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AND PONDKEEPER

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Editor: ANTHONY EVANS

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Dr. Myron Gordon, geneticist to the New York Aquarium, visits Britain this month for an aquarists' lecture tour on behalf of "The Aquarist," and he also contributes an article on the genetics of the fighting fish to this issue.

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Editorial

WATER reaction and its importance in fish-breeding is one of those topics which if investigated by an aquarists' opinion poll would probably yield an analysis of 33⅓ per cent. "for," 33⅓ per cent. "against," and 33⅓ per cent. "don't know." But through the years evidence has been slowly accumulating to show that the acidity or alkalinity of aquarium water can be a strong contributing factor to breeding success. It is, of course, necessary to recognise that pH—to use that exotic symbol for the quantitative expression of water reaction—is not the whole solution for those problem children of the aquarist, the recalcitrant breeders.

Reaction and dissolved solid content of the water seem to be complementary factors for these fishes, as an author of an article in this issue points out, and one cannot be considered without the other. Evidence suggests that pH values over a moderate range on either side of neutrality do not themselves affect fish eggs very much. On the other hand the eggs are sensitive to dissolved solids and they can also be adversely affected by the presence of organisms which are encouraged by alkaline water conditions. Therefore "soft" water—water with low content of dissolved solids—is desirable for breeding use, and it is, incidentally, more easily influenced to assume the favourable slightly acid character than is hard water. Gone is the theory that once threatened to hold sway: that each different kind of fish could be linked with a pH number that ensured a spawning.

Adjustment of water pH to the acid side of neutral can be to no purpose if the water is rich in dissolved solids; it is essential to use soft water. The whole matter of altering aquarium pH is one fraught with difficulties, but the peat method of obtaining acid water described by Herr Walter Bertholdt in his article is one widely (and successfully from the breeder's viewpoint) used in Germany to-day. It has the big advantage of being quite safe to employ. Moreover, it should be possible to obtain the same result after some experimentation by using relatively pure preparations of the organic acids from the peat, thus simplifying the procedure considerably.

Heredity in Siamese Fighting Fish

by Dr MYRON GORDON
(*Geneticist, New York Aquarium*)

Photo: Sam C. Dunton, N.Y.Z.S.

Long-finned male Cambodia fighter (left) with a "wild type" short-finned male fighter

THE inheritence of the complex colorations of the fighting fish is a complicated story when considered as a whole. If the various hereditary elements that make up the complexity are taken one by one, however, they may be understood more easily since each colour factor may be traced by applying the principles of simple Mendelian inheritance.

In the study of colour inheritance in other fishes, it was found useful to make clear that the complexities of colour patterns may be broken down to a number of simple components. In the fighting fish, as in many other species, the colour patterns depend upon the kind, number and position of various pigment cells. It has four basic kinds of colour-bearing cells or chromatophores:

1. *Iridiophores* contain guanin crystals which are capable of producing steel-blue, blue, and green colour effects.
2. *Melanophores* contain melanin, or black pigment particles which produce olive, dark brown, or black colour tones.
3. *Erythrophores* contain red pigment or pterines which produce orange or red effects.
4. *Xanthophores* contain yellow colouring matter or xanthines.

The account which follows is based upon the discoveries of Umrath and Eberhardt of Germany, and Goodrich and Wallbrunn of the United States.

Two Genes Control Iridescence

1. Gene *Ri*

Since the iridescent colours are so striking in the *Betta* let us first see how these are controlled by genic action. The fish's ability to produce the iridescent effects depends upon the gene *Ri-ri*. Eberhardt derived the symbol of the recessive gene *ri* from the observation that this gene radically *reduced* the number of *iridiophores*. When this gene is in the dominant phase, either *RiRi* or *Riri*, iridiophores cover the body and fins with the exception of the head region. When Eberhardt mated a highly iridescent male (*RiRi*) with a non-iridescent female (*riri*), he obtained 147 (*Riri*) fish in the first generation all of which were highly iridescent. When he mated an *riri* male with an *RiRi* female he again obtained, in the F_1, all iridescent fish (*Riri*), of which there were 167.

When he mated the highly iridescent fish of the first generation he obtained a total of 185 in the second generation. Of this number, 136 were highly iridescent and 49 were non-iridescent. Theoretically, if the 3:1 ratio worked out perfectly, he should have obtained 138 to 46. The results were very close to what he expected. The mating just reviewed may be expressed in genetic terms as follows:

P_1		
Iridescent		Non-iridescent
RiRi		*riri*
F_1		
Iridescent		Iridescent
Riri		*Riri*
F_2		
3, Iridescent	:	1, Non-iridescent
1 *RiRi*, 2 *Riri*	:	1, *riri*

2. Gene *v*

Now if a fighting fish is iridescent because it is carrying the dominant gene *Ri*, it may have one of three kinds of iridescence: green, blue, or steel-blue, depending upon a second gene *V-v* which influences the condition of the guanin crystals within the iridiophores. Earlier, in 1938, Umrath crossed variously coloured fighting fish and found as follows:

1. Steel-blue × Steel-blue = All Steel-blue
2. Green × Green = All Green
3. Steel-blue × Green = All Blue
4. Steel-blue × Blue = 50 per cent. Steel-blue, 50 per cent. Blue
5. Blue × Green = 50 per cent. Blue, 50 per cent. Green
6. Blue × Blue = 25 per cent. Steel-blue, 50 per cent. Blue, 25 per cent. Green

Eberhardt, in 1941, found essentially the same results and attributed them to the work of the *V-v* gene for *viridis*, green. When the gene is double recessive, *vv*, the guanin crystals in the iridiophores reflect the light so that greenish colouring is produced. In the heterozygous state, *Vv*, the gene causes the iridiophores to produce the colour of blue; and in the homozygous dominant phase, *VV*, the iridiophores, through the action of the gene, produce a steel-blue colouring. This may be clarified by presenting the results in the usual genetic terms (see Chart 1):

P_1		
Steel-blue	×	Green
VV		*vv*
F_1		
Blue		Blue
Vv		*Vv*
F_2		
1, Steel-blue	2, Blue	1, Green
VV	*Vv*	*vv*

These results point up a new and interesting variation on the familiar Mendelian 3 to 1 ratio which is expected in the second generation: the 3 to 1 ratio may also be expressed as

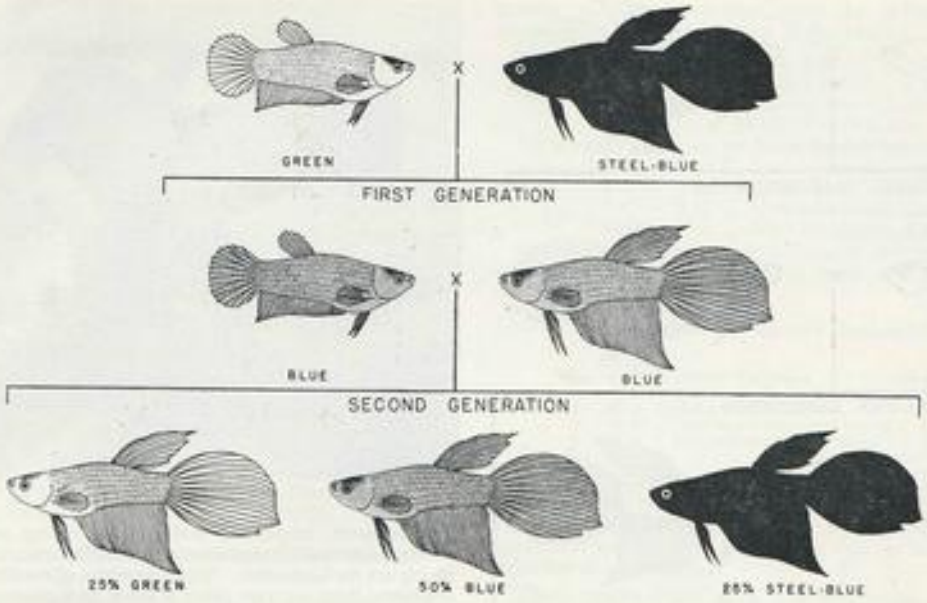


Chart 1: Results of crossing green and steel-blue fighters (see text)

1 to 2 to 1. Let us see if this F_2 theoretical ratio (1 : 2:1) is in harmony with the numbers of the various colours that Eberhardt actually obtained in the second generation. By mating two blue fighting fish of the first generation ($Vv \times Vv$) he obtained 309 F_2 fishes which were classified as follows:

	Expected	Observed	Ratio	Genotype
Steel-blue ..	77	82	1	*VV*
Blue ..	155	163	2	*Vv*
Green ..	77	64	1	*vv*
Total ..	309	309		

His results are very close to the theoretical expectancy and so we are justified in accepting the explanation of the inheritance of the iridescent colours in the fighting fish.

The method of inheritance of green, blue and steel-blue is slightly different from the ordinary type of inheritance. First, the interaction of two pairs of genes is involved. The gene *VV* will not produce steel-blue, nor will *Vv* produce blue, nor *vv* green, if at the same time the fighting fish is homozygous recessive for the *riri* gene. Only when the dominant *Ri* gene is present will the various combinations of the *V-v* gene produce their effects. This type of interaction of genes resembles the interplay of the genes *E*, the modifier of comet, and *Co*, the gene for the comet marking, to produce the wagtail pattern in the platyfish. Second, *VV* gene is expressed differently from the heterozygous form *Vv*. In this aspect the wagtail reaction is dissimilar, because *Ee*, *Coco*, *EE CoCo* or any other combination of dominant *E* and *Co* produces the same effect.

From the analysis of the two basic genes for iridescent colours in the fighting fish the following summary may be useful in determining the hereditary constitution of the variously coloured fish:

RiRi (or *Riri*) *VV*, Steel-blue	*riri VV*, Greyish-brown
RiRi (or *Riri*) *Vv*, Blue	*riri Vv*, Greyish-brown
RiRi (or *Riri*) *vv*, Green	*riri vv*, Greyish-brown

Three Genes Control Dark-Light Coloration

1. Gene *c* for Cambodia

The Cambodian variety of the fighting fish was a sensation when it was first introduced to American tropical fish fanciers in 1927, for never before was a light flesh-coloured fish with long flowing, blood-red fins seen in this or any other species. According to Dr. H. M. Smith, the variety was developed in Siam about 1900. At one time the Cambodia, owing to its striking coloration, was regarded as a distinct species of *Betta*, but breeding experiments and careful anatomical studies proved that this was not so. The Cambodia is one of many colour variants of *Betta splendens* and as such does not warrant a distinct scientific name. The hereditary difference depends upon one important gene which inhibits the formation of melanin pigment, much as the golden gene *g* transforms the wild type of platyfish to the gold platy.

Back in 1934, Dr. H. B. Goodrich and his student, Rowena N. Mercer, announced that the Cambodia type of fighting fish is recessive to the dark wild type. For example:

1. When they crossed two Cambodias together they always obtained nothing but Cambodia offspring.

2. When they mated a Cambodia with a wild type of fighting fish they obtained half Cambodia and half dark-coloured fish.

3. When they took the dark-coloured fish from the last type of mating and crossed them together they obtained approximately 3 dark fish to 1 Cambodia.

From their experiments they tentatively called the recessive gene *c* and the dominant *C*, the symbol *C* standing for *Colour*. This term has been adopted by Eberhardt. The action of the *c* gene seems to be similar to the gene that produces golden coloration in the platyfish, swordtail and guppy. This points up a frequent parallelism of some mutations in many species of fishes.

Any doubt that the early American investigators had concerning their opinion that Cambodia was a simple Mendelian recessive trait was dispelled by Eberhardt. When he mated wild fighting fish with Cambodia (or some very much like them because they, too, were pale fish with only the eyes being black), he obtained in the first generation 463 individuals of the wild type. When he mated F_1 fish that were of the wild coloration, he obtained 840 fish in the second generation of which 622 were wild type, and 218 were of the Cambodia type. On the basis of the simple

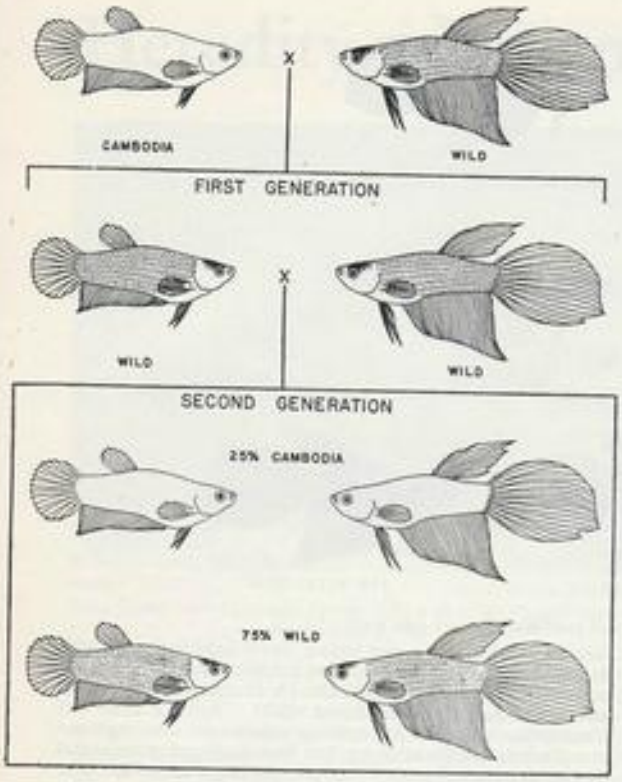


Photo: Dept. Animal Behaviour, Am. Mus. Nat. Hist

Dark-coloured, long-finned male fighter mating with a light-coloured Cambodia female beneath the bubble nest. All their offspring are dark-coloured. When members of the first generation are mated there are three times as many dark-coloured fighters as light-coloured ones produced

(Left) Chart 2: *Crossings made to show that the Cambodia fighter type is recessive to the wild fish*

Mendelian ration of 3 to 1, which may be anticipated in the F_2, he expected 630 wild and 210 pale ones, so that his results are extremely good (see Chart 2). This series of experiments may be outlined in genetic terms as follows:

P_1

Wild, Dark Brown *CC* × Cambodia *cc*

F_1

Dark Brown *Cc* × Dark Brown *Cc*

F_2

3, Dark Brown (1 *CC*, 2 *Cc*) : 1, Cambodia (1 *cc*)

In an additional mating, Eberhardt back-crossed one of the dark-brown fish of the first generation (with the genetic constitution of *Cc*) to the Cambodia type of fish (whose genetic constitution is *cc*). His results in the next generaton were as follows:

Back-cross Experiment

	Expected	Observed	Ratio	Genotype
Dark brown	451	475	1	*Cc*
Cambodia ..	451	427	1	*cc*
Total ..	902	902		

The results are quite close to expectancy. It firmly establishes the fact that the pale golden or the Cambodia type of fighting fish is a simple recessive to the wild, darker form.

2. Gene *dl* for Bald Top

Eberhardt worked out the inheritance of a peculiar variety of fighting fish which he called *dorsum lucidium* because its topside, from the head to the dorsal fin, was quite light in colour. It is a curious fact that American and English geneticists usually choose common names to denote genetic varieties, but the Germans prefer latinised names. From the words *dorsum lucidium*, he derived the gene *dl*. Think of *Dorsal Light* and you will have little trouble in remembering the derivation of the symbol *dl*. The patch of whiteness on and near the head resembles a bald spot and I will call it that. The variety is not popular because some aquarists think the bald spot is a sign of disease.

Eberhardt made the usual tests with the bald fighting fish by mating them to the wild type which have normal grey backs. He found that, in the first generation, all 420 fish were coloured like their wild parent. When he mated some of the F_1 grey-backed fish together he obtained 514 young in the second generation of which 368 had normal grey backs while 146 were bald. On the basis of the 3 to 1 ratio, expected in the F_2, the ideal results would have been 386 wild to 128 bald fighting fish. From his results he concluded that *dl* is a simple Mendelian recessive gene. The inheritance of the bald trait may be expressed as follows:

P_1

Wild, Grey-backed *DlDl* × Bald *dldl*

F_1

Grey-backed *DlDl* × Grey-backed *DlDl*

F_2

3, Grey-backed (1 *DlDl*, 2 *Dldl*) : Bald *dldl*

To double-check his results, Eberhardt back-crossed an F_1 grey-backed fighting fish to a bald one. This mating may be expressed in genetic terms as follows: *Dldl* × *dldl*.

The results expected from this back-cross of an F_1 to a homozygous recessive should fall within the ratio of 1 *DlDl* to 1 *dldl*. Here are the actual results compared with those expected on the basis of 616 fish obtained from the back-cross:

Back-cross Experiment

	Expected	Observed	Ratio	Genotype
Grey-backed	308	296	1	*DlDl*
Bald ..	308	320	1	*dldl*
Total ..	616	616		

The results are extremely close to expectancy and confirm Eberhardt's conclusion of the simple Mendelian nature of *dl*.

Combinations of Cambodia with Iridescence

Starting with known genetic strains, Eberhardt was able to combine the various hereditary traits and he could predict the colour and the frequency of the combined types. One example of this sort will show how he combined the flesh colouring of Cambodia (*c*) with the overall iridescence (*Ri*). This may be expressed as follows, up to the first generation:

P_1

Non iridescent, Cambodia *riri cc* × Iridescent, Dark Brown *RiRi CC*

F_1

Iridescent, Dark Brown *Riri Cc* × Iridescent, Dark Brown *Riri Cc*

Before the investigator mated two F_1 iridescent, dark-brown fish he could have predicted that in the second generation he should get the following types in the frequencies of 9:3:3:1. He could have worked out the 9:3:3:1 ratio by employing the familiar Punnett Square method, but perhaps the one that follows may be more convenient and it may be done more quickly. Since we are concerned with finding the solution to the problem of *Riri Cc* × *Riri Cc*, let us consider one gene pair at a time.

We know that *Riri* × *Riri* should produce 3 *Ri* to 1 *ri* in the next generation. We also know, considering the second gene pair that *Cc* × *Cc* should produce 3 *C* to 1 *c* in the next generation. We may then write the problem this way, preparatory to multiplication of the two sets:

$$\begin{array}{r} 3\,Ri + 1\,ri \\ 3\,C + 1\,c \\ \hline 9\,Ri\,C + 3\,Ri\,c + 3\,ri\,C + 1\,ri\,c \end{array}$$

Or we may write the problem in this manner:

3 *Ri* { 3 *C* = 9 *Ri C*, Iridescent, dark brown
1 *c* = 3 *Ri c*, Iridescent Cambodia

1 *ri* { 3 *C* = 3 *ri* C, Non-iridescent, dark brown
1 *c* = 1 *ri c*, Non-iridescent, Cambodia

Below are the results that Eberhardt did obtain, together with what he predicted, on the basis of 272 fish, in the second generation:

Results in the Second Generation

No.	Phenotypes	Colour Expressed	Obtained	Expected
9	*Ri C*	Iridescent, Dark Brown ..	155	153
3	*Ri c*	Iridescent, Cambodia ..	57	51
3	*ri C*	Non-iridescent, Dark brown	49	51
1	*ri c*	Non-iridescent, Cambodia	12	17
Totals 16	4	4	273	272

A comparison between the four colour types among the 273 second generation fish shows clearly that Eberhardt's prediction was accurate. Results as close as he obtained are regarded as conclusive.

These results point up a principle which should be of value to the fish fancier, one that he could use and apply with profit. Suppose, for example, he wanted an *Iridescent Cambodia* stock but none were available and all he could purchase were non-iridescent Cambodia and iridescent grey-browns. The fancier has but to combine the two desirable traits by making the matings indicated above, grow the F_1 hybrids to maturity, mate them together, and he eventually will obtain 3 Iridescent Cambodia in every 16 second-generation offspring. Is this not a time consuming job? Yes, it is, but it is the quickest positive way known.

(*To be concluded next month*)

Euglena viridis—Protozoan Fry Food

by JAS. STOTT

DURING the past year a member of the class of flagellated protozoa has received the limelight, in certain parts of the country, for being a useful and nourishing intermediate fry food when given more or less as a pure culture; it is *Euglena viridis*, and some details about this protozoan may be of interest.

Euglena is probably one of the commonest members of the flagellates and occurs at times in ponds in such considerable numbers as to colour the water a vivid green. It is somewhat spindle-shaped when inactive but its form frequently changes, for it is capable of expansion and contraction; this helps its locomotion. The principal means of movement, however, is by the long flagellum which is situated at one end of the organism.

Mode of Feeding

In the centre of its single cell body is a spherical nucleus and a contractile vacuole is situated towards the flagellated end. A considerable number of coloured bodies throughout the protoplasm are responsible, under suitable conditions, for the green coloration of the protozoan. It is the presence of these which enables *Euglena* to exist like a plant; in other words, they are holophytic feeders when conditions permit, using the chlorophyll in them and the energy of sunlight to synthesise organic substances from inorganic material.

The hair-like flagellum of the unicellular organism Euglena is seen in this drawing from a magnified specimen

When, however, *Euglena* is in conditions where the water is rich in organic matter it is capable of becoming a saprophytic feeder, in which state organic compounds, resulting from decaying animal and vegetable matter, are taken in through the surface of the "body." Under these conditions the chlorophyll bodies lose colour and size and the protozoan becomes a pale greyish-green, almost translucent.

Food value of *Euglena* for fish fry should be reasonably high, but if it is fed as a pure culture entirely variety may be lacking in diet. Alternate feeding with other forms of culture may be necessary to obtain the full value of the *Euglena* culture.

A page for the beginner contributed by

A. BOARDER

DURING the month of September you may find many young fish in your pond which have been hatched during the year. All kinds of goldfish are bronze when young except the shubunkin types, most of which change colour early. I have sometimes heard of pond-keepers who have thought that young of common carp have been placed in the pond. These people have probably been surprised when some of the fish have started to turn gold. In any pond of a fair size it is almost certain that healthy goldfish will have bred, and if there has been plenty of growing water plants for cover, many youngsters may reach maturity. The unfortunate part of this semi-natural breeding is that if some of the goldfish do not change colour they will breed later on and in time the strain of goldfish in the pond may be spoilt by the number of uncoloured fish; they appear to become more numerous each year.

It is not an easy task to keep such fish from breeding, but if the pond is not too large it may be possible to empty it each year and so remove all those fish of breeding size which have not changed colour. Some strains of fancy goldfish change colour much earlier than others. As long as proper selection of the breeders is made, the strain can be so improved over a few years that this early colour change can be definitely encouraged. Not that this is all that matters; even with a quick changing strain a lot also depends on the subsequent treatment and the amount of sunshine which the fry can get. In some seasons when there is plenty of sunshine I have noticed that the fry tend to change colour much earlier than in a cold summer. Where they are grown on well it is also a fact that they develop the tendency to change early, and nothing assists the growth more than giving them plenty of room.

This matter of space cannot be over-emphasised, as I am sure that strong, healthy fish cannot be reared unless they have plenty of space in which to grow. I have heard of aquarists who think that they can help colour change by using artificial lighting. I am not sure that this is possible and it is always rather difficult to be certain what has actually helped the colour development. In the first place, among a spawning of fish it is seen that some of the fry will change colour much more quickly than others, and I have noticed that in my fantail youngsters some change colour in three months and others may take over a year. Secondly, if the fry have had plenty of growing foods it does encourage them to develop more quickly. Unfortunately if the fry are all being reared in the pond this extra treatment cannot be given easily.

The breeding fish may spawn again but I do not think that the resultant fry will be of much good. The shorter days mean that the fry have less chance of growing on, and also the weather may not be as kind to assist their growth. The fish in the pond should be fed as often as possible during this and next month. I am certain that if the pond fish are well fed in the late autumn they build up to such an extent that they are able to withstand many of the troubles to which they may be prone. Some of these troubles do not become evident until the spring, and pondkeepers do not often connect the trouble with something they have neglected the previous autumn.

A special check should be made now on all fish in your indoor tanks. Where a tank was set up with a fair number of fish in the spring, the fish may have grown so much since that there are now too many for the tank. The maximum number will be one inch of fish to each 24 square inches of surface area. Do not take notice of the tail when measuring. I know that to measure a fish when in its tank is no easy matter. I generally mark off some inches on a piece of paper and hold it against the glass of the tank and wait for the fish to swim by. Even if you cannot be quite sure you can get a very good idea of the size of the fish. If the limit has been reached you must remove a fish so that the others can remain healthy.

If you have any trouble keeping goldfish types healthy in a tank why not try one or two paradise fish? I have been keeping and breeding a strain of these fish for some years now and I find that they live quite well in an unheated tank in my living room. Some writers say that under cold conditions the paradise fish will lose their colour and fail to breed. I disagree with this, as I have proved that in a room even where the temperature drops to 40° F. in the winter, these fish will remain healthy. I have bred fish in such conditions which have themselves bred the following year, and for colour they are hard to beat.

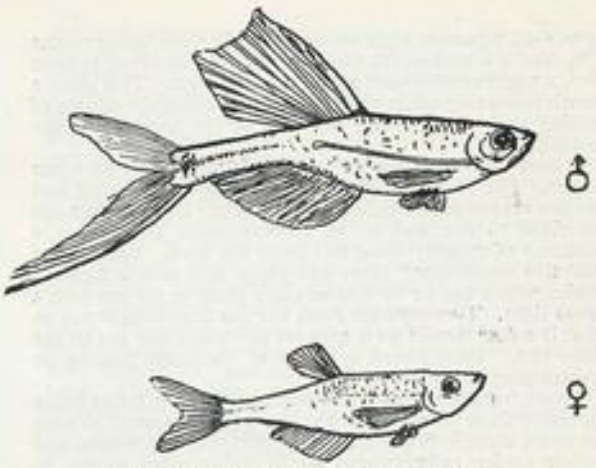
The paradise fish (*Macropodus opercularis*) is what is known as a labyrinth fish, which means that it has the power to take air from the surface when the water becomes foul or so warm that the oxygen content is lessened. Therefore such fish make fine subjects for the beginner. In addition they are not fussy feeders and will take most types of dried foods, including Bemax and dried shrimp. Of course they are very fond of live foods such as *Daphnia* and garden worms, and if small worms are given the fish soon become tame enough to take them from the fingers. These fish grow from two to three inches long and appear to me to be long lived. If they are kept in cool conditions they are likely to live far longer than if they had been kept under tropical conditions. They are very handsome fish, being a russet shade with greenish-blue vertical stripes. The head is spotted with black and the fins are red.

Paradise fish are bubble-nest builders and to watch the breeding performance is most interesting. I have found that a good pair of breeders will look after the fry quite well for some time, especially if there is plenty of room in the tank. Paradise fish are sometimes accused of being bullies, but I often find that the behaviour of fish is influenced by the treatment meted out to them. For instance, if these fish are kept in crowded conditions and sufficient food is not given, then the larger fish will almost certainly become a bully. When such conditions occur the fish are blamed when bullying happens, whereas the aquarist is to blame. My advice is to give these fish a fair trial and with the right conditions and the correct foods, no trouble will be found in keeping these fascinating fishes.

The Paddle-Gill

(Corynopoma riisei)

ORDER:—Ostariophysi, from Greek *ostarion*—a little bone, and Greek *physa*—a bladder.
FAMILY:—Characidae, from Greek *charax*—a sea fish.
SPECIES:—*Corynopoma riisei*—from Greek *koryne*—club-shaped bud or shoot, and Greek *pomatos*—a cover. *Riisei*, after the zoologist, A. H. Riise.



Male paddle-gill (above) and female (below)

CORYNOPOMA riisei is a native of Trinidad, where it was first discovered almost a hundred years ago. It is not a showy fish, head and body being a beautiful, flashing silver, and fins almost completely transparent. Nor is it large, seldom exceeding two inches in length (excluding the tail). Male and female are both the same body size, and when young are almost impossible to distinguish. Mature males, however, bear no resemblance at all to the females, as reference to the accompanying sketch will show. The dorsal fin of the male is almost two-and-a-half times as high as its basal width, and is borne proudly, spread like a fan. In addition, the lower rays of the bottom lobe of the caudal fin grow so long that they give rise to one popular name of "swordtail characin."

It must be emphasised here and now that this caudal extension has *not* been produced by crossing *Corynopoma* with the ever-popular *Xiphophorus helleri*, although I have heard this suggested quite seriously by people who should have known better. The most remarkable feature of the male fish is the presence of two very long, thin outgrowths, each terminating in a tiny discoid plate, which grow (one each side) from the centre of the free edge of its opercula. Normally these are carried close to the side of the body, in which position they are practically invisible, but as the mating season approaches, the male begins to look around for a likely female, and having found one, swims frequently alongside her, or circles round quite near her, waving the paddle-like filaments in her direction, in what appears to be a definite attempt to attract her attention. More often than not the female seems to ignore him. After a period of this sort of thing, he swims away, apparently no longer interested in females.

Theories Concerning Reproduction

What follows are facts which have given rise to several different theories, none of which has yet been proved one way or the other. The facts are that after the male has lost interest, the female begins to visit various broad-leaved plants, and after roughly cleaning a spot, usually on the underside of a leaf, presses a number of eggs from her vent upon it. The procedure is repeated again and again until her oviducts are empty. *At no time does the male approach her or the eggs*, but the eggs are fertile.

Theory number one is that the milt of the male, which must have been discharged during his courting display, is taken into the mouth of the female, placed upon the leaves when she cleans them, and pressed into the eggs she fixes to the leaves.

Theory number two is that the milt is present in quantity in the water, and fertilises the eggs in the usual way.

Theory number three, to which I confess I rather incline, is that the milt enters the oviduct of the female and fertilises the eggs found therein, so that when pressed upon the plants they are already fertilised. Some day, an enterprising pisciculturist will devise experiments from which a definite conclusion can be drawn. We must not be ignorant for ever.

The number of eggs glued to the leaves seldom exceeds 100, and upon completion of her spawning, the anxious mother-to-be assumes strict guard over them, frequently changing them to fresh positions and refusing all food until several days after they hatch, which in a temperature of 77° F. is within 36 hours. Even when newly hatched, the male still ignores the fry and his spouse, and can apparently easily distinguish between them and *Daphnia*, carefully sorting out the latter.

Transparent Fry

The fry are very small, and almost completely transparent. After absorption of their egg sacs they can eat only the smallest of foods. Nothing is better during these first few days than water which is thick with free-swimming, unicellular algae. Follow this with Infusoria, *Cyclops* nauplii, baby *Daphnia*, micro worm, pulped earthworm, brine shrimp, and above all the food to which they are most addicted—mosquito larvae. In their native habitat, they are rated second only to the guppy for their value in destroying these embryo pests. If possible, seek for the egg rafts of gnats and mosquitoes, and place them on the surface of the fry tank. You will then be doing a signal service to your fishes and to mankind.

Temperature tolerance is from about 66° to 86° F. At the higher temperature growth will be more rapid, but if maintained consistently will reduce resistance to the lower range, and shorten life. *Corynopoma* are best kept on their own—not because of their habits, which are peaceful, but because their delicate transluscence is overshadowed in the presence of more vividly and solidly coloured fishes. Their general appearance is enhanced when in a well-planted tank, the vivid green of the plants forming an excellent foil to their delicacy.

Although they pose well in exhibition tanks, the general habit of showing them in a mixed class of characins does not give them a fair chance. A swordtail characin should be judged against another swordtail characin, and not compared with such fishes as the flame, the neon, the serpae, and rosy tetra, etc.

AQUARIST'S Notebook——

by
RAYMOND YATES

SOME aquarists keep several tanks in their living rooms and it is well worth the slight expense involved to have a small switchboard made for each room. This gives a much more tidy effect and obviates the unsightly masses of tubing and wiring which one sees at the homes of some fanciers.

I have used this idea for years and have found no snags so far. The switchboards which I use are quite small and do not exceed seven inches by 10 inches. Usually they can be fixed to the wall in an inconspicuous position at a distance of roughly three feet from the floor. Each board has five small sized three-pin plugs and also a lighting fitting which can be used as an extra point or for use with a neon light. Two separate fuses are put into each board so that if a fuse should go it goes on the board and not in the fuse box. Each board is wired to the main heating or power-plug in the room.

Apart from the heaters and pumps and cover lights being operated from these panels it is also a simple matter to plug in radio, electric clocks and other electrical appliances, and where similar switchboards are in use in other rooms, to change over pumps and the like from one room to another. As plugs are constantly being pushed in or pulled out it is a wise policy to paint the plugs which provide the current for the heaters (and thermostats) a bright colour (I use yellow), which acts as a warning. All one needs to do to be sure that the power is on is to see that all coloured plugs are in position and the neon light lit up. In summer, with the warmer weather, the neon light can be dispensed with and the socket used for another purpose.

When siphoning water from a tank in any quantity it is most important to switch off the heating unit first. If this is not done, the falling water level will result in the thermostat switching on the heater, and if the whole of the water is siphoned off, the heater will be exposed to the air. A burn-out is the least trouble you could expect in such an instance and it is very easy indeed to crack the bottom glass of the tank if the heater is in contact with it in the absence of the usual water blanket.

* * *

Small angels are relatively cheap to buy these days but large specimens still command a fair price. Generally speaking it is better to buy small fish and grow them up with heavy feedings of live food (garden worms, *Tubifex* and liver) but do not get them too small. Very young angels are not easy to acclimatise to new tanks and are best avoided. Specimens which have reached a body size of half-a-crown give the best results, as by this time they are strong fish, well formed and much less "touchy." When buying large adult fish it is a wise policy to see that they are not off their food and to have them caught with a large net and carried in a wide-mouthed container holding about a gallon. Small nets, narrow-necked jars and cramped quarters terrify angels. A guiding principle for dealing with this fish is to "leave angels alone." They should never be moved unless absolutely necessary, and even when they are "off colour" all will probably be well if they are left alone.

* * *

The majority of aquarists paint the backs of their tanks black or alternatively put black paper or something similar at the back. This gives a better effect and prevents light entering from that side. The two ends, however, are rarely bothered with, which is a pity. It is a good plan to stick some black paper cut to size to the top of each end glass with the aid of transparent cellotape. The bottom of the paper blind can be weighted and stiffened with cardboard.

The effect of this is that harmful sidelight is stopped (except through the front glass) and the fish have only one window, a fact they soon learn and demonstrate when you are about. Shy fish which normally hide away behind rockery, dense plants and the like frequently hide away near your "blinds" and these can be lifted as required in the practical certainty that something will be on view. Kuhlii loach are a good example of fish which retire from the ordinary front view but can be observed through the side blind system.

* * *

Some time ago I walked into a dealer's shop on a quiet afternoon when no other customers were in and found the staff all hard at work on tongue twisters of this type. "An imaginary menagerie manager imagined he was manager of an imaginary menagerie." They assured me that they were merely passing the time but I wondered if this was not, perhaps, a form of speech training course the better to say to customers such phrases as "There are some fine *Lepidocephalichthys thermalis* in this tank," or "We expect 20 or 30 *Cnesterodon decemmaculatus* to-morrow," or possibly "These are the first specimens we have had of *Pseudopimelodus parahybae*."

* * *

One society I know took the trouble to go through the records of the local library and list all the books therein on the hobby or related subjects. This was then duplicated and issued to all interested. The surprising thing was that the list contained over 30 different books. Other clubs could well follow this example.

* * *

I am often asked by newcomers to the hobby "which is the easiest fish to keep?" Well, there is no stock answer to this because the experiences of aquarists vary and fish which one hobbyist finds easy are heartbreak to another. For my part I have tried for years to keep leeri gourami but all to no purpose. Usually they do not last a week with me although I once managed to keep an adult pair for six months, only to lose both fish within the space of two days.

Some people complain that tiger barbs and angels are difficult whereas my experience is that they are simplicity itself to keep. Lacking any form of statistical records we can only give our own personal opinions on this topic, but we can point out that surface feeders live shorter lives in an aquarium than middle or bottom feeding fish, and that large specimens, although hardier, have a relatively short life span before them. An example of this is *Apistogramma perteuse*, which rarely lives longer than 12 months. Large specimens are frequently offered for sale quite cheaply but they have only a month or so to live.

Most varieties of tropicals are to-day kept with such comparative ease that the wisest course is to recommend any of the more widely-kept characins or barbs, and to refer to some which are not easy to keep. The beginner should be warned off as regards harlequins, half beaks, hatchet fish, glass catfish, dwarf gourami, leeri gourami, platys, mollies, small angels, tiger barbs, *Cichlasoma festivum*, orange chromides and egg-laying toothed carps. I have found that the following fish when in my tanks seem practically immune from troubles and generally live so long that they have to be given away eventually—Australian rainbows, giant danios,

(*Please turn to page* 118)

Characteristics of Water for Fish-breeding

by WALTER BERTHOLDT

THERE is no doubt that the chemical composition of aquarium water is the key to the successful breeding of many tropical fish and to proper cultivation of our aquatic plants. I am thinking here especially of the hardness or softness of the water and its pH value. Of course, these factors are of no importance if we only wish to propagate guppies, platys, labyrinth fish, etc., and if we only have *Vallisneria*, *Elodea*, water sprite, *Sagittaria*, etc. These fish breed in the usual tank water, and no special attention is necessary to grow these plants, provided they get the required minimum of light.

But how different is it when we wish to raise the so-called "problem fish"—neon tetras, glow-light tetras, rosy tetras, *Rasbora*, *Nannostomus*, *Poecilobrycon*, and the *Aphyosemion* species. The same refers to delicate plants such as *Cabomba*, *Myriophyllum*, *Ambulia*, *Cryptocoryne* or the Madagascar lace plant. I remember my numerous experiments in the years when I was trying in vain to spawn these difficult fish. I tried almost everything: fresh water from the tap, seasoned water, very old water, pond water, spring water and so on. All these trials brought only very poor results, or an occasional success perhaps, which failed, however, when tried for a second time. How was it possible for instance that neon tetras were only successfully and most easily bred in the province of Saxonia in Germany, whereas in all the other parts of the country aquarists had no success at all?

Acidity and Hardness

The last years finally brought the solution of the riddle. Soft and acid water was the secret! Water tests in the above mentioned province of Saxonia showed that the water there was extremely soft. At the same time water analysis of tropical waters of the Amazon district, the native country of the neons, and the Malay Peninsula, where we find the native haunts of *Rasbora*, showed the most interesting fact that all these waters were extremely soft, viz., 0.5 to 2.5 degrees of German hardness. The pH value varied between 6.0 and 6.6.

For the explanation of the term "degrees of hardness" I would like to explain that we measure in Germany the hardness of the water in degrees of hardness. One German degree of hardness (abbreviated 1° DH) means that 10 milligrams of lime or lime salts are contained in one litre of water (4.5 litres of water make one British gallon). I refer in this connection to Dr. Werner Ladiges' excellent book *Der Fisch in der Landschaft*, in which a number of chemical water tests of tropical waters are contained.

It is therefore obvious that a successful propagation of the problem fish is only possible in soft water, which, if at all possible, should be slightly acid. One has found out, for instance, that the spawn of neon tetras is extremely sensitive to Infusoria and bacteria, which destroy the eggs. The *Aphyosemion* species only do well in water which is comparatively free of Infusoria. As soon as these beautiful fish are kept in water which is rich in Infusoria, the gills turn red and respiration is accelerated. If the fish are not placed in time in water poor in Infusoria they die without fail. Alkaline water, exceeding pH 7, is generally rich in bacteria and Infusoria, especially if uneaten food and fish and snail droppings are decomposing in it. But acid water kills off Infusoria and bacteria. We see, therefore, how important it is to keep the water on the acid side.

Now there are certain relations between soft and acid water on the one hand and hard and alkaline water on the other. Hard water generally tends to be alkaline, whereas soft water is almost always neutral or slightly acid. Our tap water is generally too hard for the successful spawning of the problem fish. London tap water has a hardness of 25° DH, and consequently may be classified very hard. If you wish to have exact details regarding the hardness of your local tap water enquire at the municipal water supply authorities. Furthermore, replacement of evaporated water turns the water in your tank harder and harder, for only the water evaporates but not the minerals contained in it. Shells of dead snails also make the water on the hard side. But, most of all, sand rich in lime makes aquarium water hard. Use, therefore, only gravel free of lime. It is easy to make the lime test on sand by pouring hydrochloric acid over it. If gases foam up lime is contained in the sand, for lime is dissolved by the acid.

Time and again I am surprised at the poor growth of aquatic plants in the tanks of my fellow aquarists. Also *Rasbora*, glow-light tetras and rosy tetras are very poor in colour. Water tests in these tanks gave average DH values of 15° to 30° of hardness, and a pH between 7.5 and 8.25. No wonder that the fish and plants cannot thrive in such hard and alkaline water. In such water almost always a lot of algae was found.

I too had constantly an abundant growth of algae in my tanks several years ago. Especially that sort of algae of about 1/16 inch length which coats the plants, especially *Vallisneria*, and finally suffocates them, prospered in my big 50 gallons tank. I tried everything at that time to get rid of the algae. If I cut down the light the algae began to disappear but at the same time the plants began to fade. Finally I hit upon rain water, and now I was successful. I used pure rain water in the algae-infested tank, and within a week the pest was gone. I never again had algae

WATER HARDNESS

SALTS dissolved in natural waters which cause them to be "hard," i.e. to give scums with soap, have poor lathering properties and deposit "scale" or "fur" on boiling, are chiefly the sulphates, chlorides, nitrates and bicarbonates of calcium and magnesium. For convenience the content of these salts in a water sample given by a hardness test is estimated as chalk (calcium carbonate), and the hardness value may be expressed in four different ways: (1) parts per million of calcium carbonate; (2) parts per 100,000 of calcium carbonate; (3) "Clark degrees"—the number of grains per gallon of calcium carbonate; (4) German "degrees"—the number of parts per 100,000 as calcium oxide. In the accompanying article the German system of expressing hardness values is used and 1° DH has as its equivalent 0.056 parts per million of calcium carbonate, 0.56 parts per 100,000 of calcium carbonate or 0.8° Clark (0.8 grains per gallon of calcium carbonate). Waters having 100 p.p.m. of calcium carbonate and over fall in the "hard" categories, of which there are "slightly hard," "moderately hard" (150-250 p.p.m.), "hard" (250-350 p.p.m.) and "excessively hard."

in my tanks after using rain water. This clearly proves that algae can only prosper in hard water.

Two years ago I began my trials with rain water. In order to accustom my fish to the soft water I mixed tap water at first with equal volumes of rain water. A fortnight later I used two-thirds rain water, and finally in the tanks with the problem fish I used 100 per cent. rain water. The success was most convincing. The colours of the glow-light tetras became more brilliant than I had ever seen them before. The same refers to other characins and to rasboras. And then I had my first success in spawning neon tetras and glow-light tetras. Also *Cabomba*, *Ambulia*, the Madagascar lace plant, *Myriophyllum* and *Cryptocoryne*, which in hard and alkaline water did so poorly, developed a luxuriant growth.

When using rain water, make sure that only very clear water is taken. This is obtained after several hours of heavy rain, when all the impurities contained in the atmosphere are absorbed and washed away. Do not use any rain from metal containers ! Well seasoned wood barrels or old cement containers are best. The rain should be stored for a fortnight in green glass carboys. When the last impurities have settled at the bottom of the containers and the water has turned crystal clear, it is ready for use in the tanks. Instead of rain water distilled water can be taken. An addition of one level teaspoon of salt to two gallons of rain or distilled water is advisable.

We see now that it is of utmost importance to give our tropicals such conditions as they find them in their native haunts. The tropical waters, apart from the fact that they are generally very soft, in addition are acid too. The acid character of the water in the tropics is produced by the large number of leaves, fruits and wood falling into the water and decomposing there. By this decaying process humus (vegetable mould) acid is produced, which gives the water a slightly yellow to brown colour, giving it at the same time the acid reaction.

At first I tried to produce an acid pH value in aquarium water by adding phosphoric or tannic acids. For instance, one needs for a 100 litre tank 0.74 grams (not grains !) of concentrated phosphoric acid for the neutralisation of 1° DH. In order to reduce the hardness value of 20° DH in a 100 litre tank to zero degrees of hardness one needs 20 × 0.74 grams = 14.8 grams of phosphoric acid. I have often made such trials and found out that the lime is changed into calcium phosphate, which is immediately absorbed by the aquatic plants as a most effective plant fertiliser. When adding phosphoric acid, do it only by diluting the required amount of concentrated acid 1 : 100, and add it little by little to the tank water. Measure the pH value carefully with pH test paper until you obtain a pH value of 6.5, or even down to 6.0. Proceed in the same way with tannic acid.

The best results, however, are obtained with peat water. The well-known German aquarist Dr. Meder has described his most successful results in the breeding of the *Aphyosemion* species in the German aquarium magazine *D.A.T.Z.* He uses peat water. Peat contains natural humus (vegetable mould) acid. This acid, together with the yellow colour particles of the peat, kills off the Infusoria and harmful bacteria. Very often turbid water is caused by Infusoria. The addition of peat water gives the water a slightly yellow amber colour but turning it at the same time crystal clear. The fish feel extremely well in such water; they are very active and show their richest colours.

Peat water is obtained in the following way: Use bale peat without any chemical additions or fertiliser. Wash it slightly under the tap in a strainer. Then take a handful of washed peat and add it to one gallon of rain or distilled water. Allow it to soak in glass jars for about three or four weeks. Stir it up regularly in order to obtain a good mixture. Slowly the water turns yellow. In the last week do not stir the peat any more. Meanwhile all the peat settles on the bottom of the receptacle and the water becomes quite yellow but crystal clear. Now it is ready for use. Siphon it off and let it flow through a piece of cloth to prevent any peat from getting into the peat water. Let it clear for a further two days and now add it to rain or distilled water, or at least to *soft* water, until you obtain a pH value of 6.5 to 6.0. Make repeated tests with pH paper in order to avoid the addition of too much peat water.

It is absolutely necessary to use rain or distilled water when producing the peat water and to add this peat water to *soft* tank water of not more than 3° to 4° of hardness. Hard water would turn the peat water neutral because peat acid is neutralised by the lime. In such hard water the peat water would therefore become ineffective. I repeat once more that repeated pH tests are necessary in order to avoid any detrimental effects. Therefore do not overdo things with too much peat water !

In conclusion I would mention that the addition of peat water to the tank water is the ideal method of giving the water the desired acid character. In this way we give our tropicals at the same time truly tropical surroundings which come as near as possible to the chemical composition of their tropical waters. Thousands of aquarists in Germany have used the peat water with most striking success now for over a year and have found out that it is the ideal solution of the water problem.

Aquarist's Notebook

(*Continued from page* 116)

blue gouramies, glowlights, penguins, feather fins, silver tetras, black-lined tetras, Buenos Aires tetras, black widows, *Corydoras*, rosy barbs, spanner barbs, *B. schuberti*, blind cave fish, most cichlids, paradise fish and the various pencil fish. Beginners will not go far wrong if they start with one or more of these. Most people begin with livebearers, probably because they are always obtainable and easy to breed. Platys and mollies, however, are anything but easy fish for the beginner and disappointment with platys has discouraged many a budding aquarist.

* * *

We have become accustomed to seeing furnished aquaria in waiting rooms and hospitals, shop windows and foyers, and many other places, but surely the last place one would expect to find a tank is built into the frying range of a chip and fish restaurant. The effect of the considerable heat quite apart from the oil and fat vapour would seem to be against success but this is now a fact and results must be awaited before passing final judgment.

* * *

I heard the other day of a new use for old fish cans, the wide circular type with narrow necks. An aquarist having one of these given him by a dealer converted it into a chicken "house" for rearing day old chicks, by inserting a 25-watt. lamp. Of the 30 chicks first introduced only six died, later efforts being completely successful. The only difficulty is disposing of the chickens later on; this is apparently almost as hard as getting rid of broods of brick-red swordtails.

* * *

I keep hearing reports from varying sources in different parts of the country of success with the hitherto incurable neon tetra disease. In all cases the treatment is simple: merely keep the fish in total darkness until such time as the disease disappears or death occurs. It seems the fish make a complete recovery in about half the cases in which this method is tried.

OUR EXPERTS' ANSWERS TO READERS' QUERIES

Would you kindly suggest some species to keep in a 36 ins. by 15 ins. by 15 ins. community aquarium? I should like brightly coloured fishes, and ones which would provide plenty of movement in all levels of the water.

We suggest the following: 6 zebra fish; 6 pristella; 6 penguin fish; 10 flame fish; 4 black widow fish, 4 baby angel fish; 2 cherry barbs; 2 half-striped barbel; 2 *Barbus schuberti*; 2 chequered barbs; 2 *Corydoras melanistius*. As time goes on, you might care to add some of the more expensive species such as neon tetras, harlequin fish, rosy tetras, etc.

I am setting up a large community aquarium, and should like to know whether it is a good idea to add a teaspoonful of salt to every gallon of water; that is, at the outset?

It is a good idea to add one teaspoonful of common household salt to every gallon of boiled tap water used to fill a tank. But once salt has been added, do not introduce any more. The habit of adding salt every now and again to aquarium water is a bad one, for eventually the water becomes too saline for the well-being of either plants or fishes.

Is it true that white cloud mountain minnows and zebra fish will not live together in the same aquarium? People have told me that white cloud mountain minnows exude a secretion which kills zebra fish.

Some fishes, like some plants, seem to thrive at the expense of others, and the view has been expressed that the presence of white cloud mountain minnows causes zebra fish to waste away and die. But, speaking for ourselves, we have always found the two species to live out their normal lives together. It is possible that the lower temperatures enjoyed by white cloud mountain minnows may lead to their surviving long after cool conditions have killed the vivacious fish from Bengal. You will find that a high temperature, the sort of temperature enjoyed by zebra fish, will soon cause white cloud mountain minnows to go off their food and die. Maybe the different conditions needed by these two species explains why so many aquarists find it difficult to keep them together in the same aquarium.

I have a pair of sailfin mollies. I am expecting the female to drop some young any day now, and wonder whether I should remove the male before the event. The last batch of fry dropped were eaten by the parent fish.

Plenty of bushy-growing plant life growing just beneath the surface of the water will do a lot towards preventing the parent fish from molesting their babies. As a rule, mollies are not specially given to cannibalism, but it would be a good idea to remove the male to another tank, and keep the female well fed with plenty of live food. A fish that is well fed is less likely to chase after and eat her fry than a fish with an unsatisfied appetite.

Can you please suggest some plants for a 36 ins. by 12 ins. by 15 ins. aquarium? I am a beginner in tropical fishkeeping.

Plants for the heated aquarium are almost as numerous as domesticated fishes. But you cannot do better than plant a double row of *Vallisneria spiralis* along the back of the aquarium; four or five well-grown stems of *Hygrophila polysperma* along each end; *Sagittaria natans* dotted here and there along the front and middle; and a large Indian fern (*Ceratopteris thalictroides*) as a show-plant in the centre.

I have a 24 ins. by 12 ins. by 12 ins. aquarium heated and illuminated by electricity. It gets little or no daylight. How many hours should I keep the light on every day to keep the plants in healthy condition?

As your aquarium gets little or no daylight, we think you should keep the light burning for about eight hours every day. You will need two 40 watt or two 60 watt lamps to keep the plants in healthy, active condition.

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

My mollies are always fighting, and they terrify the other fishes in my community aquarium. Is there anything I can do to make them more peace-loving?

Believe us when we tell you that mollies are harmless to other fishes. We think that you are confusing their rather boisterous courtship behaviour with actual fighting. The male mollie will pursue a female all over the aquarium, pushing her with his head and gently butting her on the side. But he does no harm. Possibly the other fishes give the mollies a wide berth to escape being mixed up in the rather spirited love-play. Do not worry over the behaviour of your mollies; they will not do any harm.

One of my Siamese fighting fish has been ill with swimming-bladder trouble. Now, although the fish has made full recovery, it stays hidden away in the plant life and has to be tempted to take its food. What is the matter with it?

Like human-beings, most fishes after illness need peace and quiet and careful treatment. Keep your fish well fed with live food and tiny pieces of lean meat and disturb it as little as possible. In a week or two—that is if the other fishes leave it alone—it will be strong enough to swim out from its resting place and join in the mad scramble for food with the others.

Recently I read that a 5 per cent. solution of methylene blue could be used as a cure for gill-flukes on coldwater fishes. Can methylene blue be used in the tropical aquarium?

Methylene blue can be used in the tropical aquarium as well as in the coldwater aquarium. It is very useful in the treatment of white spot disease. Add drops of the "blue" until the water is faintly tinged with it, and, at the same time, increase the temperature of the water by two or three degrees, and keep it high for a week or more, or until all signs of disease have disappeared. When using methylene blue, it is advisable to keep the bottom clear of sediment by frequent application of siphon or dip-tube.

I wonder whether you can tell me what is wrong with my swordtails? They have closed their fins and wriggle in the water like an eel.

From your description, it sounds as though your fish are suffering from the after-effects of a sudden drop in the temperature of the water. If the fish are suffering from a chill, some, if not all of them, will make a good recovery. Keep the temperature higher than normal, and feed the fish with live food or tiny pieces of lean meat. Do not give them any dried food. Keep the bottom clear of sediment, and make good the water siphoned away with boiled water allowed to cool to the temperature of the aquarium.

We have just moved to a house without electricity. I do not want to give up my tropical fish, but wonder how I can heat and aerate the water without electricity? Can you advise me?

Pioneers of tropical fishkeeping in the early 1900s got along very well without electricity to heat their tanks or pump oxygen into the water. You can heat aquariums very well and cheaply by oil-heaters or tiny gas-jets. But fix a copper or tinplate screen between the naked flame and the bottom of the aquarium. A half-inch gap between aquarium and baffle would be enough. As for aeration, this can be

performed by fixing another valve to a car or motor-cycle inner tube and governing the flow of air into the aquarium by the usual pinch-cock attached to the air-line. A heavy weight stood on the inflated tube will exert sufficient pressure to keep the improvised aerator running for upward of three hours or so before re-pumping becomes necessary.

A leak has developed between the glass and the bottom of the frame of my tropical aquarium. Is there any way I can seal it without emptying the aquarium and reglazing it afresh?

It all depends on how bad the leak is at the back of your aquarium. A mere ooze of moisture will sometimes seal itself. If it does not dry up of its own accord, wipe the spot dry with a cloth, and before it becomes wet again, press a strip of surgical tape over the faulty area. Now, as quickly as possible, apply a quick-drying enamel, varnish, or aluminium paint, over the tape. Give the tape two or three coats of paint. If the leak is more than a mere ooze, the best thing to do is to dig the glazing compound from between glass and frame, and ram in fresh mastic before the water has time to work through.

I have several tropical tanks in a row. Every one of them is set up the same way with sand, plants and the usual popular fishes. Yet while two or three of the aquaria keep perfectly clear and free from algae, the others stay cloudy and the plants soon become coated with algae. Can you tell me the reason for this?

No two tanks are ever exactly alike. The sort of fish you keep in them will alter the chemical content of the water; so will the amount of sediment permitted to accumulate on the bottom; and the sort of food fed to the fish. For instance, flesh-eating fishes produce excreta rich in fertilising elements, and these stimulate algae growths. You will always notice a richer growth of algae on the sides of an aquarium housing cichlids than you will inside a tank populated by guppies or mollies. For one thing, guppies and mollies are fond of green food, and nibble away the soft growths of algae as soon as they develop. Acid water helps to keep algae in check, and it might be worth your while to strain the water in the aquaria through scalded peat. You will have to strain the water through peat several times before you can hope to achieve the desired end; that is, a pH value of about 6.6.

Some time ago the glass tube of my thermostat got broken. I was away from home at the time of the accident, and when I returned all the fish were crowded together at one end of the aquarium. They seemed unhurt. But later on they began to lose their balance, and within a short time most of them were dead. Can you tell me what went wrong?

Your fish died from the effects of electrical discharge in the water. Quite a mild shock will upset fish, though some species seem able to stand a shock better than others.

COLDWATER FISHKEEPING QUERIES *answered by* A. BOARDER

I have some good stock of Bristol shubunkins and I now wish to breed for show. Shall I concentrate on colour first or shape? I do not mind how long I take to turn out good stuff or what is thrown out on the way.

There seems to be an idea around that it is essential to concentrate either on colour or shape but I consider that either is a wrong view. In my opinion it is essential that both points are borne in mind the whole time. It would not be of much use breeding from a hopelessly coloured fish just because it had a good shape, nor would it be much use breeding from a well-shaped fish if it had none of the correct colours. If any aquarist has sufficient patience there is no reason why a good type of Bristol could not be produced in a few years providing a good strain is used as a start. In the first place it is imperative that the best type of fish is well known and understood, as otherwise an aquarist may be on the wrong track altogether. As there are few really good shubunkins seen at the shows it is very difficult for the newcomer to appreciate a good type for show purposes.

Although show specimens do not always throw all good fish, it is a fact that such fish are almost sure to produce a few good ones, from which better may be bred. When sorting out the youngsters from a hatching from decent parents, only those which show the correct points should be kept. Among a spawning there are almost sure to be, say, half a dozen fish which would provide the almost perfect fish if one could take a piece of each and make it into one. From such a half dozen fish you would probably get several fish which carried the good points of some of the parents. In such circumstances I would not trouble to breed from any particular pair, but would let the half-dozen run together so that each male may have the opportunity of fertilising some eggs from all the females. By this method you are likely to get the fish you require far more quickly than by individual pairing. It will not matter a scrap if you do not know the exact parentage of the fry, as long as they are the ones you are after they can produce the winners.

On the other hand if you had a very good fish which failed somewhat in body shape you could pair it to a fish with a very good shape without a good colour, providing always that this fish was bred from a good coloured stock. It must be borne in mind that fish do not throw youngsters their exact replica, but tend to throw back to their ancestors over very many generations. I would always take more notice of the fact whether a fish had been bred right than go on the actual pair of fishes. With regard to the actual type for showing, it is of little use showing a fish in good company unless it has most of the required colours. I consider that the quality of the Bristol shubunkins I have judged this year show an advance on previous seasons and I see no reasons why the near perfect fish should not show up next year.

My outdoor pond is badly infested with fish lice, *Argulus*. I think the fish caught them from some roach I put in the pond last year. I have tried the Dettol and T.C.P. treatment but the fish look in trouble before the argulids are dead. Can I put something in the pond which will kill the lice and not harm the fish?

I do not know of anything which you could put in your pond which would clear it of argulids and not harm the fish. It must be remembered that the pests are very tough and what would be likely to kill them would kill small fish. Another point about adding chemicals to a pond is the difficulty of ascertaining exactly the quantity of water. I had a bad attack of this pest some years ago through introducing an affected green tench, but I cleared the pest from the pond by catching all the fish and immersing them in a solution of one tea-spoonful of T.C.P. to a gallon of water. As soon as the fish were put in the solution the lice left the fish. After a few minutes of such treatment each fish should be removed and examined very carefully, and any lice still on the fish should be removed with tweezers and killed. I found in practice that as soon as the fish were put in the solution all the lice left their hosts and even if they did not soon die they were at least removed from the fish with very little trouble. Your strength of solution was not strong enough. Try again and remember that if you put any chemical into the pond you cannot take it out again if it upsets the fish.

I am having some trouble with my pond which has been established about two years. Last year it had a great deal of algae in it and this year as soon as it gets warm a lot of brownish green scum comes up from the bottom. This clears up after rain, but I shall be grateful if you can tell me what to do about it.

The scum may be dead algae which starts to ferment when the water gets warm. This causes gases to form on it and these make the scum rise to the surface. I have often watched

this happening in a canal. During hot weather the brownish scum floats quickly to the surface. It does sink again after rain, or when it has released the gases which have caused it to rise. There is not a lot you can do except skim off as much as possible from the top and keep to as much live food feeding as possible. Uneaten dried foods would tend to increase the trouble. A good number of water snails would help but they would not be able to deal with all the scum. Add a tablespoonful of sea salt to about each 10 gallons of water in the pond. This may help.

I wish to restock my coldwater tank. In the past my fish, mainly goldfish, have eaten all the plants. Can you give me a list of fish which will not eat the plants?

I often get queries in the same strain. I can give you a list of fishes which would not eat all the plants but I can also suggest some plants which the fish will not eat. As for the fish, as long as you kept to fairly small fish, say under two inches body length, any type of goldfish should be all right. It is generally the larger fish which sometimes turn their attention to the plants. Probably you have not been feeding the fish often enough in warm weather. When re-stocking the tank try planting it with plenty of *Saggitaria natans*, the medium type and the major type. This will be too much for small fish to tackle. Some moneywort (*Lysimachia nummularia*) can be used and if the fish still eat this add some watercress. You must remember that goldfish are naturally omnivorous, which means that they eat both animal and vegetable matter. If you fail to give them the correct amounts of vegetable they will help themselves to the plants. Add some duckweed (*Lemna*) to the surface and they may eat this and leave the other plants alone. If you would like to try some other types of fish you can choose from small perch, tench, rudd and minnows. The first are very handsome but would eat any other fish small enough for them to get in their mouths.

In a recent reply concerning the hand-spawning of goldfish, you said that you do not recommend novices to strip their fish. Why is this?

This may be only a personal opinion of mine—I have many such, and when I am proved wrong I am only too willing to acknowledge that I have been wrong. In this case it may be a long time before I am proved wrong. My objections to this practice are mainly concerned with the future of the stock although I am sure that actual damage can be caused to a fish by unskilful stripping. If a fish is continuously hand-spawned it may lose all interest in a natural chasing and spawning and become lazy. Also who knows but that in time if a strain of fish were continually hand-stripped they might become unable to function normally? It is unwise to interfere with nature too much. Trout breeders hand-spawn their fish because it would be a very difficult job to collect the eggs naturally laid, but I do not think that they are very particular as to whether any slight damage might result to a fish, as they usually have many to choose from. These fish are also larger and stronger than the goldfish which we strip.

I have just moved into a new house where there is a nice pond in the garden. There are many newts in the pond and why the previous owner put them there I do not know. Will they harm the fish and what fish can I add?

The pond is not a large one but would hold say, three tench, three rudd and six goldfish. The two first named can be the golden type and the goldfish can be any one of the various types. The newts will do little actual harm to the fish. It is probable that the previous owner did not put them in the pond. Each year newts find out a pond and resort there for spawning purposes. Once this is over they leave the pond until the following year. Once they do breed in a pond they appear to return to it without fail each season. They will eat much live food which should otherwise go to the fish and they can eat small fry of the fishes. If you do not over-stock the pond in the first place it is quite possible that some fish may breed there.

Do visible scales on a shubunkin disqualify it in a show?

The Bristol shubunkin should be free from visible scales but a few would not disqualify a fish. Many very good fish are seen at shows with one or two scales showing. These usually mean the loss of a few points. The shubunkin should also have soft gill plates; this means that the gill covering or operculum is soft and practically transparent and is not hard and brassy as on a common goldfish. Only five points are awarded for soft gill plates and so even if a fish has none it can only lose these points, although there is a possibility that the five maximum points for style and type may be deducted. Sometimes a fish is seen at a show with one soft plate and one hard: such a fish usually gets half the allotted marks in this case. I frequently notice that it is the deepest and best coloured fish which have a tendency to a few scales and hard gill plates, whilst the very pale ones (which I dislike), have no visible scales at all.

IN THE Water Garden—*by* Dr. W. E. SHEWELL-COOPER

THOSE of you who have read the article I wrote last month on the subject of the propagation of rock plants, may like to know the names of a number of different kinds of plants which might be reproduced from cuttings. So, starting with the A's I am making a choice of a number which readers might like to buy, so as to have a start. Some have been chosen because they almost propagate themselves. Others have been included because they can be increased without any difficulty by division or the sowing of seeds. All are beautiful and well worth growing.

Acantholimon is better known as prickly thrift. My favourite is *A. glumaceum*, which produces numerous rose-like flowers in June on stems six inches tall. The plants when growing look very much like little green hedgehogs. They love to grow in full sun, and they insist on well drained sand. You can propagate them by cuttings, but this is by no means easy to do. You will probably be lucky if you get a strike of about 30 per cent. By dipping them in hormones, the results will be 60 per cent. Strike them in summer in the sand frames which I described last time.

Now we come to Aethionema. It can be raised from seed or from cuttings taken immediately after flowering. Start with *A. grandiflorum*, which is a neat, wiry little bushlet, with grey-green leaves. It grows about 18 inches high when it is well established, and produces long spikes of pale pink flowers in May. There is a variety, Warley Rose, which I believe would win a prize for the most popular of all rock garden plants in some districts. It has to be increased by cuttings; it blooms in April and May, producing round heads of really deep pink flowers. The whole point of this variety is that the plants are really covered with blossom, and that is why people like it.

No one could ever claim that the bugle, or Ajuga as we should call it, is difficult to propagate. It produces numerous runners and so it can claim to be a carpeter. It spreads very quickly and needs plenty of room. The one that gives least trouble from the point of view of encroaching on its neighbours is *Ajuga crispa*, which is

a dwarf variety with crinkled leaves which have a blue metallic sheen. Blue flowers appear in June on stems four inches high.

It is no wonder that Alyssum is called the madwort, for you are mad if you don't have it and you are equally mad if you grow the wrong species. There are indeed some very poor ones. Try *Alyssum saxatile* Dudley Neville, which is an apricot-flowered hybrid, and *A.s. florepleno*, which is a double flowered form and holds its blossoms longer than the singles. It is always better to take cuttings of this plant with the heel just after it has flowered. Anthyllis is a prostrate plant which looks rather like clover. If you can give it ordinary light soil it spreads into quite a large part, especially if it is in a sunny position. The cuttings should be taken off the soft side shoots any time in the summer from *Anthyllis montana rubra*, which flowers in June bearing crimson blooms on little stems three inches long. They appear from a mat of grey-green leaves.

The aromatic herbs provide scent. *Artemisia pedemontana* is one of these. It is increased by cuttings with a slight heel in the late summer. The flowers are really of not much value—it is the lovely silvery-grey foliage which is so important. Grow this plant next to another which has deep coloured flowers, and the contrast is magnificent. It produces a dense mound, often six inches deep.

Never waste good space on poor plants of Aubrictia. There are so many beautiful ones from which you may choose. This purple rock cress, to give it its British name, likes to grow in full sun, and in light, good growing soil containing lime. Keep the plants looking neat by cutting them back directly after flowering. Don't be afraid to "murder" them almost, and though they may look bare for a fortnight or so, they soon grow again and make nice green mounds for the winter. I am very fond of Crimson King, the large red purple, and J. S. Baker, the blue with the distinctive white eye. Red Carnival is a favourite, as also is the deep-violet coloured Mrs. Lloyd Edwards.

Another plant with aromatic leaves which looks a little like the thyme, but which has much larger flowers, is Calamintha. It prefers light, sandy soil and full sun. It is one of the few plants that is better propagated by cuttings, taken in the spring, instead of in the summer. *Calamintha alpina* flowers in June, producing a neat-growing little bush with purplish flowers on six-inch stems. *C. grandiflora* is definitely coarser growing and in addition is more erect in habit. It flowers over a longer period and you must expect it to be looking at its best in June and July, the stems of the flowers being often a foot long.

Those who have travelled abroad in Switzerland and Austria will know how a little dwarf thistle figures in many of the designs of embroidery and carving. This is the *Carlina acaulis*. It much prefers to grow in very poor soil, because if you do it well it is absolutely rampageous. It produces a flat rosette of prickly leaves with large, stemless flowers in the centre. They are at their best in June. Talking of the Alps, snow in summer comes to my mind—*Cerastium tomentosum*. It grows so well that you have to cut it back drastically each year after flowering, and it should be planted where it will get plenty of sun.

Breeding the Glass Fish

by JOHNSON H. HOOD

HAILING from India the delicately beautiful little "glass fish" is rarely seen at its best, but given conditions to its liking, it can display a pleasing array of amber and blue. Once the initial shyness is overcome it becomes very friendly and soon learns to welcome the hand that feeds. As with most Indian fishes, old alkaline water is very suitable and they are not averse to sea-salt, say half to one teaspoonful to the gallon, but this is not absolutely essential as I hope to show.

I bought four fish about three-quarters of an inch long, and they proved to be a male and three females. They were given a six-gallon tank to themselves. Within a month the females were bulging and the male had developed a rich amber in the body with the bright blue edging to the dorsal and anal fins forming a brilliant semi-circle of colour. The fish I had were strictly carnivorous and accepted *Daphnia*, bloodworms, *Cyclops*, chopped *Tubifex* and white worm. It was with these I conditioned my breeders. By now they had achieved a length of one inch. The male became aggressive, shepherding one female round the tank and penning the others up in a corner. The temperature ranged from 72°-76° F.

I prepared a tank, 36 ins. by 10 ins. by 10 ins., base-heated with gas, using old water five inches deep that had stood in a concrete pond some time, added one teaspoonful of sea-salt per gallon, heated up to 75° F., added a good covering of Indian fern just floating, no sand, and placed a pair of fish together one night. Next morning I noticed the fish spawning. They approached each other, quivering and, with a rush, swooped quickly into the floating plants, turned on their sides and sprayed the eggs into the plants after the fashion of goldfish.

I was curious to see if they ate their eggs so I left fish and eggs together. Next day the fish spawned again and although there were newly hatched fry all over the tank sides and plants the parents never made any attempt to eat eggs or fry. *Daphnia* and *Cyclops* were present all the time in the breeding tank. A further small spawning took place on the third day, then the parents were removed. The temperature was increased to 78° F. and although I did try a temperature of 80°-85° F. I am of the opinion that 76°-78° F. suited them better.

The fry hatched in about 12 hours and were free-swimming in 24-48 hours. There were over 180 fry but about a dozen did not succeed in filling their swim-bladder and just jerked around for a day or two before finally they succumbed. It would be advisable to keep the water surface as clean as possible. Many fry hung on the front glass so I measured several and the largest was one-fourteenth of an inch. As there was plenty of small Infusoria in the water (there had been large goldfish in the pond) I added none but watched to see if the fry would eat what was present.

Never at anytime did I see them eat Infusoria, which rather puzzled me, so I added a small quantity of *Cyclops* nauplii to see what happened. Immediately there was great animation among the fry and I was amazed to see the tiny fish engulfing nauplii. The mouth seemed to stretch as big as the head! The fry positioned themselves below the nauplii head up, bent the tail round, and shot upwards like

(*Continued on opposite page*)

Aquarium and Pond Goldfish Varieties

8. Veiltail Moor

THE veiltail moor is a highly specialised fish and is not suitable for an outdoor pond in the winter. Because of its eye formation it is not a suitable fish for the beginner and I only recommend it to those aquarists who have already gained considerable experience with other types of goldfish.

The shape of this fish resembles that of the veiltail, that is, the body should be approaching a sphere and the caudal fin should be completely divided. The base of the caudal fin should be as straight as possible without a fork. The anal fins should be paired and the other fins well developed as for the ordinary veiltail. The colour should be a dull black with no sign of bronze or other metallic sheen. The eyes should be enlarged, protruding from the orbit and standing out well from the head. The cornea should be quite clear and there should be no colour. These fish are scaled, that is, the scales are quite visible, not almost invisible as for the shubunkin.

The large protruding eyes tend to make this fish a little more delicate than most fancy goldfish, for they are very liable to become damaged, especially in a tank with too much rockwork. I suggest that no rocks should be used at all in a tank containing these fish. As the eyes are the most important feature they receive the most points, that is 20 points, with 18 for body and the same for the caudal fin. For colour the moor can get 15 points, whilst 10 points are allotted for deportment. It is in this latter category that most of the veiltail moors I have seen fail. As likely as not, when they are being judged they lie on the bottom of the tank and it is almost impossible to get them to move at all.

In my experience they are the most difficult type of fancy goldfish to judge. I remember at one show none of the moors would move from the bottom so that their caudal fins could be examined, and in addition the water in the tanks was none too clear. In this case I found after a few days that one fish had a single anal fin, which I had been quite unable to see before. The only way to make sure with this fish would be to take it from its tank, which is something a judge does not like to do. If only these fish could be trained to disport themselves better it would make it much easier for the judge and probably gain the fish many more points.

Moors are bronze in colour when they are young like ordinary scaled goldfish, and change to the desired black when goldfish would be changing to gold. Many fish never quite lose the bronze sheen and some will return to this colour after some time when they have first changed to black. I am inclined to think that sometimes the fish may lose its black and go bronze if it is given too much warmth. At least this happened to one of mine which I loaned some years ago; it turned bronze after it had had almost tropical treatment by the borrower. Some moors take a year or two to change to black, but I do not think it a good plan to breed from a fish which takes too long to change. As with some of the other scaled types I consider that it is possible to breed into a strain a quick changing tendency, which means that the fry start off right, and are more likely to change early than if this point had been neglected.

I have heard some aquarists say that to improve the body shape of a moor it should be crossed with a scaled fantail. This is a very retrograde step, as once any other type of goldfish is crossed with a moor it may take many years to breed out this strain, if it ever can be done, which I doubt. I think that the varied shapes which one can get in a spawning of moors make it one of the most difficult fishes to breed true and no-one who has not had experience of this would believe that so many different types could be produced from one spawning. The protruding eye is always found in a good moor, and often when this type of eye is seen in other kinds it denotes that a crossing has been made in the strain at some time or other.

Photo: Laurence E. Perkins

Food for the moor should be about the same as for the veiltail—some live foods, especially for young fish, with a good proportion of starchy foods, such as oatmeal and Bemax. The main faults seen in moors at shows are too much bronze in the colour, flat backs, insufficient length and breadth of tail, too forked a tail and lack of deportment.

A. Boarder

Breeding the Glass Fish

(*Continued from the opposite page*)

an unleashed spring. It was not until they were two to three weeks old that this habit was discontinued.

The great problem was to find sufficient food of the right size, so I enlisted the help of my wife and had a long, narrow bag made of silk, and through this poured pond water. I soon had a thick mixture of *Daphnia* and *Cyclops*, which was emptied into a can. When a sufficient quantity was thus obtained I took the catch home and strained it through a fine muslin cloth. In this way I obtained a good supply of nauplii and in three to four weeks the young glass fish took the shape of the adults, being then a quarter to five-eighths of an inch long. Needless to say I tried micro worms etc. at intervals but nothing would induce the fry to change from *Cyclops*.

Later I used a 60 ins. by 10 ins. by 10 ins. tank, placed the male and the three females together and allowed them to spawn at will. This time the water was the same as before with no salt added. All the females were spawned in rotation by the one male and about 500-600 fry made their appearance. However, I picked out about 100 that were feeding well and destroyed the rest, as I knew I could not possibly feed them all.

From my experience it would appear there is no difficulty in spawning and rearing *Ambassis lala* providing newly hatched *Cyclops* nauplii is available and in sufficient quantity to continue the feeding for a number of weeks.

OUR READERS Write

Kissing Gourami

IN the very informative article on *Helostoma temminckii* in your July issue, "Pisces" tells us that "Sexing is impossible without dissection." This may be literary exaggeration designed to emphasise the difficulty of sexing these fishes, but the excellent line drawing of a female fish, gives the only answer to the problem that I know. When the female ripens with spawn the posterior rays of the anal fin come out of line with the posterior rays of the dorsal fin, as is clearly indicated in your illustration.

Only too often aquarists are looking for permanent sexing differences, and missing these periodic differences which are of importance to breeders, judges, and exhibitors. At the 1952 Show of the Bristol Society, the best looking "pair" consisted of two females, but the Bristol Society insists on sexed pairs, and the premier award was taken by a correctly sexed pair as indicated by these fins.

W. L. MANDEVILLE,
Birmingham

Club Apathy ?

THIS Society was more than fortunate in obtaining the services of Mr. A. Boarder to talk to the members on "Goldfish Breeding," on Saturday, 27th June. This date was arranged to fit in with Mr. Boarder's more than heavy programme. The committee thought that this good fortune should be shared amongst societies who were within striking distance of Lancaster. Accordingly I wrote to 14 societies inviting them to come and be our guests on this occasion.

I was more than disappointed, and not a little disgusted, to find that out of the 14 letters written, only four societies had the common decency and courtesy to reply. It should be fully realised by societies that special speakers of the calibre of Mr. Boarder cannot manage to attend every society and that on these occasions societies should get together for mutual benefit and pleasure.

If this is not possible one would think that in the interests of fostering good feeling between societies the invitation would at least be acknowledged, and it is to be deplored that either through apathy or thoughtlessness this was not done. Ours is a young society, newly enrolled in the Northern Federation, and the treatment afforded us is rather bewildering. Does this augur well for the future ?

LESLIE G. LUCAS (Secretary),
Lancaster, Morecambe and
District Aquarists' Society.

Copper and Blanket Weed

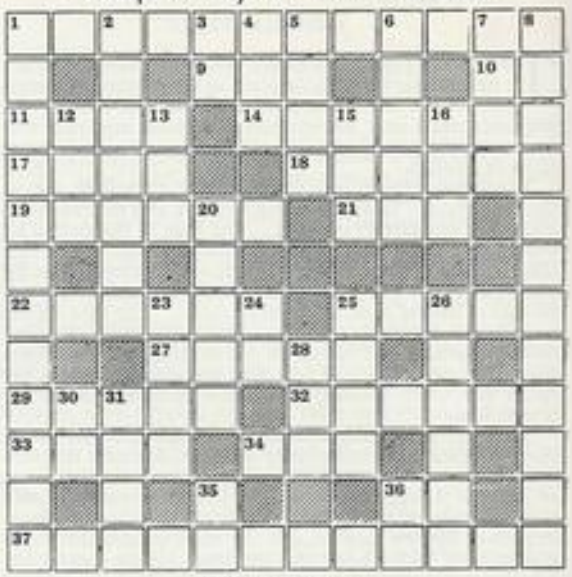
HAVING a prolific growth of blanket weed in my tropical community tank, I decided to try the effects of copper sulphate, using the quantities mentioned in *The Aquarist* (April, 1952). I dissolved 0.2027 grms. of "Analar" copper sulphate in a little water, and when completely dissolved, I added it to the 12 gallons of water in the community tank. I turned on the aerator fully to ensure that the water and the copper sulphate were well mixed.

Within half an hour, all the fish were at the top gasping. Immediately I changed two-thirds of the water for fresh water at the correct temperature. All the fish, with the exception of a pair of white cloud mountain minnows (*Tanichthys albonubes*), recovered. Within a week, all the blanket weed had disappeared. I hope that these notes may be of some use to your readers.

KENNETH HOBBS,
Lakenheath, Suffolk.

The AQUARIST Crossword

Compiled by J. LAUGHLAND



CLUES ACROSS

1 Amphibians with head-dresses (7, 5)
9 Egg cells (3)
10 This is that is (1, 1)
11 A tube, or a fish related to the sea horse (4)
14 Ruff or pope (7)
17 Forty perches (4)
18 *Crispa*, perhaps (6)
19 An arthropod, usually winged (6)
21 From from from (3)
22 Succulent bivalve, source of gems (6)
25 First stage of 19 after egg hatches (5)
27 *Rivulus* — for the stag and I (5)
29 Basket makers' willow (5)
32 See 18 (6)
33 Designation (4)
34 Inlet of the sea (3)
36 Little Albert (2)
37 Fishes "air tanks" (4-8)

CLUES DOWN

1 Literally Cyprinodonts (12)
2 Sex pose (anagram) (7)
3 Half a tope (2)
4 Roman salute returned (3)
5 Penny on the ace for *Leuciscus leuciscus* (4)
6 Roe up and around the best car is a mistake (5)
7 Intestine ends with a spike (4)
8 A soft shelled crab sounds like a marine vegetable (3-9)
12 One of the components into which an electrolyte is split by electrolysis (3)
13 One time Home Secretary among the breeders (3)
15 Dwarf but not a gourami (3)
16 Usual wedding declaration (1, 2)
20 How tank water should look (5)
23 You in a way (4)
24 Roe from the car in 6 (1, 1)
25 Beautiful pond plant (4)
26 Poser for idle Dr. (6)
28 Britains beverage (3)
30 Commonwealth nation from a sardine (1, 1)
31 Zulu regiment sounds like a school of young devilfish (4)
35 Degree of swim-bladders (1, 1)
36 Small advertisement (2)

PICK YOUR ANSWER

1. *Poecilistes pleurospilus* is popularly known as: (a) the Amazon livebearer. (b) the blue poecilia. (c) the porthole fish. (d) the striped millions fish.
2. *Chriopeops goodei* is native to: (a) Florida. (b) Guatemala. (c) Panama (d) Texas.
3. *Hyphessobrycon flammeus* (the flame fish) was named by: (a) Fowler. (b) Fraser-Brunner. (c) Meinken. (d) Myers.
4. *Esomus danricus* (the flying barb) has been found in a stream at a temperature of: (a) 92° F. (b) 102° F. (c) 112° F. (d) 122° F.
5. The "sword" of the Wiesbaden green swordtail is: (a) Black-edged with yellow. (b) Green edged with red. (c) Red edged with green. (d) Yellow edged with black.
6. The albino (Traegar) swordtail was developed in: (a) 1924. (b) 1928. (c) 1934. (d) 1938.

G. F. H.

(Solutions on page 127)

An Aquarist Looks at Morocco

by L. R. BRIGHTWELL

A YEAR or so ago I was able to tell readers something about the aquatic glories of Paris, surely the most aquarium-minded city in the world. The French genius for engineering, plus artistic arrangements and colour-blending, finds full scope in the aquarium. But strangely enough in French Morocco there is no public aquarium, although the germ of the idea is there.

What a money-maker should be a public aquarium in tourist-infested Tangier or Casablanca. Recently I was in the fish market of the latter. It was like a flower-garden in full bloom; there were banks of giant gurnards, with their huge pectorals cunningly spread with skewers to display the peacock tints and catch the customer's eye—a truly Gallic touch; there were mountains of shell-pink scampi (a prawn, *Peneus caramote*), jade-green langouste, violet-blue lobsters —rather rare so far south; enormous sea-bream with bull-dog teeth, sharks galore, tunny and other scombrids of many kinds, and, offered as a great delicacy, the common shore crab. One day I walked out with the head of a hammer-head shark. N.B.—If you go abroad on a ship of any sort, make love to the butcher; he will put your fish market purchases on ice so that when you reach home you may swagger unbearably before your less travelled friends, and dine off sub-tropic fare as fresh as when you bought it.

As regards actual efforts to encourage the aquarium movement in Morocco they are yet in their infancy. I met but one aquarist's shop but it was well worth seeing. Fish

were a side line, and restricted largely to fighters in what had been fish-paste jars—a fighter to the jar, cover askew to admit some air.

This shop was offering for sale an aerator that made the blood-pressure divers of Paris, already recorded by this scribe, seem relatively orthodox. It was in the form of a jade-green china hippopotamus, submerged, save for its blotchy back, eyes, ears and nostrils, in the shell-gravel flooring. But every two seconds it raised its nightmare head and from either nostril emerged two immense bubbles that slowly wobbled their lumbering way to the scummy surface.

It was in the carefree, and oh so cheap pre-war days that Tangier offered a sight to beat even this. A small general shop was beginning to dally with the idea of "trops." Like many shops and cafes in Morocco, the emporium sported a pet monkey. The monk in question was an example of Humboldt's woolly monkey, that so aroused Darwin's admiration. The shopkeeper slumbered on a heap of cushions in the doorway; the monk was in sole charge. Doing everything in slow motion, and apparently plunged in deepest cogitation, it laid one velvety hand upon a minute net and proceeded, walking like a slack-wire artist, along the rims of divers tanks to where resided a vigorous "fighter." With some skill, acquired no doubt by long observation of its master, it netted the fish and conveyed it to where another fighter was installed. It appeared interested in the result, as well it might have been.

Still profoundly pondering however, it appeared to forget this incident and crept gently to a tank of veiltails; the net being too small, it cast it upon the floor and scooped up a monster by hand. It studied the fish intently and for some minutes the fish's fate trembled in the balance, for most monkeys are very mixed feeders. However, this seemed to be one of the veiltail's lucky days—or did it? It was just a toss-up whether the fish made acquaintance with the monkey's enormous nutcracker teeth or rejoined its fellows. Instead it was popped in with the fighters, both males, and now revolving like an electric fan at full speed.

The monk pondered this new set-up with the awful gravity of an archbishop resolving some abstruse point of church etiquette. Apparently a guppy or so was needed and in they went—four of them. A fifth was on the way when all was forgotten in the sudden entry of a huge praying mantis that perched on a nearby jar of mixed pickles. The mantis was caught and devoured with sombre relish. Humboldt's woolly monkey then took a firm grip of an adjacent rail by its prehensile tail and, swinging floorwards, neatly retrieved the net. Regaining the shelf it then made use of an accomplishment shared by no other species. Nine-tenths of its tail became rigid, but the end forming a ring laid flat, the beast lent negligently back upon its caudal portion. In fact the tail became a shooting stick—a most impressive sight. Thus poised the aquarist passed into a monastic-like reverie upon things in general and swordtails in particular. The result you may guess. Three nice swords joined the party.

I can honestly say I did my best to rouse the shopkeeper, but a lunch of bread and cheese, mint tea and hashish had him in its grip and his snores echoed through the stacked merchandise. The last I saw of this slumbrous haven was the woolly monkey, more solemn than ever, and now armed with three nets, a diffuser and a bag of dried fish food, making towards a bowl containing a big and particularly truculent Jack Dempsey. Dempsey was obviously the next for duty.

That was going to be *some* community tank!

Tropical Fish by Air

EXOTIC tropical fish bred in far away Singapore can nowadays be in London aquaria a few days after they have been hatched. To meet the needs of aquarists the world over B.A.O.C. has produced a special type of pressurised container in which fish can be flown very long distances without harm. In building up its freight trade since the war, B.O.A.C. has carried many curious types of cargo and the possibility of the carriage by air of such bad "travellers" as tropical fish was contemplated at first only as an experiment.

The idea originated from the system used for the carriage of carp-fry by sea from Hong Kong to Singapore, where they are eaten as a delicacy. Large numbers of small fish are transported in tanks in this way, and in hot climates the problem of maintaining them at a temperature which does not harm them does not arise. Transport of exotic fish in tanks of this type was the first step taken by B.O.A.C. to promote an increasing line of business.

The first consignments were brought to Britain in York aircraft in which suitable tanks were stood on the floor and special equipment was installed to keep the water warm and aerated. The method produced many problems. For instance, if an aircraft had to stop overnight at an airfield where the temperature was low, arrangements had to be made to prevent the temperature of the water falling. For the same reason heated vans to transport the cargoes from airport to town were required and attendants were necessary for this purpose. It was not infrequent for water to be spilled within the aircraft, sometimes with the loss of fish.

In order to simplify the process, the Fisheries Department of the Colony of Singapore and B.O.A.C. cargo experts co-operated to produce the type of package used to-day and it has been most successful. Roughly the size of a four-gallon petrol tin, the can has a screw-thread glass top and two nozzles to which air lines can be attached, and can be sealed off at will. When the fish begin their journey, they are placed in water in the can and oxygen is pumped in through one of the nozzles. When a suitable volume of water has been expelled by the pressure of the oxygen, the supply is cut off and both nozzles are closed. As many as 500 small fish have been "canned" together in this way. They can live in such conditions for five days without re-packing or changing the water.

Constant temperature within the can is maintained by the use of insulating material known as onazote—about an inch-and-a-half thick—fitted around all sides. Earlier cargoes were packed into a canvas carrier which was made to fit the insulated can but now, as an economy measure, the insulating material is retained in position by the use of adhesive tapes. The packing of fish in this way, as well as being more convenient is more appropriate when the question of storing them in cargo holds arises. The packing advantages which containers of this description have over the earlier tanks is obvious and the convenience of the method has enabled considerable reductions to be made in the charge for transporting tropical fish. Special commodity rates have been introduced by B.O.A.C., reducing the normal freight rate—in many cases to as much as half. The five days during which the fish can safely remain "pressurised" means that they can be transported practically anywhere in the world.

Many varieties of elegant fish, including scats, glass catfish, "bumblebee" fish, harlequins and barbs, have been delivered to British and American aquaria in this way. Fish have been brought from India, Ceylon and British Guiana as well as from Singapore and exported to Australia, New Zealand, the United States and Canada.

The normal freight rate for shipments of cargoes of under 45 kilos from Singapore to London is 17s. 6d. a kilo but a consignment of 500 kilos of live fish would be accepted for 8s. a kilo. Cargo from Singapore to New York in the under 45 kilos category is normally carried at 34s. 9d. a kilo but 1,500 kilos of fish would be charged at only 19s. 2d. a kilo.

The normal traffic in tropical fish at present is about 500 kilos a week but B.O.A.C. hopes to build the total up to 1,500 kilos a week in the near future—enough to fill completely the cargo hold of a Stratocruiser!

For the Top of the Tank — *by* JACK HEMS

MONSTERA delicosa from Mexico is one of the most fascinating plants to grow indoors. It is not a water plant, but it loves moisture so much that it comes near to being one. And this is where the tropical aquarium comes in. For if a potted plant is stood on top of the aquarium, and a small aperture is left in the cover glass, the thick aerial roots which the plant throws out at frequent intervals along the branching stem, may be guided into the water, where they will prove quite decorative and help to draw plenty of moisture into the magnificent elephant's ears of leaves.

The leaves are slashed with deep indentations, and perforated with irregular-sized holes like the holes in a Swiss cheese. They stay shiny and green for a very long time. A large leaf may measure as much as 15 inches long by about 12 inches wide. To keep the leaves in fine condition, they should be sponged with tepid water, or given a weekly spray. In very dry surroundings, the leaves are sometimes attacked by scale insects, which look like flattened half-lentils stuck on the leaves, usually where the membrane joins with strong rib. They may be picked off with a needle, or touched with a fine-pointed brush dipped in paraffin.

In America, the plant is sometimes called the hurricane plant, because the perforated leaves offer little or no resistance to strong winds, and, in the wild, the plant will remain standing during violent tropical storms. In the States, a few aquarists have been bold enough to root it in water for aquarium decoration. From all accounts it has done well as a semi-submerged plant. My own plant, which I bought in January, sits on top of a 18 ins. by 12 ins. by 12 ins. tank housing a solitary firemouth cichlid (*Cichlasoma meeki*). The roots snake about the water, and are tough enough to resist all attacks made on them by the cichlid. The plant grows more lovely every day. Its pot is stood in a saucer kept filled with water.

According to the books, *Monstera* attains a height of 20 feet; that is in its natural surroundings. But I do not think anyone need worry about its growing to anything like this awkward size in a fish house or room. In any case, long stems can always be cut back and replanted in moist sand, or stood in a jar of water, where they will soon throw out roots and develop into new plants. *Monstera* needs a good light, but does not mind some shade. It seems to prosper under electric light; but see that the leaves are not scorched by too much dry heat.

Before I close this short note on a most distinctive plant, let me say at once that *Monstera* is not cheap to buy. A well developed specimen will cost about 25 shillings. But the plant is a good investment, for it adds great beauty to a room, and creates an atmosphere in perfect harmony with a tank of tropical fishes.

News from AQUARISTS' SOCIETIES

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

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

AFTER a lecture on water insect life, given by Mr. A. Bryan, members of the **Altrincham Aquarist Association** were able to examine a number of pond specimens under a microscope. The Association has this year joined the Northenden Society in a show, making 24 entries and receiving 10 awards.

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PROFESSOR J. Harris of the Department of Zoology in the University of Bristol, spoke to members of the **Bristol Aquarists' Society** on the behaviour of fishes at a recent meeting. Previous lectures have been given by Mr. Zanas Webb (Birmingham), on line breeding fancy goldfish and by Mrs. W. Meadows (London), on breeding tropical egglayers.

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THE Catford Aquarium, Reptile and Pond-keepers' Society has now shortened its title to the **Catford Aquarists' Society.**

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PRESENTATION of a stocked tropical aquarium has been made by the **Coventry Pool and Aquarium Society** to the children's ward of Gulson Hospital, Coventry. Members make weekly visits to the ward to service the tank.

Photo Walter Robert s

Mrs. A. Burton (West Middlesex A.S.) receiving trophy for best furnished aquarium from Mr. Steve Race (B.B.C. artist) at Wembley Aquarium and Pool Association's Exhibition. This was the second successive award of the trophy to West Middlesex

HEATING and water temperatures was the subject of a talk given by Mr. J. E. Seale to **Croydon Tropical Breeders' Circle.** At the preceding meeting, Mr. F. C. Katritzky gave a talk illustrated by epidiascope pictures on water plants and their culture.

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FIRST exhibition staged by the **Dunstable and District Aquarists' Society** formed part of a Coronation celebration display and was viewed by over 1,500 people. At a recent evening meeting Mr. R. Holland spoke on spawning and rearing barbs.

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OWING to their title, members of the **Friends Aquarist Society** are often asked whether the society is part of the Quaker movement, but, in fact, the name is without significance in this respect and indicates only the friendly nature of the society. The first quarterly number of "Betta News" (13 pages) has been produced by members, and contributions are solicited from other clubs and individuals for future issues.

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THE committee of the **Harrow Aquarists' Club** has decided to bench fishes in their show in 4-lb., square, screw-topped store jars, where this suits the exhibitor, to avoid adverse effects from transfer of fishes to new water. Suitable aquaria will also be available for larger fish and for exhibitors without the standard jars.

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SECOND prize was gained by a furnished aquarium entered in the Shelf open show by **Huddersfield and District Aquarists' Society,** and member Mr. E. Aubrook gained first and second awards with his aquatic plant exhibits. In a table show in competition with Halifax A.S., the Huddersfield society gained 28 points to the opposing society's 19 points.

LYONS **Club Aquarist Section** ventured into new fields when it staged an exhibition at the Lyons 1953 Sports Carnival. Twelve 24 in. aquaria were on show, three being coldwater. Also shown was a minute aquarium (3 in. by 2 in. by 2 in.) fully equipped with compost, plants and five fish. The display proved to be a popular addition to the other carnival attractions.

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NEW title for the **Nelson and District Aquarist Society** is the Nelson Aquarium Society. Secretary is Mr. R. Mutlitt, 32, Barkerhouse Road, Nelson, Lancs.

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SHELF A.S. SHOW

THE **Shelf and District Aquarist Society's** First Annual Open Show, held during July, is believed to be the first entirely open show to be held by a local society in the West Riding of Yorkshire. The society hope that it will be continued as an annual event. The show was held in Shelf Church schoolrooms amid delightful surroundings; walls were suitably draped in green and cream, with a waterfall at one end of the hall dropping into a well-laid-out pool surrounded by flowers. An interesting display of cacti was on view, loaned by Mr. Thorpe, a gold medallist in this sphere.

The furnished aquaria were in a double block, almost the entire length of the hall, and ample space was afforded to view the exhibits. The single fish entries were in a second block at one end of the room, in tanks mounted in three tiers. It would seem that the top tier of these, containing the cichlid entries, was suitably housed as the judges were reported to have said that they had not seen a finer set of cichlid entries in a show, and that the exhibitors were to be con-

Miniature Aquaria Contest

A RECENT meeting of the **North Herts. Aquarists' Society,** held in the Old Guild Room, Hitchin, took the form of a Novelty Miniature Aquaria contest. Small tanks, 12 in. by 10 in. by 8 in. were provided, complete with small shingle, and the competitors, who were allowed half-an-hour only, had to completely set up the furnished aquaria, providing their own rocks, plants and fishes. A great deal of interest was aroused with this novel competition, and the judge, Mr. J. H. Gloyn, of Welwyn Garden City, one of the National judges, placed the winning three tanks as follows:—1, Mrs. E. Cooke, Letchworth; 2, Mrs. P. Pearmain, Letchworth; 3, Mrs. P. Parker, Hitchin. (The winners are seen with their aquaria in the picture on the right.) Mr. Gloyn afterwards gave a talk on furnished aquaria, from the judge's point of view.

gratulated on their fine condition. Judges were Mr. E. Chapman and Mr. H. Loder.

Three-dimensional films were taken of some of the personalities at the show one evening and were shown locally in a cinema newsreel. There were also some colour films taken of the exhibits and these are expected to be shown locally, together with other colour films of fish, either in September or early October.

Aquarist on Holiday

INVITATIONS have been sent for readers of *The Aquarist* holidaying in the areas of the following aquarists' societies to meet their members at society meetings:

Brighton: Meetings of the Southern Amateur Aquarists are held fortnightly on Mondays, 8 p.m., at Fabian House, Richmond Place, Brighton, Sussex. Secretary: Mr. H. M. Wright, 2, Rotherfield Crescent, Brighton 6.

Dublin: Society of Aquarists holds monthly meetings and visitors should obtain details from secretary, Mrs. E. Spurling Jewell, 89, Walkinstown Road, Crumlin, Dublin.

Folkestone Aquarist Society members meet on the first and third Thursdays of each month, 7.45 p.m., at Folkestone Public Library. Secretary: Mr. C. A. White, South Point, Limes Road, Folkestone.

Hastings and St. Leonards Aquarist Society meetings are held on alternate Wednesdays, 7.30 p.m., at the Cinema Cafe, Norman Road, Hastings. Secretary: Mr. J. P. Brown, 47, Pevensey Road, St. Leonards-on-Sea, Sussex.

Ryde Aquarist Society meets on the fourth Wednesday of each month, 8 p.m., at the School of Art, George Street, Ryde. Secretary: Mr. C. G. Petty, 27, Arundel Road, Ryde, Isle of Wight.

Torquay and District Aquatic and Pondkeepers' Society meetings are held on the second and fourth Mondays each month at Belgravia Club, St. Marychurch Road, Torquay. Secretary: Mrs. J. Brocking, The Westbury, Belgrave Road, Torquay.

Secretary Changes

CHANGES of secretaries and addresses have been reported from the following societies: **Barnsley and District Aquarist Society** (Mr. W. Blackburn, 19, Ridings Avenue, Smithies, Barnsley, Yorks.); **Walthamstow and District Aquarists' Society** (Mr. J. Bennett, 18, Sunnydene Avenue, London, E.4).

Aquarist's Calendar

2nd-5th September: **Kingston and District Aquarist Society** annual show at the Y.M.C.A. Hall, Eden Street, Kingston, Surrey. Show secretary, Mr. A. Beckett, 13, Plough Road, West Ewell, Surrey.

3rd-5th September: **Southampton and District Aquarists' Society** annual open show. Show secretary: Mr. H. C. Golesworthy, Westways, Romsey Road, Nursling, Southampton.

3rd-6th September: **Accrington and District Aquarist Society.** Fourth annual open show of furnished aquaria at the Town Hall, Accrington. Show secretary: Mr. S. Ratcliffe, 4, Rutland Street, Accrington, Lancs.

3rd-12th September: **Nottingham and District Aquarists' Society** annual show and exhibition at the Albert Hall Institute, Derby Road, Nottingham.

5th September: **Harrow Aquarists' Club** seventh annual show at Roxeth Parish Hall, South Harrow (near South Harrow Station), 2.30-8.30 p.m. Show secretary, Mr. W. L. Wilson, 57, Constable Gardens, Edgware, Middlesex.

8th September: **Glasgow**—Lecture by Dr. Myron Gordon at Christian Institute, 70, Bothwell Street, Glasgow, C.2, 7 p.m. Admission by ticket only.

9th-12th September: **Hartlepools and District Aquarists' Society** annual show at Scouts' Hall (late Methodist Chapel), Elwick Road, West Hartlepool.

10th September: **Newcastle**—Lecture by Dr. Myron Gordon at Y.M.C.A., Connaught Hall, Blackett Street, Newcastle upon Tyne, 7 p.m. Admission by ticket only.

10th-12th September: **Coventry Pool and Aquarium Society** show and exhibition of tropical and coldwater fishes at Queen's Road Baptist Church Hall, Coventry. (Revised announcement.)

11th September: **Sheffield**—Lecture by Dr. Myron Gordon at City Hall, Sheffield, 7 p.m. Admission by ticket only.

11th-12th September: **Bethnal Green Aquatic Society** fourth annual show with open classes and the London area fighter championship open class. 11th, 7 p.m. to 10 p.m.; 12th, 2 p.m. to 8.30 p.m. at the Bethnal Green Institute, 229, Bethnal Green Road, London, E.2. Schedules obtainable from Mr. W. Richardson, 98, Warner Place, Bethnal Green, London, E.2. Closing date 14th August.

11th-12th September: **Walthamstow and District Aquarists' Society** annual show at Hawthorne Road Hall, Hawthorne Road, Walthamstow, E.17.

12th September: **Birmingham**—Lecture by Dr. Myron Gordon at Birmingham and Midland Institute, 1-18, Paradise Street, Birmingham, 2.45 p.m. Admission by ticket only.

13th September: **Manchester**—Lecture by Dr. Myron Gordon at Free Trade Hall, Manchester, 2.30 p.m. Admission by ticket only.

14th-19th September: **Blackpool and Fylde Aquatic Society** annual show with open classes. Schedules and full details from Mr. W. Robinson, 3, Denwood Bank, Warton, Preston, Lancs.

15th September: **London**—Lecture by Dr. Myron Gordon at Friends' House, Euston Road, London, N.W.1, 7 p.m. Admission by ticket only.

18th September: **British Herpetological Society** London Group meeting "Young and home bred reptiles and amphibians," 7 p.m., at Linnaean Society's Rooms, Burlington House, Piccadilly, London, W.1.

19th September: **Federation of Guppy Breeders' Societies** annual show at St. Martin's School of Art, Charing Cross Road, London. Schedules from Mr. W. Howe, 24, Kerfield Crescent, Grove Lane, London, S.E.5. Closing date: 5th September.

23rd-26th September: **Oldham and District Aquarist Society** third annual show at Regent Street School, Regent Street, Oldham, Lancs. Show secretary, Mrs. Vera Tripp, 187, King Street, Oldham, Lancs.

24th-26th September: **Banbury and District Aquaria Society** annual show at Banbury Town Hall. Schedules and details from Mr. R. A. Butler, 225, Warwick Road, Banbury, Oxon.

24th-26th September: **East London Aquarists' and Pondkeepers' Association** "coming of age" exhibition. Open classes—Club furnished aquaria for Coronation Trophy (to be won outright). Senior and junior individual furnished aquaria for the Essex championships. Full particulars from show secretary, Mr. F. A. Petto, 52, Humberstone Road, London, E.13.

26th September: **Federation of British Aquatic Societies** general assembly, 2.30 p.m. at Friends' House, Euston Road, London, N.W.1.

26th September-3rd October: **Huddersfield and District Aquarists' Society** annual show at Parochial Hall, Springwood Street, Huddersfield Yorks.

2nd-3rd October: **Bristol Aquarists' Society.** 1953 Coronation Open Show at the Y.M.C.A. Hall, Bristol. Schedules obtainable from Mr. R. Woodbine, 18, Grantham Road, Kingswood, Bristol.

4th October: **Federation of Northern Aquarium Societies** Twelfth (Autumn) Assembly. Lectures, film show, trade stands. Zoological Gardens, Belle Vue, Manchester. Tickets (2s. 6d.) from Mr. H. Ashbrooke, 38, Broady Street, Stretford, Lancs.

26th October: **British Herpetological Society** London Group meeting, "Crocodiles and Tortoises," 7 p.m., at Meeting Room, Zoological Society of London, Regent's Park, London, N.W.8.

October Lectures

A SERIES of lectures on aquarium-keeping to be given by Mr. A. Boarder has been arranged by the Borough of Wandsworth at the following libraries in the Borough on the dates given: 2nd October: West Hill; 8th October: Balham; 15th October: Tooting; 22nd October: Clapham; 29th October: Streatham.

Crossword Solution

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

PICK YOUR ANSWER (Solutions)

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