were other topics discussed by Mr. Mandeville, and the latter subject provoked a lively discussion. The speaker said that his object had been to cause his listeners to think about these matters, and his address was successful in this. After tea at the Zoo the meeting toured the Aquarium, where an impressive display of sharp-shooting at flies by archer fish was presented by the curator, Dr. Gwynne Vevers, as a special attraction. Next meeting of the Society, open to all aquarists who apply for tickets (5s. each, to include tea and Zoo Aquarium visit), will also be at the Lecture Hall of the Zoological Society of London, Regent's Park, on 28th May at 3 p.m., when an "Any Questions?" panel will answer questions submitted from aquarists before that date. Tickets and additional details can be obtained from Mr. J. E. Edwards, 62, Berrylands Road, Surbiton, Surrey.

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THE results of the first leg of **The North West London Group of Aquarists Societies** Competition Year, 1960/61, held at Independent A.S. were as follow: Guppies (Male): 1, F. Mead; 2, E. Darner; 3, G. Glass; 4, J. Haynes. Guppies (Female): 1, G. Phillips; 2, G. Phillips; 3, K. Denham; 4, E. Large. A.O.V. Egglayers: 1, E. Lander; 2, W. Fryatt; 3, W. Fryatt; 4, E. Lander. Egglaying Toothcarps: 1, J. Fletcher; 2, W. Webster; 3, J. Rowe; 4, J. Mostyn. Points Gained: Willesden 14, Independent 10, Riverside 9, Hendon 9, Hampstead 8. The N.W.L.G.A.S. Shield was presented to Willesden & District A.S., the winners of Competition Year 1959/60, by Mr. F. Tomkins, chairman of Independent A.S. Riverside Aquarium Society (Hammersmith) were welcomed to their first competition meeting since joining the N.W.L.G.A.S. and the next competition meeting of the N.W.L.G.A.S. will be at Riverside A.S. in June.

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THE winners of two recent table shows of the **Sheffield and District A.S.** are as follow: Platies—1, R. Elliott; 2, S. A. Abdy; 3, T. Stevenson. Rasboras and Egglaying toothcarps—1, E. Townend; 2, G. Lloyd; 3, R. F. Middleton. An interesting talk, given by Mr. H. Foden of Huddersfield was well received. He spoke on various aspects of the hobby, prompted by members' questions. Mr. F. R. B. Slate, assisted by diagrams, drawn by Mr. H. Grove, gave a talk on electricity in such a manner that even the youngest member could understand how to wire the aquarium up without the possibility of faults.

The secretary, Mrs. M. Knowles, 171, Woodseats Road, Sheffield, 8, will be pleased to exchange news letters with other societies.

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AT the annual general meeting of the **Greenock and District A.S.** Mr. D. O. Carr, hon. secretary, resigned his office after holding this since the club's inauguration in 1949. However, he is now treasurer. Mr. Carr's services as secretary, and hard work given to the Club during those years, were much appreciated by the members.

The club has now settled down to the 1960 syllabus which is an interesting one and monthly table shows have been restored after a year's lapse. Membership is fairly satisfactory but unfortunately there are no lady members. Meeting nights are now held every second and fourth Wednesday of the month. The secretary is Mr. L. B. Scott, 37, Lyle Street, Greenock.

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RECENT activities of the **Oxford A.S.** included visits by members from the Reading, Basingstoke and High Wycombe Aquaria Societies, who took part in a competition to find the six best fish from each society. The result was 1, High Wycombe; 2, Basingstoke and 3, Oxford.

Mr. R. Beaton, Oxford Aquaria Society's chairman, thanked the visiting societies for attending and helping to make the evening such a success. The chairman also paid tribute to Mr. M. Gibbs, who has had to resign from the position as secretary to the society owing to business commitments.

At the following meeting a large attendance of 53, including 12 members from the Northampton A.S., were entertained at a film show given by Mr. Mason-Smith of Cambridge.

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A YEAR of interesting events and a satisfactory balance in hand were reported at the annual general meeting of the **Derwent Aquarist Club.** The chairman, Mr. Fred Reader, spoke of the possibility of inter-club table shows and referred to the forthcoming lectures by Dr. F. N. Chadfield, of Sheffield, when all interested in fish-keeping and breeding would be admitted free, but by ticket only.

Officers elected for the ensuing year were: chairman, Mr. Fred Reader; secretary, Mr. J. Cook, 36, Butler Street, Derby; treasurer, Mr. T. Swinburn; librarian, Mr. W. Gwynne; auditors, Messrs. K. Allen and J. Burrell, P.R.O., Mr. H. P. Finch. Appointed to the committee: Mr. S. Yeomans (re-elected), and Messrs. G. Ireland and M. Brighton, in place of Messrs. K. Allen and G. Hobson.

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AT a gathering of the Lancashire Section, F.O.B.S., at their headquarters, 58, Bolton Road, Salford, 6, a slide lecture was given by the well-known guppy breeders, George and Ingred Smith. Mr. and Mrs. G. Smith, accompanied by the provincial secretary Mr. Chas MacRae, had travelled up from London and were enthusiastically welcomed by members and friends.

The lecture was followed by a table show for both guppies and other tropicals. Notable amongst the prizewinners were the visiting aquarists from other local societies. The meeting wound up with a presentation to Mr. C. MacRae of a shield presented annually by the section to the Federation member who had supported the section the most in the previous year. A cordial invitation is extended to aquarists, first Sunday in the month, 2.30 p.m.

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A CLOSED show, which was successful in all respects, was held recently by the **Oldham and District A.S.** Following a rather indifferent period, the support given to this event proved that the object of stimulating interest in an effort to put the society back on its feet again had been achieved. The results were as follow: Guppies and Platys: 1, F. Greasley (platy); 2, E. Shaw (guppy); 3, A. Worswick (platy). Mollies and swordtails: 1, H. Stockton (molly); 2 and 3, H. Stockton (swordtails). Barbs: 1, C. Walker (chosen barb); 2, F. Greasley (*Barbus conchonius*); 3, C. Walker (chosen barb). Member's furnished aquarium: 1, E. Shaw; 2, H. Stockton; 3, A. Worswick. Furnished aquarium (3 species bred by exhibitor): 1, E. Shaw; 2, F. Greasley; 3, W. Lander. Best fish in show: C. Walker (chosen barb). Highest aggregate: F. Greasley.

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AT the annual general meeting of **Atherstone A.S.** the following officers were elected: president, Mr. J. T. Adcock; vice-presidents and treasurer, Mr. W. A. Wainwright; chairman, Mr. A. E. Burgess; vice-chairman, Mr. H. H. Jones; joint show secretaries, Mr. R. Dipple, Mr. J. Jones; secretary, Mr. R. A. Davis, 4, Ambien Road, Atherstone, Warwickshire. Committee, Messrs. J. Bagnall, H. Beale, J. Routledge, J. Simpson, F. Hall.

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AT **Catford A.S.** second open show an additional trophy will be awarded and has been generously given by Kingfisheries, of Beckenham. The trophy will be awarded annually for the best pair of livebearers. Many late entries last year had to be refused owing to the large number of entries received. Aquarists intending to compete at this year show, therefore, would be well advised to send their entries early. Show schedules are obtainable from the show secretary, 53, Howard Road, Bromley, Kent. The show will be held on Friday and Saturday, the 10th and 11th of June, at Catford Secondary School for Boys, Brownhill Road, Catford, London, S.E.6.

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ON the 1st April, the **East London Aquarists' and Pondkeepers' Association** received Mr. Bob Cabrow from the Hendon A.C., who gave a very interesting talk and showed many coloured slides of tropical fish. About 30 members attended. On Friday, 6th May, the first of the table shows for this year will be held and is for barbs, danios, characins and Jet Guppy. On 3rd June there is a table show for labyrinths, rasboras, Jet guppy.

The club meets on the first Friday and third Tuesday of each month at 8 p.m. at Ripple School, Ripple Road, Barking. Old and new members are welcomed.

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MEMBERS of the **Cambridge and District A.S.** were entertained at the March meeting by a very interesting selection of films by Mr. Mason-Smith. At the meeting the chairman

of the Oxford A.S. issued a challenge to Cambridge for an inter-cities show to be held annually. After some discussion it was left to the committee to make arrangements.

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A TABLE show for guppies was held at the March meeting of the **Southampton and District A.S.** Twelve fish were benched and the winners were as follows: 1, Mr. W. J. Smith; 2, Master G. Price; 3, Mr. D. Wiltshire and 4, Mr. C. Spinks. Mr. Forrest-Jones, the judge, also gave an interesting talk on the guppy, and followed this by answering members questions.

Entry forms for the Southampton Open Show, 23rd-25th June, may now be obtained from Mr. D. E. King, 55, Magnolia Road, Bitterne, Southampton.

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AT a recent meeting of the **Merseyside A.S.** the table show and quiz with Wirral aquarists was won by Merseyside, the results being: Quiz—Merseyside 17½ pts., Wirral 10½ pts. Table show results: Merseyside 52 pts., Wirral 26 pts.

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THE **Slough A.S.** open show will be held on the 10th and 11th June at the Slough Community Centre, Farnham Road, Slough. There are 34 classes for club furnished aquaria, tropical fishes and tropical breeders. Entry forms and schedules can be obtained from Mr. E. C. B. Knight, Jasmine House, Hatch Bridges, Windsor. Friday the 3rd June is the closing date for entries.

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THE recent **Dundee A.S.** bulletin gives the latest Scott Trophy placings which are as follows: 1, A. R. Bell 11 pts.; 2, A. Cross and G. B. Kirkland 8 pts.; 3, P. N. Greening 6 pts.; 4, E. J. Seymour 5 pts. In the inter-club show with Perth, Dundee were successful by 25 pts. to 15 pts. A new trophy has been presented by Mr. P. N. Greening, the hon. president, for presentation annually to the winner of the breeders (livebearers) class.

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THERE was a varied film show at **Belle Vue Society's** April meeting. "Goldfish," a Chinese film, showed how advanced in developing fantastic shapes and colours the Orient has become. The Manchester Goldfish Society were invited and there was a large and interested audience.

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FEDERATION OF SCOTTISH AQUARIST SOCIETIES

A MOST successful meeting of the Federation was held in March, when about 100 aquarists attended. The programme included a talk on "Experiments on Fish," by Mr. R. N. Campbell, of the Freshwater Fisheries Laboratories, Faskally, Pitlochry.

The table show attracted 82 entries and the winners were:

Guppies (8 entries): 1, Wallace S. Russell, Dundee A.S. (double sword); 2, Alex. Robertson, Dundee A.S. (black veiltail); 3, Alex. S. Ramsay, Dundee A.S. (double sword); 4, George Henderson, Edinburgh A.S. (lower sword). Characins (39 entries): 1, Angus Jeffrey, Kirkcaldy A.S. (*Chirodon axelrodi*); 2, J. Menzies, Kirkcaldy A.S. (*Metynnis schreitmuller*); 3, Walter Bisset, Edinburgh A.S. (*Nephanalyprion flammeus*); 4, Angus Jeffrey, Kirkcaldy A.S. (*Poecilobrycon harrisoni*). Barbs (21 entries): 1, Angus Jeffrey, Kirkcaldy A.S. (*Barbus nigrofasciatus*); 2, Harold J. Downie, Edinburgh A.S. (*Barbus stoliczkanus*); 3, J. G. Main, Inverness A.S. (*Barbus arulius*); 4, H. Berrun, Inverness A.S. (*Barbus nigrofasciatus*). Egg-laying toothcarps (14 entries): 1, Angus Jeffrey, Kirkcaldy A.S. (*Aplocheilus panchax*); William Cockburn, Dundee A.S. (*Aplocheilus lineatus*); 3, George Reid, Alloa A.S. (*Aplocheilus lineatus*); 4, Edward J. Seymour, Dundee A.S. (*Aplocheilus calliurus*). Best Fish on Show (92 entries): Wallace S. Russell, Dundee A.S. (double sword guppy).

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SECRETARY CHANGES

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

Dewsbury and District Aquarist Society (E. Glyn Peate, New Hall Cottage, 3, Nova Lane, Birstall, near Leeds). Gloucester and Cheltenham A.S. (E. C. Sturgess, 51, Tivoli Street, Cheltenham). Hampstead Aquatic Society (P. B. Unna, 120, Mansfield Road, Hampstead, London, N.W.3). Oxford Aquaria Society (A. Henderson, 132, Hiroshel Crescent, Littlemore, Oxford).

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NEW SOCIETY

RECENTLY a new society was formed in Salisbury. The name is the **Salisbury and District A.S.** and the secretary is Mr. R. C. Price, 2, Coltsfoot Close, Amesbury. Meetings are held on the fourth Friday in each month and so far there are 18 members.

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AQUARIST CALENDAR

20th May: Goldfish Society of Great Britain meeting; 2.30 p.m. at the Kingsway Hall, London, W.C.2.

10th-11th June: Catford A.S. second annual open show at the Catford Secondary School for Boys, Brownhill Road, Catford, London. Show schedules can be obtained from the show secretary, Mr. S. Cornuck, 39, Howard Road, Bromley, Kent.

10th-11th June: Slough Aquarium Society. Annual open show at the Slough Community Centre, Farnham Road, Slough. Schedules can be obtained from Mr. E. C. B. Knight, Jasmine House, Hatch Bridge, Windsor.

24th June: British Herpetological Society meeting (snakes); 7 p.m. at the Linnean Society Room, Burlington House, Piccadilly, London, W.1.

23rd-25th June: Southampton and District A.S. annual open show at The Avenue Hall, The Avenue, Southampton. Information from the show secretary, Mr. D. E. King, 55, Magnolia Road, Bitterne, Southampton.

1st-2nd July: Three Counties Show. Annual open show at Reading. Show schedules from the show secretary, Mr. G. Thompson, 57, Royal Avenue, Calcot, near Reading, Berks.

14th-16th July: Merseyside A.S. Open aquaria show at the Liverpool show, Wavertree. Details and schedules from Mr. W. T. Kelly, 31, Siddeley Street, Liverpool, 17, or Liverpool show secretary, 40/X, Victoria Street, Liverpool, 1.

15th-16th July: Bedford and District A.S. open show to be held in connection with the Bedfordshire Agricultural Show. Show schedules can be obtained from the show secretary, Mr. R. Pope, 51, Aylesbury Road, Bedford.

22nd July: Goldfish Society of Great Britain meeting; 2.30 p.m. at the Kingsway Hall, London, W.C.2.

1st-6th August: Portsmouth A.S. eighth annual open show at the Twyford Theatre, Portsmouth Community Centre, Twyford Avenue, Stamshaw, Portsmouth. Show schedules can be obtained from the show secretary, Mr. W. Ryder, 493, Commercial Road, Portsmouth, Hants.

24th-27th August: The Midland open show, Bingley Hall, Birmingham. Schedules available from Mr. J. Edwards, 6, Amy Terrace, Osler Street, Birmingham, 18. Entries close 9th August.

9th-10th September: East London Aquarists' and Pondkeepers' Association annual open show at the Central Hall, Barking Road, East Ham, London, E.6. Details can be obtained from the secretary, Mr. E. Saunders, 32, Claremont Road, Forest Gate, London, E.7.

24th September: Kingston open show.

22nd-23rd October: British Aquarists' Festival, Belle Vue Zoological Gardens, Manchester. Schedules from Mr. Geo W. Cooke, Spring Grove, Fieldhill, Batley, Yorks.

Crossword Solution

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

Shirley Aquatics Ltd.

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Blood-red Goldfish breeding pairs, 6" **20**/-, 7" **30**/-, 8" **40**/-

Deep-red Comet-tailed Goldfish breeding pairs, **40**/- and **60**/-

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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. Sundays 10 a.m.—12 noon. May—July Sunday afternoons also. TERMS OF BUSINESS—Cash with order please. Fish sent by rail. Tropical minimum order £5, insulated container and carriage 10/-. Cold-water minimum order £2 plus 10/- can and carriage. Plants by post (minimum order 10/-) please add 1/6 post and packing.