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Editorial

AT first sight the new idea of the Federation of British Aquatic Societies to introduce a scheme whereby articles sold for use by aquarists can be examined and given approval seems to be a sound one. It is always useful to have an objective judgment on an article before purchase, and such a service is particularly attractive to the beginner in the hobby, who is perhaps without previous experience with which to assess the worth of a piece of equipment. So much depends, however, on the nature of the assessment of any article which is to be approved or disapproved and also upon the individuals who are to be the assessors. On these matters we believe that the "Products Endorsement Plan" will be subjected to the most detailed questioning.

It will be recalled that a rather similar scheme was launched by the Aquatic Traders Association not many years ago. Lack of support for it by traders subsequently and dissension over its application have led to an unofficial if not official burial of the scheme. The failure of one attempt does not portend the failure of another one, of course, and we do not want to be accused of pessimism over the new plan of the F.B.A.S. Those in favour of the broad principles of such a scheme, and we count ourselves amongst those, will point to the success of similar well-known approval schemes for household articles. But it is unfortunately true that what works well on a national scale for domestic goods is less easily applied to the closely-knit and much smaller community of fish-keepers and traders.

The publicised details of the F.B.A.S. plan have already invoked criticism on other grounds. Manufacturers are being asked to pay quite a substantial fee for the examination of the goods submitted to the F.B.A.S. and a further annual sum to secure renewal of approval if it is granted. Some assurance would be desirable that these charges are the minimum economic rates at which the scheme can be operated. If it can obtain full support from the trade the F.B.A.S. is obviously a suitable body to run the scheme and the future progress of it will be watched with interest.

The Aquarium as a Living Picture

by STEWART G. KNOCK

(*Illustrated by the author*)

ALTHOUGH I have been interested in aquaria all my life, it was not until last year, when I paid a special visit to the Hendon show, that I realised that the usual conception of a planted aquarium is now old-fashioned. You see—I live in the country and do not belong to any aquarists' society, so therefore cannot judge whether the beautifully fitted tanks that I saw there were just a fair sample of present-day fitted aquariums, or whether the Hendon club has members who are "fish fans" in their spare time but artists by profession. Suffice it to say that many of the tanks were, in short, living pictures, and showed a knowledge of composition and proportion, and also an appreciation of colour and form where plants were concerned.

I should explain to readers who have not seen such aquaria that the back and side walls were covered in cement which ran in natural strata, and incidental rocks and retaining walls for plants were also in keeping. The heaters and thermostats were, in most cases, adequately hidden. I think a name could be coined for such tanks—I would suggest "Tailored Aquariums," or for alliteration, "Tailored Tanks."

I was so shocked on my return home, when faced by my own tanks which were set up in the usual way with carefully arranged rocks, sand and plants within four clean glass walls, that I knew I should have no peace of mind until I, too, had created an underwater cave-like vista!

My first effort was directed at a small 18 in. breeding tank, which I thought would provide experience—which it did. I fashioned the walls of cement, making the three slabs of a thickness varying from $\frac{1}{2}$-$\frac{3}{4}$ in. I found, however, that even with such a small aquarium the slabs were quite heavy, and, if carelessly handled, would easily have broken. The presence of so large a quantity of cement in a tropical tank, although adequately soaked beforehand, also raised doubts in my mind.

It was here that I hit upon the idea of making the backgrounds of glass, but with a thin coating of cement only, except for an occasional protuberance. I found that even heavy reliefs could also be obtained by laying on, one above the other, strip after strip of glass thinly coated with cement. I found too, that wide ledges, to relieve the general flatness and cast useful shadows, which offered peaceful retreats for the fishes, could also be made with glass—as I will explain later. In this way it will be noticed that the use of cement is reduced to a minimum.

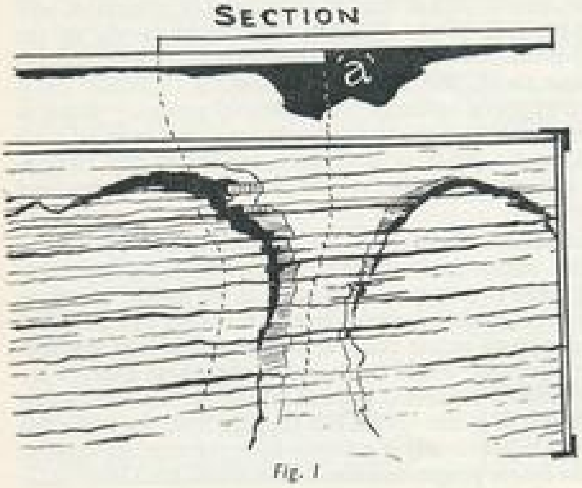

Fig. 1

Fig. 2

As for the three sheets of glass required to form the back and sides, I discovered that odd broken panes lying about the place could be cemented together strongly, and without difficulty, by overlapping them and building up the joins with strips of glass strengthened by an irregular $\frac{1}{4}$ in. seam of cement (Fig. 1). The resulting projections (a) (which were, of course, made to follow the lines of strata by cutting with the blade of a knife before setting hard) also helped in breaking up the general flatness of the background. Advantage can be taken of such projections. They can be added to, in places, to form flat arches, or be increased in importance by the addition of a number of small, staggered ledges. Such ledges can also be made into an interesting feature by bringing a number well forward in the nature of a buttress, but with gaps behind through which the fish can pass (Fig. 2.)

Construction Details

First of all, what tools and materials are required? Well, for a two feet tank: about a half-bucket of *sifted* sand and two or three pounds of cement, and enough glass to form the back and sides, with some odd pieces to make ledges and retaining walls for the plants; a small trowel, a glass cutter, an old knife and an old tin tray upon which to mix your cement. You will find that after the main coats have

Fig. 3

Fig. 4

been applied to the sheets of glass, you will constantly be mixing very small quantities, as you proceed to add ledges, arches, caves or other features that appeal to you. An empty lighter-fuel bottle, without the glass drip nozzle, comes in very useful here, as the water can so easily be controlled.

The proportion of cement to sand is 1:3, and—an important point—when adding cement to a background that has already dried out and is hard, damp the latter so that it will not blot up all the moisture from the new application, causing it to dry out too quickly.

No longer is it necessary to wait for perhaps a day before being able to shape or carve newly laid cement, for there is a liquid which, when mixed with water, induces the cement to set sufficiently hard to be "carveable" in anything from several hours to 15 minutes, according to the amount added to the water. It is called Cementone no. 8, and costs under ten shillings per gallon. There may be other hardeners on the market, but this is the only one I know and of which I have had actual experience. A gallon would be sufficient to complete at least a dozen tank backgrounds, so that groups of aquarists or clubs could combine in the purchase of a gallon, and go shares.

Before starting operations, several rough sketches should be prepared, until you are satisfied that the design you propose to carry out is really the best of which you are capable. Remember that what you are about to make will probably be facing you for many years.

In making your design, remember these points: provision should be made to hide the heater and thermostat. Do not leave any crannies where small fishes might get wedged, or ailing ones hide away to die. Take careful measurements of the inside walls. Make the back wall take up the entire width, less $\frac{1}{8}$ in. (in case your aquarium is not quite square). The side walls will keep the back wall in position (Fig. 3), especially if the former are able to stand alone with parts of the retaining walls (which are to form plant beds) cemented to them as feet (Fig. 4).

In designing your aquarium interior, careful thought must also be given to the beds where your plants will be placed. I think surrounding walls, giving a 3 in. depth of compost, would suit most aquariums, but take care to avoid any suggestion of formality or unnaturalness. The general slope of the walls should roughly conform to the lie of the strata, and upstanding rocks should also be cut with strata running parallel to the background (Fig. 5).

It will be found that mulm will automatically drift to where it can easily be collected if the compost or sand is arranged to form a basin, as it were, the lowest part being somewhere near the centre of the base (Fig. 6).

If you think of making a pillar or arch around which fishes can play (as I have shown in Fig. 5 and sketch B) the construction will be of pieces of glass, as also will be the platform on which it stands (Figs. 7, 8 and 9). The thermostat is concealed behind this pillar, and the plan (Fig. 9) and the method of cementing the glass together (Fig. 10) are shown.

The heater should be as near as possible to the centre of the tank, and hidden from view by strata-covered glass (Fig.

Fig. 5

Fig. 6

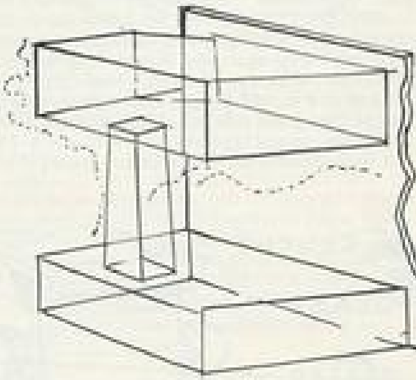

Fig. 7

Fig. 8

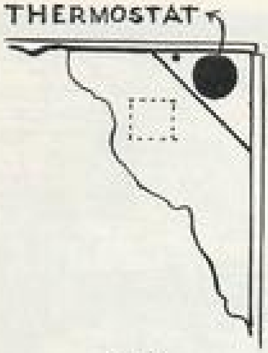

Fig. 9

10). Lead rings placed around the heater will counter buoyancy, and a strip of glass placed beneath it will prevent amalgamation with the compost (Fig. 11). Another arrangement for thermostat and heater is shown in sketch A. Here, the thermostat is concealed behind the column in the right corner and the heater lies in a well between the back and the little wall just underneath the largest fish—quite a good arrangement for a small tank. A change of heater can be effected without disturbance of plants, and it will be found that heat circulation is quite satisfactory.

Of course, the first step after deciding your design is to make the back and side panels. Mark out your overall sizes accurately and squarely on paper, and place your pieces of glass on them in position. See that the height will be only just above water level (i.e. about [illegible] in. below the inside top of the tank frame). This gap will facilitate manoeuvring when setting up. For example, outstanding ledges on a side might just be in the way of a ledge projecting from the back. The gap of [illegible] in. will permit clearance by raising one a little when swinging the side panel into position (Fig. 12).

Cover the glass panels unevenly with about [illegible] in. of cement, but with about [illegible] in. where seams occur, if you are

Sketch A (top) and sketch B (below)

using several odd pieces of glass to form one slab (Fig. 1). When the cement has set sufficiently to retain an impression, mark off your strata lines with the blade of an old knife, cutting nearly down to the glass foundation. These lines should not be equidistant. Let them also slope up gently on one side and the back, and down at the same angle on the opposite side (Fig. 13). The distance between strata lines should vary from, say, [illegible] in. Your cement mixture should not be too sloppy but of a consistency that can be easily spread with a trowel or old table knife.

Before the slabs have hardened, and while still damp, the general flatness of the surface should be made more interesting by increasing the projection of some of the bands of strata in various parts and, where the thickness will allow, by scraping back other bands almost to the glass. This will help to remove the unnatural uniformity.

As I have stressed before, one should aim at breaking up the appearance of "a three-sided box" as in Fig. 13. This

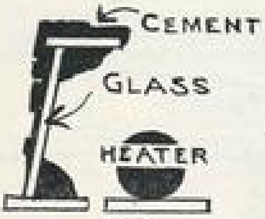

Fig. 10

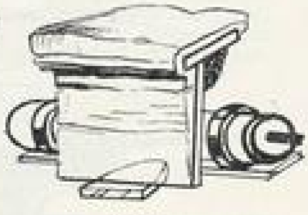

Fig. 11

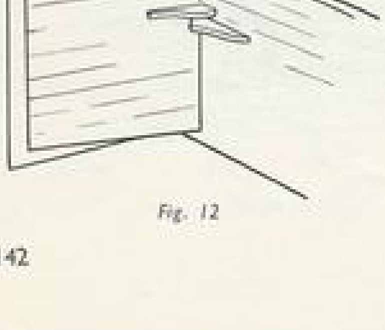

Fig. 12

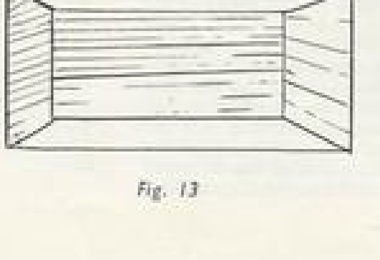

Fig. 13

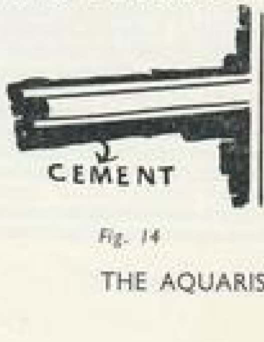

Fig. 14

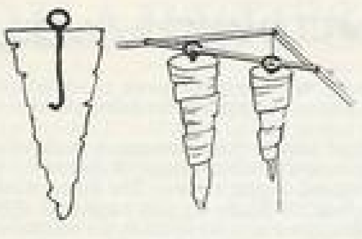

Fig. 15

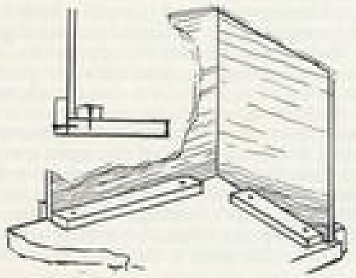

Fig. 16

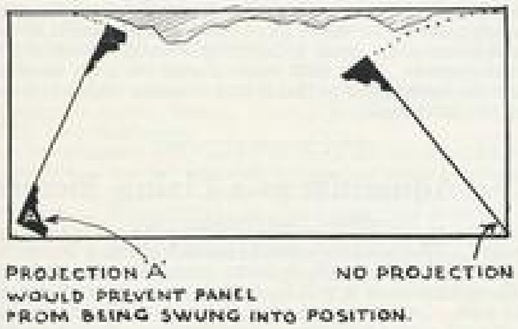

Fig. 17

can be done by the addition of a number of projecting shelves, made either of glass covered with cement (Fig. 14), or even slithers of sandstone obtained by splitting an old stone roofing tile. Some of these ledges can project as much as 3 in., and the angularity of the whole scene is greatly mitigated if several are placed just below the water line. Of course, they will follow the direction of the strata, some even just penetrating the water surface.

While on the subject of breaking up the box-like appearance, it will be appreciated that the two corners where the sides meet the back offer the best opportunity to attain this end. One corner will house the thermostat, as in Fig. 9 (and also the wire of the heater), and the other can be quite different in design, featuring either a cave formation, niche, or interesting strata arrangement. An additional point of interest can be gained by using several pendants in the middle distance appearing through the (water Fig. 5). These should vary in length, and can be made by inserting into a thin cone of cement, a galvanised wire with a loop on top (Fig. 15). Through these loops a rigid galvanised wire can pass and be supported on the back and side of the background panels—just above water level. In this way, the position of the pendants can be adjusted to taste and also removed quite easily for servicing the aquarium.

I must now refer again to the bed of the tank, which offers endless possibilities in its layout, and should be designed in relation to the background walls. I think it will be found best to make it in several sections. Any section can be supported with a glass foot (Fig. 4) and the thin covering of cement need not reach the bottom, as it will be hidden by the compost. Before installation in the tank, all cement-covered glass should be left to soak for at least a week.

My aquaria were fitted up about eight months ago. Fishes and plants have all been very healthy. The backgrounds in some cases have altered very little in colour, but in others have assumed a darkish green shade. However, this does not upset me at all. Just as it is often said that there is no better background to a beautiful woman's face than black—so I think dark green is a wonderful foil to set off the colour and form of fishes!

A few pieces of wood nailed together (as in Fig. 16) will be a great help in visualising the general effect of what you are making, as the panels can be brought together in an upright position and the foreground more easily schemed and adjusted. Incidentally, do not forget that after the back is in position in the tank, your side panels have to go in. Therefore, any projecting ledges that you have introduced must allow for this. A glance at Fig. 17 will indicate what

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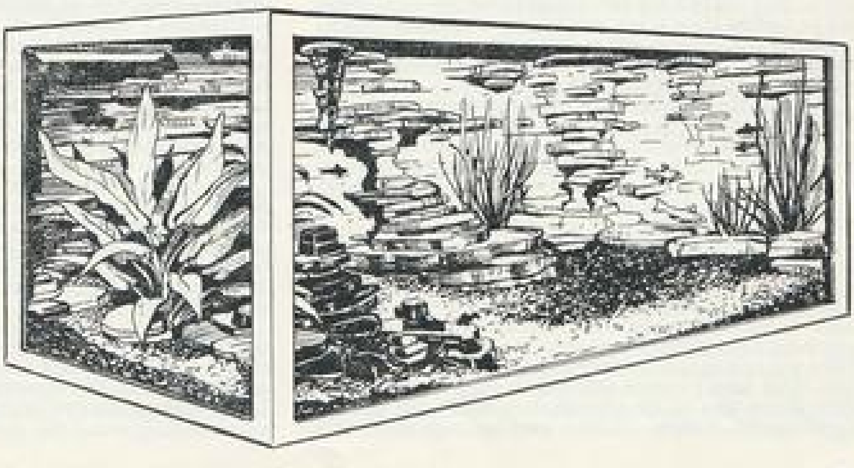


Sketch C: *an example of an aquarium in a position where the main view of it includes one end (e.g. in the corner of a room). One end panel has been left clear of stonework and the interior design and planting is planned to allow for the direction from which it is mainly seen.*

In the Water Garden in October *by* ASTILBES

THERE is an idea that unless dead leaves are left in the pond to decay and so produce nourishment for the following year the plants will fail to flower. There is no need to leave these dead leaves in the pond, however, as a great deal of mulm and waste matter from the fishes is likely to be present for the benefit of the plants.

The necessity for a good depth of soil at the bottom of the pond is often discussed but where small ponds are concerned it is better to refrain from placing anything at all at the base of the pond. Where a small concrete pond has been made and some soil has been placed over the bottom it will be found that in a year or two the roots of the water plants will have become so entangled that it is almost impossible to separate them so as to introduce a fresh subject. It is better to plant each subject in a container so that it can be moved and re-potted if necessary. It will be found that most water plants soon extract the nutriment from the soil in a fairly small pot, but where possible pots should be used which have holes near the base to enable the roots to escape into the water, where they will find plenty of nourishment, but it will still be fairly easy to remove the whole from the pond if required.

The only time when it is policy to place soil in the pond is when a separate channel has been formed around it where pondside specimens are to be planted. In such a position it is possible to leave the soil undisturbed for years, but it is not in the way when you want to clean out the main pond each year. The necessity for this soon becomes apparent when the accumulating detritus rises to such a height that the depth of the water is greatly reduced. It is certain that the smaller the pond the more necessary it is to clean it out each year. Many people have lost fishes during the winter and early spring when the water has frozen over, not because of the cold alone but because the water is so foul that the poisonous gases have been trapped underneath the ice and so the fishes have been asphyxiated. It has been proved that even very small fishes can go through very severe winters as long as the water is pure.

Annual Cleaning

Be guided by the size of your pond and if it is no larger than about 60 square feet in surface area it will be safer to clean it out each year. Obviously it is impossible to clean it out thoroughly unless everything, including the soil, is removed. Where this is not possible, if the water is lowered some of the mulm may be dragged out with a large scoop. In doing this it is certain that all the remaining water will be soon as black as ink, and the catching of any remaining fishes will become almost impossible. It is at a time like this that the pondkeeper wishes that he had never put soil into the bottom of the pond.

Although the cleaning of the pond may be one of the few tasks necessary for this month there is the important point to watch of feeding your fishes. As long as they will feed it is imperative that some food should be offered as often as once a day, as long as none is left uneaten. If the fish are well fed right up to the cold weather it is certain that they will be able to build up their strength so that they may go through the winter far more safely than if they were in a half-starved condition.

Some ponds may contain a good number of small fry, which have been hatched there, and some people catch these up and try to winter them in small tanks. Unless the pondkeeper has plenty of tank space it is probable that more fishes will be lost than if they had been left in the pond. I have often seen it stated that unless goldfish are at least three inches long by the autumn they cannot live through the winter out of doors. This is quite incorrect as fish only one-half inch long have been known to winter quite safely in outdoor ponds, the main point being that the water has been pure.

It is a good plan to make new ponds at this time of the year. The concrete will set better if it is not subjected to too much sun and drying winds. The longer it takes to dry the harder it gets. There are many methods of building a pond but the type which is easiest is the natural-sided one, with a gradual slope to the sides. This enables the pond-maker to dispense with any form of shuttering, which would be essential if a pond with almost vertical sides were made. Shuttering can be expensive and to make a fairly large pond proves troublesome as well. It is also a fact that the concrete is less likely to crack under the stress of freezing if the sides are sloping, though it must not be thought that because the sides of a pond have been made sloping no subsequent cracking can occur.

Once a very severe frost happens and the water is frozen over to a good depth the sides of the pond get encrusted with ice and then there is plenty of stress from it. If it is possible to keep the sides of the pond free from ice there will be less likelihood of cracks forming. It has been suggested that the ice slides up the sides of a sloping concrete pond but it will not do this once a thickness of ice covers the concrete.

If a fresh pond is made do not make the path surrounding it in one piece with the actual pond concrete. If this is done it is almost certain that when the pond freezes the path will also freeze; it will be lifted up by the expansion of the earth below and a crack will develop around the top of the pond concrete. Any path made should be quite separate from the actual pond so that it may move up without affecting the pond itself.

The Aquarium as a Living Picture

(continued from preceding page)

I mean. The side panels should be made about $\frac{1}{16}$ in. on the narrow side. This will facilitate setting-up, and the gap will not be seen as it will be hidden by the front frame of the tank.

Should your aquarium be situated near a corner of the room where it is normally viewed from an angle and not full face, an excellent effect can be obtained by the use of one side panel only, with an important plant near the vacant side.

Although I personally do not favour snails in a tank, owing to their habit of dying and of blocking my filter, I have nevertheless, carefully cemented just a few empty shells here and there. They look most natural, and so far no-one has suggested that my snails appear to be somewhat sedentary! In some of my sketches the tanks may appear to be underplanted, but more water weeds would have obliterated too much detail, I fear.

I have tried to give as many details as possible to enable readers to embark on the making of a Tailored Aquarium with a clear view as to what is entailed and with a fair amount of confidence. Anyone with a taste for model-making will be absorbed in the task. There is room here for unlimited imagination—in fact, it is akin to painting a three-dimensional picture.

I do not know whether the fitted aquariums that I saw at the Hendon show were inspired by similarly arranged tanks abroad or not, but in any case, if the movement could only be developed in this country with sufficient enthusiasm, I feel convinced that aquarists of Great Britain would be in a class of their own.

AQUARIST'S Notebook——

by

RAYMOND YATES

BEGINNERS can never understand why they fail in their breeding efforts with egg layers, and ask "Where did I go wrong?" as if it was as easy as that to answer. There are so many aspects to consider with breeding, and the expert cannot advise unless he is fully conversant with all the circumstances and sees the actual conditions under which things have gone wrong. Most failures are due to lack of preparation beforehand, both in the practical side of having everything ready and also in having the detailed requirements of the fish in question in your mind, either from aquarium literature or from experienced friends. If you know exactly what conditions the parents and baby fish require, nay demand, and keep these in mind all the time the possibilities of failure will be much reduced.

Many newcomers fail because they lack patience. They are in too much of a hurry, too anxious to get things moving. I know of several people who have thrown away spawnings of glowlights merely because no sign of fry could be seen, although the tiny glowlights often hide away in the mulm or peat bottom for several weeks. The breeders are often dumped together merely because they happen to be of opposite sexes, quite regardless of their condition, and the fish are blamed because nothing happens. Sometimes the owner has no idea of the sex of his fish but just hopes for the best. All this is very hit or miss, the idea being that nature will do all that is necessary and then the owner can take all the credit. They always say "I have spawned some so and so" as if the fish had no say in the matter. Fish will rarely spawn if they are unsuited to each other, out of condition or if the conditions are unsuitable to them, or, more importantly, to their offspring to be. This fact is overlooked by many in their enthusiasm. Planning a fish family is like planning a human family; careful preparation has to be made long in advance.

The enthusiast will read up all about the fish in which he is interested and get as much information from successful breeders as possible. Plenty of other hobbyists will tell you how to do everything even although they have never spawned or even kept that variety themselves. Now a pair or several pairs of the fish should be obtained and these should be observed whilst being brought into condition, a period of several weeks perhaps. The time of the year must be considered—just any old time won't do. Now the breeding tank or tanks can be prepared, the spawning media got ready, unwelcome enemies like *Hydra*, planarians and snails removed and arrangements for screening light and draughts made ready. Too many aquarists have their water too deep for the young fry, whereas others do not seem to realise that scum and dirt on the surface are detrimental factors.

Check on heat so that the babies are not forced to live in torrid surroundings or chilly water approaching the danger limit. Is the water the right pH or thereabouts, and what about the hardness? Is your aerator working properly with a minimum of disturbance (if you use one at all) and is the air it feeds in clean or full of oil fumes or tobacco smoke. Find out just how long in hours it is between the babies hatching to food being required and keep to this. How many broods have been lost by eager aquarists polluting the water with food a day or two before the fry were in any position to eat anything! Follow feeding suggestions faithfully, no more and no less. Don't add a bit more for luck; the only luck you'll have is bad luck.

The food problem is perhaps the major snag of all; young fry must be fed regularly however inconvenient it may be to their owner. Fry never grow fast enough for our liking and great patience is needed. Keep on feeding the minutest food whilst any tiny fish still remain; the fact that some are now large, too large for this food, merely means you must also feed them your second-stage food, but don't starve to death the slower growers, a mistake often made by the inexperienced. As for your foods, have them ready. Don't wait for your hatchings before you think about your Infusoria, green water, sifted *Daphnia*, brine shrimp and commercial fry foods—have everything ready.

One source of trouble is lack of space, and it is true that no fish can be brought on in cramped conditions. Don't try it, cull as many of your fry as you can bring yourself to give away or feed to older fishes. You can't bring them all on. Use some discretion over which fish you keep and remember that fry cannot stand netting or moving about or pouring or sudden temperature changes. With some experience most fishkeepers can spawn the majority of fishes, but hatching the eggs and rearing the fry is where most fall down. The major causes of failure are probably (in order of their importance): 1, lack of real knowledge of the exact requirements of the fish concerned; 2, lack of patience; 3, casual and incorrect feeding; 4, lack of space, and general overcrowding.

A record should be kept of the actual dates of all spawnings and hatchings so that a check can be kept on growth. Once out of the initial stage most fish grow very quickly if well fed and given ample space but cramped fish with only average feeding are very slow growers and tend to runt. With labyrinth fishes the danger period when loss can be expected is rather longer than usual and you are not out of the wood until the labyrinth organ has formed. This is why young leeri gouramies are so liable to die off when seemingly very robust fish.

*   *   *

Some years ago attempts were made to obtain rapid and increased growth of young fish by the addition of antibiotics (in this case aureomycin) to their diet because similar experiments with chickens had had most successful results. However, after a long period it was generally agreed that fish did not respond to this treatment and that results were either negative or, in some cases, growth was actually retarded. Continental experiments on these lines with guppies produced evidence of growth being retarded. Where coldwater fishes were used results were just negative. Penicillin and streptomycin fed directly, produced definite signs of increase in growth up to almost one-half as much again as normal growth rate. Antibiotics being soluble in water may have been the reason why previous feeding experiments failed, although this would not explain growth being actually retarded. The fact that these antibiotics are soluble in water has been quite a blessing in the treatment of many fish diseases, and these substances are used mainly, if not entirely, nowadays by most of the large public aquaria in the fight against disease. Probably the most effective is terramycin but aureomycin and chloromycetin prove very satisfactory. The usual dose is 50 milligrams (mg.) per gallon.

Mr. J. K. Hutton of Auckland, New Zealand, gives some interesting information on effects of antibiotics in a letter published in *The Aquarium Journal*. He used to keep some Tuxedo swordtails in a tank and, from time to time, he added a 50 mg. capsule of aureomycin to their tank. This was done haphazardly, when the spirit moved him, so that these fish got some heavy doses. He found that the males lost interest in the females, and that the latter bullied the males in no uncertain manner. The females each produced in due course a brood of young and then died off, one after another. The young refused to grow normally and were fully mature at 1¼ inches in length or even less. These tiny swords bred in the usual manner but the offspring were dwarfed. Perhaps some reader has had unusual experiences in the use of antibiotics which he may care to pass on for the benefit of other aquarists—we know very little on this topic as yet. Those clubs who have donated furnished aquaria to hospital wards will probably already know the effect of penicillin on white spot, one of the very first experiments tried out, but have they found out anything else? If so, let us hear from them.

* * *

As I have said before, Nottingham are one of the most go-ahead clubs in the country. However, of late they have discovered that the annual excess of expenditure over income is over £100 and that something must be done. They are not the first club to find themselves in this position to a greater or lesser degree, and it will be interesting to see the steps taken to regularise things. They can (*a*) do nothing, (*b*) try to increase their income, or (*c*) try to reduce expenditure. The first course is out of the question and they are loath to resort to the last, so a sub-committee has been formed to make suggestions and recommendations to bring in more £ s. d. There must be other ways beside raising subscriptions and hoping for show "profits," and perhaps other clubs can suggest new and novel ways and means which they have tried out successfully. This is a matter of interest to every club, because cutting expenditure in the long run means reducing club interests and activities to a minimum.

* * *

At a recent meeting of the Nottingham Society, Mr. Inman gave a talk on "Diseases of Coldwater Fishes," and mentioned that the three most common troubles which beset fancy goldfish are fungus, gill flukes and fin congestion. For fungus he suggested that affected fish be given a bath of malachite green, one grain to one gallon, the fish being dipped therein for not more than 30 seconds, and then put in a tank containing sea salt. This dye was first tried out in the U.S.A. about 20 years ago, a concentration of 1 in 15,000 with a dip not lasting longer than one-half minute being used. However, this is a beastly chemical to use as it is rather like methylene blue, and leaves just as bad a stain if it gets on to anything. The colour of the solution is blue; only the crystals are green. Personally I have found Phenoxetol much quicker, safer and a lot less trouble. Mr. Inman also suggests the same treatment for gill flukes. I have not tried malachite green for this trouble as it can usually be overcome in adult fishes by adding one teaspoonful of hydrogen peroxide (20 volumes strength) to each five gallons twice a day.

* * *

At a large show I was somewhat surprised to find the judges' comments on the exhibits pinned up on the wall for any visitor to read. Many of the points raised were good and worthy of consideration, but a few were rather witty and tended to score off the unfortunate exhibitor. The latter, after all, had only done his best in his quiet way. I agree that judges should give detailed comments and suggestions and even criticisms in writing to the club secretary after the show, but feel that these should be kept to the club members and not put on public view. In this instance some of the remarks were quite scathing, being something on the lines of "No doubt Picasso would love this tank—we don't," and so on. Quite a large number of good suggestions were put forward which will stand repeating. I have condensed these as follows.

Dense planting gives a sombre effect. Cold colours of certain fishes can be offset by using warm-toned plants. Do not use too many varieties of plants, you would never find so many in such a small space naturally. Mix up hard and soft-leaved plants, never use all hard-leaved plants. Zebras need complete contrast or at least blue rockwork; never give them a grey or brown rock background. A dark background is essential to do justice to glowlights. Bubbles should always be brushed off rocks, leaves and glass if a natural effect is wanted. Remember that all rocks should be embedded and not just stuck in, and they should preferably be tilted in line. Rockery which is too symmetrical looks artificial; flint is rarely natural. Gravel should be the right texture for the fishes concerned, should match or contrast in colour. Some rockwork looks as if it would be better employed in grinding corn and it is unfortunately true that some horrible effects are produced with unsuitable stonework. When setting up a tank it is never a bad idea to ask the opinion of another fishkeeper concerning the effect—he may see things from a different angle, see something the judge would see to which your eye is blind.

* * *

A comparatively new addition to the tanks of the hobby is *Epalzeorhynchus kallopterus*, which is perhaps better known as pal fish, flying fox or selimang. Some time ago I visited a lady breeder who had a dozen of these fish, each about three inches long. They seemed to be in excellent condition, so I asked if I could have a couple, but she explained that she had had an outbreak of white spot in the tank. To cure this she had put in 250 mg. of aureomycin. The only other occupants of this large tank were some blue gouramies which had been covered with white spots. She assured me that the pal fish had systematically gone over each gourami and had actually removed the white spots. This seemed to be a very tall story. However, although no white spots were visible the gouramies certainly showed signs here and there of tiny, filmy patches such as appear on a fish which has had some damage to its mucous covering. I decided to risk it and took two home with me. Twenty-four hours later both fish were covered in white spot. I was in a bit of a quandary because they seemed to resemble clown loach, which do not take kindly to chemical cures and mercurochrome in particular. I did not want to risk quinine so I decided to chance mercurochrome. Were they worried? Not on your life. Within four days the white spot had gone and they were thoroughly at home.

These fish have the worrying habit of resting in unusual and alarming positions (like clown loach) and it takes time to get accustomed to their odd antics. At first they are somewhat shy and hide away, but not for long. They are always hungry and will eat most foods, although they are not snail killers like clown loach. Dried food, *Daphnia*, *Tubifex*, fresh and tinned fish, shredded meats, liver, etc., all go the same way, and are taken at any level of the tank except the surface. They have keen sight and catch food as it sinks, but rarely show undue haste after food although they often swim round the tank at high speed. When they tire they go over the leaves or glass sides with the thoroughness of *Plecostomus*. They can jump, and their aquarium should be covered to prevent suicidal tendencies. The frequent chasing seems to be quite harmless, other varieties of fishes being ignored. They like to have their own area of the tank in the way of cichlids, but also spend hours in a vertical position against the glass just below the surface. With age spots appear on the tail, and the fish become quieter. Pal fish have really taking ways, seem to be quite fearless and absolutely refuse to be pushed around by larger fishes.

Starting a Tropical Aquarium—10 *by* AQUARIUS

IN this article some guidance on the breeding of egg layers will be given but it must be understood that the information is intended mainly as an introduction, for there are so many kinds of tropical egg layers and their methods of breeding vary so much that each species may require totally different treatment.

Types of egg layers include the bubble-nest breeders, mouth breeders, gravel-nest makers and egg-scattering species. A certain method is usually adopted by breeders for each of these types and so a little information on the various groups will assist the beginner and perhaps enable him to make up his mind which kind will be the best for a start.

Some of the bubble-nest breeders are so very interesting when breeding that they will be dealt with first, as generally speaking they cannot be described as difficult to breed as long as some common sense is used by the aquarist. In this group are found the gouramies, paradise fish and fighting fish. The easiest one for the beginner is the paradise fish, as this species will stand quite a bit of neglect and indifferent treatment, and will even breed in an outdoor pond during the warmer times of the year.

Labyrinth Egg Layer

The paradise fish (*Macropodus opercularis*), is what is termed a labyrinth fish as it can take a gulp of air from the surface of the water and use this when the oxygen content of the water is too low for its comfort. This means that the fish can live in water foul enough to kill many other species. The warmer the water the more often will the paradise fish come to the surface for air.

For breeding the paradise it is necessary to have a proper pair, of course. As a general rule the male fish is larger than the female and has brighter colours. These colours are intensified when breeding is about to take place. It is far better to try out your pair in a tank by themselves, as although they can be bred in a community tank it is a far safer method to see that the breeding pair have a tank to themselves where other fishes are unlikely to worry them or eat the eggs. It will be found that the finest food to get the pair into condition is chopped small garden worms. This must be given in addition to the ordinary feeding, and once a day will not be too often. If garden worms cannot be procured then white worms or *Tubifex* (fresh) can be used.

When the female fish is nearing the time for laying this is very obvious from her rotund belly, which shows quite plainly that there are many eggs therein. When this sign is seen it is a good plan to place the male fish in the breeding tank and have a partition so that the female is in his view but separated for a time. Continue to feed them both well and it is probable that in a short time the male will begin building a bubble nest. It is well to have a few plants in the breeding tank, and a thicket of them in one corner is advisable in case the male should get a little fierce; then the female can hide from his attentions.

The male will blow bubbles at the surface of the water and will make a small bunch or nest sometimes in or near a corner or a piece of water plant. These bubbles do not burst immediately, as one might expect, but remain for days unbroken. The male will then display to the female fish and a prettier sight would be hard to find. The fins are all spread almost to splitting point and the fish assumes his brightest colours. The female fish may come close to the partition to watch the male and when all appears in order the partition can be removed. It is possible to breed these fish with no partition at all, but this is mainly when the female is forward in breeding condition. If she is not when the pair are put together the male might injure the female fish in his haste to breed.

If the pair are in condition the male will try to entice the female under the nest and this may take many journeys from under the nest to the corner where she takes her stand. In due course she will follow the male under the nest and then with a quivering of fins he will wrap himself round her and both fish will gradually sink; at the same time the female will lay a number of eggs and the male will release the milt for their fertilisation. As they near the bottom of the tank they break away and then the male, and often the female too, will gather up the eggs by mouth and shoot them into the nest. This takes a few minutes, after which the whole process of egg-laying is repeated many times until the female has laid most of her eggs. Once this happens the male may chase the female fish away from the nest and not allow her near it or to take any further part in the proceedings.

Unless the tank is fairly large and well planted it is advisable to remove the female once she appears to have finished laying. This must be done with care so that as little interference is caused to the male and the tank; the eggs must not be disturbed whilst catching the female. If the partition can be gently lowered into position first she can be caught much more quietly.

Offer small pieces of worm to the male but do not be surprised if he does not appear to eat much whilst the eggs are incubating. If the temperature of the water in the tank has been about 70°-75° F. the fry can hatch in two days; a cooler water will mean a longer period of incubation. The male will be in constant attention to the nest all this time, and if any eggs fall from it he will blow them back again and continue to rebuild the nest by adding fresh bubbles from time to time. After a couple of days from hatching the fry will start to swim from the nest and appear to be very weak. The male will soon give up his attempts at keeping them in the nest.

Fry Rearing without the Parents

Some aquarists remove the male at this stage, but many males may be trusted to assist the fry for some time. Some males will not behave themselves so well and in such cases can be removed earlier, that is before the eggs hatch. However, if any eggs fall from the nest they will probably fail to hatch if they remain on the bottom. Therefore, when the male is not left with the eggs it is a good plan to place a saucer gently under the nest and when nest and eggs are safely in it to float the saucer on top of the water. In such a position the fry will usually hatch out all right.

The feeding of the fry of egglayers presents many more problems than the rearing of the young of livebearers. The fry are usually far more delicate and cannot fend for themselves for at least a couple of days. They are born with a small yolk sac which will keep them going for a time. Once they are free swimming they will be looking for food. At this stage in the proceedings great care must be taken. The fry can eat only the smallest types of food and they need to be feeding almost all day long. If they are able to find plenty of suitable food in the early days it is a good step towards their successful rearing. Without doubt the earliest food for such fry is Infusoria.

This can be provided in different ways. It is possible to culture a good crop of these in the actual hatching tank, but care must be taken that the water is not polluted or the fry will die. They are wee specks of life at this stage and soon pass out if anything goes wrong with the water. Infusoria can be bred with the usual lettuce leaf or potato-peeling methods, but a very good plan is to add some drops of "Liquifry" to the water, when many Infusoria will appear in a day or two. It is absolutely essential for the breeder of egglayers that he should have a small microscope. There is no need to use a large magnification, the busy breeder will find that the student's type of microscope with a magnification of about 70 will be found ideal. This is sufficient to show you quite plainly whether there are any organisms in the water.

Infusoria Stage and After

Just dip a finger in the water and let a small drop lie on the slide, and Infusoria will be immediately visible under the lens if any are present. A better microscope will take longer to fix up (the student type can be left ready for use at any time) and the magnification may be so great that perhaps only one organism can be seen at a time, when it is necessary to inspect a small patch of water. Each day the water must be examined as the Infusoria might have been all eaten or have died, and the fry can then soon be in a starving condition. It is useless adding water thought to contain living Infusoria. You must be quite sure that the water actually contains living creatures.

The infusorian known as *Paramoecium* or the slipper animaculae are very suitable for fry. They appear in the water under the glass as quickly moving, tiny sausage-shaped creatures, something like the shape of a slipper sole. Where plenty of these can be added to the fry tank it will be found that the fry will make good headway. Good though this food may be for a few days, it is not sufficient for the youngsters once they are about a week old. They should then be able to take micro worms, tiny *Daphnia*, brine shrimps or mashed earth or white worm. Do not add any *Daphnia* to the tank too soon, as these water fleas live on the Infusoria and so if the fry are not big enough to eat the water fleas then the Infusoria can disappear and the fry will not be getting enough food.

Once the fry are on to small *Daphnia* it will be found that they make good headway. They can then have some dried food added to their diet. But be very careful here, do not give this too early as it can upset the balance of some kinds of fry. A very good dry food for the fairly early stages is dried egg yolk. This is best given by adding some to a little water in a test tube, shaking well until all is well mixed, and then pouring a little into the fry tank at intervals. The egg yolk remains in suspension in the water and the advantage of using this is that it can be seen inside the bellies of the fry soon after it has been fed to them.

However, care must be taken to see that this food is not used too soon as some fry get so packed out with it that it interferes with their swim bladders and they appear unable to leave the surface of the water. The well-known worm shredders can be made good use of now as not only are they suitable for mashing up the various worms but dried foods can also be grated up to a fine powder with them.

From now on the feeding of the fry will present less problems; it is always in the first ten days with most egg-layer youngsters that things can go wrong, after this it is far more simple and the rearing is only a matter of feeding, separating to larger quarters and seeing that the water does not get foul.

The breeding of all the bubble-nest builders can be carried out as above described, but with fighting fish it must be realised that once the young get about half grown the males must be kept separate or they may fight. Do not keep them in very small jars—give them a chance to grow; use a large tank with plenty of divisions so that they are not like prisoners trapped in little cages. Other egglayers will be dealt with in following articles.

"Giant" Lobster for Aquarium

A LOBSTER, weighing 9½ lb. and thought to be 20 years old, caught by two visitors to Salcombe, South Devon, has been accepted by Plymouth Aquarium because of its size.

The visitors, Mr. F. C. Myers, of Loughton (Bucks.), and Mr. R. A. Clark, of Epsom (Surrey), caught the lobster by hand after Mr. Clark's eight-year-old son Christopher had seen it on the rocks.—*Yorkshire Evening Post.*

FRIENDS & FOES No. 50 — Black-flies

SIMULIDAE

LARVAE of Simulidae cut or burst their way out of their eggshells, but although emerging into running—sometimes fast-flowing—water, they are not at the mercy of the current. They are able to use their salivary glands to produce a life-line, as it were, of silken thread, which they pay out gradually from a safe anchorage, to which they can return if a suitable camping site is not found.

Sometimes on the stems of aquatic plants, sometimes upon stones, the larvae spin a few threads of silk, and anchor themselves firmly to them by using the hooks of the "sucker" at the rear extremity of their bodies. They then sit up like minute begging dogs, and twist their bodies through a half circle to bring their mouthparts to face the current. The force of the current usually bends their bodies so that the filter (like a moustache) round the mouth successfully encounters particles of vegetable and animal matter and guides them to the mouth, where they are usually swallowed.

Slow progress is made about the plants or bottom of the river by alternate gripping of surfaces with

Larva of black-fly Simulium

the posterior hooks and the mouth parts. A quicker method is by spinning life lines from one part of the river to another.

Pupation takes place in silken cocoons spun by the larvae, and is always under water. As the pupae develop the males can be told from the females by the size of the eyes—large for males, small for females. The pupae cases split and the imagines emerge surrounded by a bubble, which conducts them safely to the surface of the water, from which they can emerge unwetted.

The female flies frequently find numbers of males awaiting them, and a nuptial chase ensues as soon as they are on the wing. When the females swarm round man or beast seeking a vulnerable spot, the males are often with them, but only as escorts, not as raiders.

C. E. C. Cole

Planning Experiments in Fish-keeping

by Dr. F. N. GHADIALLY

DORLAND'S medical dictionary defines an experiment as "A procedure gone through in order to discover or to demonstrate some fact or general truth." No amount of observing of natural phenomena can answer all the questions that enter our minds. Experiments open up an entirely new approach that allows us to extend our knowledge.

I like to look upon an experiment as a question—a question asked by the scientist to nature. As a rule she does not yield her secrets easily or readily but we can corner her by experiments and force her to do so. We therefore have to plan and create a set of circumstances such that she is forced to answer our question one way or the other. Thus we may want to know whether a given drug is better or worse than another drug for treating a given disease or whether one variety of food produces better growth than another.

These are questions to which only well-planned experiments can give an answer. If the plan is well thought out and well executed then the experiment gives an answer and may be considered successful. Conversely, certain experiments are just doomed to failure; one look at the plan is sufficient to tell us that the lay-out is faulty and cannot give an answer. However, even when the plan is quite sound sometimes unforeseen complications arise and the experiment may be ruined and need repeating. During the course of years scientists have learned by long and bitter experience the sort of experiments that are worth doing and the sort that are valueless or even misleading. Each one must find this out for himself by studying past experiments performed by other workers and by one's own efforts. Let us now consider the problems and the pitfalls that face the experimenter.

The Question

As we have seen, an experiment may be looked upon as a question. The first and foremost requirement is that this question be quite clear in the experimenter's mind. It is best to write it down on a piece of paper and study it. It must be clear and concise and there must be no ambiguity about it. Another very important point to remember is that the question should not be a general one or a composite one. Nature reveals her secrets only in very tiny bits at a time and a large general all-embracing question cannot be answered by a single experiment. It can, however, be ultimately answered by a series of experiments.

Thus supposing on looking at some substance such as a drug, you say to yourself I wonder whether this is poisonous to fishes? This seems a good enough, simple enough question on the face of it, but actually it is not, it can be answered only after a number of experiments—not by a single experiment. First of all, the word "fishes" is too vague, so let us restate the question and say which species of fish we are going to use and whether we are going to use adults or young fry: I wonder whether this substance is poisonous to mature adult guppies?

This narrows it down a bit; the next thing that needs narrowing down is the quantity of the substance. After all, almost anything thrown in the water in a large enough quantity will adversely affect our fishes, so we think about the sort of quantity we are interested in and re-ask the question (the problem of suitable doseage will be considered again later): I wonder whether 1 millilitre (ml.) of this substance per gallon of aquarium water will poison mature adult guppies?

The word poison is too vague; what do we mean by it? Maybe we had better first decide whether the substance can produce a lethal effect, so the question is now framed: I wonder whether 1 ml. of the drug per gallon of aquarium water will kill mature adult guppies?

We can do this experiment in a furnished aquarium or in a bare tank containing nothing except fish and water. On reflecting we feel that the drug may combine with plants, gravel or mulm or both at the bottom of the tank and complicate the issue, so let us perform our experiment in a bare tank. Let us amplify our question to include that and now that we think about it let us also put in a few more details. The question may now read: will this drug when used in a concentration of 1 ml. per gallon of aquarium water kill healthy adult mature guppies maintained in a bare tank of suitable proportions at 80° F.?

This is now a reasonable question; not all the details have been clearly defined, but it has been narrowed down sufficiently for the planning of a preliminary experiment. More details such as how long we intend to leave the fish in this water, how long we intend to go on with the experiment, can be worked out as we go on. For the first experiment is only a pilot experiment. In the light of information gleaned from it we can then lay out a proper full-scale experiment.

You will now appreciate how vague our first question was and why it would have been impossible to plan an experiment on it. To answer that question or even part of it with reasonable confidence would call for scores of experiments with various varieties of fishes, adult and young, and various dosages of the drug operating over various periods of time and various permutations and combinations of these factors. This may seem far-fetched and unnecessary to some, but let me assure you that elaborate experiments involving hundreds and thousands of animals are done daily to check the toxicity or efficiency of new drugs and to control and standardise the numerous drugs used in human and veterinary medicine. If we want to do the thing properly that is the only way.

It is no good doing so-called experiments such as taking a lump of something and throwing it into an aquarium full of fishes. Such a technique would tell us little or nothing. If the lump was too small or the tank too large a poisonous drug may escape detection. On the other hand you know as well as I do that a handful of ordinary dried food is as good as anything to kill a tank full of fishes.

Is A better than B?

Many of our questions take this form. To take a few instances. Is it better to breed zebra fish on pebbles or on marbles? Is it better to use lettuce leaves to make Infusoria or is it better to use hay? Hundreds of such questions are asked every day. The very way in which the question is framed seems to suggest that A is better than B or that B is better than A. The fact that there might be no worthwhile difference and that both could be as good or as bad is often not given any consideration at all. So the first thing to remember when faced with this sort of question is that there are not just two but at least three alternatives which must be considered.

I think the reply to the question "Is it better to breed zebra fish on pebbles or marbles?" could be that there appears to be no great or obvious difference, as hundreds of zebras have been bred successfully by both methods. This is all we can venture to say from the facts available at the moment; maybe if a series of experiments was carried out some small superiority of one method over the other may be demonstrated. Such an answer, of course, takes into consideration only one or two factors, it judges the issue solely on the merits of numbers of successful spawnings and the number of eggs or fry obtained. But we can use other criteria.

For instance, we might point out that pebbles can be picked up free whereas marbles have to be purchased, so from the financial point of view pebbles are infinitely superior to marbles. Thus we see that in answering such a question we must clearly identify, isolate and consider separately the criteria on which the issue can be judged.

Yet another point that must be borne in mind is that what is true in one set of conditions may not be true in another; i.e., A may be better than B in some cases and B may be better than A in others. To illustrate this let us consider the often-asked question "Is methylene blue better than mercurochrome for treating white spot?" The answer to that would be that if fishes are to be treated in a bare container methylene blue is the drug of choice as it is so harmless to fishes, but that in a furnished tank mercurochrome (which is more toxic to fishes than methylene blue) would be preferable as methylene blue is so very very harmful to plants.

I have now indicated how the question first arises in the mind and how it must be modified and qualified. I suggest that you exercise your mind by asking such questions and then modifying them to make them usable for an experiment. To start you off, here are two general questions that need the treatment indicated. Does peat stimulate plant growth? Does the addition of common salt to a tank benefit plants and fishes? Both these are common questions asked by aquarists again and again, but nobody really knows the answer. Some think they do and we all have our pet ideas and opinions on these subjects. If someone got down to it seriously we would know, but it would involve scores of experiments to find the truth. Why not try your hand (at least on paper) and see how you would go about tackling these problems?

Materials and Methods

Having decided on the question (the problem as it is usually called) the next step is to find out what we are going to need in the way of equipment and other facilities and set about getting them all together. The ideal, of course, would be to write out just what you need and buy it or order it. But it does not work out that way even for scientists working in well-equipped laboratories with good research grants. To a greater or lesser extent the ultimate form of the experiment and the type of work done is dictated by what is available to us. Numerous modifications may be necessary to our first idea to fit the available materials. With thought and ingenuity a working compromise can usually be struck but one must be extremely careful not to jeopardise the project by accepting anything that is only second best. Every experiment calls for a certain basic minimum; if this is not available then you have got to face it that you just cannot do the experiment as it stands.

Let me illustrate this by the sort of thing that I have run up against in the past in my work. In an experiment dealing with the growth of tumours (cancers) in rats I knew from pilot experiments and statistical considerations that I would need about three or four hundred rats to get a clear-cut answer to solve the problem on hand. Now the space to house such a large collection of animals was not at that time available. Nor would the combined efforts of my technician and myself have been adequate to inject all these rats several times every day, as the plan called for, and to feed them, look after them, weigh them and observe their tumour growth, etc. A team of workers could have done it but not a solitary worker.

The course open to me was either to abandon the project, and I did not like doing this as it was a crucial experiment testing a hypothesis which had taken a considerable time to develop, or to work with a smaller number of animals and then repeat the experiment three or four times as needed until sufficient numbers had been built up to give an answer. Thus the initial experiment was modified and redesigned. This in no way lessened the value of the final result but because of the repetitions necessary it took a year instead of three months to perform. Similarly the absence of a highly specialised costly piece of equipment may necessitate modifying the experiment or going to a place where such equipment exists.

I am telling you all this to make you realise that we all have our difficulties in procuring the right set-up, and that compromises have to be made by everybody. So do not be discouraged easily and say "Ah well! One cannot do research without a lot of costly equipment." There are problems which can be tackled with very few tanks, and to tackle others, dealing with the culture of live foods such as white worms, etc., would need no tanks, only a few odd wooden boxes. Conversely, there will be some problems which for their solution demand so much that it would be completely absurd for a private individual even to attempt to attack them. Ultimately, however, it is the will and enthusiasm that counts.

Function of the Control Group

Most biological experiments need what is known as a control and one often hears the term "a well-controlled experiment." As a matter of fact the entire experiment is planned to do no more than reveal a significant difference between a control and an experimental group of animals. Let us illustrate this by an example. Every now and again new hormone foods are placed on the market.

The manufacturers of one such food claimed that it produced more males (as judged by external appearances) in a spawning if fed daily to growing fry. Supposing we want to test this claim, how would we go about it? What some aquarists did was to try out a bottle of this food: they fed the food to a batch of growing fry and counted the number of males and females at the end of the experiment. Varying results were obtained; some reported that it "worked," as they obtained 70 or even 80 per cent. of males in certain spawnings, whereas others reported only 30 or 40 per cent. of males in a spawning and said the food was no good. As a matter of fact these so-called experiments are valueless and the results do not mean a thing. It would be impossible on the data presented to reach any decision whatsoever.

The reason for this is that there is no way of knowing whether or not such results would have been obtained anyway, whether the food was used or not. Though as a rule the number of males and females in any given spawning are about equal this is only a generalisation, and as a matter of fact we know that it is by no means rare to have a spawning where one sex may hopelessly outnumber the other. One could therefore argue that such naturally occurring variations might quite easily explain the observed differences. The only way to solve this problem properly would be by using a control group.

Suppose that we have at our disposal 200 fry two or three weeks old (all from the same spawning). We would then have to divide them into two groups of a hundred each and place them in two tanks exactly alike in all conceivable respects such as size, water, temperature, etc., feed one group with the hormone food and the other on the same basic food mixture without the hormone. If this ideal could not be attained we would have to feed this group with ordinary proprietary dried food.

The group receiving the hormone food would then be called the experimental group and the group receiving simple dried food would be called the control group. Of course, there can be no objection to giving both groups equal quantities of live food, as long as we see to it that this is done moderately and occasionally so as not to spoil their appetites for the dried foods. In any case we must record what live food was given and how much and how often. When we report the results this would be valuable, particularly if our results were negative. Nobody can then say that the reason why the hormone food did not work was because though we placed it in the tank the fish never touched it as there was always so much live food about all the time. For similar reasons the amount of hormone food administered should also be recorded.

At the end of a few months, when the fish are easily sexable, we terminate the experiment and count the total number of fish alive, and the number of males in each group. From this we can calculate the percentages and state our results; e.g. 70 per cent. of fish in group A and 55 per cent. of fish in group B were males. Total numbers alive at the end of the experiment in group A, 85 fish, in group B, 92 fish. Of course, if an unduly large number of fish die during the course of the experiment in either or both groups we would have to repeat the whole experiment. However, let us concentrate on the result as stated.

What would you say now—does this result show that the food is working and that the makers' claims are justified? No, it does not. It is suggestive but not conclusive. Such a result could be obtained by chance. It is quite possible that by sheer chance when we divided the 200 fish into two groups we placed more future males in group A than in group B. If you find this hard to believe let me give you an example.

Suppose we toss a coin ten times: if it turns up heads seven times and tails three times would we then have proved that in all future coin tossing it would be safer to bet on heads instead of tails? Of course not! The same philosophy applies here and it is quite possible that the next time we repeat either of these experiments we might get very different results. The degree of certainty with which we can state that these results are in fact real and not produced by chance depends (*a*) upon the total number of fishes used, for the larger the number the less likelihood of chance affecting the results significantly, and (*b*) it depends on the sort of result we obtain. For instance, if we had obtained 95 per cent. males in group A, and 55 per cent. in group B, we would have felt more confident than, say, if our results showed 60 per cent. of males in group A and 55 per cent. males in group B. As a matter of fact, in the latter case we could almost certainly feel that there was no significant difference between the two groups whereas in the former instance we should say that the results were almost certainly highly significant.

The best thing would be to repeat the experiment a few times and if each time we obtained more males in group A than in group B, even though the differences obtained in each experiment may only be small ones, we may be able to show by statistical methods that the results are in fact significant, i.e., that it was highly improbable that the difference seen was obtained by sheer chance and not as the result of the hormone food. All this has been placed on a firm mathematical basis, and as you are no doubt aware, this subject is called statistics.

I have explained this in descriptive rather than mathematical terms, but if you want to do experiments yourself which need statistical methods for their evaluation, a small elementary book on the subject written in a very simple straightforward manner that I can strongly recommend is *Principles*

(Please turn to page 153)

An African Characin

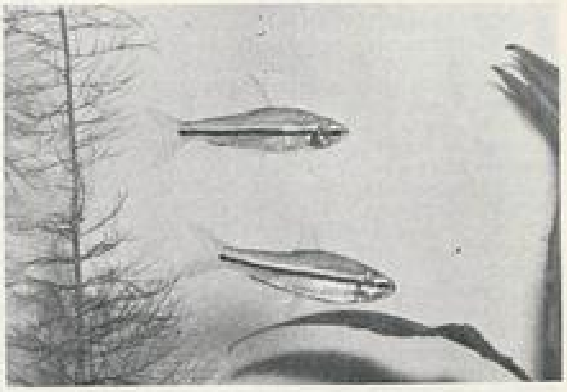


Photo: Laurence E. Perkins

NANNAETHIOPS UNITAENIATUS is a chubby little fish about one and three-quarters of an inch long. It is a characin, but its fins are so transparent that the adipose fin is barely visible, with the result that one might fail to observe it and mistake the fish for a carp. It is abundant in all the African freshwater streams that are tributary to the Cross River, and I believe also in all the tributaries of the Niger.

The fish is conspicuous by the black line that runs all the length of the body on both sides, from the mouth through the eye to the caudal fin. Above this black line there is a coppery line which sometimes looks quite golden in the bright light of a lamp, especially so when the lamp is placed behind the observer's back and at a level with the glass front of the aquarium. Below the black line there is a silvery band fading gently into gold or copper which appears to tint the scales towards the belly of the fish so that they look like tinsel on a Christmas tree, now gold, now silver.

Above the black line where it enters the caudal fin there is a pinkish or reddish tint, but this is not always visible. At the other extremity the black line between the mouth and the eye fades slightly, but is very black where it passes through the eye so that it seems to cut the golden circles of the eye into two parts. Around the gills under the mouth there is a bright silvery spot like white gold.

All the fins are nearly transparent, so that the fin rays might be easily counted except for the fact that these beautiful little creatures are never still for a moment. The caudal fin is comparatively large and well forked, but in the older fish the lower lobe seems to be slightly longer than the upper lobe. The pectoral and the ventral fins terminate in a delicate sky-blue tint. The fish is never at rest, although it seems to move forward in slight jerks and every moment or two it appears to hesitate, stop, and open all its fins to their fullest extent so that the dorsal and ventral fins stand at an angle of about 45 degrees. In this position all the fins are clearly visible and show the sky-blue at their extremities.

The fish are found chiefly in clear running water or clear pools within a temperature range of 75°-85° F. The temperature of my aquarium is 80° F.—the temperature of the room here in Nigeria.

The fish live naturally on mosquito larvae and insects which fall on the water, in addition to the many lesser creatures which live within the water.

J. Paterson

Microscopy for the Aquarist—23 *by* C. E. C. COLE

LAST month the abbreviation N.A. for Numerical Aperture was introduced, a term first used by Professor Abbe (of Jena glass and condenser fame) to describe the light-gathering capacity of one lens when compared with another. The largest N.A. which any objective can have when there is air between its bottom lens and the cover glass over the object being examined is called unity—the figure one—1.

Most modern objectives have the N.A. engraved upon them by the makers. The lower the N.A. figure the less powerful the lens.

Any lens with an inscribed N.A. exceeding unity is not intended to be used (although it *can* be) unless the bottom lens is immersed in some liquid medium specified by the makers of the lens. The liquid usually mentioned is cedar-oil. Less frequently the lens is designed for immersion in water. The working distance of such lenses is obviously very, very short, and great care is necessary to avoid damaging them. The depth of focus is nil, or practically so.

It is silly to invest in an oil- or water-immersion lens if we have no intention of using it immersed in the proper medium. Dry objectives are cheaper and will give as great a N.A. Why should we have a high N.A.? What good does it do? How is it obtained? Upon what does it depend?

The whole business is closely bound up with resolution, the wavelengths of light, refractive indices, etc., and it seems to me that for a better understanding we must consider all these vital factors in its determination, and understand them, too. Firstly, then, exactly what is resolution?

To put it as simply as possible, the resolution, or resolving power of a lens, is its ability to show two adjacent points of an object as two separate points, and not as one large, slightly fuzzy point.

On the left are two points resolved and seen separately (short wavelength and wide cone). On the right, with a longer wavelength or narrow cone, the two points are less well resolved and are seen merged

The unaided human eye, if first class, has the ability at a distance of ten inches from an object, to separate points of that object which are 1/250 of an inch apart. Some eyes are better than others, of course, and even the same eyes differ in efficiency at different times and under different conditions.

A good objective, however, used under the best possible conditions, can resolve and separate details which are only 1/125,000 of an inch apart. To permit the human eye to see the details so resolved, a magnification of 500 is necessary, this being accomplished partly by the object glass and partly by the ocular or eyepiece.

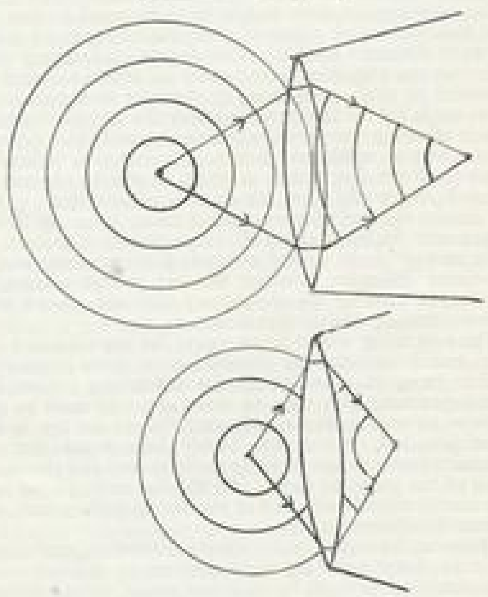
The details are then just perceivable. Magnification up to 1,000 times will probably enable them to be studied more comfortably, but any amount of magnification will fail to show greater details. If the object glass does not reproduce anything in the image it simply cannot be shown. Magnification beyond the point where what has been resolved can be comfortably examined is called "empty magnification." Permissible to a degree, it detracts considerably from the clarity of the image when carried to excess. The above remark applies to first-class high-power dry-object glasses. It is not intended to imply that 1,000 times the magnification of what is seen with a low-power lens, or a medium-power lens, is desirable. For reasons that will be made plain as we proceed, the N.A. has a marked effect upon the resolution. The best rule to adopt is not to use a magnification exceeding 1,000 times the marked N.A. of an object glass. Thus the maximum magnification a 2 in. lens of 0.15 N.A. will take without "empty magnification" is 150 ($0.15 \times 1{,}000$). A 1 in. object glass (of N.A. 0.2) can take 200, a 1/3 in. (0.5 N.A.) 500, a 1/6 in. (0.85 N.A.) 850, and so on.

With oil- or water-immersion lenses with exceptionally high N.A. we can comfortably exceed a magnification of 1,000 diameters, by still applying the 1,000 times N.A. rule.

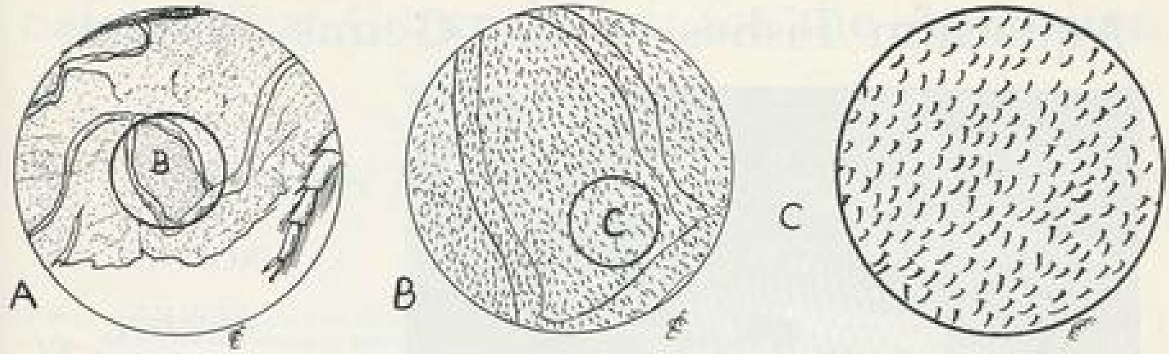
To increase N.A. we must obtain broad-based, short cones of light which enter the object glass at the widest possible angle. How does the angle of entry affect resolution? How do we get wide-angled cones? To understand how, we must learn a little about the wave nature of light.

Each point of a self-luminous object radiates light in every direction. In effect this makes every point the centre of a sphere of light. It is obvious that no lens could ever receive all the sphere of light, and this results in an imperfect representation of the point by that portion of the wavefront which passes through a given lens. Moreover, when light passes through a small aperture (the lens aperture) it tends to spread slightly, so that the image of the point is surrounded by what are called "diffraction rings"—it is reproduced as a tiny disc varying in size according to the wavelength of the colour of the light being used. For this reason most microscope lamps are provided with light filters of either blue or green glass to ensure rays of only one colour (of a medium wavelength) being used.

(Continued on page 153)



A broad cone of light admits a greater portion of the wavefront than a narrow one and results in greater resolution of detail



The portion of the wing of a water beetle (Ilybius fuligino) encircled in field A is shown in field B to have bristles instead of "dots" as appeared in A. In field C, with higher magnification the bristles are revealed to have a thorn-like appearance. A, 2 in. objective, X 8 ocular; B, $\frac{2}{3}$ in. objective, X 8 ocular; C, $\frac{1}{6}$ in. objective, X 8 ocular

It is a fact that the diffraction discs are smaller, and interfere less with resolution, when entering the object glass from as acute an angle as possible.

One way of admitting a greater portion of light from a given point would be to use wider lenses, but these would necessitate employing very large back lenses for our object glasses—and we are restricted by the diameter of our microscope body tubes.

The practical way, adopted universally, is to bring the lower lens of the object glass nearer to the point of light, and this automatically increases the angle of entry of the light and assists in resolution. This is why high-power objectives are invariably short focus—they must be near the object before they can focus it. Manipulation of illumination follows to ensure use of the maximum N.A. This will be dealt with shortly.

Why we can exceed unity when using immersion objectives will be illustrated next month. In the meantime continue to examine as many objects as possible with low-power objectives. Do not be discouraged by the fact that such objectives have comparatively low powers of resolution. They have a tremendous advantage over high powers in giving you a much better overall picture of the objects being examined. There are, in fact, a great many subjects upon which it is *impossible* to use high powers.

Planning Experiments in Fish-keeping

(continued from page 151)

of Medical Statistics by Bradford Hill (in it you will also find references to other larger works on the subject). Perhaps you know the author's name, since it is mainly from this work that the present controversy about the connection between smoking and cancer of the lung started.

Most people have an antipathy towards numbers and calculations and hence to statistics. There is a natural tendency to take a hostile attitude to anything which we do not appreciate or understand. This arises from a sense of inferiority or fear; we fight back or joke about it to boost our ego and cloak our ignorance. Most of us do not know a word of Chinese but that does not mean that it does not exist or that it is no good.

We often hear silly remarks like "Oh, you can prove anything by statistics," or "The proof presented is only a statistical one," as if this was some second class or inferior way of proving a point. Now there is no doubt that just as we can have good experiments and bad experiments, we also have the problems of differentiating between good logical statistical analysis based on sound figures, and poor analysis, or the use of wrong statistical methods for the problem at hand, which would lead to entirely erroneous conclusions. But that does not mean that wholesale condemnation of the system is called for or justified.

To summarise, we have seen the value of the control groups in biological experiments and also how essential it is to apply statistical analysis to the results obtained. The actual method of producing comparable control and experimental groups now needs further study.

(Continued in next month's issue)

Lagarosiphon major

THIS plant is a very popular one among aquarists as it is a very good oxygenator. It was known for many years as *Elodea crispa* and bears a strong resemblance to the *Elodea* species in the whorls of small leaves it shows. The plant grows with long branching stems with whorls of small thin leaves which are curled back. This gives the plant the appearance of having a continuous horn-like shape with compact leaves so tight that it is almost impossible to see between them. It originates from Australia and Africa and is stated by some to be tender and not suitable for the outdoor pond. It does, however, grow quite well in outside ponds in the southern counties of England, where it is quite hardy.

This plant likes a good mulm in the bottom of the tank in which to establish its roots. Once a good medium is there, the plant will make very strong growth and in a pond can grow stems four feet or more in length in a season. Once it is well rooted in a tank there is a tendency for the stems to run up to and around the surface of the water. It is impossible to stop this, but if some of the stems are broken off occasionally it will be found that the plant will send out fresh shoots from near the base of the plant and so make a thicker mass. The pieces broken off can be induced to form roots by allowing them to float in water.

When introducing fresh cuttings into a tank it is important to see that the unrooted stems are not just pushed into the sand. Sometimes these will take root and grow but more often than not the stem will rot and the plant will not flourish. A better plan is to lay a piece of the stem on the

(Continued at foot of page 154)

Aquarium Fishes of the Genus *Leporinus*

Photo : Laurence E. Perkins

Although perhaps the least colourful of the aquarium Leporinus species, Leporinus fredirici is quite an attractive fish

by

RODNEY YORKE

ALTHOUGH known to aquarists for a great many years *Leporinus* are now rarely seen, which is a pity because they are interesting and very showy fish in their smaller sizes. All grow quite large in captivity (about 12 inches) and need a big tank and neighbours of similar size. With fishes of their own size they are quite peaceful, but they have very hearty appetites indeed and require a large and varied diet. They probably prefer a mainly vegetable menu, but are always ready for anything of a meaty nature their owner cares to offer. When very young they really need algae but the necessity for this soon goes with growth.

These fish have the habit of hanging head-downward in the water in the manner of the pencil fish, and are sedate and slow movers as a rule, but if need be, they can move like the proverbial greased lightning. All are excellent jumpers and their tank must be covered or losses will result. They not only jump but make a long-distance effort of it of four feet or more. They are hardy fish (if well fed) and rarely get the more general fish diseases. They are also very long lived and specimens have been known to last as long as 17 years. One public aquarium in the north has several which have been on constant view for about seven years and are now very large fish.

Generally speaking sexing *Leporinus* is impossible, but the suggestion has been made that females are heavier and lighter in colour when they reach maturity (considered to be at over six inches in length). Wild specimens have been caught considerably over a foot in length but it is agreed that small young fish are best for aquarium purposes. They are not common, are hard to collect and hardly ever bred, so they are quite "pricey" fish. Last year I saw some 1½-inch *Leporinus fredirici* on sale and these were 17s. 6d. each.

Hardly any records of breeding are known but an American source suggests a large tank of 30 gallons or more. Some change of water appears to be required to stimulate them and alkaline and somewhat hard water is preferred. Eggs are not dropped on plant clumps. Rapid side-by-side swimming (like the pencil fish) is indulged in, eggs being dropped all over the place. Both fish show varied colour changes during the spawning act.

Leporinus seem to do better and show better colour if several are kept together, the temperature range being 70°-80° F. One aquarist reports that they are particularly fond of meal worms when large. Salt is no worry to them and they do not appear to be unduly worried by the more common chemical cures used by aquarists.

Three Common Species

These fish belong to the characin family and come from South America. There are three common species of *Leporinus*, these being the black-banded (*L. fasciatus*), *L. fredirici* and the black-lined (*L. melanopleura*). The first two are the more common.

The black-banded is yellowish red when young, turning to orange with maturity. Young fish show five upright bars, but these duly split as time goes on until 10 bars appear, about three years being taken for the complete change. *L. fredirici* is less colourful, being greyish with some vertical darkish bars and several irregular blotches or spots. *L. melanopleura* is rather darker with a dark band or blotched band running from nose to tail. It has a somewhat reddish tinge which increases in late spring. All these three species carry well and are worth buying if and when opportunity offers.

Lagarosiphon major

(continued from preceding page)

sand and place a small stone over it as an anchor. The cutting will then soon make roots. When used in a pond it will be found that large fishes can soon break off the new stems, but it is not difficult to net these out if they are not needed. Once the roots of this plant get established in a good depth of black mulm, as found in most ponds, it makes rapid growth.

Lagarosiphon is a very fine plant for the fish breeder, as the leaves form a good medium for the reception of eggs. Eggs which are able to enter the actual whorls of leaves are not likely to be eaten by any fish as the leaves form an excellent protection.

Safety Heat-Control Unit for the Aquarium

designed by J. MAYES

A device which gives warning of heater failure and which will boost heating at times when air temperatures are low

WE are approaching the time when on most days the tropical aquarium will require full heating, so now is the time to clean and adjust thermostats and make preparations for protecting the fishes from the winter's extreme cold temperatures. I give details of a thermostatic unit that will make any aquarium, regardless of size, automatically proof against heater failure, and render the aquarium self heat compensating during extreme cold weather and mains power cuts. Many parts required for this unit will be found in the hobbyist's spares box.

Here is a list of parts required; if the instructions are adhered to, the unit will assemble like a child's Meccano. I have been through the "trial and error" stage with this unit so that I can give authentic and correct data now.

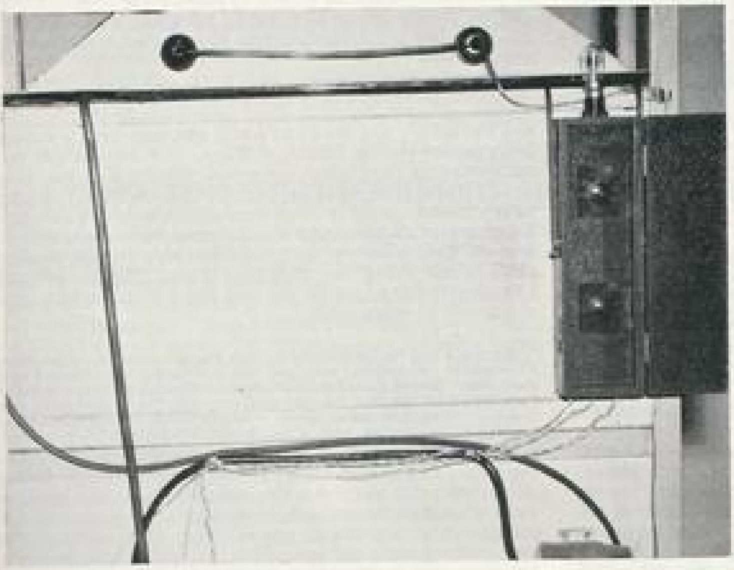
Materials Required

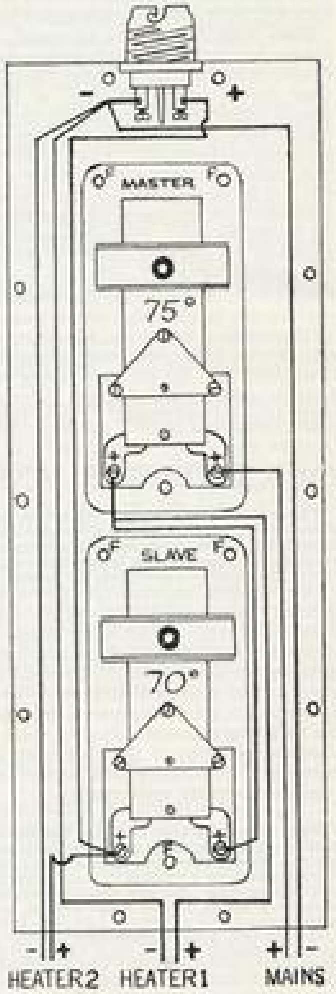
Planed deal, 3 ft. of 2 in. by 13/16 in., 1 ft. of 3 in. by 5/16 in.; two 3 ft. lengths of ⅛ in. steel welding wire; 3 ft. of ⅛ in. plastic sleeving; 1 aluminium or brass plate, ⅛ in. by 2⅞ in. by 9¾ in.; two 1 in. brass hinges; two small hooks and eyelets; one dozen ½ in. brass counter-sunk screws, same for hinges but ¼ in. length; two ½ in. round-head screws and washers; ½ in. panel pins; one S.B.C. lampholder; one 240 volt, 5 watt neon lamp; two JL Constat thermostats, 10 amp rating; 12 ft. of double wire, heavy duty plastic; glass wool.

(Note that planed wood loses about 1/16 in. on its planed edges; thus 2 in. becomes 1⅞ in. and 3 in. becomes 2⅞ in.).

Construction

Make up the sides and ends of the housing box (9¾ in. long, 2⅞ in. wide and 2 in. deep) from the wood 2 in. wide, with a lid made from the 3 in. wood to be





In the photograph the safety unit (lid open) is shown behind the aquarium; it is kept in position by the anchor wire over the top edge of the aquarium frame. The diagram above shows the layout and wiring within the box of the unit seen when the control knobs and scales are removed hinged on to it. Drill a hole in one (top) end to take the lampholder and counter-bore this hole to take the locking ring of the holder. Drill three holes at the other end of the box to take three leads. Now see that the metal "temperature plate" is absolutely flat. Screw it to the open part of the box and try it against the aquarium glass; corrections can be made so that it rests perfectly flat against this. Then remove the plate for fixing the thermostats and wiring up.

Remove the adjusting knobs from the termostats and their bakelite covers and position the instruments on the plate so that they clear its sides and one another by about ¼ in. This will allow for tucking all wiring neatly around them and for padding with glass wool. Holes marked F in the figure are used to fix the thermostats to the temperature plate and to secure the covers. The screws of the thermostats will be found long enough for this.

Now wire up all the terminals of the thermostats as shown in the figure, with single wires for the input and double wires for the output. Screw the thermostats and their covers on to the plate as they are now complete. Attach three long wires to the negative side of the lampholder with solder and fix the wire to the positive terminal as shown in the figure. Pair the wires as the diagram shows and bring them through the holes in the bottom end of the box. Fix the lampholder into the top end of the box and then screw on the temperature plate so that the thermostats are inside the box. Pack glass wool around the side and end spaces in the box and cover this below the lid with a tightly fitting mask of thick cardboard with cut-outs to show the temperature scales on the thermostats. After gluing this in position the box exterior can be painted.

The welding steel wire (⅛ in. diameter) is used to make an anchor wire to keep the box against the aquarium glass. It is covered with the plastic sleeving and must be formed by hand to prevent the damage to its covering which would occur if a vice were used. Loops formed at the ends of the wire swivel over round-head screws placed with their washers at the centre of each long side of the unit. The "gripping" edge of the wire should be positioned about two-thirds down the length of the unit on the metal plate side so that it can be slipped over the aquarium edge. One length of wire can be used to design this anchor wire by trial and error (without plastic sleeving on it) and then the finished job can be made to the dimensions determined, with the plastic-sleeved length.

How Unit Works

This unit is practical and straightforward and does not show its neon warning light until trouble has arisen. The unit works on this principle: the "master thermostat" operates the aquarium normally but, when heater failure occurs, the temperature will drop approximately 4° F. and the "slave thermostat" will close its circuit, bringing the emergency heater and neon warning light into operation. As the slave 'stat controls aquarium base temperature it will remain a closed circuit, as heat rises much faster than it will descend.

The master 'stat will cancel all circuits when the temperature returns to normal and heating will go on as before, except that now the neon warning light will be operating, showing that the aquarium is now working on its emergency heating.

Self-heat compensation works from the cold gradient at the base of the tank; the slave 'stat will switch on and off as required by the heater when it is overloaded and cannot supply enough heat during severe frosty weather and mains power cuts. As the units are enclosed and packed with glass wool, outside temperatures do not affect their operating efficiency and they are therefore working at true aquarium temperatures.

Set thermostats' working temperatures in a room tempera-

(Please turn to page 159)

OUR EXPERTS' ANSWERS TO TROPICAL AQUARIUM QUERIES

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

I have just bought a large aquarium to set up with a variety of plants and fishes. As I am deeply interested in underwater plant life, I should be grateful for the names of a few plants most suitable for growing in a bright light and a depth of 15 inches of water, and the best positions for them.

We always recommend the tall-growing "aquarium grasses" known as *Vallisneria spiralis* and *V. torta* for the back of the tank. If set fairly closely in staggered rows, the plants will soon form a dense green background and plenty of cover for timid fishes. Towards the middle of the tank plant several clumps of *Cryptocoryne cordata* and *C. willisii*. These plants are slow-growers, but they add great beauty to the underwater scene. For the sides use *Hygrophila*; and, towards the front of the tank, tiny clusters of the dwarf-growing *C. beckettii*, which always looks tidy and keeps a lovely fresh green appearance.

My community tank contains the following fishes: swordtails, mollies, giant danios, penguin fish, guppies, zebra fish and platys. Every now and again I find a fish dead on the bottom. Sometimes I have noticed extensive mutilation around the head and underparts. Do you think these dead and multilated fish have been killed by the giant danios, or is some other species to blame?

When you keep a fair number of different species in a large aquarium it is only natural that one or two of them will die before their companions, for you must remember that some species have shorter life-spans than others, and you cannot estimate a fish's longevity by size alone. It is not uncommon for a harlequin fish, *Pristella* or neon tetra to live for upwards of seven years, whereas a guppy or zebra fish or flame fish seldom lives for more than three years—if so long. Dead or dying fish are usually nibbled at by other healthy fishes; and it is always the soft parts of the body that are nibbled or eaten first—for instance, the eyes, the gills, and the belly. On the other hand, you may have a vicious bully among your collection of fishes. Of those which you mentioned in your letter, we would suggest that you keep a careful watch on the behaviour of the swordtails. A large male swordtail can do a lot of damage if it suddenly develops a vicious streak, and quite a number of male swordtails do become vicious as they reach full size and learn that smaller, more timid fishes are afraid of them. Large penguin fish often develop into fin-nippers, but seldom make an all-out attack on other fishes.

My male red Siamese fighting fish has grown quite a lot since I bought it six months ago, and has developed long caudal and anal fins. These fins, however, look as though they are matted together, and the fish has become very inactive, staying in one place for long periods of time. Do you think this fish has contracted some disease, and, if so, should I destroy it?

We do not think there is anything wrong with your fighting fish. Fishes with highly developed fins usually find it difficult to swim about quickly, and they rest in one position more often than the usual, fast-swimming tropical aquarium species. Fighting fish do not as a rule swim about all the time. But a male will spread his fins and display before a female, and become quite excited if it can see another male

Photo: Laurence E. Perkins

Among the barbs with which the beginner may hope for breeding success is the nigger barb (Barbus nigrofasciatus)

on the other side of a clear glass partition. So long as your fish takes its food freely, and comes to the top of the water every now and again for a mouthful of air, leave it well alone.

Please tell me the names of some easy-to-breed barbs

The rosy barb, the half-striped barb, the nigger barb and the spanner barb are among the easiest barbs to breed if given clear water, a thick growth of fine-foliaged plant life and plenty of live food or finely cut lean red meat. It is a good idea to separate the sexes for a week or two to bring them into tip-top condition.

I have been told that base-heating by two or more ordinary electric light bulbs placed in a shallow box is just as efficient as the more conventional submerged heater. Is this true?

We would not like to say that ordinary electric lamps are as efficient for heating an aquarium as a properly designed glass or cable heater. You must remember that the life of the average household electric lamp is very limited when it is kept alight for hours on end and in a position (horizontal) for which it was not intended to be used. But a good heater may last for several years. Then again, a proper heater is not easily damaged by a sudden knock or jar. This cannot be said of an electric lamp after several hours' use. A sudden vibration is often sufficient to snap the filament. It boils down to this: for a very small tank containing, say, guppies or mosquito fish, base-heating by an electric light bulb is quite successful (so long as you keep a watch on the bulb to make sure it does not burn out). But for medium-sized or large tanks, it is wiser and more economical to employ the conventional glass or flexible cable heater.

I have a tank containing white-cloud-mountain minnows and guppies. As a rule, this tank is maintained at a temperature in the mid-sixties, but during a recent hot spell, the temperature rose to the eighties. Then, as suddenly, it fell to the sixties again. Now the guppies are moping about with folded fins and several of the minnows have died. Do you think this sudden variation in temperature was enough to upset the fishes?

As your fishes have been used to a low temperature the sudden rise and equally sudden fall would upset most of them. Then again, mountain minnows are not fond of a high temperature at the best of times, and the sudden rise into the eighties was enough to kill some of them. Your best plan would be to raise the temperature a few degrees above normal, and keep it there until there are signs of improvement. Then, and not until then, let the temperature return to normal. If any fish fails to recover, and exhibits difficulty in swimming, it is kindest to put it out of its misery.

I am puzzled by the fact that the same common name may be used for two or three different species of fish. This is very awkward for the beginner in fishkeeping. Why don't aquarists stick to one name for a fish?

You cannot expect aquarists to think alike when it comes to giving a common name to a fish! Some common names are more descriptive of a fish than others, but certain aquarists may prefer to use a name which appeals to them for personal reasons such as rainbow fish rather than guppy, or petticoat fish rather than black widow fish: it's all a matter of taste. Then again, a common name given to a fish in America may not make sense to an aquarist living in England, and *vice versa*. For instance, during the time of the coronation of the late King George VI, some dealers in London sold shubunkins as "coronation fish." It is always safer to ask for a fish by its scientific name, for then you are almost certain of getting the fish you want. Most reputable dealers know the scientific names of the fishes they sell, and will see that you get the fish you require.

COLDWATER FISH-KEEPING QUERIES answered by A. BOARDER

I have recently made and stocked a small pool of 125 gallons. In one book I read that mussels are very strongly recommended and I have put in six. In another book it says that they are of no value. Which statement is correct?

In a new concrete pond it is a bad policy to introduce freshwater mussels. These molluscs can only move about and live in a good depth of mulm and mud. Unless your pond has this then the mussels would soon die and then they soon smell very badly and pollute the water.

I wish to obtain some Bristol shubunkins with a good blue colour. Where can I get them?

I am often asked where good specimens of fancy goldfish can be obtained and frankly I am at a loss as to what to advise. There are so few really good fish about, and it is difficult for me to know who has the right fish at the moment. Some breeders I know may have a few but again they may have sold out. If I give their names they are flooded with orders they cannot fulfil. The best way to get certain strains of fish is to watch the advertisements in *The Aquarist*, and then if you cannot find what you want insert a "wanted" notice yourself asking for the type of fish you require. Another method is to attend one or two fish shows and then contact the owners of the types of fish you need.

I have a fish and lily pool and find the water has turned quite red and the lilies have died. The fish appear to be all right. The pond was filled with water for eight months before planting and it is difficult to know where the red came from; can you advise?

The red is probably caused by myriads of Polyzoa, sponge-like minute organisms which often fill a pond, especially when there are insufficient oxygenating plants therein. It often thrives in water which is on the acid side and so a little lime added may help to get rid of the trouble. Also it will be found that if the fishes are removed from the pond for a time and some *Daphnia* (water fleas) are introduced they will eat the Polyzoa and so clear the water.

When the fishes are returned they will eat up the *Daphnia* and by this time it is possible that the water plants will have become established and so choke out the Polyzoa. It is possible that the water lilies were not correctly planted in the first place. The water should have been lowered so that the crowns of the lilies were just covered. As they started to grow so the depth of the water should have been increased. It is possible that if the water was very acid this might not have suited the lilies.

I should be grateful if you can suggest how I can improve the look of my pond. At the moment it is the colour of green pea-soup. It has very little vegetation and no fishes at present.

The trouble with the water is the usual one of infestation by algae. This is a tiny single-celled plant which thrives in open water exposed to the sunlight, especially where there are few other plants in the pond. Once a healthy growth of water plants is obtained it will be found that the algae will gradually be starved out. It is possible to kill much of the algae by putting some solution of potassium permanganate in the water until it is of a fairly deep red colour. It is useless to just empty and refill the pond as it will only go green again in a short space of time, unless you can get plenty of water plants established.

I have an out-door pond which is about eight feet square and two feet deep. I try to keep freshwater mussels and black planorbis snails in it as scavengers. The goldfish eat the snails and mussels. Can I use anything else as scavengers?

I suggest that you introduce a couple of tench, either the native green ones or the more showy golden ones. These fish are very good scavengers and are not likely to harm your goldfish. Some people use catfish instead but these can get very big in time and will eat any small goldfish.

I have quite a large pond (natural), of about one-third of an acre. I have a number of fish therein, including hi-goi, goldfish, common carp and roach. All appear to thrive except the carp and they do not appear to grow: how can I improve their condition?

Try feeding with brown bread each day. If you can get rid of many of the roach it will give the carp a better chance of feeding. The carp are rather slow feeders but the roach can be very quick indeed. When any food is offered it is probable that the roach snap up most of it before the carp get a chance to reach it. There may be other reasons, of course, why the carp do not thrive. It is a well-known point among pond stockists that certain waters may be ideal for some types of fish and yet others fail to do well in the same pond. The water may be too hard or even too acid and it would be a good plan to test the water to see if it has a medium pH value.

I have a tank 24 in. by 12 in. by 12 in. in which I have seven goldfish—in all about 12 in. of fish. They dash about rubbing themselves on the gravel and some have badly split fins. One or two carry their fins folded down, especially the dorsals. Some appear to have pieces missing from the fins as well as being split. What can I do to improve the state of the fish?

From your description I think that the tank is in a very unhealthy state. The water has been polluted, either by decaying vegetation or by decaying uneaten food. The action of the fish suggests that there may be an infestation with flukes on the fish. These are invisible to the naked eye but cause the fish much irritation. The splitting of the fins could have been caused by the fish rubbing the fins along the gravel or they could have been weakened by the attacks of the flukes. When fish continually lower the dorsal fin it is a sure sign that they are in bad condition. I have rarely seen a goldfish keep the dorsal fin down for long if it is in good condition. You may be getting near the limit of fish for your tank; it is far easier to keep a few fish healthy in a tank than to try to overcrowd it. I recommend you to give all the fish a bath in Dettol (one-quarter of a teaspoonful to a gallon of water); leave the fish in for 15 minutes. Thoroughly disinfect the tank with household ammonia solution; about a teaspoonful should be all right. Leave this for a time and then clean the tank and refill. Split fins can join up again once the cause of the trouble is eliminated. The warmer the water the sooner will the damage be repaired. Once you have set up again go easy with the dried food. Half of the troubles in tanks are caused by overfeeding.

I have had a frog in the pond and have taken it out and put it some distance away but it always returns. Will it do any harm to the fish?

At this time of the year the frog will do no harm at all. I do not think that my own pond is ever free from them. In all my years of fish breeding in outdoor ponds I have only had one case of a male frog clasping a female goldfish, but the fish was unharmed when I removed the frog. I think it quite probable that the fish was very sluggish as it was full of eggs, and being a fantail it was not too speedy a swimmer at the best of times. I think that the possibility of a frog doing damage to a healthy goldfish is thousands to one against.

After cleaning out my pond three times since March I have as many snails as ever. They are, I believe, *Limnaea stagnalis*. Can you tell me anything I can put in the pond to kill the snails without harming the goldfish?

I suggest that you cease feeding your fish artificially and then you will probably find that they will eat many of the snails, especially the small ones. Do not try to kill them by putting any chemicals in the water. The best thing you can do would be to introduce one or two green tench; they feed mainly on snails and would soon make short work of them. Crush most of the larger ones you can see and feed to the tench, and then leave them to clear up the small ones.

I would be glad if you could tell me how to colour the inside of my pond light blue. I have not rendered the inside yet and wondered whether I could mix a colour with the concrete, or paint it afterwards?

If you must colour the inside of the pond it would be much better to incorporate some blue colouring with the concrete, as any colour added after the cement had set would always be liable to peel off. If you leave the concrete without adding any colour you will find that in a short time it will become dull and greenish and look far more natural than if you paint it blue. This blue would soon turn to green.

I am intending to set up a coldwater tank at my school and would like to have a selection of British fishes. Which kinds could I keep together?

It would be possible to keep most of the British freshwater fishes together as long as they were small. The carnivorous ones would, of course, attack anything small enough for them to manage and so it would be as well if they could be kept by themselves. The carnivorous ones are pike and perch. Many of the other fishes will eat small fry of any kind but are usually all right with fishes of about their own size. The freshwater fishes which would be best for your purpose are: rudd, tench, dace, bleak, minnows, carp and gudgeon. The minnows prefer running water but will live in a well-oxygenated tank. The gudgeon also like streams, and mostly keep to the bottom of a tank. Roach and bream are not very suitable for tanks although small ones could, of course, be kept. You will find that with all the fishes mentioned you will succeed with fairly small specimens, and when they grow it would be better to put them into a pond and re-stock with small ones.

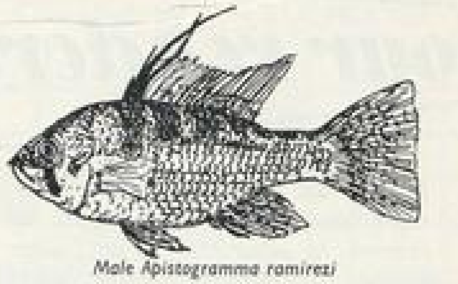
I have turned a greenhouse into a fish house and am wondering if I can use a fumeless paraffin-oil heater to raise the temperature of the house without causing any harm to the fish?

The oil heater will be quite safe for the fishhouse as long as you only use the best paraffin and clean the burner each day. I know many successful breeders of fishes who warm their fishhouse by an oil lamp.

TROPICAL FISHKEEPERS' REFRESHER COURSE: *by Pisces*

Dwarf Cichlid

(Apistogramma ramirezi)



Male Apistogramma ramirezi

ORDER:—Percomorphi, from Greek *perke*—perch, and Greek *morphe*—shape.

FAMILY:—Cichlidae, from Greek *kichle*—a kind of sea fish.

SPECIES:—*Apistogramma ramirezi*, probably from Greek *apistos*—false, and Greek *grammakos*—streaked. *Ramirezi* is after M. V. Ramirez—a dealer in fishes of Venezuela.

SINCE the end of World War 2, after importation restrictions had been relaxed, one or two "new" fishes began to appear. One of these, the subject of this article, arrived in the summer of 1948, as near as I can discover, and made an immediate hit with those fortunate few able to obtain them.

A peaceable cichlid, of a size enabling it to be kept in a moderate-sized aquarium, and of startling beauty when in ideal conditions—this was indeed a novelty. Water reaction (pH) seems to play an important part in persuading the fishes to don their most gorgeous raiment—an acidity of 6.4 stimulating a full display of colour. As the pH changes from 6.4 to neutral and on to alkalinity the fish become comparatively drab. They have been bred, however, in pH 6.0-7.4.

A little trouble to secure and maintain good conditions is amply repaid, for both sexes share almost all the colours of the rainbow between them. Orange, blue, lavender, red, pink, emerald-green, and black in patches, bars, stripes, and spots place them in a class of their own.

At breeding time the female displays noticeable pink spots all over the abdomen, but these are absent at other times. She is generally a little paler than the male.

Colour extends into the fins, which are fairly large, and always carried proudly. The whole bearing of the fish is confident and serene, as though they know they are beautiful and command admiration.

Temperature tolerance is good. For normal living a range from 72° to 78° F. is satisfactory, but to induce spawning it is better to go a little higher—from 79° to 90° F. is suitable.

The fish are choosey when it comes to pairing, but not so much as angels. It seems fairly certain that from two of each sex a likely couple will be found. Egglaying follows the usual scheme of things. The eggs are laid in masses through an ovipositor and fertilised by the spraying of milt in their vicinity.

The sites vary: some couples will invariably choose a broad-leaved plant, some a flat stone or rock. The eggs laid are many, from 300-1,800. Some, of course, are infertile, but their proximity does not seem to affect the other eggs. Fanning of the eggs is performed by either the male or the female. This appears to vary from couple to couple. Sometimes the female will leave the eggs in the sole care of the male—at other times she will not let him approach them. Whoever takes over does the job thoroughly and conscientiously.

The eggs hatch after three days, but the young remain stuck to the stone or leaf, fins moving vigorously, creating quite a current. The parents can be left with them, and are usually reliable. Nevertheless there is the odd occasion when, through fright or hunger, father, mother, or both, consume all the fry.

When free-swimming (from five to seven days after hatching) all the young swim close-packed together, a sight not to be forgotten in a hurry.

The fry are very small—about half the size of angel fry—and must be fed the smallest of green and live foods. With an adequate supply growth will be rapid and sustained. Follow on with new-hatched shrimp, sifted *Daphnia*, pulped white worm or micro worm, *Cyclops* nauplii, new-hatched gnat larvae, and other *small* live foods.

Safety Heat-Control Unit for the Aquarium *(continued from page 156)*

ture of 60° F. Connect heater No. 1 but leave heater No. 2 disconnected for the time being.

Set the master 'stat to normal; now set the slave 'stat to the high temperature position. The neon light will now be operating as heater No. 1 switches on and off. Determine the temperature the aquarium will be working at; for example, 72°-76° F. When the heater switches on at 72° F. turn the slave 'stat's setting knob slowly to the low temperature position until the neon light goes out. Now connect heater No. 2 and the unit is set and will operate and take over should the heater fail at any time. Self-heat compensation will commence when room temperature drops to approximately 45° F.

Matching Heaters

The emergency heater is used for emergencies only, and it is not intended for permanent use. Its working capacity is such that it will stop the temperature from dropping to a dangerously low level until such time as a new heater can be fitted, and to compensate heat loss when the normal heater (No. 1) is not giving all the heat required. If the normal heater is rated at 150 watts then fit an emergency heater of about 100 watts rating. Some may prefer to make their own emergency base heating as I did; a 30 watt hot-wire element against a 150 watt immersion heater. The unit fitted to a master tank then, of course, must have an emergency heater at the same rating as the normal heater.

When the unit is heat compensating the aquarium it must not be taken as heater failure; the season of the year will decide this. During this cycle of operation on a freezing winter's day the neon warning light will be seen intermittently during the time the room is at low temperatures.

If the heaters are arranged as I have suggested, when heater failure occurs the neon warning light will remain on permanently.

our readers write

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

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

Sex Changes in Fishes

I AM delighted to learn that Mr. L. Warburton has commented upon my story on the significance of sexual changes in the swordtail (*The Aquarist*, July). His observation concerning a female swordtail which apparently is undergoing some external sexual changes in the direction of a male is of importance.

Pictures of known functional female swordtails showing external male traits are not easily obtainable. I hope that Mr. Warburton will provide us with a photo of the fish under his observation.

I am interested but not convinced that Mr. Warburton's female swordtail in question is now "so obviously a male that nobody would ever dream of questioning its sex." Despite its appearance and behaviour, the question regarding its "new" sex must still remain unsettled until he obtains positive information of its ability to fertilise other and virgin females. It would be helpful also to learn whether its anal fin is capable of being moved in such a way that its distal tip can be directed anteriorly. This it would have to do, if the gonopodium were in the "thrusting" position just prior to the actual contact required for copulation.

The endocrinology of gonads and other glands is quite complicated and cannot be discussed adequately here. One point should be made clear. Mr. Warburton assumes that male hormones are derived solely from testicular tissues. My understanding is that this is not necessarily so—and we have some evidence against it. We reared several apparently male platyfish-swordtail hybrids with "good" gonopodia and swords. When dissected these "male" hybrids had *no gonads at all* (reference: Berg and Gordon, 1953, *Pigment Cell Growth*, Academic Press, N.Y.). Male secondary characters are not necessarily influenced by testicular hormones alone. The adrenal and pituitary glands provide some androgenic agents.

Mr. Warburton has the opportunity to be of great service in making a thorough-going study of his sex-changing swordtail. I wish the fish in his possession a long and a doubly fruitful life, but when the time comes, as it does to all living creatures, and the swordtail begins to display senescence, then I hope Mr. Warburton will carefully preserve it for miscroscopic examination.

My purpose in writing the original story was not to deny the possibility of spontaneous complete and functional sex reversal in the swordtail fish, but to urge that a more critical analysis be made of the available evidence.

MYRON GORDON,
New York, U.S.A.

Aquarium Wiring

WITH reference to the article by Mr. Laurence Sandfield "Unobtrusive Wiring for the Aquarium" in the September issue of *The Aquarist*, may I suggest to Mr. Sandfield that he heats and illuminates his aquarium by some means other than electricity. This will not only eliminate the wiring which he has so painstakingly hidden but will make his home a great deal safer.

His circuit diagram does not agree with his wiring layout, and neither does what he intended. If in the former case he closes both switches by mistake and then the thermostat contacts close he will blow a fuse. In the latter case he does this without help from the thermostat, and the wiring instructions for this component only confuse the matter further.

He provides a three-way terminal block for each lamp when one two-way would serve the lot and reduce wiring. How does he remove his hood without going to work with a screwdriver on his thermostat connections, and why does he not refer to his fittings as "plugs" or "sockets" without alluding to their sex? I eventually decided that a "mail two-pin" (penultimate paragraph, page 127) was either a postal threat or a mediaeval game.

Worst of all, at a time when there is a nation-wide campaign against accidents in the home, he uses a lead with a plug on each end in such a way that when one plug is removed from its mating socket on the stand, it exposes a live pin and being on the stand it is at such a level that a child could unplug it. May I respectfully suggest to Mr. Sandfield that he should have asked his "electrician colleague," both to wire his aquarium and to write his article.

N. R. HERIOT,
Windsor, Berks.

Numerous letters have been received from readers pointing out the errors contained in the article referred to by Mr. Heriot. It is very much regretted that these should have escaped editorial notice. Next month a selection of letters and corrected circuit details will be published.—EDITOR.

F.B.A.S. Scheme

THE F.B.A.S. is circularising the Trade, suggesting that goods produced be submitted to the F.B.A.S., with £10 per article, plus £5 for each further one, when the Federation, through a committee of "experts" and "specialists" (sic) will examine these, and if to their satisfaction, will issue an endorsement, which they seem to think will be of advantage to the manufacturer. They say nothing about returning the £10 plus *if* the article is found to be trash, or what they will say to the makers in this case.

Perhaps the presumption embodied in the idea is the most revolting. Who are these "experts" and "specialists" who are going to "endorse" the productions of the well-known makers? Apart from which, this £10 per product which is to be forwarded with the goods, leaves a nasty taste in the mouth, if one tries to swallow the idea. The wise fancier will treat goods carrying this "endorsement" with suspicion, and how justified he will be.

ARTHUR DERHAM,
Watford, Herts.

Marine Aquaria

THE letter from Mr. John Boursot and the article by Mr. Brightwell on the subject of marine aquaria in Britain (*The Aquarist*, June, September) raise several points that prompt me, as a marine aquarist, to write to you.

Firstly it is not the lack of literature on the subject that surprises me, for the literature is there for the person who is prepared to search for it; it is the apparent lack of initiative amongst fish-keepers in general that astonishes me.

A century ago marine aquaria were maintained both successfully and unsuccessfully in their hundreds. To-day with family week-end motoring our fertile shores are neglected as a collecting ground by all but a handful of "eccentric" aquarists. One suspects that possibly the lack of classes in shows and (dare we suggest?) the unlikelihood of making a few pounds tax-free profit from the hobby may have something to do with it.

Dealers are not to blame for the position. The position with regard to exotic marines is a vicious circle. The price of these fishes is high because the demand is small. The demand is small partly because the price is high. Since the war British dealers have made the effort, but for one reason or another the aquarists have not co-operated with them, and dealers in this imperfect world have to stock the goods that their customers will buy. Many of our native fishes and invertebrates are as colourful as the average fresh-water tropical, and such fish as wrasses can be collected on our shores without any charge whatsoever.

Water, however, is a problem of sorts. Real sea water is obviously the best medium for marine animals. I have had no experience of commercial packs of sea-salt mixtures, but I have kept and spawned native marine fishes in the Midlands in synthetic sea water that has been carefully mixed from a reliable modern formula.

One other point occurs to me. Is it the duty of the aquarium press to put, as Mr. Brightwell expresses it, "a little more salt in some writers' essays," when there is no obvious demand for it? I say "Yes," and hope that as a result of this policy we might have a revival of the oldest department of our hobby in the not too distant future.

JOHN S. VINDEN,
Birmingham, 15.

Aquarium Cinematography

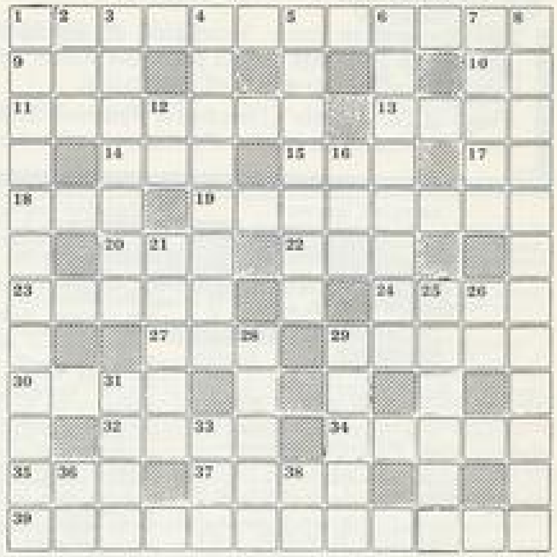
I HAVE been reading with great interest Mr. Mason Smith's series of articles on cinematography technique. It is just the thing the newcomer to photography needs.

In his last article, however, Mr. Mason Smith states that ". . . daylight Kodachrome cannot be used in artificial light." This is not so, since a conversion filter is available for this very purpose under the Kodak series 80 (assuming that by artificial light Photoflood lighting is meant). Its use, however, might possibly be limited in the field of aquarium photography because it requires about three times more exposure than that of "A" type Kodachrome when used in conjunction with daylight film. Incidentally the filter is a fairly deep blue in colour.

M. J. COULTER,
Dagenham, Essex.

The AQUARIST Crossword

Compiled by J. LAUGHLAND



CLUES ACROSS

1 Despite the name this fish is not angelic (8, 4)
9 What the French aquarist pours into his tank (3)
10 One of the great divisions of the Dark Continent (1, 1)
11 Do these fish have nine lives? (7)
13 Revolver beginning to turn upset five and roe (4)
14 Devilfish fry? (3)
15 See 9 Across (3)
17 In short, the writer's boss (abbrev.) (2)
18 Cod liver is the source of one kind (3)
19 All of the cat kind, but not cat-fish (8)
20 Employ upset without physical training (3)
22 Degree in law and small dace (2, 1)
23 Lateral division in church (5)
24 Impetuosity leads to upset in lane (4)
27 Golden fish is nearly a notion (3)
29 Small edible crustacean (5)
30 Tadpole transformed (4)
32 Split atom for encircling pond (4)
34 Extreme (5)
35 She started with *Nannostomus anomalus* (3)
37 Space (4)
39 Do they tickle the lumber area in a vessel? (12)

CLUES DOWN

1 Slip coat fern (anag.) (12)
2 Sporting body (1, 1, 1)
3 Roach (7)
4 Method of ensuring regular Infusoria supply (4, 4)
5 Haweswater Powan (7)
6 Do run, elf, for a flatfish (8)
7 Not foul (5)
8 Tough and yearly ones (5, 7)
12 Very high military rank (1, 1)
16 Sicken (3)
21 I slog for the ould town (5)
25 Pertaining to milk (6)
26 —shucks? (2)
28 Land (5)
29 Gauge depth (5)
31 All (4)
33 Large floating vessel (3)
36 At the point where non-regulars retire (2)
38 Old English (1, 1)

PICK YOUR ANSWER

1. The name *acus*, as in *Farlowella acus*, means: (*a*) Long; (*b*) a needle; (*c*) pointed; (*d*) a snout.
2. The family Bunocephalidae is native to: (*a*) North Australia; (*b*) East Asia; (*c*) South America; (*d*) West Africa.
3. The Orinoco catfish is the popular name of: (*a*) *Corydoras arcuatus*; (*b*) *Corydoras julii*; (*c*) *Corydoras melanistius*; (*d*) *Corydoras nattereri*.
4. In the wild *Rasbora daniconius* reaches a length of about: (*a*) 6 inches; (*b*) 8 inches; (*c*) 10 inches; (*d*) 12 inches.
5. *Barbus everetti* (the clown barb) was named by: (*a*) Boulenger; (*b*) Day; (*c*) Günther; (*d*) Hamilton-Buchanan.
6. The genus *Hydrocleis* (water key) is represented by (*a*) 3 species; (*b*) 6 species; (*c*) 9 species; (*d*) 12 species.

G. F. H.

(Solutions overpage)

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.

BRISTOL SHOW

ENTRIES to the annual show of **Bristol Aquarists' Society** held last month numbered approximately 400. For the first time a guppy breeders' show was included, organised by the Bristol and Bath section of the Federation of Guppy Breeders' Societies.

RESULTS

Goldfish (five inch): 1, Mr. H. T. Jago; 2, Mr. W. Ham; 3, Mr. D. D. Headford. Bristol shubunkins (three inch): 1, Mr. L. G. Emery; 2, Mr. G. Harper; 3, Mr. S. Lloyd. Five inch: 1, Mr. H. R. Stone; 2 and 3, Mr. W. Hicks.

Veiltails: 1, Mr. L. E. Rose; 2, Mr. E. A. Mason; 3, Mr. W. Butler. Telescopes: 1, Mr. E. A. Mason; 2, Mr. W. Butler; 3, Mr. V. Capaldi. Nymphs and comets: 1, Mr. H. G. Thomas; 2, Mr. L. G. Emery; 3, Mr. M. Hill.

Fantails (scales): 1, 2 and 3, Mr. A. W. Rudge; (calico): 1, Mr. H. W. Ellis; 2 and 3, Mr. F. Chappell. Pond or river fish (seven inch): 1, 2 and 3, Mr. D. Headford. Bristol shubunkins bred in 1956: 1, 2 and 3, Mr. L. G. Emery.

Moors bred in 1956: 1, 2 and 3, Mr. T. L. Dodge. Fancy fish bred 1956: 1, 2 and 3, Mr. C. B. Roe. Breeders' class, team of six fancy fish bred 1956: 1, Mr. L. G. Emery; 2 and 3, Mr. W. Hicks. Team of four fancy fish bred 1956: 1 and 2, Mr. C. D. Roe; 3, Mr. N. O. Grimston.

Furnished aquaria, tropical: 1, Mr. L. E. J. Challenger; 2, P. C. Hull; 3, N. J. C. Stamps. Inter-club: 1, Bristol A.S.; 2 and 3, Bristol A.S. Keynsham and district branch. Moors: 1, C. S. C. Whiteford.

Furnished vivaria: 1, M. S. Bellis. Aquatic plants: 1, L. E. J. Challenger; 2, C. D. Roe; 3, L. E. J. Challenger. Fighting fish: 1, H. G. G. Rundle; 2, Mr. W. H. Webb; 3, Mr. H. G. Rundle.

Labyrinths (excluding fighting fish): 1, Mr. and Mrs. Jefferies; 2, Mr. W. H. Webb; 3, Mrs. Dobson. Barbs: 1, Mr. H. G. Rundle; 2, Mr. R. Cockram; 3, Mr. L. Littleton.

Characins: 1, Mrs. Dobson; Mr. W. H. Webb; 3, Mr. H. G. Rundle. Cichlids: 1, Mr. W. H. Webb; 2, Mr. R. James; 3, Mrs. Dobson. Egglayers: 1 and 2, Mr. W. H. Webb; 3, Mr. R. Cockram. Mollies: 1 and 2, Mr. W. H. Webb; 3, Mr. H. G. Rundle. Guppies, short tail: 1, Mr. R. Forest-Jones; 2, Miss M. Hill. Long-tail: 1, Miss M. Hill; 2, Mr. R. Forest-Jones; 3, Mr. L. E. J. Challenger. Female: 1, Mr. L. E. J. Challenger; 2, and 3, Miss M. Hill. Swordtails: 1, Mr. R. Cockram; 2, Mr. L. Littleton; 3, Mr. W. H. Webb. Platys: 1, Mr. R. James; 2, Mr. L. Littleton; 3, Mr. R. James.

Tropical breeders' class. Team of six: 1, Mr. H. G. Rundle; 2, Mr. W. H. Webb; 3, Miss M. Hill. Six egglayers: 1, Mr. R. Cockram; 2, Mrs. Dobson; 3, Mr. H. G. Rundle.

GUPPY BREEDERS' SHOW

Class 1: 1, Mr. F. W. Humpidge; 2, Mr. E. Shearn; 3, Mr. P. Pavitt. Class 2: 1, Mr. D. Nicholls; 2, Mr. F. W. Humphries; 3, Mr. L. E. J. Challenger. Class 3: 1, Mr. P. Pavitt; 2, Mr. J. Martin; 3, Mr. D. L. Edmonds.

Class 4: 1, Mr. W. E. Cox; 2, Mr. F. W. Humpidge; 3, Mr. F. Kaliszewski. Class 5: 1, Mr. R. Forest-Jones; 2, Mr. L. E. J. Challenger; 3, Mr. G. Body. Class 6: 1, Mr. P. Pavitt; 2, Mr. P. Pavitt; 3, Mr. R. King. Class 7: 1, Mr. A. V. Taylor; 2, Mr. A. Maher; 3, Mr. A. V. Taylor. Class 8: 1, Mr. A. V. Taylor; 2, Mr. C. Body; 3, Mr. E. J. Challenger.

Photo: D. R. Miller

IT was estimated that well over 14,000 attended the furnished aquaria exhibition put on by the **Bexhill and District Aquatic Society.** This is the fifth year the exhibition has been held.

Mr. E. H. Riddle of the F.B.A.S. who was on holiday in Bexhill, and is a personal friend of many of the members, spent many hours with the exhibition, and gave interesting talks on tropical fish, plants, etc., and their health. Mr. Riddle, with Mr. T. Quickenden (Hastings A.S.) judged the tanks for the challenge shield, which was won by Mr. D. Barfoot; 2, Mr. P. Norris; 3, Mrs. J. Willcocks; highly commended, Mrs. E. Good. Mr. Barfoot is seen in the photograph (centre) receiving the shield from Mr. Riddle, watched by entertainments manager Mr. A. W. Allcock.

HAMPSTEAD SHOW

THE **Hampstead Aquatic Society** held its fifth annual show on Saturday, 15th September in conjunction with the Hampstead Horticultural Show. Exhibits of tropical and coldwater fishes were judged by Mrs. W. M. Meadows and Mr. C. W. G. Creed, and numbered 102.

Mr. Lester Coatman's entry in the A.O.V. tropical catfish class was judged to be the best fish in the show. Results were as follows:

Coldwater Classes. Common goldfish: 1, Mr. R. O. B. List. Fancy goldfish: 1, Mr. W. Adams; 2, Mrs. Walker-Smith. Shubunkin: 1, Mr. L. G. Lawrence. British coldwater: 1 and 2, Mr. L. G. Lawrence. Foreign coldwater: 1, Mr. L. G. Lawrence.

Tropical Classes. Hyphessobrycon and Hemigrammus species: 1, Mr. P. B. Utton; 2, Mr. A. H. Brown; 3 and 4, Mr. L. G. Lawrence. A.O.V. Characin: 1 and 3, Mr. L. Coatman; 2 and 4, Mr. P. B. Utton. Danio, *Rasbora* and white-cloud-mountain minnow: 1 and 3, Mr. R. O. B. List; 2, Mr. A. H. Brown; 4, Mr. P. B. Utton. Barbus species: 1 and 3, Mr. W. Adams; 2, Mr. P. B. Utton; 4, Mr. L. Coatman. Tropical loaches: 1, Mr. R. O. B. List. Corydoras species: 1 and 4, Mr. R. O. B. List; 2 and 3, Mr. K. J. A. Pye. A.O.V. tropical catfish: 1 and 2, Mr. L. Coatman; 3 and 4, Mr. R. O. B. List. Egg-laying tooth carps: 1, Mr. A. H. Brown; 2, Mr. L. Coatman; 3, Mr. K. J. A. Pye. Male guppies: 1, Mr. P. B. Utton; 2, Mr. K. J. A. Pye.

Female guppies: 1, Mr. P. B. Utton; 2, Mr. K. J. A. Pye. Mollies: 1, 2 and 4, Mr. L. Coatman; 3, Mr. R. O. B. List. Platy: 1 and 2, Mr. P. B. Utton; 3 and 4, Mr. K. J. A. Pye. Swordtails: 1, 2 and 4, Mr. P. B. Utton; 3, Mr. L. Coatman. Siamese fighters: 1, 2 and 4, Mr. W. Adams; 3, Mr. L. Coatman. A.O.V. labyrinths: 1, Mr. K. J. A. Pye; 2 and 3, Mrs. J. A. Brown; 4, Mr. T. Pilgrim. Angel fish: 1, Mr. P. B. Utton. A.O.V. cichlids: 1, 2, 3 and 4, Mr. L. Coatman.

HENDON FILM SHOW

A THREE hours' film show for aquarists has been organised by **Hendon and District Aquatic Society** to take place on Saturday, 20th October at 7 p.m. in the Hall at Claremont Road, Hendon. The films include those shown at the last International Aquarists' Congress held in Antwerp, and have been brought to this country by Mr. Carels and Mr. Wante, two of Belgium's well-known aquarists. Tickets are available at one shilling each from Mr. B. Calrow, 6, Axholme Avenue, Edgware, Middlesex, and seats can be booked by telephone (EDGware 4431 or EDGware 5482).

Crossword Solution

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

PICK YOUR ANSWER (Solution)
1 (b). 2 (c). 3 (c). 4 (b). 5 (a). 6 (a).