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Editorial

IN the selection of letters from readers published in this issue will be found one that gives praise to photographic reproductions which appear in *The Aquarist*. We will not pretend that we were not gratified to receive this letter; it did, in fact, please us very much. In particular we were glad of the opportunity it gave us to record our own thanks for and appreciation of the work of the photographers who specialise in our field of interest, and also to acknowledge gratefully the technical skill of those responsible for the translation of the photographs into the printed result seen by the reader.

Illustrations in journals are, as our correspondent suggests, somewhat taken for granted these days, despite the fact that the average amateur's experience with a camera teaches how difficult it is to capture what to the eye is so clear in front of the lens. This difficulty is specially great with aquarium subjects. The photograph chosen for special mention by our correspondent was one by Mr. Laurence E. Perkins, who has specialised so successfully in the photography of fishes. Readers will be familiar with his work for we are pleased to include pictures by him often in our pages. Recognition of the status of Mr. Perkins as a photographer in the aquatic field was recently given in *The Observer*, which published a number of his photographs as part of a series of pictures representing the work of prominent British photographers of natural-history subjects.

AT this time of year opportunity will present itself to many readers to experiment with keeping British freshwater fishes in aquaria. Young specimens from rivers become available and the chance should not be missed to become familiar with the engaging ways and splendid hues of some of our native species. From the humble minnow and stickleback to the eel and pike, to select examples from only the commonest species, will be found a number of types with individual points of interest and which will settle down to be "old faithfuls" in aquaria. About some of them we know less than we do of many of the tropical fishes, so the chance is offered of recording new information.

THE BARBEL *by* WILLIAM J. HOWES

THE barbel is far more widely distributed in the rivers of this country nowadays, because in recent years well-known anglers have introduced the fish to those rivers where its numbers are low or it is non-existent, and where it is considered that the conditions will suit them. The barbel is a member of the Cyprinidae or carp family. It is essentially a freshwater species and classified amongst those British fishes which are termed coarse to distinguish them from the game fishes, salmon and trout.

A barbel, *Barbus barbus*, has four barbules or "feelers" hanging from the corners of its mouth. These are extremely sensitive and function not only by touch, but by taste, enabling the fish to test its food for edibility. The body of a barbel tapers sharply from powerful shoulders to a large unevenly forked caudal fin. This tail fin is broad and powerful, and is in keeping with the barbel's scoop-like lower fins. In action this gives the fish a terrific driving force, and the barbel is one of the fastest of our freshwater swimmers.

Coloration of the barbel varies considerably and is usually influenced by environment. From bright gravelly rivers they are a beautiful golden brown on the back, shading down to gold on the sides and to a yellowish-white abdomen. Fish from the deep, slow pools, such as we may find in the River Thames, have backs of a bronze-green, shading to gold on the sides, and the underpart is a light cream. The fins on the lower portion of the body are tinged with red.

Normally the barbel prefers that part of a river which flows strongly, and the foaming water of a weir stream is one of its favourite haunts. This love of the well-aerated water makes the barbel an unreliable inmate for the aquarium.

If one or two small specimens are obtained they should be provided with a large tank, and good aeration is necessary. Suitable specimens are not always easy to come by, but a request to an angling friend may result in one or two small fish. (However, many anglers of a few years' experience have not even *seen* a barbel under 12 in. in length, let alone catch one!)

Suitable specimens may be purchased from one of the several fish farms which supply fishes for stocking lakes, rivers and streams.

If small enough the barbels could be introduced to the aquarium, but the garden pool should suit them better. If the pool is reasonably large, and the barbel introduced are of suitable size, there is every possibility that the fish will adapt themselves to the conditions of the garden pool.

If the pool is fitted with some piece of apparatus for aerating the water the fish will find conditions more to their liking and settle down very well. Gravel should be provided in either pool or aquarium, for in their natural environment barbel choose that part of a river which flows over a bed of gravel.

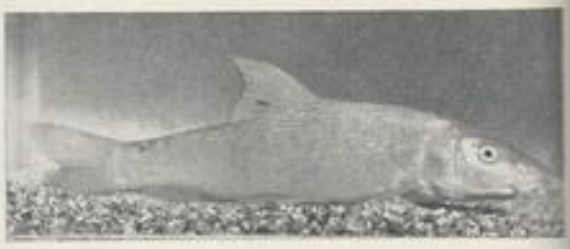
I doubt very much whether this species will be induced to breed in captivity. I have never heard of anyone having this much success with them. In fact, well-known public aquariums have tried on several occasions to keep barbel under aquarium conditions, and they have had little success.

The barbel is a bottom-feeding species, with enormous appetite, and will normally feed on the same kind of food as other British coldwater fishes. This means that the barbel may be fed on earthworms. These may be given whole, or broken up, according to the size of either fish or worms! They are also fond of water snails, maggots, freshwater shrimps and various other aquatic life. If a diet can be arranged to include some of these, and provided that the conditions offered the fish are suitable, there is every possibility that the barbel will live quite well and give the aquarist much satisfaction.

Barbel are regarded as being somewhat of a mystery fish, for there is still much to be learned about them, so the aquarist who keeps a record of his observations may be able to contribute something useful to science.

Photos: W. J. Howes

This weir pool at Romney on the river Thames is a typical home of the barbel. This fish delights in the foaming water and strong current



Here a young barbel is seen in its usual resting position on the gravel at the bottom of an aquarium

Cacti in the Fish House

CUTTINGS can be taken from many kinds of cacti during the growing season. The cuttings should be allowed to lie in the sun until a firm skin has formed over the cut part. Do not bury the end of the cutting in sand or soil. It is better to make up a pot of porous soil and have an inch of sharp sand with a little peat on the top. The cutting should just rest on the top of this and if tall can be kept in position by tying it to a small stake. Damp occasionally or syringe in bright weather. When good roots have formed the cutting can be potted into ordinary soil, taking care that the roots are not broken.

Aeration in Aquaria

by A. L. DOWNING (*Water Pollution Research Laboratory, Stevenage, Herts*)

At one time it was thought that in aquaria there was a natural balance between the respiration of fishes and the photosynthetic activity of plants, the oxygen evolved by the plants being consumed by the fishes and the carbon dioxide exhaled by the fishes being utilised by the plants. It was not until the rates of some of these processes were measured and consideration was given to the possibilities of the interchange of the respiratory gases at the air–water interface that this conception began to be doubted.

In a critical review in 1949, Atz[1] effectively disposed of this "balanced aquarium myth," but he went on to conclude that carbon dioxide was the critical respiratory gas, attributing many cases of fish mortality to an accumulation of this gas rather than to lack of oxygen. He also concluded that putting more plants into an aquarium did not make it possible to support more fishes than would otherwise have been the case. These conclusions were, however, based on the observations by Breder[2] that the water in an aquarium came rapidly into equilibrium with atmospheric oxygen and the assumption that by contrast carbon dioxide produced by respiration is lost relatively slowly.

As we shall see, however, it is not really feasible to make accurate generalisations about the effects of such phenomena in aquaria without making quantitative calculations involving a knowledge of the dynamics of all the processes governing the distribution of the respiratory gases. At the Water Pollution Research Laboratory there is active research on this type of system, since it has features relevant both to the development of toxicity tests and the elucidation of the oxygen balance in polluted waters. Application of this more rigorous approach to aquaria reveals that some current conceptions are far from justified.

Interchange of Oxygen and Carbon Dioxide Between Air and Water

There is a continuous interchange of molecular oxygen and carbon dioxide between water and the air above its surface. As a result the system tends towards a dynamic equilibrium in which the water becomes saturated with the two gases, the saturation concentrations depending on the temperature, concentration of other substances present and the partial pressures of the two gases in the air. The equilibrium concentration of oxygen in pure water is about 9.3 parts per million (p.p.m.) at 15° C. and that of carbon dioxide 0.6 p.p.m. Note, however, that because of ionisation pure water in equilibrium with carbon dioxide will contain a small proportion in the form of bicarbonate ion. In natural water the proportion of combined carbon dioxide may be much greater than that of the molecular form.

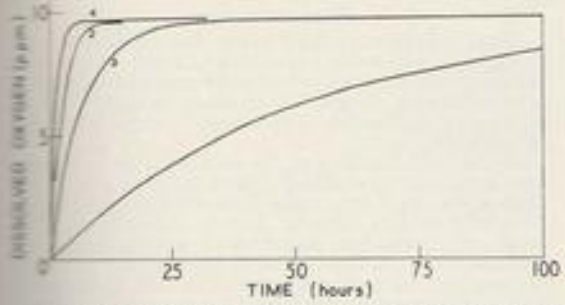


Fig. 1. Comparison of typical rates of uptake of oxygen in a stagnant pond and in a river with those in aerated aquaria. Curve 1: stagnant pond, exchange coefficient 1 cm./hour; curve 2: river, exchange coefficient 20 cm./hour; curve 3: aquarium aerated by diffused air bubbles (air flow 1 litre/minute sq. metre); curve 4: aquarium aerated by diffused air bubbles (air flow 5 litres/minute sq. metre). Depth of water: 50 cm. Temperature: 15°C.

An important property of the system is that the rate at which the equilibrium is approached, that is the rates at which the gases are absorbed or desorbed, is proportional to the degree of super-saturation or under-saturation in the water, or as it is commonly called the "saturation deficit." It also depends on the area of the surface and on the degree of agitation. The speed at which the interchange will take place under given conditions is characterised by what is called an "exchange coefficient," which is a measure of the rate of mass-transfer per unit area of surface per unit saturation deficit. Typical values of the exchange coefficient for such different systems as a stagnant pond, a fairly placid river and a freely rising bubble are respectively 1, 20 and 150 micrograms/hour p.p.m. sq. cm.

The significance of these values is illustrated in Fig. 1, which shows the variation in the oxygen content with time in initially deoxygenated water during natural aeration of the pond and the river and artificial aeration of an aquarium at two different rates of air flow. A common depth of 50 cm. (about 1.7 ft.) and a temperature of 15° C. is assumed and the calculations for the aerated aquaria take into account the number of bubbles (assumed to be 0.4 cm. in diameter) which would be instantaneously present at constant flow.

Whereas the time taken for the water to become half-saturated during natural aeration of the pond is about 35 hours it is only about 2 hours in the river. The maximum rate of aeration, indicated by the initial slope of the relevant curve, is only about 0.2 p.p.m./hour in the pond but it is 20 times greater in the river. However, it is seen that by diffusing air at, for example, flows of 1 or 5 litres/minute/sq. metre of water surface, in an aquarium (which without artificial aeration would have a rate of aeration similar to that in the pond) the rate of uptake of oxygen is greatly increased and with the high flow exceeds that in the river. In fact almost any desired degree of aeration can be achieved by diffusing air into the liquid at an appropriate rate.

As it happens, the exchange coefficient for carbon dioxide is of a similar order to that of oxygen[3, 4], so we should expect it to be absorbed or desorbed at the same rate as oxygen when the saturation deficit is the same. However, referring to the examples given above, the initial rate of entry into a stagnant pond or aquarium containing no dissolved carbon dioxide would be only 0.012 p.p.m./hour and that into the river 0.24 p.p.m./hour, since the saturation deficit is only 0.6 p.p.m., about one-fifteenth of that of oxygen.

Oxygen and Carbon Dioxide Concentrations in Aquaria

From an approximate knowledge of the rate at which fishes consume oxygen and liberate carbon dioxide, the variation of the concentrations of these two gases in water in which the rate of aeration is known can be estimated, though there will be some degree of uncertainty inevitable

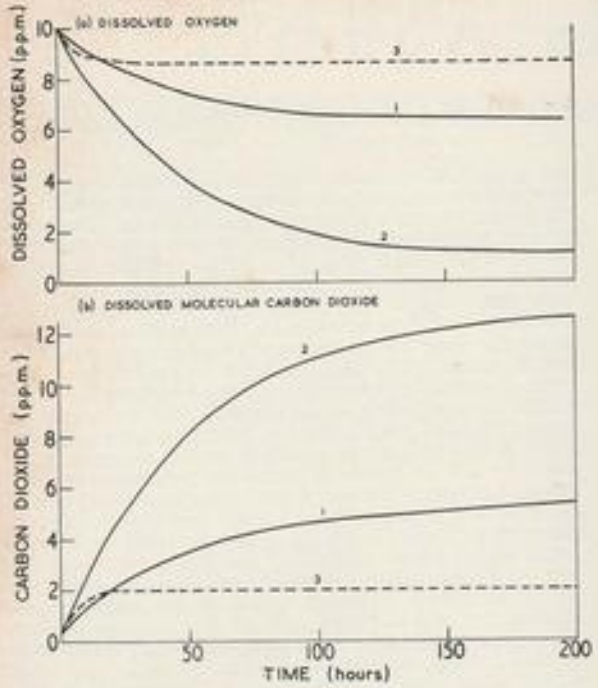


Fig. 2. Variation in the concentrations of dissolved oxygen and carbon dioxide in an aquarium with the number of fish present and the degree of aeration supplied. Depth of water: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Fish were brook trout weighing 25 grams. Curve 1: 10 fish, natural aeration; curve 2: 25 fish, natural aeration; curve 3: 25 fish, aeration by diffused air bubbles (air flow 1 litre/minute)

in calculations based on the behaviour of living things. For oxygen this is merely a matter of solving a differential equation expressing the principle that the rate of change of concentration is equal to the rate of solution minus the rate of consumption[5]. The same is true for carbon dioxide, if the water is initially in equilibrium with this gas, but if the water is markedly alkaline the interplay of the ionic equilibria must also be taken into account.

Typical solutions of the equations for oxygen and for the carbon dioxide when the ionic equilibria are not involved are given in Fig. 2. It is assumed that the water in the aquarium is 50 cm. deep, has a surface area of 1 sq. metre, and is initially in equilibrium with the air at a temperature of 15° C. It contains brook trout (*Salvelinus fontinalis*), each weighing about 25 grams, consuming oxygen at an average rate of about 3.6 milligrams/hour per fish[6] and, assuming a respiratory quotient of unity, producing carbon dioxide at a rate of 4.95 milligrams/hour per fish.

If the aquarium contains 10 fish, and if there are no plants and no artificial aeration, then it is seen from Fig. 2 that the oxygen concentration will be gradually reduced to an equilibrium value of 6.3 p.p.m. in a period of about a week, and simultaneously the concentration of carbon dioxide will rise to about 5.4 p.p.m. Under these conditions the fish are unlikely to be discomforted and would be expected to survive indefinitely but for a gradual accumulation of metabolic products, for instance ammonia.

If now the number of fish is increased to 25, then the oxygen concentration is reduced to about 1.1 p.p.m. and the carbon dioxide concentration increased ultimately to about 12.8 p.p.m. The low oxygen concentration would be lethal in the absence of carbon dioxide and even more so when it is present[7]. On the other hand it is not expected that the carbon dioxide concentration would be lethal if oxygen was plentiful.

Thus in this instance carbon dioxide is not the critical respiratory gas. Moreover, if the water contained a reserve of alkalinity, the concentration of carbon dioxide being initially below the value in equilibrium with air, then it would not accumulate so rapidly as in the example given, since to begin with it would be converted into bicarbonate or carbonate ion. The concentration finally attained would, however, be the same.

The obvious remedy for the above situation, in which the aquarium is over-populated, is simply to provide more aeration. This serves both to increase the oxygen concentration and reduce that of carbon dioxide. For instance, if 1 litre of air/minute is diffused into the aquarium containing 25 fish the oxygen concentration should be raised to about 8.6 p.p.m. and the carbon dioxide concentration reduced to 2.1 p.p.m. Clearly many more fish could be supported under these conditions, without the oxygen concentration becoming dangerously low again.

Replacement of Water

If the water in the aquarium is replaced either intermittently or continuously with fresh water in equilibrium with air this will also serve to maintain a high level of dissolved oxygen and a low concentration of carbon dioxide. There will also be the additional advantage that undesirable metabolic products are continuously removed. It is quite easy to calculate what the rate of replacement must be to maintain any desired level of concentration of either respiratory gas. This again is merely a matter of solving a simple equation expressing the principle that the algebraic sum of the various rates of supply and demand must be zero at the required concentration[5].

To take an example, if the oxygen concentration in the aquarium containing 25 fish is to be maintained at 8.6 p.p.m. by replacing water continuously and without diffusing air, then the rate of replacement must be about 130 litres/hour or about one-eighth of the volume of the aquarium per hour. For rough comparison, replacing half-saturated water by 1 litre of fully saturated water would add about 5 milligrams of oxygen to the aquarium; the absorption of about the same weight of oxygen by aeration would require passage of about 6000 bubbles each of 0.4 cm. diameter through the water.

Role of Plants

If the aquarium contains plants the situation is more complicated, but is still susceptible to rough calculation if the approximate average rates of photosynthesis and respiration are known, though it is necessary to assume that all, or some definite fraction, of the liberated oxygen is absorbed in the liquid.

To illustrate the basis of the calculation let us suppose that in the aquarium already described, containing 25 fish, there is also some tape grass (*Vallisneria spiralis*), a plant commonly used in aquaria. Leaves of this plant, about 30 sq. cm. in area, have been found to produce oxygen at a rate of about 0.6 milligram/hour in daylight[8], and this would be accompanied by the absorption of 0.82 milligram of carbon dioxide/hour, since in photosynthesis, on balance, one molecule of carbon dioxide is absorbed per molecule of oxygen liberated. (There is some evidence to suggest that in addition to molecular carbon dioxide plants can utilise bicarbonate ion directly, but for the moment we will assume the former is the operative mechanism.) The plant will also be respiring continuously on average at about one-tenth of the rate of photosynthesis[9]. Thus on balance the plant will liberate 0.54 milligram of oxygen and absorb

0.74 milligram of carbon dioxide per leaf per hour during daylight and will absorb 0.06 milligram of oxygen and liberate 0.08 milligram of carbon dioxide per hour at night.

If first of all we suppose that the aquarium contains 100 leaves, that the duration of daylight and darkness are about equal, that there is no artificial aeration and that the water is in equilibrium with carbon dioxide and oxygen, then the concentration of dissolved oxygen will vary in accordance with curve 1 of Fig. 3, ultimately reaching an equilibrium in which the concentration falls from about 3.6 p.p.m. during the day to about 3.0 p.p.m. during the night. The concentration of carbon dioxide, on the other hand, will ultimately vary between about 9.9 p.p.m. during the night and 9.0 p.p.m. during the day (Fig. 3). It will be seen that the concentration of oxygen is at all times higher, and that of carbon dioxide lower, than had no plants been present.

The position is even better if the aquarium is continuously illuminated with light of adequate intensity, since the oxygen concentration would then be increased to 6.2 p.p.m. and the carbon dioxide reduced to 5.6 p.p.m. If the water

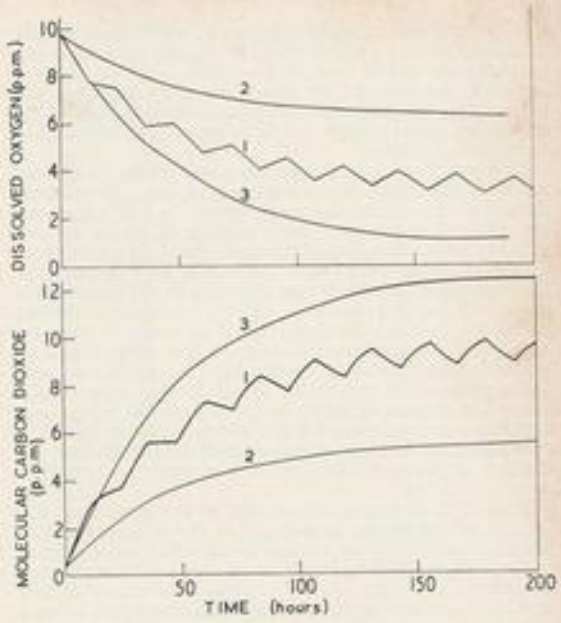


Fig. 3. Effects of plants on the variations with time of the concentrations of dissolved oxygen and carbon dioxide in an aquarium. Depth of water: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Brook trout (25) were present and natural aeration was taking place. Curve 1: natural illumination (12 hours light/day) and 100 leaves of Vallisneria spiralis; curve 2: continuous illumination and 100 leaves of Vallisneria spiralis; curve 3: no plants present

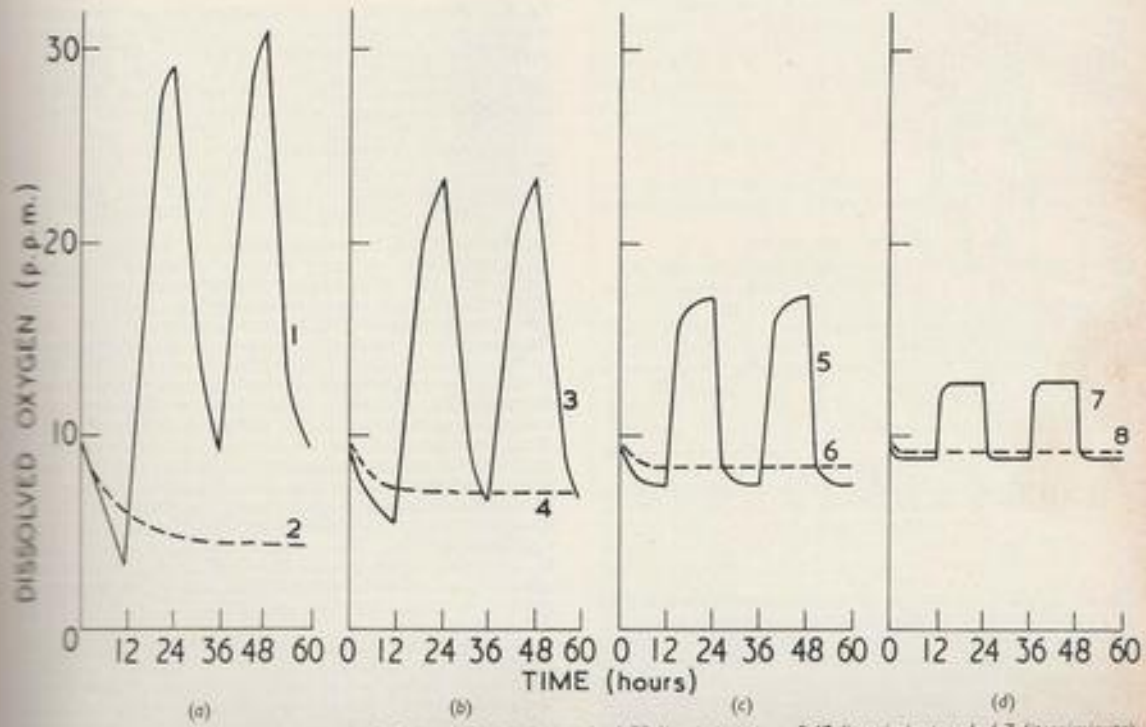


Fig. 4. Effect of the rate of aeration (a, 0.67 litre of air/minute; b, 1.33 litre/minute; c, 2.67 litres/minute; d, 6.7 litres/minute) on the variation with time of the concentration of dissolved oxygen in an aquarium containing 75 brook trout, and plants, compared with that in the aquarium without plants. Depth of water: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Curves 1, 3, 5 and 7: natural illumination (12 hours light/day) and 2500 leaves of Vallisneria spiralis; curves 2, 4, 6 and 8: no plants present

was rather alkaline, accumulation of free carbon dioxide would not occur so rapidly and the diurnal fluctuations in concentration would tend to be smaller. Thus, in these instances the presence of plants distinctly improves the environment for fish in respect of the concentrations of the respiratory gases, quite apart from providing them with a more natural habitat.

However, it does not follow that it will always be advantageous to have plants in the aquarium, as further considerations of their possible effects will show. In Fig. 4 is shown the effect of a relatively large number of plants at four different rates of aeration of the aquarium, under conditions of natural illumination. All the curves have been calculated assuming arbitrarily that the water in the aquarium is initially in equilibrium with the air immediately before nightfall. It should be noted that if an aquarium were set up in this way conditions during the first night would be generally less favourable to the fish than the subsequent equilibrium conditions, which would develop quite rapidly at the higher rates of aeration. It is seen that when such conditions are established at the lower rate of aeration, the concentration of oxygen always exceeds that attained in the absence of plants, but falls below it at night at the higher rates.

This effect is largely independent of the number of fish present, as will be seen from Fig. 5, so that if the concentration of dissolved oxygen is close to the lethal concentration in the absence of plants, addition of plants will cause lethal conditions at night. Actually there will be a certain "critical" rate of aeration at which this effect will be at a maximum, since it depends upon two opposing factors.

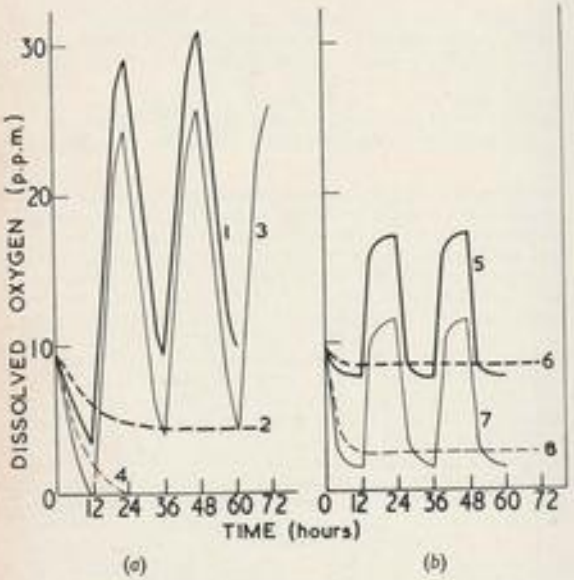


Fig. 5. Effect of the number of fish on the variation with time of the concentration of dissolved oxygen in aquaria containing both fish and plants, compared with that in the absence of plants. Two different rates of aeration were used (a, 0.67 litre of air/minute; b, 2.67 litres/minute). Depth of water: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Curves 1 and 5: 75 brook trout, natural illumination (12 hours light/day) and 2,500 leaves of Vallisneria spiralis; curves 3 and 7: 400 brook trout, other conditions as for curves 1 and 5; curves 2 and 6: 75 brook trout, no plants present; curves 4 and 8: 400 brook trout, no plants present

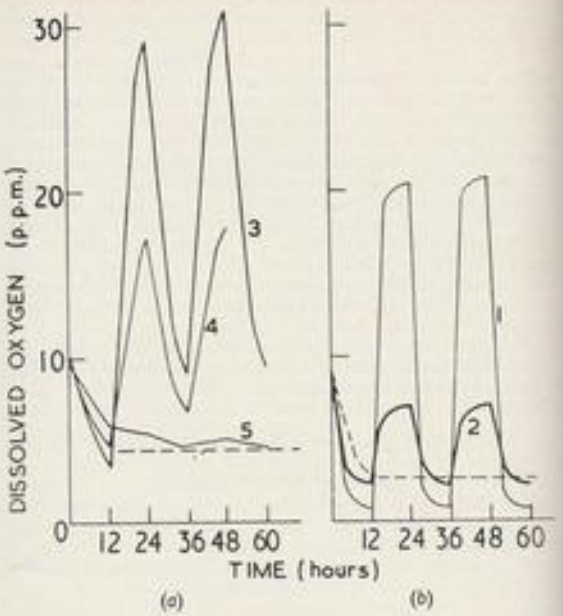


Fig. 6. Effects of the rate of photosynthesis on the variation with time of the concentration of dissolved oxygen in an aquarium at two different rates of aeration (a, 0.67 litre of air/minute; b, 2.67 litres/minute). Depth: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Broken line indicates the concentration of dissolved oxygen when no plants are present. Natural illumination (12 hours light/day) was used in all experiments. Curve 1: 400 brook trout and 5,000 leaves of Vallisneria spiralis; curve 2: 400 brook trout and 1,250 leaves; curve 3: 75 brook trout and 2,500 leaves; curve 4: 75 brook trout and 1,250 leaves; curve 5: 75 brook trout and 63 leaves

On the one hand, increasing the rate of aeration prevents the accumulation of large reserves of dissolved oxygen during the day which could otherwise help to maintain higher oxygen concentrations during the night; on the other hand it reduces the difference between the equilibrium concentration to which the system tends at night, and that in the absence of plants. This effect is shown in Fig. 4.

It can be proved algebraically that this "critical" rate depends only on the ratio of the rates of plant respiration and photosynthesis and on the durations of light and dark. If the latter are equal and respiration is one-tenth of photosynthesis the critical rate is about equal to a rate of change in the concentration of oxygen of 0.2. p.p.m./hour per p.p.m. of oxygen deficit—in our hypothetical aquarium this is equivalent to the rate attained by diffusing air at a rate of 1.33 litres/minute. The extent to which the concentration at night falls below that in the absence of plants for any given rate of aeration increases with increase in the rate of removal of oxygen by plant respiration. This is shown in Fig. 6 (*b*).

Another point to consider is that when the rate of aeration is low and the rate of photosynthesis relatively high, the water tends to become highly super-saturated with dissolved oxygen. It has been alleged that this can affect fishes adversely, though the evidence on this point lacks weight. It is certain, however, that in a hard water the pH is increased very considerably (that is the water becomes more alkaline), sometimes to lethal values, owing to the high rate of removal during photosynthesis of carbon dioxide,

which, of course, behaves as an acid in solution. Apart from this extreme effect, and assuming that moderate levels of super-saturation do not discomfort the fishes, then it will be seen [Fig. 5 (*a*)] that the presence of plants will allow more fishes to be kept in an aquarium than would have been the case in their absence and, making the same reservations, that the more plants there are the more fishes can be kept [Fig. 6 (*a*)].

Variations in the carbon dioxide concentration would tend to be rather like mirror images of the corresponding curves for oxygen (except in alkaline conditions when the variations would be smaller); when the oxygen was high the carbon dioxide would be low and vice versa. An example is given in Fig. 7. A point to notice here, however, is that the predicted concentration of carbon dioxide during active photosynthesis is zero. Now in some circumstances this could mean that the rate of photosynthesis would be curtailed owing to a restriction in the supply of carbon dioxide and in consequence neither the day-time nor night-time concentrations of oxygen would be as high as has been predicted.

For instance, this might occur in a very soft water, containing little combined carbon dioxide, dissociation of which when present would yield the molecular form, or it could happen if the liquid turbulence was so low that supply of carbon dioxide was limited by the rate at which it could diffuse through laminar "films" of liquid to the plant cells. It might also happen in an alkaline hard water, unless the plant could utilise bicarbonate ion, since the proportion of molecular carbon dioxide normally present would in any case be small.

Limitations on Photosynthesis

Apart from the possibility of a restriction of photosynthesis due to limitations in the rate of supply of carbon dioxide, it may also be limited by the intensity of illumination. Approximate calculations from meteorological data indicate that whereas the intensity of sunlight is sufficient to support high rates of photosynthesis in summer, in winter the maximum rate may be reduced to one-fiftieth of its value[5]. In our hypothetical aquarium the limiting rate in winter might be no more than the rate of input of oxygen when diffusing air into the deoxygenated water at about 100 to 200 millilitres/minute, unless, of course, additional artificial illumination was provided.

The limitations imposed by the rate of supply of carbon dioxide are rather imponderable because of the possibility of the plant utilising bicarbonate ion rather than molecular carbon dioxide and because little is known of the effects of liquid turbulence. It seems likely, however, that the limiting rate in winter will generally be higher than that due to decreasing light intensity, except perhaps in very soft water, but in summer the position may be reversed.

Decay of Organic Matter

Another factor to consider in relation to plants is that in a "natural" aquarium plants which have grown during the summer will die and begin to decay at the beginning of winter. While oxygen is present this decay will occur, at any rate on the surface of the plant, by a process of aerobic biochemical oxidation. Potentially the amount of oxygen required to decompose all the plants would be about equal to that liberated in photosynthesis during their growth.

In general the decay process is fairly slow, but if a large number of plants are present the rate of demand on the oxygen resources of the aquarium could be quite high. Thus in these circumstances the aquarium could easily become uninhabitable by fishes unless the decaying vegetation was removed. Alternatively, increased aeration or replacement of water would alleviate the situation and the approximate minimum required rates for safety could be

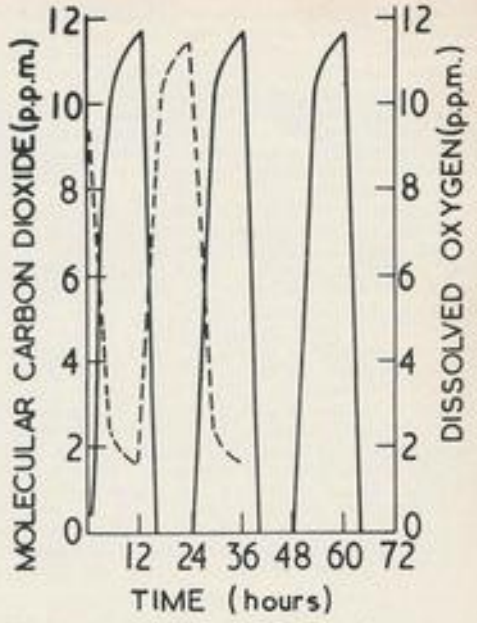


Fig. 7. Comparison of the daily variations in the concentrations of dissolved oxygen and molecular carbon dioxide in an aquarium in which there is a high rate of photosynthesis. Depth: 50 cm. Surface area: 1 sq. metre. Temperature: 15°C. Brook trout (400) were present and the aquarium was aerated by air diffused at 2.67 litres/minute. Natural illumination (12 hours light/day) was used; 2,500 leaves of Vallisneria spiralis were present. Continuous line, carbon dioxide; broken line, oxygen

calculated for a given situation by methods similar to those already mentioned in previous examples.

General Conclusions

The following conclusions can be drawn from the results of calculations of the type outlined:

1. In all circumstances it is beneficial to aerate aquaria since this tends to maintain low concentrations of carbon dioxide and concentrations of dissolved oxygen close to the saturation value, that is neither too high nor too low.

2. Replacement of water is useful in the same way as aeration and it also serves to remove waste metabolic products, which may be quite an important function in some circumstances.

3. In a stagnant pond or aquarium relying only on natural aeration the amount of oxygen entering the water per sq. metre of surface, at the minimum concentration at which in the normal way all fishes will survive (about 4 p.p.m.), will probably range between about 50 and 100 milligrams/hour, depending on the temperature and other circumstances. If there is no other source of oxygen, for instance by photosynthesis or replacement of water, then if more fishes are present per sq. metre than would consume oxygen at a rate of 50 milligrams/hour there is a danger that the dissolved oxygen will fall below this value of 4 p.p.m. Figures for the rates of consumption of oxygen by various species of fishes are given in the literature[6, 10, 11]. For trout, for instance, an average value would be about 200 milligrams/hour per kilogram of fish.

4. It seems unlikely that carbon dioxide will be the "critical respiratory gas" unless there are fishes present

which are particularly sensitive to it in relatively low concentrations. In the normal way the concentration of carbon dioxide will tend not greatly to exceed the oxygen deficiency, and from the known toxicities of the two gases it would seem that most fishes would be in distress from lack of oxygen long before carbon dioxide became toxic. On the whole it would seem more appropriate to regard oxygen as the critical gas. However, there is no doubt the presence of carbon dioxide increases the toxicity of low oxygen concentrations.

5. Whereas the addition of a limited number of plants to an aquarium may be beneficial it seems likely that, in many cases, this benefit is due as much to the provision of a more natural habitat for fishes and possibly to their utilisation of some metabolic products, as to their influence on the oxygen and carbon dioxide concentrations. A heavy growth of plants is likely to prove a source of danger because (*a*) they may cause too high a degree of super-saturation in an unaerated aquarium, or (*b*) the incidence of a very dull day when natural illumination is being relied on, or some other restriction in the rate of photosynthesis—for instance limitation in the supply of carbon dioxide—may ultimately lead to lethal low concentrations of oxygen at night, or (*c*) lethal night-time concentrations of oxygen may occur anyway in the normal course of events in a heavily populated aquarium with a fairly high rate of aeration, or (*d*) the water may become too alkaline owing to absorption of carbon dioxide, particularly if there is continuous artificial illumination.

6. A large number of decaying plants are undesirable because the resulting biochemical demand for oxygen may reduce the oxygen concentration to lethal values.

To summarise these conclusions, it seems that *with respect to the respiratory gases* the ideal aquarium should be one in which there is vigorous aeration, fairly rapid replacement of water, a limited number of healthy plants and not too many fishes. This would appear to be in accord with what has been found by many aquarists by experiment, trial-and-error and logical reasoning. It is hoped that the present treatment gives some further insight into the basic reason why this is so.

Acknowledgements

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BIBLIOGRAPHY

1. Atz, J. W., *The Aquarist*, 1949, **14**, 159.
2. Breder, C. M., *Copeia*, 1931 : 66.
3. Hammerton, D., and Garner, F. H., *Trans. Instn. Chem. Engrs.*, 1954, **32**, Supplement no. 1, 18.
4. Department of Scientific and Industrial Research, 1956: *Water Pollution Research* 1955, p.35. H.M. Stationery Office, London.
5. Downing, A. L., and Truesdale, G. A., *Zoologica*, 1956, **41**, 129.
6. Graham, J. M., *Canad. J. Res. (D)*, 1949, **5**, 270.
7. Alabaster, J. S., Herbert, D. W. M., and Hemens, J., *Ann. appl. Biol.*, 1957, **45**, 177.
8. Manning, W. M., Juday, C., and Wolf, M., *Trans. Wis. Acad. Sci., Arts and Lett.*, 1938, **31**, 377.
9. Rabinowitch, E. I., 1951, *Photosynthesis and Related Processes*, p.?, Interscience Publishers Inc., New York.
10. Shepard, M. P., *J. Fish. Res. Bd. Canada*, 1955, **12**, 387.
11. Fry, F. E. J., and Hart, J. S., *J. Fish. Res. Bd. Canada*, 1948, **7**, 169.

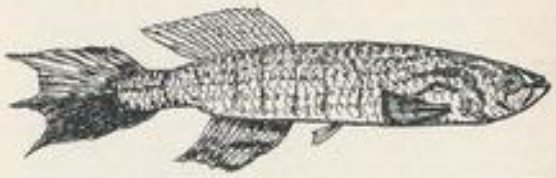
New Aquarium in South Africa

In the photograph is shown the interior of the giant shark tank of the newly completed Aquarium at Durban, shortly before it was stocked and opened for public viewing this spring. The tank holds 300,000 gallons and is 18 ft. deep; it cost over £25,000 to erect. Panels of toughened glass (one is shown in the smaller photograph) in its sides enable visitors to watch the sharks and other large sea fishes. As well as providing a beach-front attraction for holiday-makers, the Aquarium is a research station for marine biologists who are studying the habits of the fishes of Natal

Photos: "The Natal Mercury"

Blue Gularis

(Aphyosemion coeruleum)



ORDER: Cyprinodontes, from Greek *kyprinos*—a kind of carp, and Greek *odontes*—tooth.

FAMILY: Cyprinodontidae.

SPECIES: *Aphyosemion*, believed from Greek *a*—prefix meaning without, and Greek *phye*—growth (thus "small") and Greek *seimeion*—a mark; *coeruleum*, from Latin *caeruleus*—dark-coloured, dark blue.

THIS West-African native is not by any means a "toy" tropical. Fully grown it is an extremely handsome 4 inches overall. Nor is it a "beginner's" fish for a community tank. Its mouth is wide and large—capable of engulfing a fully grown male guppy without difficulty, and it is by no means averse to attempting this, not slyly when the owner's back is turned, but in broad daylight in front of a line of spectators!

Its native habitat appears to be in muddy waters or slow-flowing small streams which may at times dry up, and varying in pH and hardness according to the season. Breeders in this country have attempted to simulate natural conditions when attempting to breed this fish, giving slightly acid conditions and heavily planting the aquaria with floating plants which obscure much light.

There are very marked differences between the male and female of this species. The male has differently shaped fins, the most striking being the caudal, which is three-pronged and colourful. An orange or yellow patch covers the upper portion of the lower lobe, and below this the fin is patterned in blue and grey. All other fins show this grey or dark-blue streaky pattern on a yellowish background. The overall body hue is blue with "gourami" mottling on the head and the first half of the body, and bars of darker colour at intervals on the second half.

Photo: *Laurence E. Perkins*

Blue gularis (Aphyosemion coeruleum)

The female is comparatively drab, with rounded fins, and almost an inch smaller than her spouse.

Temperature tolerance is good, although the gularis seems to prefer cooler water than many "tropicals," being happiest in from 68 to 75° F.

In their native quarters the main item of food of the gularis is mosquito larvae and pupae, of which they consume countless numbers and thus perform an extremely useful task to both man and beast. In captivity they sometimes require coaxing before they will readily accept a new food. They are not alone in this, of course. Many fishes are very choosey, and will not take just anything different until they have acquired a taste for it. I say acquired because at first they will spit out the new item in their diet, and do so time and time again, until they seem to get its flavour, whereupon it disappears for good and anxious search is made for more of the hitherto-rejected food.

Gularis lays eggs on or in the sediment or compost on the bottom of the tank, so that it is as well to take every precaution possible to ensure that this is not the hiding place of pests such as planarians, snails, etc. A new aquarium, with sterilised plants and boiled compost, containing a goodly proportion of peat, is recommended. A small quantity of sea salt added to the water will improve it—not more than, say, a teaspoonful per gallon.

Slow but sure is the spawning. The two fish will take up positions side by side on the bottom of the tank, and eggs will be laid singly, at long intervals, the whole process extending into a fortnight or more. Breeding fish should be removed to another aquarium to give the fry and eggs the best chance of survival. Strong light should be avoided, as it appears to have an adverse effect upon the eggs. It would be interesting to know the reason why this is so. It might be a good idea to cover up all sides of the fry tank until the young are free-swimming.

It may be a month or more before any fry hatch out. When they do they cling like minute glass splinters to glass or plants until they become free-swimming.

With sufficient Infusoria, growth of fry is rapid, until at the end of a week or so, small live foods can be given. Little and often is the method to be adopted. As the fry grow (they already have large mouths) the food size should be increased similarly. At 3-4 months the fish are of breeding size.

An interesting point made by Paul Arnold was that the higher the temperature to which the eggs were subjected the *longer* they took to hatch. This, on the face of it, seemed contrary to anything yet experienced by breeders. The reason advanced by Arnold, which seems eminently sound when one thinks about it, was that at high temperatures, say, 90° F. and over, the streams in which the eggs were laid would dry up. It is obvious that if fish hatched into a dry river bed they would be fried fish in no time at all. So the eggs remain quiescent until cool water floods the streams again and starts their development. Dame Nature thinks of everything!

Microscopy for the Aquarist—41 *by* C. E. C. COLE

LAST month we looked for, and found, a number of different species of male water beetles, and examined their internal and external features, paying particular regard to the organs of generation—aedeagus and parameres.

In the article I mentioned that before I found that not all male beetles had the large circular suckers to be found in *Dytiscus marginalis* upon the first pair of legs, I thought the aedeagus of the males were ovipositors of females. You, who have been told and shown otherwise, will not make the same mistake.

The ovipositors of many females are somewhat more difficult to locate and expose. They are situated in much the same position as the corresponding organs of the males, but differ greatly in construction according to the egg-laying habits of the species to which they belong. Some are short and soft, others hard with a marked serration upon one edge. Two greatly contrasting ovipositors are sketched on this page.

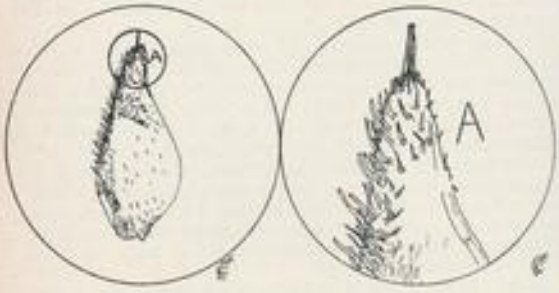
The soft ovipositors belong to species of beetles which lay eggs upon the surface of plants. The hard and serrated ovipositors are used to cut clefts or make incisions in aquatic stems or leaves in which to place single eggs.

One of the commonest of British water beetles (*Acilius*) lays its eggs in masses in moss, or among rotting submerged twigs.

Eggs, too, differ in shape from long and narrow to almost globular. Those deposited in clefts are usually long and narrow. It is well worth while to take home a sample or two of any eggs you may discover, and attempt to hatch them out in shallow containers. They may prove to be those of creatures other than water beetles. If so, you will know another time what to expect when you find them.

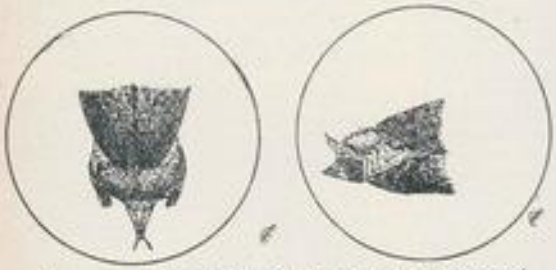
For example, just about now you will be able to see a large number of floating water lily leaves with whole series of more or less evenly spaced, elliptical holes cut through their thickness, visible from above and below the leaves. Lift one out and hold it to the light. Some of the holes are empty, but others contain eggs about half the size and of similar shape to a rice grain.

These are the eggs of an aquarist's enemy, the *Notonecta* or back-swimmer. They can easily be hatched out at

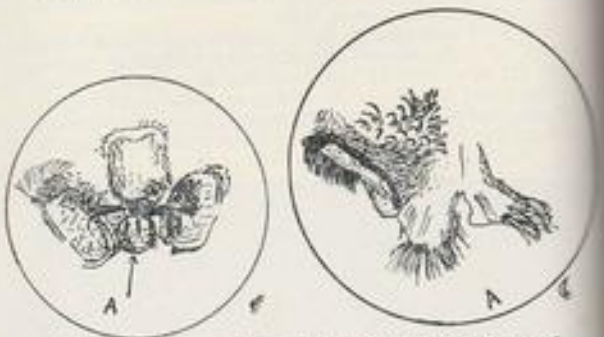


Ovipositor seen with ⅛ in. objective, × 5 eyepiece (left). The area marked A is shown on the right as it appears with ⅛ in. objective, × 5 eyepiece

Ovipositor of Ilybius as seen with 2in. objective, × 8 eyepiece



Appearance of the back (left) and side (right) aspects of ovipositor and end of abdomen of water beetle viewed with a hand lens



Left : part of proventriculus seen with ⅛ in. objective, × 5 eyepiece. The area marked A is shown (right) as seen with ⅛ in. objective, × 5 eyepiece

One of the toothed processes of a proventriculus (⅛ in. objective, × 5 eyepiece)

home and are just one more interesting object for the microscope. If the eggs are properly treated slides of them can be made which show various stages of embryo development. Untreated eggs are quite opaque, showing only two tiny reddish eye-spots through the thickness of the shell, if the embryo is sufficiently advanced in development.

There are, as I have mentioned before, various processes to which objects destined for mounting as permanent slides should be subjected. Next month I will discuss them in their logical sequence. Just now I will mention that I have been experimenting with a mountant known as "P.V.A." to see just how good it is and whether by its use it is possible to make permanent slides of aquatic subjects more quickly. There is at present every indication that it will prove a boon to those of us with only a limited amount of spare time, but it is still early days to make definite statements one way or another. I shall be happy to report later on, however, before this series of articles is over.

This month is a "boom time" for aquarists everywhere. There is a tremendous outburst of activity in every pond, pool or puddle. Now we should be busy with fine nets and jam jars, collecting samples of all kinds of aquatic life, in readiness for the long, dark evenings of the autumn, during which we shall have more leisure to examine them thoroughly. A whole series of miniature aquaria can be set up if we wish to study the animals alive. If this is done, however, remember to keep the jars or containers out of direct sunlight. Even a few minutes in sunshine will raise the temperature of the water in the jars several degrees, and this can prove fatal to many creatures. Keep the jars covered, too, to prevent escapes.

Have you yet seen a *Daphnia* moult, or lay a fresh batch of eggs? Collect one or two water fleas, place them in a cavity slip and, with a 2 in. objective and ×5 eyepiece, watch them closely. Sooner or later you will witness this remarkable phenomenon, which they undergo after the release of each batch of youngsters.

Have you watched the development of an alevin within the egg of a fish? No? Then put a goldfish egg or two in a staining pot or flat glass dish, and watch its development from the start. The whole process takes from 4 to 14 days, depending upon temperature, but you don't have to stay glued to the microscope all the time!

There are hundreds of other things we can do, but no doubt your imagination is as good as mine, and you can safely be left to indulge it.

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 an aerator for my tropical aquarium. Is it necessary to keep this aerator running all day?

Unless the aquarium is overcrowded with fishes, there is no need to keep a small air pump or aerator running all day. Two or three hours every day should keep the water well aerated. It is a good idea to install a filter and to use the aerator to keep the water flowing through this; the constant turning round and filtration of the water will do a lot towards keeping the water in the aquarium in a healthy condition for the fishes.

I have just placed some leaf fish (*Polycentropsis abbreviata*) in a 18 in. by 12 in. by 12 in. aquarium, and should like to know the sort of conditions that suit these fish best.

P. abbreviata like acid water, say, water strained through peat or rotted oak leaves, shady conditions and a fairly high temperature (72° to 82° F.). For food, give them *Tubifex* worms, chopped earthworms and large *Daphnia*.

Will you please tell me some substitutes to use in place of water plants for spawning oviparous tropicals?

Nylon mops used for scouring kitchen utensils make successful spawning mats, and so do bunches of willow roots. Hay may be used also, but if lef tin the aquarium too long it will rot and cause Infusoria to develop and so foul the water, unless, of course, you have fish eggs hatching out, in which case the Infusoria will come in very useful as a first food for the fry.

Will you kindly give me the names of a few so-called tropical fish which will live at average room temperature, say, between 65° and 70° F.?

The following fishes will live very well at warm-room temperature: white-cloud-mountain minnows, *Corydoras paleatus*, bloodfins, Australian rainbow fish, rosy barbs, half-striped barbel (*Barbus semifasciolatus*), mosquito fish (*Heterandria formosa*) and paradise fish.

Would it be safe to house Leer's gourami in the same tank as guppies and neon tetras?

This gourami attains a size of about 4 inches, and at this size it likes to bully smaller fishes. In a large, well-planted aquarium it would not do much, if any harm, but we would not advise it as a tank companion for small fishes in a small aquarium.

Is it true that a roe-filled female barb will die if there is no male in the tank to breed with her?

A roe-filled female barb may die if the eggs are not expelled by the excitement brought about by being chased by a male. Sometimes, however, a roe-filled female will get rid of her eggs by rubbing her sides against the rocks or sides of the aquarium.

I should like to be able to draw upon a regular supply of earthworms from my garden. Please can you tell me how to attract earthworms to one spot and keep them there at all seasons of the year?

One of the best ways of attracting earthworms to one spot in a garden is to start a compost heap. Construct a rough open-sided box with the aid of planks of wood, and throw into it all the vegetable refuse, tea-leaves, strips of woollen waste, torn sheets of newspaper, cardboard and the like that you can obtain. In between each 6-inch layer of such rubbish spread a thinner layer of garden soil. Make each layer of rubbish wet before adding soil to the growing pile. Leave the pile for about 2 months before disturbing. Then turn one section of it at a time with a garden fork. As you turn the heap over, you will notice scores of small red worms wriggling in the rotting rubbish. During the warm summer days, keep the heap well watered. In the cold days of winter you will have to dig deeply into the compost heap to bring the worms to the surface.

I have been told that quite a number of tropical fishes need green food in their diet. Is this statement true?

Yes, certain species of tropical fishes do need green food in their diet, and some more than others. Some of the sucking catfish, for example, will die if they are not supplied with algae or a substitute green food to eat. *Plecostomus plecostomus* is one of them. It will gradually grow thinner and thinner if it cannot find algae, *Nitella* or similar

soft greenstuff to eat, and before the inexperienced aquarist realises what has gone wrong it will be too late to remedy the deficiency in the diet and the fish will die. Mollies like duckweed to eat, and algae. But if these two green foods are absent from their aquarium, they will get on very well if provided with proprietary vitamin food, such as Bemax, or frequent small sprinklings of fine oatmeal. Finely chopped cooked spinach makes a good substitute for algae, and most greenstuff-eating fishes such as barbs and *Jordanella* will eat it.

I spawned my angel fish a week or two ago, but some of the eggs turned white and the parent fish picked them off the rock and swallowed them. The next day they proceeded to eat the rest of the eggs. How can I prevent the fish eating their eggs?

Cichlids usually eat infertile eggs, or eggs attacked by fungus, for they know instinctively that if left where they are they will soon contaminate the healthy eggs. The trouble lies in the fact that once the fish start to eat some of the eggs they soon develop an appetite for the rest. If cichlids are seen to be eating their eggs, it is best to remove them from the aquarium, and leave the eggs to hatch out without any more care from their parents. A gentle stream of oxygen bubbles from an aerator will prevent sediment from settling on the eggs and so giving rise to bacterial infections.

I am going to decorate the room in which I keep my tropical aquarium. Is there any way in which I can prevent the fumes of the paint from entering the water and maybe harming the fishes?

Place double folds of wet newspaper between the cover glass and the top bars of the aquarium. These moist pads will prevent fumes from contaminating the water. But while the decorating is taking place, keep the windows open to get rid of the paint smell as quickly as possible.

Is it true that algae does not grow so readily in acid water as it does in alkaline water?

Acid water does inhibit the growth of algae. Green water filtered through peat will lose a lot of its greenness within a day or two, and an aquarium with a peat subsoil will invariably remain clear of algae all the year round.

I am thinking of heating several large tanks by gas. Is it possible to obtain tiny burners to screw into the gas piping extending along the staging upon which the aquaria will rest?

You should not experience any difficulty in obtaining small batswing burners to screw into your gas pipe. If you cannot obtain them at a well-stocked ironmonger's stores, try a local supplier of laboratory equipment, or even the local gas office (maintenance department).

Please tell me the sort of plants that grow in the waters where angel fish are found; that is, in the wild state.

Angel fish frequent reedy waters and waters containing rank growths of underwater grasses. If you plant a large aquarium with giant *Sagittaria*, *Vallisneria*, Amazon sword plants and the like you will create the sort of environment that angel fish appreciate.

Is it a good idea to give fish a salt bath every now and again to prevent them becoming diseased?

It is not a good idea to give healthy fishes a salt bath. Some fishes dislike salt, and then again, the sudden change from freshwater to saltwater would not do fishes any good. If a fish has some disease, then it is a different matter, for saltwater often helps to kill parasites and bacterial infections. After all, one doesn't dose a healthy human being every now and again with pills and medicine to prevent him from becoming ill in the future!

We shall be going on a week's holiday shortly, and I am wondering whether I should arrange for a neighbour to feed my tropical fishes while we are away. Please tell me what to do.

If your fishes are well fed on live food and scraped raw meat for several days before your holiday, they should survive quite well until your return. Just before you leave for your holiday, empty a good portion of live *Daphnia* into the aquarium. The presence of a few gravid female guppies will help to keep the fishes nourished, for any fry dropped will be eaten by the other fishes.

Is it all right to add bumble-bee fish (*Brachygobius xanthozona*) **to a tank already housing tiger barbs and** *Corydoras* **catfish?**

Yes, it will be quite safe to add bumble-bee fish to your aquarium. They will not do any harm to either the catfish or the tiger barbs.

Is it correct that a wide, shallow tank is better for fish-keeping than a deep, narrow tank? I am thinking of constructing a tall, narrow tank for housing angel fish.

The greater the surface area exposed to the atmosphere, the greater will be the amount of oxygen absorbed by the water from the air. All the same, so long as you do not overcrowd your tank with fish, and if you plant it well with oxygenating plants such as *Vallisneria*, there is no reason why your tall decorative aquarium should not prove successful.

"Coo, nothing but angels—we must be in heaven!"

AQUARIST'S Notebook——

by

RAYMOND YATES

ELECTRICAL equipment from time to time breaks down and requires repair, and this applies equally to the varied items of electrical equipment used in the hobby. Many makers will undertake the repair of their own products but this often takes quite a time, and the speed factor has to be reckoned with, more particularly in winter. There are few other repair avenues open to hobbyists who are unable to tackle the job themselves, but for some years the firm of Warburton & Co. of Romiley, near Stockport, has set itself out to repair all defective electrical aquarium gear and some thousands of aquarists have availed themselves of this opportunity. I was talking to Mr. L. Warburton, himself a keen aquarist and breeder, the other day, and he mentioned that even the repair of aquarium equipment has seasonal peaks. The spring is a very busy time because most fanciers are getting ready for the breeding period, and small-wattage heaters for small tanks are in really great demand.

He passed on to me two heaters, one reconditioned and one new (his own make) and, frankly, it was impossible to tell the difference between them. In fact, they were both practically identical because the reconditioned ones are almost entirely rebuilt with new materials. However, purchase-tax regulations make it necessary to use at least one major secondhand component, and this is normally the porcelain former or the glass tube or even the rubber bung. Old cable or heating spirals are never used. He still gets a lot of immersion thermostats sent up but these are not repaired, the difficulty being mainly because of the vast variety of glass tubes used. External-fitting thermostats which clip on or stick on to the outside of the tank present no difficulty. Mr. Warburton mentioned that repair is facilitated and a better job is done, and certainly a cheaper one, if the thermostats have not been tinkered with by the owners! The amount of additional damage which is done by unskilled attempts at repair defies description.

Much the same remarks apply to pump repairs. If pumps have been interfered with it does not prevent their repair but it does make the repair more expensive. Similarly, repair is quicker and cheaper if the pump is sent on the first sign of defection. Too many people wait until the pump is completely worn out. Some people even fail to pack them properly when sending by post; an extra sixpence in postage can save many times this in repair costs if further damage occurs in the post.

Some pump repairs are not undertaken by the firm. These are mainly to the small, plastic-cover types which usually cost under £2 originally and which are not capable of economical repair. They can be sent to the makers for repair, of course, most of whom are able to oblige. Spares for continental pumps are generally available and Mr. Warburton finds quite large numbers of foreign makes in use.

Many people forget to give full details when sending in items for repair. For example, supply voltage should always be quoted for heaters and pumps. For the former, wattage should also be stated as some broken heaters are impossible to rate for wattage. The firm advises about this, if required wattage is not known and if details are sent such as size of tank, situation (warm or cold room), etc.

Mr. Warburton tells me that he is finishing a book, to be published shortly, dealing with electrical matters connected with the aquarium hobby. It is a book for tropical-fish keepers which, for once, will say practically nothing about tropical fishes, but which may fill a long-felt want with some real information about electrical matters. The second section of the book is more technical and will interest the more advanced, whereas the first section is for the average aquarist who knows next to nothing about matters electrical.

* * *

The coldwater enthusiast rarely needs to use a thermometer for his tanks but it is almost a must with the tropical fraternity. Of course, the very experienced can do without; you can, in the course of years, tell the temperature by touching the water or the glass with your finger, or even by the look of the fishes, but this is a refinement achieved by few. Most people insist on having a thermometer in a conspicuous position and check it regularly. Newcomers look at its readings hourly until they are more seasoned in the hobby. Well, there are thermometers and thermometers. For tank purposes one does not really need too fine an instrument, as a couple of degrees either way rarely makes much difference. The majority of thermometers suffer from being rather large. I have had some a foot long for a tiny tank! They get in the way, impede both fishes and nets, encourage algae growth in awkward places and spoil the view of the underwater world.

A new arrival on the scene is the "Dumpy" thermometer made by the well-known firm of Singleton Bros. Ltd., makers of "Es-Es" products. This is an improvement on the previous compass thermometer which they marketed. The aluminium casing has proved troublesome in the past in some areas owing to corrosion. It is now treated with a special synthetic varnish which is completely water resistant and obviates corrosion troubles. The suction ring is now made from soft P.V.C. plastic and will not suffer from erosion as did the rubber jackets. The size is exactly the same, although it looks smaller, and the accuracy when set is within plus or minus 0.5° F. The suction ring can be easily removed and replaced and spares are available. If the suction ring is inadvertently taken off the silicone grease inside the ring must not be removed as this is part of the water-tight seal. The thermometer should be installed in a corner of the tank, with the pointer upright (at 12 o'clock), set to the desired temperature. A mere glance at the pointer will then show that all is well. Where a number of tanks are kept this is a real facility. I have tried out this newcomer and found it very satisfactory indeed and much less cumbersome than the thermometer of more formal shape.

* * *

Aquarists everywhere are grateful to Imperial Chemical Industries, Ltd., for the introduction of polythene, which has proved to have so many uses. However, I was rather surprised to find the following extract in the March, 1958 issue of the *I.C.I. Magazine*. "For the first time live fish have been transported by air in a polythene bag filled with oxygen and water... The fish were 24 inch long beaverfish, native to Eastern Canada, and they were flown to Paris for exhibition there." It seems a pity to disappoint these "eager beavers" but they weren't even second or third—in fact some millions of fishes must have been transported in polythene bags in the last few years throughout the five continents. A London dealer some years ago provided these bags for customers to take home purchases and a Birmingham trader was among the first to show off fighting

fish, each ready for sale in a small polythene bag. Have we no hobbyists with I.C.I.?

* * *

My recent notes on keeping aquaria outside in the worst of an English winter were written, of course, before the full rigour of the past winter hit us. What a time I had! Once I shovelled snow all over the tank so that it was hidden from view. Bad as the weather was the old tank stood up to everything that came, and the ice never caused real concern. Several times all four sides and the surface got an inch-deep coating inside, but I repeatedly broke up the surface ice. The fish (golden orfe) did not suffer apart from the low temperatures.

It is advised never to break pond ice with a hammer, as the vibrations can injure fish. However, I never hesitate to use the hammer on inch-thick surface ice on the tank and no adverse results happen. The best way is to put a kettle of boiling water (supported) on the ice and this will make a clean hole in it. Some water can then be siphoned out and the hole covered over with wood or sacking. No further freezing of your pond water takes place. With an outside tank this does not apply because the four sides are all exposed to the weather.

* * *

Tubifex being relatively cheap, many aquarists tend to overfeed them to their fishes. A prevalent but mistaken idea is held that the tank scavengers (e.g., *Corydoras*) will clear up any which are not eaten by the major denizens of the tank. It is true that tank scavengers do clear up quantities of *Tubifex*, but many hobbyists fail to realise just what large numbers of the worms they introduce to their tanks. Fishes have limited appetites (particularly for *Tubifex*), and the worms which are left quickly burrow into the tank gravel, which all too often provides them with an excellent hide-out. *Tubifex* do not die in warm water of tropical-tank temperature and can and do live for weeks in the gravel base. They soon lose their original red coloration and the fishes lose their interest in them, with the result that quite a colony builds up, quite frequently unknown to the aquarist. The waving worms withdraw when the light is switched on or a fish passes by and they go un-noticed by the tank owner, who is blissfully unaware of the danger in his tank.

If constant aeration is provided no trouble develops, but where aeration is not used, or little used, the fishes soon begin to show discomfort by hanging round the surface, breathing rapidly and being obviously distressed. The trouble is that the worm population is using up the oxygen content of the water to the detriment of the fishes. Once this is realised, look carefully over your gravel and mentally note the location of each large batch of worms (seen as a waving mass) and then siphon out *all* the gravel in these areas. You will be surprised how many *Tubifex* worms come away with this gravel, and it will need half a dozen washings under the tap, with constant stirring, before you can be sure you have eliminated these unwelcome guests. Merely adding fresh gravel to a tank which already has a thriving *Tubifex* colony is a waste of time; the worms soon find their way through the new gravel.

Hobbyists who find difficulty in keeping *Tubifex* in summer will be surprised to learn that these worms will live in colonies at the bottom of the aquarium for many months. One method which helps to eliminate this trouble is to feed the worms on to a rock or slate covering the bottom gravel, but fishes being what they are, some worms are swept or crawl off the slate. However, if *Tubifex* is fed in really tiny quantities no trouble occurs.

* * *

Some hobbyists preserve specimen fishes from time to time and for this purpose they generally use formalin, which does a good job and is not very expensive. However, colour fades and the eyes become unpleasantly opaque, but one has done the best one can. After some time in the preserving solution (a week or two) it can be drained off and the specimen jar filled up with water. For all practical purposes the specimen will last indefinitely. The formalin need not be thrown away as it can be used again and again, but it is necessary to filter it through a piece of blotting paper before re-use. Mercurochrome can often be used as a preservative instead, about six drops of a 2 per cent. solution being added to a pint of water. This drug has the advantage of retaining all colour, but the eyes cloud in the usual way. I add two or three drops of Phenoxetol to the preserving jar. I came across this method by sheer accident; a dead clown loach was put in a jar containing some mercurochrome and Phenoxetol and it was forgotten for about 3 weeks. When found it was still in perfect condition except for the eyes. I have not found Phenoxetol effective as a preservative when used by itself.

* * *

London Zoo is very much in the news lately and figures for 1957 are interesting. Some 17,000 more visitors went to Regent's Park than in 1956, which means an average increase of roughly 47 more visitors daily, but the Aquarium had 40,000 more visitors, or approximately 110 more per day. This is good news because the number visiting the Aquarium in the past has maintained a steady ratio with the total admissions. This large increase in the number of visitors to the Aquarium is no doubt due to the improvements there and the special attractions on view. One particularly distinguished visitor was H.R.H. Princess Margaret, who visited the aquarium on 19th December, 1957.

The sea-water hall of the Aquarium has seen considerable changes. A separate circulation has been provided for the octopus tank and this has enabled octopus to be kept throughout the year. During September one female octopus laid over 100,000 eggs in the tank, and they hatched 6 weeks later; this was possibly the first time such an event has occurred in an inland aquarium. The young octopus larvae need plankton during their early stages and efforts in marine laboratories to feed them beyond their first 7 days have been unsuccessful. Those hatched in the Aquarium at the Zoo lived for about a week.

New species of fishes added to the Aquarium (not previously on view there) were hatchet fish, glass tetra, *Anostomus anostomus*, clown barb, *Rasbora dorsiocellata* and *R. pauciperforata*, half-banded loach, snakeskin gourami, dwarf Australian rainbow fish, freshwater sole, Connemara sucker, *Cichlasoma cutteri* and the shrimp fish (*Aeoliscus strigatus*). Over 250 fishes were donated to the Aquarium, including four kissing gourami, 12 angels, nine cardinal tetras, 12 argus fish, eight puffers, three snakeheads, 30 *Gambusia*, three tinsel barbs, 33 mudskippers, three blennies, three bitter barbs, five catfish, three sergeant majors, 25 butterfish, two lungfish, eight shrimp fish, two frogfish, five stinging catfish, 22 pomacentrids, six silver fish, two roach, seven hybrids (roach-bream), five bream, two chub, four barbel, five bearded rockling, three clown loach and single specimens of thornback ray, pompadour fish, brown trout, golden carp, climbing perch, black shark, sucker fish, wolf fish, combtail, *Botia*, *Synodontis* and 11 goldfish. Other interesting gifts were cuttlefish eggs, water beetles (*Dytiscus*), axolotls and a fish described as a "changeable fish"—we all keep these, surely? Over 70 books were presented to the library but for once none related to our hobby.

Admission to the Aquarium during 1957 produced £14,665, an increase of £2,334 over the preceding year, which is interesting to compare with the £2,309 increase in admission of visitors to the gardens. The cost of the

(*Continued on facing page*)

It can Happen to You!

by A. BOARDER

AFTER 21 years' freedom from cats my pond has now been visited by a night marauder and I have lost all my large prize-winning fantail goldfish. I made this pond 21 years ago and ever since I have rather prided myself on the fact that things have gone fairly well with it. Often aquarist visitors have said that they were surprised that I had had no trouble with cats, and related many dire happenings to their and other peoples' ponds. I had always taken precautions during the breeding season and had a large frame of wood and wire to cover that part of the pond where it was shallow and where the fish always spawned. Each night I would place the screen in position and remove it by day, when I was usually about.

My losses have taken place during the past few weeks and a count last month showed only 10 fish, instead of 16. Within 2 days two more had gone and a particular fish I had noted one night had gone in the morning. Strangely enough only the largest fish have gone and these were all the old fish I used to show during the years of 1947 to 1950. During that time these fish were never beaten, and reigned supreme as the finest fantails in the British Isles. I won many prizes with them and several cups and special awards. On several occasions one of them took the "best fish in the show" award and I do not think that there was another such team of prize-winning fantails in the country.

I decided to stop competitive showing in 1950 and have since used the fish for breeding purposes. I am glad to say that I still have plenty of young fish and a few of them are large enough to breed this season. I suppose that the value of each fish was in the region of £10, but whatever their money value I am certain that nowhere in the British Isles could they be replaced. Some, or I suppose most, of the missing fish were getting on in years, and could have been 14 years old or more. This made them rather sluggish and the fact that we have just experienced a long and trying winter did not improve matters. I had noticed that the large fish had been browsing at the surface of the water since the weather had turned somewhat warmer and so in this position the fish were an easy prey for cats.

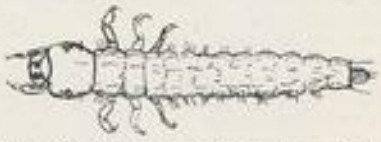
I completely emptied the pond and could find no trace whatever of the missing fish. I have now made a number of screens with which to cover the pond each night. These were made 3 feet wide, and to cross the pond at the narrowest side. Each timber frame is covered with wire netting and the whole pond can be covered or uncovered in the space of a couple of minutes. As the pond can be left quite clear of netting during the day time the look of the pond will not be spoiled.

I have heard it suggested that a tax should be placed on cats. I agree and suggest that it should be £10 per annum, except where the owner is able to keep his cat on his own premises. My fish do not stray into other peoples' gardens and so it is logical to expect their pets to do likewise. But there is no controlling a cat, except when it is a kitten, fussed and petted.

Look out Mr. Boarder! Such is the insinuating cunning of these pampered, night-prowling marauders that they can claim worshippers even amongst aquarists, and we expect that some unoperative mail will come your way!—EDITOR.

FRIENDS & FOES No. 67

Water Beetles *(continued)*



Larva of water beetle Helochares (magnified)

Coleoptera

THIS month we come to a genus of beetle with members not exceeding a quarter of an inch in length and with more than usual solicitude for the welfare of their eggs. This is the genus *Helochares*, which roughly translated means, I believe, "rejoicing in the sun."

There are only two known British species: *lividus* and *griseus*. *Lividus* is pure Latin for blue, or bluish, but the beetle is supposed to be yellow; *griseus* means grey.

Look for them in spring among submerged grass or plants. When examining look close at the toothed claws on the feet, and note that the maxillary palps greatly exceed the length of the antennae—a most unusual feature. If you catch a female, examine the underside of her abdomen; as likely as not she will be carrying a cocoon of eggs about with her.

These eggs hatch into minute larvae, which make their way to the surface of the water and hang suspended from the meniscus, with their spiracular openings thrust through it in direct contact with atmospheric air.

This genus is another one of the Hydrophilidae family. The beetles are vegetarians, but the larvae are carnivorous. Nevertheless they are so slow-moving and small that they are not likely to be any sort of menace to either fishes or fry—free-swimming fry at any rate. They are of such a size that it is extremely probable that many of them fall victims to browsing hard-mouthed fishes.

When ready to pupate the larvae leave the water and hollow out a small, circular chamber in soft mud above the water line, difficult to find except by accident.

C. E. C. Cole

Aquarist's Notebook

(continued from the opposite page)

Aquarium (salaries, wages, exhibits, provisions, fuel, light, general maintenance) came to £10,998, a reduction of £898 over 1956. The surplus on the Aquarium (receipts over expenditure) came to £3,667, compared with £435 the previous year, but it must be remembered that in addition £778 was spent on the Aquarium-roof reconstruction in 1957 and £3,943 on this project in 1956. From the foregoing it will be seen that public interest in the Aquarium at Regent's Park is still on the increase and the general position appears to be very satisfactory indeed.

* * *

Even the army is getting fish minded. A recent issue of *Soldier* gave a cartoon of a duel between a sword fish and a revolver (trigger) fish!

The Garden Pond in June *by* ASTILBES

ALTHOUGH the garden pond should be looking very attractive at this time of the year, it must not be supposed that nothing else need be done around it. Many ponds can be made far more beautiful if attention is paid to the surroundings. Where the pond is a formal one set in a lawn or surrounded by regularly shaped stones it may not be possible to do very much about improvement to the vicinity. However, even with such a pond it is imperative to see that all grass verges are trimmed neatly each time the lawn is mown. The grass should not be allowed to encroach over the stone boundary or the edge will look very ragged and untidy. If the edging shears will not remove the grass well enough, a line should be laid along and the grass can be trimmed with an edging iron.

Where rockeries are incorporated with a pond it is very necessary to see that the plants are not allowed to get out of hand, especially once they have finished flowering. Such Alpines as aubretias can look very untidy once the flush of bloom is over. It is then a good plan to cut back all the long growth and leave just a small clump to strengthen up for another year. It is surprising how much such plants can wander and become a nuisance if left untrimmed. I have seen beautiful ornamental walls made with great care and skill, only for them to be completely covered with aubretia and other creeping Alpines within a couple of years. All the time and skill spent in building the wall is then wasted.

Aubretias are not as bad as some plants, as they are not inclined to root everywhere they grow. This cannot be said of some of the rock plants and such a one is *Cerastium tomentosum* (the gardener's swear-word), for this will spread all over a rockery and choke out everything else. The roots become so numerous that the only way to get rid of them is to remake the whole rockery.

When larger plants are cut back there is no need to have a number of vacant patches. Many small choice subjects can be planted, or even small growing annuals such as the dwarf-growing *Nemesia* can be planted. These are best set in small clumps, as they make a much better display than if planted singly.

Some of the dwarf antirrhinums are very suitable for filling in gaps in the rockery, but be sure to grow only those types which are immune to rust disease, if it is prevalent in your district. There are some grand colours now available in these showy plants and they often do very well on fairly hot dry situations which they are likely to find on rockeries in the summer.

The bog garden can be a delight at this time of the year and many new plants can still be added. Where some fresh ones were raised from seed they can be planted at any time during this month. It is not too late so sow some more seeds of quick-flowering annuals in sites where they can be allowed to grow and flower. The best plan in such cases is to clear a good space and introduce some new soil. See that it is very fine and sow the seeds thinly. Very lightly cover with some sandy soil and protect from birds. A few strands of black cotton on small sticks just above the plants will usually keep off sparrows and chaffinches. A very good tip for the gardener is to save all the long stalks of the golden rod and use them as small stakes. It is surprising how strong these sticks are and they last quite well. They are even good enough for small pea sticks.

Some good annuals for quick flowering to sow near the pond are: *Mignonette*, *Mathiola* (night-scented stock), *Calendula* (Radio), candytuft, *Clarkia*, *Cosmea*, *Eschscholtzia*, *Myosotis*, *Godetia*, *Impatiens*, *Leptosiphon*, *Linaria*, *Phacelia campanularia*. For a hot spot on the rockery *Mesembryanthemum criniflorum* will make a grand show, especially if we get a hot summer. For a damp spot near the pond few plants will make a better display than the new types of *Mimulus*, such as *M.* Red Emperor, *M.*

Photos: Laurence E. Perkins

Left: larva of a water beetle (Dytiscus), a menace to fish fry. Right: silver water beetle head downwards on a stalk of Elodea

Photo: Laurence E. Perkins

Feeding pond fish at the same region of the pond regularly causes them to congregate there quickly when the water surface is disturbed by hand

moschatus and *M.* Queen's Prize strain. These plants delight in plenty of moisture and will continue to flower all through the summer. Another grand plant which likes a damp spot is *Aquilegia*. The new hybrids with the beautiful long spurs are very pretty and can be had in many colours, especially the soft tones. These are, of course, perennials and will continue to give satisfaction over many years. Some new ones to try are: McKana Giant Hybrids, Mrs. Scott, Elliott's strain and Crimson Star.

When planting young specimens of *Aquilegia* see that some well-rotted leaf mould is incorporated into the soil and make sure that although plenty of moisture is available the site is fairly well drained. Many people are in the habit of saving their seeds from year to year. This is not a good policy at all. The producers of garden seeds go to great pains to see that the particular strains are kept pure. If one keeps seeds from plants grown in a small garden it is almost impossible to keep them true. Especially is this the case with the new long-spurred hybrid *Aquilegia*. If plants are grown from one's own seed it will be found that the spurs gradually get smaller and that after a year or two most of the seedlings produce flowers like the old-fashioned columbine, from which the strains were evolved. It may be thought a saving of cash but if one keeps count of the time spent in gathering and cleaning seeds it will be found not only better to buy fresh from a seedsman but cheaper in the long run.

Many of the *Primula* will be in flower and these can be added to so that an almost continuous flush of flowers can be had all through the summer. Some summer-flowering ones are: *Primula pulverulenta*, *P. sikkimensis*, *P. japonica*, *P. bulleyana* hybrids.

The inhabitants of the pond must not be neglected with so much thought going to the surrounds. If you have a fair number of fishes in the pond see that some extra food is given at intervals. Always feed with care in a pond as it must be realised that there will always be plenty of food there of some kind or other. The water plants themselves provide a valuable diet to many fishes and all kinds of live creatures make their homes among the leaves. Many worms and other forms of live food find their way into the pond, especially at night, and so provided that the pond is not over-stocked there is little need to give a lot of extra food.

What food is given should always be given at the same spot each time. This will bring the fishes along to that spot so that it will be easier to examine them for any damage or to be able to catch any if wanted. Garden worms should be broken before being fed to the fishes. Small pieces of dry brown bread can be thrown on the water at times to see if the fishes are hungry or not. If they are it will not be long before they are at the surface after the bread.

If you have a number of fry in the pond and it has a shallow part, it is a good idea to feed some very fine food in this spot so that the youngsters can get some food away from the older fishes. Watch out for pests in the water which can kill the fry. Newts, both young and old, can eat fry, and many are eaten by larvae of dragonflies, both the long-bodied larvae and the short. Water boatmen and water beetles, together with their larvae, can kill fry. Although it is difficult to catch these pests during the day it is far easier at night, if you visit the pond quietly; with the aid of a torch many will be seen.

See that the pond surface does not get crowded with leaves of water lilies, etc., for then the fishes will not be seen at all. In thundery weather it is a good plan to run some fresh water into the pond, especially if it is a small one and exposed to most of the sun. This procedure is especially beneficial if there are any golden orfe in the pond.

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

Alien Introductions

MR. RAYMOND YATES' comments on introducing plants and animals to thinly populated areas have brought forth some excellent examples of hasty, illogical thinking. Mr. E. J. Druce (*The Aquarist*, February) asks why one should presume to interfere with what may very well be a most admirable existing condition; because of these last three words the question is meaningless. The animal and plant species in any habitat are constantly competing for food in the struggle for existence; some, by progressive specialisation, may become dominant; others, like *Elodea canadensis*, gain temporary dominance and then fall by the wayside, but the outward, visible sign of this is a constantly changing population. The condition can never be admirable, either for a contestant, or for an onlooker interested only in the food or sport which the animals and plants may provide.

A further vague feature of Mr. Druce's letter is his use of the word "alien." What exactly is an alien species? Is it a species introduced to a new habitat from just across the road; or from 10 miles away; or from a foreign country? Who's the guilty agent, nature or man? The word is rarely defined and much abused, and is therefore better left alone. I think an evil fairy hovered above Mr. Druce as he impetuously put pen to paper. The fairy that puts people under the misapprehension that England's flora and fauna are peculiarly unique. They seem to forget, or perhaps never realised, that we have many, many species from the continental and Mediterranean flora and fauna, and what is more that many species we regard, in our insular way, as native, were introduced in historic times by the invaders of these islands.

It is necessary, for a moment, to turn from the serious. Next time Mr. H. Chorlton (*The Aquarist*, April) picks up his tackle and heads for the water, he really must take care. These birds flying at the surface of the water could have algae spores on their feet which might develop in the water and hinder his beloved angling! And those beetles and water boatmen; they fly from neighbouring ponds and carry dreaded fungal spores. Oh! and the cows that come down to the water to drink bring the most frightful parasites with them! Really, Mr. Chorlton, algal, fungal and bacterial spores are omnipresent and nothing you do, or prevent Mr. Yates from doing, will alter such a condition.

Messrs. Druce and Chorlton might at least appreciate that Mr. Yates' introduction of species will do much to repair the deleterious effects of man's industrial hand, of rapacious collectors and of inefficient anglers. All Mr. Yates' introductions will not succeed, but his experiments are worth the trying. Scientifically, Mr. Yates' suggestions are no more an interference with animal and plant communities than Messrs. Druce and Chorlton's angling, even though anglers supposedly allow fish to breed, and replace stocks. Mr. Yates' suggestions are backed by a love of nature and science, but Messrs. Druce and Chorlton's objections are, alas, influenced by financial conditions, and they, like the dread, implacable ratepayer who thinks that all heaven and earth exists at his expense, want things all their own way. Finally, I think that much labour could have been saved had Mr. Yates' original notes been taken at a little more than face value.

DUNCAN SCULTHORPE,
Trinity Hall, Cambridge.

Public Aquariums

IN your excellent and challenging Editorial of March you ask, ". . . when will the coasts of Britain show some modern examples of useful Aquariums?"

Firstly then, to claim that our Company is running two such Aquariums which are modern and combine education with entertainment. Photographs of our exhibits, which we use to further explain certain interesting facts about the living creatures we keep, are sent with this letter.

Too many present-day aquariums still continue to present their specimens in the way so popular in the Victorian era. In each tank one sees vast numbers of fish and in some

This picture and the one on the opposite page show examples of the informative panels provided in addition to the living exhibits at Paignton Aquarium

dimly lit corner half-a-dozen labels with the popular name and Latin name thereon—and nothing else. No information of interest to the public, no attempt to present the exhibits as living examples of ecological communities.

Some of the greatest aquariums in this country could be greatly improved with just a little more imagination. We agree with you that it is high time aquarists became aware of the public.

Paignton aquarium is the first of its kind in this country, where 20 tanks are backed up by over 50 biological models and exhibits made by Marine Exhibitors Ltd.—and the public love it. So there is ONE "modern example of a useful aquarium."

L. A. J. JACKMAN,
The Seashore Aquarium, Paignton,
Devon.

WITH reference to the big outbreak of "Aquariumitis": as I have frequently pointed out in *The Aquarist*, a marine aquarium to be of real educational value *must* have either a very fully illustrated guide book, or better still — a museum attached. Only so can larval stages, local plants, etc., be properly demonstrated. The Plymouth Guide Book (1924) was so detailed that many teachers still value it as a textbook. But the only Aquariums in the United Kingdom having museums attached are Millport, Cullercoats and Teignmouth. Of these, Millport is the finest.

L. R. BRIGHTWELL,
Truro, W. Cornwall.

Top Lighting

I WAS in the process of setting up a tropical tank for the first time when I read in your January issue of the trouble experienced by one of your readers caused by the sudden switching on of top-lighting. The prospect of all my fishes dashing madly about and losing their colour was quite disconcerting.

I overcame this problem by purchasing a dimmer or regulating switch. These can be obtained from electrical dealers, costing about £1. Generally they are made to order and the total wattage of lights to be used should first be determined. In operation the switch has four positions giving different degrees of lighting. Even from complete darkness the transition to quarter and then half light can be effected almost instantaneously without detriment. I then find it advisable to wait a few minutes before bringing on the more powerful light. Not only do the fishes benefit from this gradual, rather than explosive, "sunrise," but the whole tank is enhanced in its spectacular value.

In effect I have four different moving pictures, but the most fascinating time of all comes when switching off the lights late at night, when the fishes show quite revealing changes of character. For example a male Siamese fighter positively prowls in the half light, hovering momentarily with full spread of finnage in the uppermost corners of the tank; a pair of young leopard catfish cease their puppy-like gyrations and settle down diligently in search of food; a shoal of neon tetras gradually disperse, their colour fading as they gently drift downwards, seeking shelter for the night near a rock or plant.

G. W. WOOD,
Surbiton, Surrey.

Brighton Society

THE members of Brighton Amateur Aquarists' Society were rather intrigued to read the news from Bexhill and District Aquarist Society in the March issue of *The Aquarist*. Brighton Amateur Aquarist Society has been in existence for several years. Whilst agreeing that recently the Society has had many ups and downs we have continued in being and have seldom failed to hold our fortnightly meetings. The chairman for 1958 is Mr. E. G. Barnard and the secretary is myself. We meet on alternate Wednesday evenings, at 8 p.m., at 47, Sidney Street, Brighton. (In June we meet on 4th and 18th). Our membership is growing and we have a number of very keen junior members. Enclosed is one of our handbills which are available in many pet stores, etc., in Brighton.

EDWIN A. BILLENNESS,
Secretary, Brighton Amateur Aquarists' Society,
23, Osborne Road, Brighton 6, Sussex.

We apologise for publishing the erroneous announcement of the Brighton Society's disbandment. We have received a letter from Bexhill and District Aquatic Society also offering apologies for any inconvenience caused by the news paragraph submitted to us.—EDITOR.

Photographs

I HAVE often thought, on looking through magazines and periodicals, and in particular *The Aquarist*, how much one takes for granted the photographs which are nowadays so essential a part of such publications.

What photographic skill I possess is directed entirely into the colour field, but I am still able to appreciate an excellent black-and-white rendering, such for instance as the photograph by Mr. Perkins on page 32 of your May issue.

The skill and patience necessary to photograph an almost completely transparent (and therefore almost invisible) object such as the body of a newly-hatched fish, is exceptionally well demonstrated in this picture, which shows Mr. Perkins to be a master of the art of illumination. What retouching, if any, has been done, shows an equal degree of skill, giving a final result which is in my opinion one of the most remarkable photographs you have ever published.

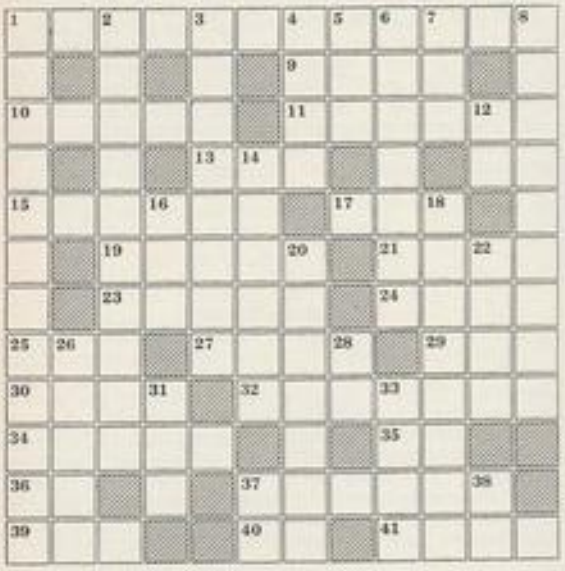
The block-maker is also to be complimented, as this was probably a difficult print. In view of the inevitable losses which occur in block-making, the fact that this picture still retains its fascination is much to his credit. My congratulations to all concerned in its reproduction.

L. WARBURTON,
Stockport, Cheshire.

The photograph of goldfish fry was, in fact, published without retouching.—EDITOR.

The AQUARIST Crossword

Compiled by J. LAUGHLAND



CLUES ACROSS

1. I hurt U.S. rival for upset popular tropical (7, 5)
9. Historic fiddler heading north upsets fish eggs (4)
10. If bird bodes ill for pond fish (5)
11. Members of scalare family, broadly (6)
13. Is this source of 5 Down, or vice versa? (3)
15. I paw it for the N. American deer (6)
17. City of Glasgow's own regiment (1, 1, 1)
19. *Aequidens*, a beginner's favourite (5)
21. The waste passed by animals through kidneys and by fish through the skin (4)
23. Resin so spilt would hardly curb the sea horse (5)
24. Variety (4)
25. Decoration for senior officers (1, 1, 1)
27. Allows (4)
29. A chilly direction (1, 1, 1)
30. Trout losing tail is rather upset for trip (4)
32. Red pile answered (7)
34. Not the kind of crime one would expect to be committed in a fish house (5)
35. In command (1, 1)
36. It remains when the rest be gone from the bute (2)
37. Young goat leads card game to steal fry? (6)
39. Pounds, shillings and pence (1, 1, 1)
40. I.e., from the tide the decoration is left (1, 1)
41. The kind of light you would expect from the glowlight tetra (4)

CLUES DOWN

1. Ensanguined side arm and end for popular tropical fish (3, 9)
2. Producing live fry (10)
3. Variety of guppy (8)
4. The thing that tears your *Daphnia* net (4)
5. Among aquarists a female fish (3)
6. Fish louse (7)
7. Pishes' eggs (3)
8. Tanks so treated will retain heat longer (9)
12. Little lancer (2)
14. Ringer upset becomes Scots cryer (6)
16. Hard water? (3)
18. Satirical (8)
20. Starfish (7)
22. Eagle (4)
26. Arranges (5)
28. Starting price of spawn (1, 1)
31. Angler's weapon (3)
33. Fish rather like cod (4)
37. He should be addressed as Sir (2)
38. Name of Italian river and also of Chinese (2)

PICK YOUR ANSWER

1. Which one of the following well-known botanists was born in the seventeenth century? (*a*) Gmelin; (*b*) De Candolle; (*c*) Linné; (*d*) Micheli.
2. The species *Poecilistes pleurospilus* is popularly known as the: (*a*) blue poeciliid; (*b*) green poeciliid; (*c*) keyhole fish; (*b*) porthole fish.
3. Which is the largest of the following species? (*a*) *Apistogramma agassizi*; (*b*) *A. pertense*; (*c*) *Nannacara anomala*; (*d*) *N. taenia*.
4. *Thoracocharax brevis* was an earlier name of: (*a*) *Carnegiella strigata*; (*b*) *Gasteropelecus maculatus*; (*c*) *Thoracocharax securis*; (*d*) *T. stellatus*.
5. The floating plant *Riccia* was named after an Italian botanist from: (*a*) Florence; (*b*) Genoa; (*c*) Rome; (*d*) Venice.
6. The plants *Ceratophyllum demersum* (hornwort), *Fontinalis antipyretica* (inconsumptible willow moss), *Hottonia palustris* (water violet) and *Hydrocharis morsus-ranae* (frog-bit) have it in common that all: (*a*) are found in Africa; (*b*) grow submerged; (*c*) were named by Linné; (*d*) are stoloniferous.

G. F. H.

(Solutions on page 65)

News from AQUARISTS' SOCIETIES

Monthly reports from Secretaries of aquarists' societies for inclusion on this page should reach the Editor by the 12th of the month preceding the month of publication.

THE GOLDFISH SOCIETY OF GREAT BRITAIN

At the May meeting the chairman gave details of the proposed new ASLAS section and also some news of the Summer Show to be held on the 12th July, and added that a Convention is being arranged for a Sunday in September. Last year the President (Capt. L. C. Betts, M.B.E.) carried out a series of experimental spawnings with specially selected parents and the fry were distributed to members. Fish from these matings were on display and members gave an account of the conditions under which the fish were raised. This enabled comparisons to be made and some valuable information was gained. In summing up the President stressed the need of "moving water" as an aid to vigorous growth in young fish.

A number of his latest Chinese acquisitions were exhibited by Mr. T. S. Horeman. Among these were globe-eyes and bubble-eyes, and these were considered fine examples of the Chinese breeders' art. Mr. Horeman also discussed his methods of keeping the rarer adult species. The annual general meeting is scheduled to take place on Saturday the 14th June at the Feathers Hotel, Broadway, London, W.1, at 2.45 p.m.

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RECENTLY the members of **Dewsbury and District Aquarist Society** listened to an excellent lecture by Mr. Mackeral, of Halifax. He spoke on the keeping of the rarer and more timid varieties of fish which are now on the market and some of the recent imports which have arrived. The Society is holding an exhibition at the annual Batley Show on the 28th June.

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THE speaker at the last meeting of **Middleton and District A.S.** was Mr. H. Loder, the well-known Burnley aquarist. His subject was "The Sexing of Fish," mainly of tropicals, and there were many queries at the end of a most instructive and amusing lecture. Members also visited the zoo at Chester recently.

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ASSOCIATION OF YORKSHIRE AQUARIST SOCIETIES

The founder member societies belonging to the above Association are Birstall, Bradford, Bridlington, Castleford, Dewsbury, Doncaster, Halifax, Leeds, Rotherham, Skipton and York. Dr. G. Cust, of the Birstall Breeders Group, has been elected chairman; Mr. L. Grenshaw, of Leeds, vice-chairman; Mr. K. Denham, of Dewsbury, treasurer; and the secretary is R. Winterburn, 15, Woodhall Place, Thornbury, Bradford, 3. The next meeting is on the 28th June at 2 p.m., at the Church Institute, Albion Place, Leeds.

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AN Open Show will be held by **Blackburn and District Aquarists' Society** if sufficient support is forthcoming and the probable time will be at the end of August. At the annual general meeting, Mr. R. Fielding was elected president, and Mr. C. H. Whitsey, chairman. The secretary is Mr. Joe Haworth, 38, Avondale Road, Darwen.

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RECENT activities of the **Kingston and District Aquarist Society** have included the return contest with Clapham A.S., which was won by that club, and also a talk on the "Microscope." Inter-club shows have been arranged with Catford and Streatham. In the ASLAS

Table Show, members took two first cards, Mrs. Barber (goldfish), and Mr. Henty (swordtails). Mr. Rundle took two seconds in swords and mollies.

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MEMBERS of the **Folkestone Aquarist Society** were entertained recently by Mr. Bone, of Deal, who gave a very amusing talk on his experiences. The Society is also paying a visit to the Zoological Gardens at Regents Park, including a conducted tour of the Aquarium.

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AN instructive talk was given to the **Bexhill and District Aquatic Society** by Mr. P. H. Smith on the development of fish from the embryo to the free-swimming stage. The two 36 in. by 12 in. by 12 in. aquariums are now installed in the Hellingley Hospital.

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AT the monthly meeting of **Ilford and District Aquarists' and Pondkeepers' Society** a very interesting talk on reptiles was given by Mr. Leuscher, and the table show was for platys and mollies.

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MEMBERS of the **Carassius Club** are preparing, expecting and hoping for good results from the recent spawnings of twintail fish which have been reported. At the last meeting toad and frog tadpoles and their differences were discussed, also the breeding and copulation of the earthworm.

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THE seventh annual open show of the **Romford Aquarists' Society** will be held on the 23rd August. There are 23 classes, including coldwater fish, and schedules will be sent out as soon as they are ready to all previous entrants and clubs.

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A SHORT talk was given by Capt. E. Howarth at the **Bournemouth Aquarists' Club** meeting on the selection of fishes for a home community aquarium. This was followed by the main topic of the evening, which was a lecture by Mr. J. M. Saxon, B.Sc., on the "Evolution of Fishes," and was illustrated with pen sketches. In the Guppy Cup Competition, Mr. Coombes took the first three awards and Mr. Travers won the Platy Table Show, Mr. Morgan being second and third. Visitors would be welcomed, and the club meet at The Cricketers' Arms Hotel, Windham Road, Bournemouth, on the first Monday of the month.

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THE annual general meeting of the **Inverness and District A.S.** was held recently and the officers are as follow: President, Mr. H. Bottom; vice-president, Mr. R. Preece; treasurer, Mr. H. Clark; and the secretary, Mr. John A. F. Bain.

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FORTHCOMING events in the programme of the **Smethwick and District Aquarist Society** are "Aquarists' Microscopy," and a Table Show on the 18th June for Breeders—2 classes (Egglayers and Livebearers—4 fishes). The annual meeting is to be held on the 2nd July.

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THE April meeting of the **Nottingham and District Aquarists' Society** was not so well attended compared with previous meetings. Mr. D. McInerny's recent radio talk (Network Three) was discussed, and all those present were impressed with the way Mr. McInerny described his attempts and successes. The Table Show for Characins other than *Hyphessobrycon* was won by Mr. S. Starbuck. The 21st anniversary celebration dinner and entertainment has been fixed for Wednesday the 29th October at the King's Hall Restaurant, Long Row, Nottingham.

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THERE was a large attendance at the last meeting of the **Southport Aquarist Society** to hear Mr. C. Appleton discuss "Pond Life."

Mr. Appleton is a local expert on life in ponds and streams, and he backed up a very entertaining lecture by producing live samples in glass containers of local pond flora and fauna which he had collected from nearby streams, etc. The audience expressed their thanks to Mr. Appleton for one of the most instructive evenings spent by the society this season.

The chairman, Mr. J. Taylor, unfortunately could not be present and Mr. Stanley Radam, vice-chairman, named the winners of the Home Aquaria Competition, who were: 1, Mr. A. Gore; 2, Mr. J. Dix; 3, Mr. C. Roberts.

The winner was presented with an engraved plaque.

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RECENTLY the B.B.C. Film Unit has been filming at the Paignton Aquarium.

The sequences filmed will form part of the television broadcast from Paignton Aquarium on 10th June, when this film will be combined with a live television relay telling the story of seashore creatures and the ways in which they are collected for public exhibition.

The cameraman responsible for much of this work is George Shears, who recently filmed one of the operations in the B.B.C. series "Your Life In Their Hands."

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THE open show of the **Bedford and District Aquarist Society** will be held this year on the 11th and 12th July. Schedules can be obtained from C. P. Hanchard, Show Secretary, 78, Leaves Spring, Stevenage, Herts., and the last date for receipt of entries is the 12 th June.

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FORTHCOMING HENDON FILM SHOW

The **Hendon and District Aquatic Society** will celebrate their 500th meeting on Saturday, 20th September, when they have invited Messrs. Carels and Wante, the celebrated continental aquarists, to show their unique coloured movies containing their latest tropical fish collections. A venue has been arranged, but accommodation is limited to 900 visitors. There is unlimited car parking, refreshments on the spot for all. The Nymphae Society of Belgium will also attend. Application should be made for particulars now from Mrs. B. Robertshaw, 30, Montaire Court, Highfield Avenue, Colindale, N.W.9. Club secretaries may apply for block seat bookings.

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THE **Staines and District Aquarists' Society** held a show recently to which members of the Riverside, Spelthorne, Southall, Uxbridge, and Windsor and Slough clubs were invited. There was a good attendance and all classes were well supported with good quality fish, including many unusual species, and 107 entries were made in the six tropical and one coldwater classes. The best fish in the show, a fine *Aequidens curviceps*, was exhibited by Mr. and Mrs. Digby, of Southall. The Staines chairman, Mr. J. Chandler, in welcoming the guests, said that as good support had been given to the show it was hoped that next year it could be extended to cover other aspects of fishkeeping. Other shows have been arranged by the Society for this season, and local aquarists who may be interested are asked to contact the secretary, Mr. P. Whitehead, at The Ship Inn, Staines Causeway. The results were: Livebearers.—1, Rundle; 2, Huxley; 3, Crawford. Characins—1, Kiely; 2, Ainsworth; 3, Pryor. Cichlids—1, Digby; 2, Digby; 3, Watson. Anabantids—1, Owen; 2, Biggs; 3, Mrs. Owen. Barbs.—1, Digby; 2, H. Moore; 3, Watson. A.O.V. Tropical—1, Hill; 2, Ainsworth; 3, H. Moore. A.V. Coldwater—1, G. Moore; 2, G. Moore; 3, Digby.

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AT the last meeting of **Corby and District Aquarists' Society** the first of a series of three table shows, which will be run throughout the summer, and for which a cup has been offered to be won by the member with greatest number of points, was held. First was Mr. A. R. Paley with a green molly; 2nd, Mr. J. Krzenek; 3rd, Mr. H. Thompson.

There were also discussions on tropical subjects, such as the use of snails in aquaria.

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AT the annual general meeting of the **Dundee Aquarium Society** the following officers for season 1958-59 were elected: President, P. N. Greening; vice-president, J. L. Forbes; secretary and treasurer, G. B. Kirkland; show manager, A. Cross; librarian, K. Webster.

The final placings for the Scott Trophy were as follows: 1, A. Cross; 2, A. J. Roger; 3, J. L. Forbes; 4, A. S. Ramsay. The trophy, plaques and prizes were presented by Councillor A. McKillop, of Perth Aquarist Club, who also judged the A.O.S. Table Show held the same evening, the results of which were: 1, A. S. Ramsay (dwarf gourami); 2, J. L. Forbes (*Etomus davricus*); 3, A. Cross (*Helostoma rudolfi*); 4, A. Fisken (blue gourami).

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THE speaker at the last meeting of **Bristol Aquarists' Society** was Mr. T. L. Dodge, of Birmingham, who spoke on "Show Organisation and Preparing Fish for Shows." Mr. Dodge has been a very popular organiser of the M.A.P.S. open show for over 11 years and his talk ranged from publicity, to traders, on to staging public address systems, sizes of tanks, catalogues, admission prices, distributing help, in fact, everything that anyone ever thought of about the subject.

One interesting fact that seemed to surprise the members (in Preparation of Fish) was that he does not stuff the fish full of food immediately before going into a show—enough and no more. It keeps them on the move in the show tank, and a good salt bath is essential as it gives the specimen that clean, sparkling look.

The lecturer next month will be Prof. H. Whiting, of Bristol University, a lecturer at the department of education there.

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THE **Scottish Aquarium Society** are hoping to include amongst speakers during the next session, Dr. H. D. Slack, of the Glasgow University, and Mr. T. Stuart, of the Scottish Home Department Fresh Water Fisheries Laboratory, Pitlochry, as well as other interesting lectures on tropical and coldwater fishkeeping.

As usual the annual open show will take pride of place during the session, and this year it is being held in the McLellan Galleries, Glasgow, from Wednesday, 12th November, to Saturday, 15th November. Schedules will shortly be available from Mr. K. A. M. Robertson, 32 Edzell Drive, Newton Mearns.

SECRETARY CHANGES

CHANGES of secretaries and addresses have been reported from the following societies—Dundee Aquarium Society (Mr. G. B. Kirkland), 2, Kerrington Crescent, Barnhill, Dundee). Leinster Pond and Aquarium Society (Mr. J. Davidson, "Clara Meyer," 23, Ballytore Road, Rathfarnham Club, Terenure, Dublin). Study Aquarist and Pond Keepers Club (R. L. Cross, 18, Wandle Court Gardens, Beddington, Croydon, Surrey. Tel. CRO 8981).

Crossword Solution

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PICK YOUR ANSWER (Solutions)
1 (*d*). 2 (*d*). 3 (*a*). 4 (*b*). 5 (*a*). 6 (*c*).