The AQUARIST and POND-KEEPER

(Incorporating "The Reptilian Review")

Devoted to the Study of Aquatic Reptilian and Batrachian Life

# EDITORIAL

IN handbooks and instructional matter regarding all forms of livestock, stress is always laid on the necessity of fresh air, and advice is always given on the methods and arrangements for supplying ventilation, etc. The one exception, so far as we can discover, is the fish, and, while we hasten to admit that circumstances are such that fresh air, in the sense that we know it, hardly enters into the question, we would insist that water, the fish's natural element, is a subject all too often overlooked, even while fresh air, as exemplified by artificial aeration, receives due consideration from time to time. Therefore we make no excuse for including in this issue three articles touching narrowly upon one another, on the subject of water, and more will follow on this matter, for it is high time that more study was given to the one element which we rarely consider. Admittedly the pH values of water have been tackled from time to time, but it is an angle which, as reference to these articles will prove, matters not one-hundredth part as much as some writers would have us believe, and in itself has very little relation to the difficulties which beset the aquarist attempting to breed certain species of fishes. Largely through ignorance of the whole subject, many aquarists have tended to regard the subject of pH values with far more seriousness than it deserves, to give it up as a bad job when they discover that, of all values, it rarely remains constant. The concentration of salts which must necessarily occur when tanks are repeatedly topped up with tap water subsequent to evaporation seems to be always overlooked, and some time ago we read that water softened in the domestic water-softener became less alkaline, and consequently more acid and more suitable to some species of fishes, whereas the alkaline strength remains the same, the change in the water being only noticeable by the hardness test. Very rarely indeed is any difference noted in the pH value, and then it is so slight as to have little significance to the aquarist. So, what with these and diverse allied problems confronting us, it is high time that the subject received more attention, and not only will this be done, but the results of many experiments proceeding now, put in hand by the authors of the articles in this issue, will be published in due course, so that, even if the problems presented are not all cleared up, as we do not for one moment anticipate, since it is so complex a subject, it will at least give aquarists some cause to think.

# THE AQUARIST AND POND-KEEPER

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*Aqua, Cunæ vitæ, ager nobis*

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The Editor welcomes the opportunity of considering original contributions on all branches of the hobby and its allied interests; authentic breeding records, personal experiences, and photographs. Contributions should be typed or clearly written on one side of the paper only. MSS or prints unaccompanied by a stamped addressed envelope cannot be returned, and no responsibility is accepted for contributions submitted. Correspondence with intending contributors is welcomed. Copies of any article published, together with its illustrations, in pamphlet form, for the use of schools, museums, clubs, etc., may be obtained on application in quantities of not less than 50 at prices to be obtained from the publishing offices.

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Wrap fish in clean wet cloth without squeezing; then wrap in greaseproof paper, pack round with cotton wool in tin box, and despatch as soon as possible after death. This method of packing is important.

## EDITORIAL—*Continued*

and doubtless explain some of their own little mysteries.

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In the next issue we hope to publish an article by Dr. Elkan on the breeding of the Clawed Toad (*Xenopus lævis*), which should prove of exceptional interest to keepers of this quaint amphibian. The accompanying illustrations are a notable feature, including a series published for the first time, so far as we know, of the metamorphosis stages from egg to mature toad. Dr. Elkan has, for scientific reasons, put a great deal of time and energy into his researches on this subject, and the article should be missed by none who are interested in the matter.

* * *

Readers should not fail to include a visit to the Ideal Homes Exhibition this month, where a unique display of living water animalcules will be shown, as described on another page. We have been honoured in giving some slight assistance in the matter, and we can give every assurance, not only of a spectacular and most unusual exhibition of these creatures, but of the tremendous pains taken to ensure the success of this part of the show.

* * *

It is strange to note that the bulk of queries we are called upon to deal with still hanker round the age-old problems of overcrowding and over-feeding. It almost makes one think that we, and we use the term to refer to all aquarists, not merely ourselves, are striving in vain to teach the newcomer the ethics of our hobby, for one would think, by now, that both these problems would have been answered almost by world-wide discussion. One aspect of it was once raised by the Scottish Aquarium Society, and we most definitely agree that this business of "an inch of fish to a gallon of water" needs a little explanation or a new description more helpful than it is at the moment. Take, for example, the stock two-feet-long tank. Working on this basis, the novice blithely stocks his tank with six or eight two-inch goldfish, long before the plants have had a chance to settle down, and speedily finds himself in trouble. The fishes eat the plants, which are too immature to stand it, and die off, over-feeding thickens the water with the products of decay, and the fish, after gasping for a day or two at the surface, turn miserably over and die. What use is it for them to try and grow? The over-feeding problem is more easily solved, since most novices panic and change the water when it gets thick, and we do not know but what goldfishes do fairly well on changes of water. But this overcrowding business—why not be more honest and say "a gallon of water for every inch of body length which will be reached when the fish concerned is full-grown"? That would give our six or eight young goldfishes fifty to eighty gallons of water, a much better proposition.

# MELANIA TUBERCULATA

**By A. LANGE**

*(Translated from the German by Hans Brick)*

THE Cowrie or Kauri Snail (*Cypraea moneta*) was, and still is, the small money to several West African tribes, and although it requires 2,500 of these shells to reach the value of one shilling, it nevertheless proves that attention has been paid to snails for many years by others than lovers of nature, and aquarists.

The keeper of aquariums has had many species of snails in his tanks, with or without purpose, and observed them with more or less joy. As lovers of nature we always find interesting facts everywhere, and those humble members of the mollusc family in their variety, splendour of colour and beauty of form deserve our special attention.

What riches the South Seas contain could be seen recently in a special exhibition in the Berlin Natural History Museum, arranged by the well-known South Seas explorer, Kuno Schweers, who, in his twenty years of collecting, offered us such an immense amount of material, in quantity, quality and variety, that it would be a hopeless task to deal with it in this article.

Of first importance to the aquarist are the living specimens of fresh-water snails, and it is a pity to note the small number of these which are already known to aquarists. Also, the keeper of marine aquariums is offered a big opportunity with a host of very interesting species, the keeping of which should be tried.

Articles on fresh-water snails are rare, but still you can see how great the possibilities are for investigation by keeping these creatures. I would mention only the very fascinating chapters on the famous Mollusc Nursery of E. Kemmler in Enningen (Wurtemberg), dealing particularly with *Marisa rotula* and *Ampularia urceus* in the *Deutsche Almanach* (1938). It deals with the South American species, whereas my article here will describe a Malayan species which I reckon to be one of the most suitable species for any tropical aquarium.

*Melania tuberculata* is a snail having a tower-like shell with a stout and tough operculum, the shell being a slim, beautifully formed and designed house. Fully grown

Melania tuberculata

specimens are about 1¾ inches high and are, therefore, not too big, and their appearance can be judged from the illustration. The colouring of the shell is yellowish-brown to grey-green, with red-brown to dark-brown markings. The edge of the aperture is protected by several thorns. The operculum is dark brown, the body of the snail is black and the foot is white.

The mode of living of these snails particularly adapts them to aquarium keeping. They move slowly and continuously along the bottom with the foot plunged in the sand. It is reckoned to cover about eight inches a day. It feeds from the animal and vegetable detritus which accumulates on the floor of the tank. Only half-decayed mulm is its nourishment and, therefore, no plants, no algæ and no roots will be damaged. Through the very slow motion there is no danger of disturbing the

*(Please turn to page 60)*

# Osmotic Regulation in Fishes

By A. FRASER-BRUNNER

EVERY aquarist knows, I expect, that most marine fishes die quickly (sometimes instantaneously) if transferred to fresh water, while, similarly, the majority of fresh-water fishes are killed equally rapidly by sea water; whereas there are quite a few species that can live equally well in either. Have you ever paused to ask why this is so? You should, for the answer is one that concerns intimately the welfare of the inhabitants of your aquaria, as you will appreciate later on.

The first attempt to answer this question was made by the French physiologist, Paul Bert, round about 1870, and since his time a great body of experimental work has been done in connection with it, which shows it to be a matter of fundamental importance and far-reaching consequence in the life of the fish. To discuss the question fully would take several issues of this paper, for it would lead us into the tortuous by-ways of bio-chemistry and bio-physics, and into a minute study of the structure and functions of many parts of the fish's anatomy. Such an exhaustive treatment is not only impossible, but unnecessary, for our present purpose, and in the brief span of this article only the broad outlines of what is known need be considered.

As far as the present problem is concerned, fishes can be divided into two groups. One is comprised of those forms which can tolerate a wide variation in the salinity of their surrounding medium—the change from fresh to sea water, for example; they are called *euryhaline* forms. We need not consider them further for the moment, although they have been largely instrumental in helping us to understand the matter in hand.

The other group consists of those fishes which have a restricted tolerance of salinity change, including those species which can live only in fresh water or only in sea water; these are known as stenohaline forms.

Now, the stenohaline fresh-water and the stenohaline sea-water fishes present at first what seems a curious paradox, in that the difference between them is actually based on a resemblance. This resemblance is in the composition of the blood, which, though varying a little in different species, is not very different in the purely fresh-water fish from that in the purely marine fish, and, what is more important for present consideration, the osmotic pressure of the blood is roughly similar. If you grasp this point clearly, you will see that the rest of the problem revolves round it.

The stenohaline fresh-water fish lives in water which has a lower osmotic pressure than its blood—the fish, we say, is *hypertonic* to its surroundings. This being so, there will be a tendency for water to pass into the body by osmosis through the limiting membranes and for some of the blood salts to pass out by diffusion. If this is allowed to happen, the blood and tissues will become so diluted that they will be unable to function normally, and death will result.

Obviously, then, the fish must have some method of control. This we find in the kidneys. To compensate for the dilution of the body fluids going on all the time by osmosis, the fresh-water fish possesses kidneys with extensive glomerular surfaces. Glomerulæ are, in effect, filters, and their function is to allow large quantities of superfluous water to pass out of the body, while retaining the salts necessary to keep the internal osmotic pressure of the body fluids at the right level. We may mention, in passing, that since so much water is being absorbed all the time through the oral membranes and gills, it is unnecessary for the fresh-water fish to drink.

Consider now the case of the stenohaline marine fish. Here the position is reversed. The salt content of the blood, being near that of the fresh-water forms, is much lower than that of the surrounding water—the fish is *hypotonic* to its medium. As a consequence, water is all the time being drawn out of the tissues by osmosis, and salts tend to enter the body. In other words, the animal tends to become more concentrated.

Here again, some kind of control is necessary, for if life is to be maintained the marine fish must conserve as much water as possible and expel a great deal of salt. The kidneys cannot accomplish this, for they would have to excrete a solution hypertonic to the blood, and only mammals are able to do this; but in marine fishes the glomerulæ are either much reduced or absent, so that little water is allowed to escape, and the excess salt is

eliminated by means of excretion from the gills. Since water is passing out of the body instead of entering, the marine fish has to drink large quantities of water, which is absorbed through the lining membrane of the stomach and intestine.

It will, I hope, be clear that the problem centres on the necessity for the fish to maintain its *milieu intérieur* at a more or less constant pressure irrespective of the *milieu extérieur*, and that the physiological adaptations of the kidneys and gills are secondary to the basic problem of osmosis.

When an euryhaline fish is transferred from fresh to salt water, or vice versa, there follows a period of passive change, varying in length in different cases, during which osmosis and diffusion occur, and the concentration of the blood changes rapidly until a point is reached where the necessary regulating mechanism is brought into play, and active adjustment begins, eventually restoring the concentration to normal; such fishes being transitional between the purely fresh-water and sea-water forms, are favoured in this respect, having regulating structures in both gills and kidneys to a varying degree. Such species as Scats and Archer-fish are of this type—all brackish-water forms and those that migrate between fresh waters and the sea, in fact. I find that the common Three-spined Stickleback and the Archer-fish, both of which are euryhaline, while possessing fewer and smaller glomerulæ in the kidneys than, say, the goldfish, at the same time have them much better developed than a typically marine fish like the Sea-horse, in which they are practically non-existent.

These regulating mechanisms work in one direction only. The kidneys of a stenohaline fresh-water fish must excrete weak solutions and conserve salts, so that they are powerless to aid the fish if it is placed in a hypertonic medium; in that case the fish loses weight, *i.e.*, water, rapidly, becomes highly concentrated and shrinks till the point of death is reached. Similarly, the gills of a marine fish cannot expel water, but must continue to excrete salt while water inflates the body after immersion in fresh water; as mentioned earlier, death may be almost instantaneous in such cases.

So far, it will have been observed that the matter demands a study of the osmotic pressure of both water and blood, and of the structure of the kidneys and limiting membranes. There are, however, many other aspects of the subject. For example, a study of the properties of the salts dissolved in various waters and their reactions upon the body fluids show that in many cases their effect may be toxic, and there is definite evidence to show that the death of fresh-water fishes in sea-water is not due so much to the actual osmosis as to the poisoning from excessive natrium chloride. The qualitative and quantitative analysis of the fish's urine also provides valuable data; while the study of permeable membranes is, of course, of considerable value.

Most research on this interesting question has been undertaken with reference to the difference between sea-water and fresh-water fishes, as stated above, because these differences are relatively large and comparatively easily demonstrable, and yield measureable results. But I would now point out that the difference between fresh water and sea water is only a difference in the salt content, and that if we now turn our attention to "fresh waters" only, as being the main concern of the great majority of aquarists, we find that under this heading are included waters of varying salinity. Indeed, while the chemical composition of sea water remains very much the same in all seas, that of fresh water can be very different, according to the locality in which it is found and the minerals with which it comes into contact. Waters flowing over granite rock, for example, have usually a very small solution content, and are "soft"; while those from chalk or limestone districts have a much greater mineral content, and are "hard." Needless to say, the greatest concentration found in any waters which we should commonly call fresh is very small compared with that of sea water, but nevertheless purely fresh-water animals have precisely the same problems to face in adapting themselves to the varying salinities of fresh-water as our euryhaline species did in effecting the wider transition from fresh to sea water.

It seems certain, indeed, that among the purely fresh-water fishes there are found those that can be transferred from "soft" water to "hard" water without serious interference with their life processes—we might almost call them fresh-water euryhaline species. Since the quantities of salts concerned are so small (as compared with sea-water), such an adjustment can be dealt with by a slightly modified kidney.

On the other hand, it is equally clear that in fresh waters we find stenohaline forms to which a relatively strong increase or decrease in osmotic pressure may prove harmful. Consider, for example, some of the Characins; they have evolved over a great period of years—

millions perhaps—in South America, which is largely a granite continent and in which many of the waters are very soft. Consequently their whole physiology is adapted to those conditions, and it is unlikely that they possess the regulating power necessary to adjust themselves to a transfer into, say, Thames water, which is comparatively "hard." Such a change, of course, would not result in sudden death, but its resulting effect on the blood concentration would lead to small derangement in the metabolism, which again would lead to further ills, and the fish would gradually decline. This does not apply to all Characins, for I have found that *Hemigrammus caudovittatus* does better in hard water. Recently I have studied the effect of very hard water on a pair of *Aphyocypris poeni*. Since the composition of the native waters for this species was not known to me, I placed them in water the salinity of which was much in excess of any probable natural waters. Thames water, which normally has a hardness in the neighbourhood of 22 (by the scale of the standard soap test), is relatively hard for a natural water, but the tank in which these fishes were placed had an accumulated hardness of 78.4, which, by the process of making up for evaporation with new tap water, was increased to about 86 in the following eight weeks. Over this period the fish lost weight to the extent of three milligrams (.003 grams), representing nearly 10 per cent. of the original weight. Other experiments still in progress promise even more striking results, and it is interesting to note that the increased osmotic pressure causes the fish to lose weight in the same way as a fresh-water fish does when placed in sea water. In other words, the problem of hard and soft waters is the problem of fresh and sea water on a microscopic scale. When it is realised that this osmotic effect implies alteration of the blood concentration, it will be clear that the whole physiology of the fish, and particularly such matters as the ripening of the ovary, are profoundly affected. Many failures to breed fishes could probably be traced to this origin. Also, assuming that such species are induced to spawn, it must be remembered that osmotic exchange takes place through the egg-membranes, and the embryo is likely to be weakened by abnormal conditions, giving rise to deformed or undersized fry. Other matters, too, such as the toxic action of salts and their effect on the albumins in the serum to form serum colloids, which can considerably diminish the filtering power of the kidneys (to which most "dropsy" is probably due), must be considered.

What I am suggesting is that many of the stenohaline fresh-water fishes have a limited "hardness tolerance." Aquarists are particularly well placed for investigating this matter, and I would strongly recommend that anyone successfully breeding and rearing a given species should make a point of ascertaining the "hardness" involved. pH values, not being quantitative, are of little value in this matter, nor are they even of specific value qualitatively—for example, it might be possible to neutralise the pH reading with potassium cyanide, but the effects on the fishes would be unfortunate.

The standard soap test is better and very simple, while, of course, an accurate analysis is the ideal. Perhaps I should explain that by "soft" water I do not mean "softened" water. The ordinary household water-softener merely makes the water soft to soaps by replacing one set of salts by another, the osmotic effect of which is not very different. Natural soft waters are desirable when obtainable, or the salinity may be built up and controlled on a basis of distilled or clean rain water.

Here is an excellent opportunity for the ordinary aquarist to add to the sum of scientific knowledge at the same time benefiting his hobby. If each breeder made the observations suggested and sent his results, from time to time, to THE AQUARIST, it might well be possible, in a few years, to compile a table giving the salinity tolerance for most of our aquarium species.

## A WATER-TIGHT FILTER

The filter tanks obtainable to-day, the type having a celluloid filtering apparatus standing inside, packed around with the filter medium, have the one drawback that they must be maintained on the same level as that of the aquarium.

This can be adjusted so as to allow the filter tank being placed below the level of the aquarium, out of sight, which is frequently to be preferred. Have the filter tank made with a metal cover which screws down, by means of butterfly nuts, on to the top frame of the tank, fitting a rubber gasket to ensure its water-tightness. In this cover have two holes drilled to take standard compo tubing. One hole takes the syphon tube just to the top of the filter medium, the other the tube which is coupled to the air-lift, this one reaching to the bottom in the usual way.

osmotic pressures to which they are subjected in our tanks. It is probably mainly due to these water conditions that English aquarists as a whole are not so successful in keeping and breeding tropical fish as aquarists in Germany and other countries, where the waters over wide areas are naturally softer and less affected by harmful chemicals.

A number of the experiments show that, while a small amount of chemical content is best for the fish, distilled water or clean rain-water approximate more closely to natural conditions than tap-water. In controlled tanks Angel Fish kept in tap-water spawned irregularly and the eggs either proved infertile or hatched weak fry which died after a few days; Angel Fish in distilled water spawned regularly and successfully reared their fry after each spawning. Red Swordtails in tap-water were only of average colour and were not very successful in breeding; similar Swordtails in distilled water developed gorgeous deep colouring and had large broods at quite regular intervals.

A pair of Black Mollies kept in tap-water bred only at long intervals, and the female gave birth to very small families; upon the last occasion only one fry was produced. The water was gradually changed to 90 per cent. clean rain-water and immediately the Mollies looked better and their velvety colouring became more intense. After a few weeks a family of 19 was born, and four weeks afterwards a family of over 20 was born, the previous family by them being nearly an inch long. This experiment is continuing.

The calcium and magnesium compounds present in natural waters are usually divided into two groups. (1) The carbonates, held in solution in combination with carbonic acid as bicarbonates; (2) the sulphates, chlorides and nitrates present in simple solution in water. The carbonates, when freed from carbonic acid, are precipitated as solids, and the most simple way of liberating the carbonic acid for this purpose is by boiling hard for five to ten minutes. This hardness which can be removed by boiling is termed the temporary hardness of water, and usually forms the major part of the hardness of English waters. The sulphates, chlorides and nitrates, however, are responsible for hardness which cannot be removed or destroyed by boiling, and this is termed the permanent hardness of water.

The practical effect of boiling water to remove the temporary hardness and so reducing the chemical content of the water for aquarium purposes can be seen from a test of the tap-water available in Central London. A simple test will show that the hardness of the tap-water is between 16-18 degrees of hardness (Eng. measure) but that, after boiling, the same water has only the permanent hardness (Bach.) left, amounting to just 3 degrees of hardness. It is, therefore, recommended that tap-water or other hard water should always be boiled vigorously before it is used in an aquarium.

For many years water-softening plants have been installed in all commercial undertakings where water is used extensively, and, more recently, smaller plants have become very popular for domestic use. These water-softeners are of two kinds, working upon two very different principles, the one, known as the lime-soda method, is that most usually used in the large commercial concerns, and removes the hardness of the water by precipitating, in a changed form, the chemicals which cause it; this precipitated sludge is then filtered from the water. The other, known as the " zeolite " or " base-exchange " process, is that almost invariably used for domestic purposes, and softens the water by *replacing the calcium and magnesium compounds present in solution in the water by chemically equivalent proportions of the corresponding sodium salts.*

From the foregoing paragraph, therefore, it will be seen that while water softened by the lime-soda process will have had its chemical content reduced to an extent which makes it very suitable for use in the aquarium, *water softened by the usual domestic base-exchange process has the same amount of chemical content exerting approximately the same amount of osmotic pressure upon aquarium fishes and is not so good for aquarium purposes as the original tap-water.*

The greatest danger resulting from the use of water with a high chemical content is the natural outcome of topping up aquaria to make up for evaporation. It is perfectly clear, after a few moments' reflection, that when water evaporates the ratio of the chemical content to water in the aquarium increases, and if water which is not comparatively pure chemically is used the aquarium water will rapidly build up its chemical content to an extent almost unknown in nature. This must, of necessity, subject the fishes to very harmful osmotic stresses and consequent severe physical strains. An experience, which indicates what may happen, is that of an aquarist who kept a number of tanks of Fancy Goldfish in an

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# The Composition of Aquarium-Water

By ALFRED ASHFORD

WATER is the commonest and yet the most important factor in the life of a fish, but it is the one thing of which the average aquarist knows nothing. Considered from one angle, this ignorance and the consequent amazing lack of appreciation of the complexities of the medium which is so intimately bound up with every phase of a fish's existence, may, perhaps, be excused, because in England good tap-water is universal, and aquarists are apt to accept the modern water supply as being as near perfection as possible. When it is considered, however, that the water is the first essential for keeping fish, it would appear to be reasonable to insist that the composition of the water should be checked as being suitable before placing any fish in it.

A few years ago, of course, much was heard of the pH values of aquarium-water, but, unfortunately, by studying the pH one is approaching the subject of the composition of water, backwards, from one of its minor subsidiaries. The aquarist consequently lost himself in that maze of confusion which is the inevitable outcome of an attempt to understand results while completely ignoring the circumstances and causes preceding them. The pH value of water may roughly be described as the measurement of the excess of alkaline salts over acid, or of acid over alkali in the water. It has no other relationship to the chemical content of the water, consequently many waters of widely differing composition may have the same pH value, but to pretend that because this pH value is suitable these waters must all suit an aquarium fish is to disregard utterly the law of osmosis. It is the quantity and the nature of the chemicals present in the water which is of basic importance to a fish, and until the composition of any water is known and understood it is idle to consider its pH value; further, until the composition of the water is controlled, it is impossible to have proper pH control.

As far as can be seen in a quick survey of the aquarium literature published in English during the past eighty years, the first suggestion of the importance of a knowledge of the chemical content of aquarium-water was made as recently as 1933 by Mr. Christopher W. Coates in his book, "Tropical Fishes as Pets." Mr. Coates, who is in charge of the Department of Tropical Fish at the New York Aquarium, included in his book a chapter entitled "The Chemistry of Aquaria" which, while not going very deeply into the subject, gave a very good indication of its importance and the far-reaching results to be obtained from a thorough study of it. Strangely enough, aquarists neglected the opportunity thus presented to them to investigate a new and very interesting branch of their hobby, and Mr. Coates' pioneer effort has apparently been already forgotten.

During the past year or two, in England, a few isolated aquarists have begun independent inquiries into this question of the chemical content of aquarium-water. Mr. W. P. Bradley, of the Fish Culturists' Circle, has continually urged the importance of a proper investigation of this subject, while Mr. T. E. Briant, another member, who, as a biochemist, fortunately had both the scientific knowledge and suitable opportunities of conducting adequate experiments, took the matter up enthusiastically and was able to give to the Fish Culturists' Circle, shortly before his recent departure to his new home in South Africa, a most illuminating talk upon hard and soft waters and their effects upon tropical fishes. (The Scottish Aquarists' Society, alone among clubs, also paid some considerable attention to this subject.—Ed.)

Although a considerable amount of experimental work has still to be carried out, it definitely appears that Mr. Briant's discoveries are, for the English aquarist at least, of incalculable importance. So much of English tap-water is abnormally hard, containing many impurities dissolved in it, the most important of which are the calcium and magnesium carbonates and the sulphates, chlorides and nitrates of lime and magnesia, that it is not surprising that our tropical fishes, most of which come from soft waters of relatively low chemical content, suffer from the unnatural

# OSMOSIS

By ARTHUR L. PALFREYMAN, M.P.S.

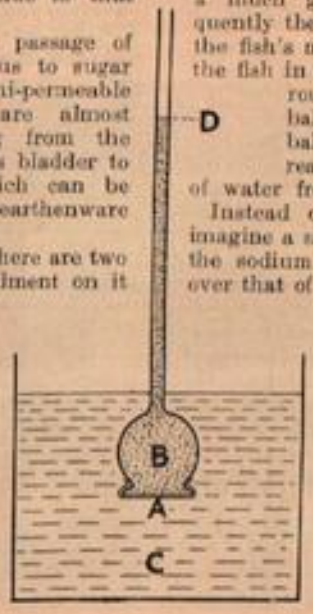
IT is a well-known physical phenomenon that, when two solutions of different concentrations are separated by certain kinds of membranes—termed "semi-permeable membranes"—there is a passage of solvent from the weaker solution to the stronger until both attain the same concentration; this phenomenon is known as osmosis, from the Greek, meaning "a push," and the resultant pressure on one side of the membrane as the osmotic pressure.

Osmosis and osmotic pressure are best demonstrated by the simple apparatus illustrated. A thistle funnel has a membrane of pig's bladder (A) stretched across its mouth and firmly attached there; into the inverted funnel a quantity of sugar solution (B) is placed, and the mouth of the funnel then immersed in pure water (C), so that the surface of the sugar solution is at the same level as that of the water. After a while the level of the solution will rise (D) and then remain constant, and that of the water will fall: obviously a pressure must be at work inside the funnel, causing the level D to rise, and this is called the osmotic pressure, due to that particular sugar solution.

The membrane will allow free passage of water molecules, but is impervious to sugar molecules, and is known as a semi-permeable membrane. These membrane are almost infinite in their variety, ranging from the naturally occurring ones like pig's bladder to the artificial chemical ones which can be deposited in the pores of a porous earthenware pot.

Inside the membrane, therefore, there are two pressures, one due to the bombardment on it by water molecules, and one due to sugar molecules. That due to the water is negatived by the similar pressure of the water outside, leaving an excess pressure due to the sugar.

The only way the essential balance of pressure can be obtained, since the sugar cannot pass the membrane, is for water to pass *into* the funnel from C, diluting the sugar solution and thus lessening its pressure on the membrane. This process is known as osmosis, and continues until a balance is set up with the atmospheric pressure outside, gravity, etc., and the height of D over its former level is an indication of the osmotic pressure of that particular sugar solution. This can be proved experimentally to be in direct relationship to the concentration of sugar present.




The sugar and water can be replaced by almost any chemical and its solvent, providing that a suitable membrane is chosen; most membranes are only partially impermeable to the dissolved substances, but in all cases the passage of the pure solvent *into* the solution is much more rapid than the passage of the solute into the pure solvent.

Supposing a salt-water fish were put into a tank of concentrated salt solution: the fish would die in a very short time, and obviously not from sodium chloride ("salt") poisoning, for surely there is enough of that chemical in its natural element?

Although there must be a proportion of salt in the fish's body, there is, in this experiment, a much greater proportion outside; consequently there is an immediate tendency, at all the fish's membranes, for water to pass *out* of the fish in an endeavour to dilute the the surrounding strong salt solution and so balance the osmotic pressure. This balance obviously the fish cannot reach, and it dies virtually from loss of water from its tissues and organs.

Instead of taking such an extreme case, imagine a salt-water fish put into a tank where the sodium chloride concentration is a little over that of the sea. The difference in pressure inside and outside the membranes would immediately tend to readjust itself, water passing out, and possibly sodium chloride entering, until a balance was reached. Probably the fish would live—but its normal functions would be inhibited, or at least impaired, and development and spawning would suffer.

All water that is supplied for domestic use here in England

has dissolved salts in it, varying according to the district. Some of these salts, of which the calcium and magnesium cause "temporary hardness," can be nearly all removed by boiling, but the sodium salts which are almost always present cannot easily be removed without leaving some other chemical in the water. Consequently it would seem to be a bad policy to place fish, whose natural habitat does not contain this high percentage of dissolved minerals, into our English tap-water.

The fish does not contain in its cells anything like the amount of these minerals present, and, although it might live, it often would not retain its natural colouring, nor would it spawn satisfactorily. The loss of water and the probable influx of these minerals, which the fish cells are forced to allow to balance the osmotic pressure, must surely have an inhibiting action on the more delicate functions of the body?

Another condition which has some small bearing on the well-being of the fish is the pH or acid value of the water, and then only after the osmotic effects have been balanced.

Chemically-pure water is the standard, being neither acid nor alkaline, and its pH value is 7. If a certain amount of acid is added, the acid value increases and the pH value drops—say, for example, to 6: if the exact amount of alkali necessary to neutralise that acid is added, the pH value again becomes 7; if double is added, the water becomes alkaline with the value of 8. Again, if the original amount of acid is added, the water is once more neutral and the pH value again 7, although the *amount* of dissolved salts is now in the ratio of 4 to 0 from the original pure water.

It has been definitely proved that some species of fish will spawn if the pH value of the water is slightly below 7, or acid, and others if it is slightly alkaline—but from the foregoing paragraphs on osmosis it would seem that, not the pH value but the *amount* of dissolved substance is what is vitally important to the fish.

Bringing all this to a practical conclusion—not tap-water but distilled or rain-water should always be used as a basis for aquarium water. For fresh-water, and especially tropical, fish, requisite quantities of the appropriate chemicals should be added to reproduce the conditions natural to the fish when the requirements of the particular fish have been ascertained; the pH value of the water will automatically be suitable.

## THE COMPOSITION OF AQUARIUM-WATER

(*Continued from page* 42)

upstairs room for a period of nearly two years and nearly always used tap-water (hard London water) for topping up. During the second year the mortality amongst the fish was abnormally high; in every case the cause of death was dropsy, and, as most people are aware, dropsy is usually caused by weakened organs working at strain. It is fairly safe to assume that the high mortality amongst these fishes was solely due to the chemical content of the hard water continually increasing in an unnatural fashion.

It is when we consider the tropical waters from whence our aquarium fishes are obtained that we begin to realise how unnatural are the water conditions in which we expect our fish not only to live, but to thrive and to breed. There is little accurate information available about the composition of most tropical waters, as few of the rivers of the world have yet been chemically examined, but there is every indication that their chemical content is small and their degree of hardness very low. Many of our tropical fishes come from swamps and shallow waters in regions where the annual rainfall is colossal and consequently the waters, particularly at spawning times, are to a large extent soft rain-water. That the heavy equatorial rains must have this effect in many parts of the world is very probable when we consider that they reduce the salinity of the Atlantic Ocean itself so that it is two degrees less about the Equator than in the regions of the tropics of Cancer and Capricorn.

The Amazon is stated to have only two degrees of hardness, while Dr. W. Ladige, writing recently in the *Wochenschrift*, comments upon the fact that many of the streams of Ceylon consist mainly of "very soft rain-water."

It is also a significant fact that all tropical aquarium plants are intolerant of hard-water, and will only flourish in tanks in which the rain-water or distilled water is mainly employed. The Madagascar Lace-plant, in particular, objects so strongly to lime that it will not live for many months in London tap-water.

This subject of the composition of aquarium-water presents one of the widest and most important problems known.

# BABY TERRAPINS

## *I.—Their General Care and Management*

**By WINIFRED BAKER**

AT this season of the year there arrive, from various parts of the world, a number of very pretty little baby terrapins. Those most commonly imported are: European Pond Tortoise (*Emys orbicularis*) and Reeve's "Turtle" (*Geoclemys reevesii*). Then there comes a very charming group of "babies" with prettily-coloured "shells" and markings. These hail from America, mostly from the Southern States, which makes them rather difficult to keep in health in Britain during the winter. They include: The Painted Terrapin (*Chrysemys picta*), the Lettered or Yellow-bellied Terrapin (*Pseudemys scripta*), the Elegant or Mobile Terrapin (*P. elegans*) and the Ornate Terrapin (*P. ornata*).

Less frequently seen are the Neat Terrapin (*P. concinna*) and the Pseudogeographic or Leseur's Terrapin (*Graptemys pseudogeographica*). With the exception of the last-named, I have kept specimens of these pretty and interesting little terrapins over a number of years.

Another "baby," not pretty, perhaps, but interesting to keep, is the Alligator Terrapin (*Chelydra serpentina*), also a native of America. In passing, let me say that this species is rather ferocious and is best kept either by itself or with other terrapins rather larger. But of the individual species I shall speak in subsequent articles.

These baby terrapins mostly require the same kind of treatment—excepting the baby Europeans and Reeves', perhaps—in captivity in Britain, so we can consider them, first of all, in a general way.

They are really only "half-hardy," so will not be able to hibernate outside during our long and cold English winters, coming, as some of them do, from places as far south as Florida and Louisiana.

But with the summer all before us we can first consider the keeping and housing of these pretty little "babies" under outdoor conditions.

One of the best methods is to have a piece of ground, containing a small cement pool, specially enclosed for them with small mesh wire netting, or the miniature garden may be surrounded by a shallow brick wall. Again, another very pretty way is to sink the whole "garden" about a foot below the general

Inside the enclosure forming Miss Baker's tortoise garden. The attractive little pool, furnished with a water lily, is surrounded with vegetation forming at once attraction and shade, while the gravel walk and sandy approach to the half-sunken shelter, on the right, is exposed to every scrap of sunshine, so that the tortoises and terrapins living in this Chelonians' Paradise have access to shade, sunshine, water, or sleeping quarters, just as they individually prefer.

surface of the surrounding area. This method has the advantage of being very snug and secluded, but entails more work in the making.

The cement pool may be of any size to suit individual ideas or space available, but it should not be too large or deep, otherwise it will be very difficult to catch up the little terrapins when they have to be brought in when autumn comes. The pool is better if made with a deep and shallow end and should have a sump and plug to empty away the water when this becomes too soiled. (If the pool is to be very small, the water can be baled out, of course.) I have such a pool for larger terrapins in my own garden, and have found an old rubber hot water bottle stopper the finest thing possible to use as a plug. They last a very long time—I have only used two in about five years! Yet my pool has never leaked and it freezes almost solid in very severe weather.

The little terrapin garden can be prettily planted with miniature shrubs and flowers. It should be as sunny as possible, for these babies will avail themselves of every scrap of sunshine. Those who care for gardening can construct a tiny rockery and fill with rock plants, for these tiny terrapins will do no damage to the flowers. They are timid and will take a "header" into the water on the least provocation—a splash and a row of heads peeping out inquisitively is all that will be visible of one's pets, until they have become tame—even then they believe in the "safety first" slogan.

Whilst on the subject of pools I might say that for those who are unable to construct a cement one, a half-tub, sunk into the earth, makes a pretty good substitute, or an old sink can sometimes be bought from a builder and will make an excellent pool, with a suitable bung to stop up the hole. With these substitutes, however, care must be taken to see that the little terrapins can get out easily—this is *very* important—for they do not care to remain continually in the water; indeed, on sunny days they seem to spend most of their time basking on land.

I have always taken my terrapins in at night, even in summer time, because the English nights are usually rather chilly and the water in these little pools cools down so much more readily than in a large, natural pond. But opinions must necessarily vary on such a question and each individual must decide for himself. I have a large, indoor tank in which I place the terrapins, the water being shallow. I also arrange for a dry, retreating place, filled with hay or moss and little pieces of cork-bark, so that they need not sleep in the water unless they wish—individual terrapins (even of the same species) vary very much in their preferences for sleeping in or out of water.

These terrapins are carnivorous and should be given live food as often as possible. The American group, however, will also eat water plants, and I have found them to be very fond of the English Frogbit. They also eat the tiny leaves of Anacharis (Canadian Water Weed) pretty freely. They may be given scraped raw beef, small earthworms and mealworms, and they will readily devour "bloodworms." (These last can be purchased from certain dealers who advertise them in THE AQUARIST.) Any small pond creatures, such as fresh-water shrimps, can be offered them, but they seem to vary in their individual likes and dislikes regarding food.

If anyone should ask: "Can these little terrapins become real pets?" I would answer—emphatically "yes." They are delightful little creatures, so lively, bright and amusing. They will become tame enough in time to feed from one's fingers and their antics are sometimes so comical that one just *has* to laugh.

Two will seize opposite ends of some luckless worm and a regular tug-of-war will then begin in which the stronger may pull the weaker all round the tank until either the terrapin or the worm gives way! When sufficiently tame and unafraid they will come paddling across the water if a piece of meat or a small worm is held invitingly in view. Generally the elegans are more pugnacious and inquisitive, anxious to be "in the know" about what is going on in the world around them—the little scripta are shyer and more retiring, surveying life very seriously through their round, white eyes.

All are very endearing; to possess them for any length of time is to love them for all their quaint and pretty little ways. In passing, I may say they were always the special favourites of A.E.H. (late Editor of this journal), who had a very warm place in his heart for the little creatures.

As autumn comes along arrangements must be made to bring these little terrapins indoors, for they cannot safely be left outside, being quite unaccustomed to ice and frost.

By the way, I might here mention that there are many flat dwellers who keep, or would wish to keep these little terrapins, but have no garden in which to put them—so they have to remain indoors all the year round. They can be kept in an indoor vivarium, fitted up with

(*Please turn to page* 59)

# Living Micro-Organisms on the Screen

*Microscope-projection to Provide a "Micro-Zoo"*

BIOLOGY in its most fascinating, lively form is to provide a thrilling and entertaining kind of enlightenment at the next "Daily Mail" Ideal Home Exhibition, which is to be held in the entirely new setting and surroundings of Earl's Court, S.W., from 11th April to 6th May.

For the first time in this country audiences will see on a grand scale microscopic or minute organisms living and moving under enormous magnification on a screen eight feet in diameter. No tricks of the cinema are to be employed. The audience will see actual creatures—mainly marine and fresh-water animalcule such as Hydra, Volvox, Paramœcium, Cyclops and tiny sea-worms, sea-slugs, and so on—actually living, moving, feeding and perhaps fighting in a globule of water placed in the microscope behind the screen. Even bacteria will become visible.

### Sea and Pond Subjects

Experiments have already been carried out for many months to build up the technique of this unique presentation, which is to be known as "The Micro-Zoo," and these will continue until the actual opening of the Exhibition, under the organisation of Mr. Edward Henry Ellis, Technical Consultant of London, and several expert assistants. Even with the lessening volume of aquatic life, due to the onset of winter, enthralling experimental shows of entertaining variety have been given recently, and, since the seas and ponds will be in the flush of new spring life when the Ideal Home Exhibition opens, vastly increased scope will be given.

Three powerful projection microscopes are to be used in turn to provide swift change of subject and avoid the disabilities caused by the heat and light rays on the subjects. Mr. W. E. Watson Baker, President of the Quekett Microscopical Club and Managing Director of Messrs. W. Watson & Sons, Ltd., the famous microscopical instrument makers, of High Holborn, is co-operating enthusiastically and providing these instruments and special lenses. A back-projection screen of the latest cellulose type has been supplied by Gainsborough Studios for the experimental displays and has given brilliance in detail and illumination.

### "Temperamental Creatures"

"One of my greatest difficulties so far," said Mr. Ellis in an interview, "is that these creatures of the cool, shadowed depths of ponds and seas become temperamental in the intense light and warmth needed for the projection. Some are killed by too long exposure to this light, and some become somnolent. We have sufficiently overcome the difficulty, however, by separating the foci of light-rays and heat-rays. By the use of three microscopes and swift handling we are now able to show these creatures in living intimacy on a scale that will be enthralling to scientific as well as lay audiences."

Mr. Ellis's two principal assistants are Messrs. F. Kenyon and Neville Rudolf, who have worked with him for many years on problems as far apart as those associated with building materials and swimming-pool waters.

### "Zoo" Grows in a "Lab."

In the laboratory at his home in Shere, Surrey, he is building up an aquarium of tanks which imitate the natural conditions for the various fresh-water and marine creatures. From this he hopes to have permanent breeding colonies of even the rarer specimens of minute plant and animal life. Research in ponds, streams and ditches by himself and his staff provides the fresh-water stock. Sea creatures are being supplied by the Marine Biological Laboratory at Plymouth, whose research launch brings in specimens from which selection is made for the "Micro-Zoo." By 11th April, when the Exhibition opens, it is hoped that daily consignments will be arriving at Earl's Court.

Besides the "Micro-Zoo," the organisers of the Ideal Home Exhibition are planning other unique features of entertainingly educational

*(Please turn to page 66)*

# THE RINGED PLOVER

*(Charadrius hiaticula)*

**By HERBERT DRAKE, M.B.O.U.**

THE photography of British Bird Life is perhaps not the pastime of the aquarist and pond-keeper, but those who delight to patrol the sea shore, sand dunes and creeks in search of fish information and marine aquaria, should bear in mind that bird life has allied interests and relationship to fish lovers.

The Ringed Plover enlivens our shore wastes in the spring, and is the most personal and friendly of all the small waders.

Many arrive in spring from South Africa and reside with us all around the coastline. They are most sociable, and will link up friendship with birds of entirely different race, colour and habits.

The " stone runner " scrapes out a depression on the shingle beach and there deposits her clutch of eggs, usually four in number. The eggs are pear-shaped, of a buff stone colour, spotted with black, the average measurement, 1.4 by 1 in, and most closely resemble the surrounding stones; occasionally the scrape is lined with small pieces of stone or shell, cockle shells being quite a favourite, and I have noted fragments of the blue mussel shells.

The adult male in spring has the forehead and stripe behind the eye white. The chin, neck and throat is white, it carries a black collar, the outer tail feathers are mostly white, the rest being brown with white tips; lower breast and belly white; legs of orange. The collar of the female is less defined, and the bird itself is slightly smaller.

After breeding, the adult birds undergo a complete moult. Two broods are usually produced; the young of the first broods should be located about early May, the second brood as late as August.

By the end of April the birds are courting, and the shingle spits are alive with their musical mating song and dances, the males making tiny depressions or false nests.

During the nesting season the birds are very fussy and agitated, and use every art to entice away intruders, practising the broken wing habit as that of a Partridge with her chicks. The young are the most charming of baby waders, and run with amazing speed, then to squat concealed among the surrounding stone and vegetation, and most difficult to locate.

Ringed Plover always sleep head to wind, standing on one leg under the lea-side of hill or tussock; if disturbed, the whole flock takes to flight, wheel out to sea and return to another part of the beach. The birds are hardy and plucky and will drive other birds from the territory.

The photograph depicts the female bird covering her eggs, and of late years the increase of this specie has been noticed on the East Coast of England.

It is sometimes referred to as Stone Hatch, Ringed Dotterel, Tullet, Dulwilly, or Sandy Laverock.

# A Word on the Puff-Adder: South Africa's Mystery Snake

By J. SAUER VAN PLETSEN

I SAY "mystery" snake with emphasis, since, for practically centuries, the puff-adder has been credited with all sorts of impossible feats and doings and has become associated with a lot of legendary nonsense.

Unlike the mamba, which is only found in various parts of the Transvaal and practically the whole of Natal, but not at all in the Cape Province and Orange Free State, the puff-adder is common to the whole of South Africa, in fact to the whole African Continent, and can be regarded as one of the country's deadliest reptiles. The mamba, because of its speed and aggressive ways, and the virulent effect of its venom, is usually accredited as being South Africa's most venomous snake, but in reality the puff-adder is a more dangerous fellow just because he is usually so slow, somnolent and lethargic. He is fond of regarding man as a convenient bed-fellow, biting his bed-fellow most atrociously (and fatally) if he annoys, startles or hurts him by rolling over on to him during the night! And yet, for all his familiarity with man and for the fact that he is quite a common snake in the country, there are thousands of people, not only in South Africa, but in many other parts of the world as well, who hold strange and silly ideas concerning this particular reptile. The chief of these are (a) that the reptile can only bite by striking at you backwards, (b) that it is a snake absolutely incapable of sudden, swift movements, (c) that it gives birth to its young by sacrificing its own life, the baby adders eating their way through the stomach lining and outer skin of the mother, the latter, of course, dying from this ordeal.

The belief of how the reptile is only able to bite by striking backwards is, of course, due to the fact that it is the only snake in the country which has a fondness for such backward slashes. But that does not mean that a puff-adder is unable to bite by striking at an enemy, or something which it is desirous of capturing, by means of a direct frontal lunge. It can and it does. Furthermore, for all its somnolence and lethargy, a puff-adder, if thoroughly scared and desperately desirous of seeking safety in flight, can move with extraordinary rapidity. Not by sailing swiftly over the ground, like some of the larger species of cobras, but by transforming itself into a kind of live cracker and leaping backwards through the air in a series of eight, nine or even twelve feet leaps. It is specially fond of reverting to this means of escape where it is cornered by meercats, polecats or even dogs on the banks of a dry donga or gully possessed of high, steep sides. It is on record that on one occasion such a puff-adder travelled a distance of sixty yards in almost as many seconds. This cracker-jumping, as well as its ability to strike at you backwards, even taking a bite at a man's leg where he sat on horseback, is all the more remarkable if it be taken into consideration that the squat, fat, stumpy body of the reptile is far from being as supple and sinuous as that of the average snake, and is practically bereft of constricting powers. Yet it is able to leap backwards like that, and as to its vicious and ferocious backward-biting capacities, there is the classical instance of how a puff-adder snapped backwards at a horse and its rider, sinking its terrible fangs into the saddle-flap along the horse's side. The unsuspecting rider only noticed it, getting the start of his life at the same time, when he got home and dismounted! The adder had sunk its fangs right through the leather, couldn't get free again and just hung on.

Puff-adders give birth to live young, and the legend of how such young gnaw their way out of the mother is one that has obtained a very firm hold in South Africa. The idea is so preposterous and so impossible that one wonders how it ever came to be believed in at all. For one thing, the skin of a puff-adder is so tough and thick that it makes quite a good belt if properly cured and tanned, and as no reptile is fitted with teeth or fangs capable of doing any gnawing, it is simply absurd to think that such baby adders would be able to gnaw their way out. The source of this legendary tale is probably due to the fact that puff-adders, like the majority of reptiles, are confirmed cannibals. What is more, they are

patricides and matricides as well! The baby adders, fully venomous the moment they are born, immediately leave their mother and fend for themselves. Any old male, meeting such babies, would think nothing of making a meal of as many of them as it could catch. So would their own mother. These babies are but an inch and a half long and are easily gulped down, but that does not mean to say that they are dead when they find themselves inside the stomach of their captor. Far from it. Very many of them are fully alive still and by wriggling and squirming, some manage to find their way out again per the mouth of their captor!

An ordinary frog, for instance, is seldom dead after a reptile has swallowed it. It remains in a comatose state for quite a time before it dies and it, too, would wriggle out again if it could but manage to turn around in the reptile's stomach. It is for this reason that any snake takes good care to swallow its catch head first. I have personally disembowelled a spitting cobra (the South African *rinqhals*) fifteen minutes after it had swallowed a large river frog. By carefully cleaning the slimy, squashed frog and putting it in the sun to dry, the creature commenced stretching out its legs, a violent shiver ran through its whole body, it lifted its head, gave one maddened leap, and plopped more or less gaily into the river again!

The size to which some South African puff-adders grow is simply amazing, this, of course, depending on the amount of fattening food they are able to obtain regularly. I am not referring to its length, but to its girth, for the average puff-adder seldom attains a longer length than four feet four inches or so. In the Transvaal I came upon a puff-adder, its presence betrayed by a mass of shrieking, excited birds, that was almost the thickness of an average man's thigh. As a matter of fact, I at first took the reptile to consist of two adders intertwined. We subsequently came upon its mate and were amazed at the huge lump in her body, which looked like a miniature football. This "football," on examination, proved to be the body of a young hare.

I mentioned at the commencement of this article that the puff-adder is one of South Africa's most dangerous snakes. I am once more repeating this assertion. Its deadliness lies in the fact that it is such a sluggish, almost docile snake. The explanation of this paradoxical statement is that the snake does not easily give way and that it is such a sound and heavy sleeper. Anybody who hears the snores of a puff-adder for the first time is bound to bet anything that the snoring emanates from a human being and not from a snake.

The mamba, for instance, would show instant flight or scuttle swiftly away when you happen to come across it, and so would the various species of cobras, etc. But the puff-adder is different. Stretched out full length in the shade of a tree or bush or lying right across a footpath of the veld he would sleep the clock round. He might wake up and hiss warningly, but he takes his own time and leisure to give gangway. Ten to one you never see him or never hear his warning hiss and blithely step upon his tail. It hurts abominably and your calf, your knee or your thigh makes instant acquaintance with its terrible fangs. Remember that those curved fangs of the reptile are one inch long and venom drips from them even before the creature has actually struck. If there is one thing which you will remember all your life, which will always send a cold thrill of horror right through you, then that thing is to receive a direct look from the lidless, cold, beady eyes of an infuriated puff-adder. It is death grinning at you with a sinister smile.

## TEST YOUR KNOWLEDGE

*(The answers to these questions will be found (on page 56)*

1. Which of the following water plants belong to the fern family: *Salvinia, Ceratopteris, Marsilea, Fontinalis*?
2. What common native fresh-water fish is popularly known according to locality as prickle-fish, bandies, barnacles?
3. Has the Rosy Barb any barbels?
4. Have the Spiny Eels (*Mastacembelidæ*) any ventral fins?
5. The tadpole of one of these batrachians (frog and toad) remains black throughout the whole of its existence as a tadpole. Which is it?
6. Has a frog's tadpole any rays in its median fin?
7. About how many different species of Catfish do you think are found in British Guiana?

# Making a School Study Pond

**Written and Illustrated by F. EVANS**

*(Continued from page 25, last issue)*

FIG. 4 shows clearly the concrete troughs for sub-aquatic plants, and also how the brick-walling has been rendered in cement and made water-tight. The troughs are placed so as to be just a few inches below the water-level and are filled with rotted-turves, which act as good rooting soil for aquatic plants. Wire-netting was also used to reinforce the concrete troughs.

In Figure 4, also, a rustic bridge of reinforced concrete faced with flat broken stones is shown being placed in position. The rockery is being placed in the upthrown soil, and it is interesting to note that the stone was obtained from that taken out of part of the walls of the Houses of Parliament, which in 1937 and 1938 were in course of renovation.

Many tons of this stone were obtained, and the father of one of the boys, a haulage contractor, fetched this material from Westminster for a nominal charge. Once the work was started there was no lack of offers of substantial help of this character.

Figure 5 shows the pond filled with water for the first time and being tested for leakage. It proved quite sound and it has stood the test of a year's use without any appreciable fall in the water level. This picture shows the rockery at a later stage of development, and how the rustic bridge has been faced-up with broken stone.

Figure 6 shows a still further stage. The boys are laying an approach with broken concrete slabs to make an attractive piece of random-paving. On the left in the background can be seen the rustic stone fountain standing in the shallow bird pond, from which an overflow runnel, lined in cement, works its way down through the rockery stones and back into the pond.

Rustic stone steps have been worked attractively into the rockery, as well as flat patches of turf. Conifers of the cypress type are to be planted at random in the outer edges of the rockery. Rockery plants have been supplied by the Education Committee on requisition, and both teachers and pupils have brought plants from their own gardens to help

Fig. 4.—Here the sides have been rendered, and the planting troughs constructed, while a narrow bridge has been added, and is seen being supported by a pile of bricks during the hardening process.

Fig. 5.—The pool filled, being tested for leakage. The boys are making a start with the surrounding rockery.

the display, so that by the summer of last year a most attractive corner had been added to this school quadrangle.

The following materials were used :—

2 tons 6 cwts. of Portland cement;

6 cubic yards of Thames ballast;

6 cubic yards of sharp sand;

700 rustic-faced fletton bricks;

6 bags of hydralime and 1¼ tons of paving slabs, for crazy paving;

6 tons of broken stone—from the Houses of Parliament;

1 cubic yard of rotted turves for filling the troughs to hold the aquatic plants;

30 yards of wire netting as reinforced framing for the submerged concrete troughs and for similar work.

The pond and rockery have been brought into use in the school nature lessons and has stimulated interest in and provided examples of plant and pond life. The project has taught, amongst others, the following lessons :—

(1) How to plan and construct a garden pool.

(2) How water is naturally purified. How oxygenating weeds do their work. Which are the commoner oxygenators.

(3) The names and habitat of the commoner aquatic plants.

(4) Fish and their care. How a fish breathes and the reason for a supply of oxygen in the water. How fish can be kept healthy and how they can be fed.

(5) Pond life, such as daphnia and infusoria. Scavengers of the pond, such as water lice, fresh-water shrimps, mussels, etc. The Caddis worms and their homes. Pond pests, such as fish-lice and leeches. The Dragon Fly and its life history. Pond skaters and water boatmen.

The above are a few of the studies which the pond offers, and it is the source of a great deal of interest amongst the children who visit the pond during breaks in the school lessons.

The fish in the pond at present are three golden orfe.

An isolation tank for the treatment of unhealthy fish is now being planned.

Figure 7 shows the pond and rockery completed in their main features. The whole is an excellent example of what can be done by the co-operation of all persons and officials interested in schools. Already there are reports in the school of numerous instances where the boys, with the co-operation of their parents, are constructing their own ponds in the gardens of their homes.

Fig. 6 (above) shows one of the final stages of this most excellent job of work. The pool has been satisfactorily tested, and found to be watertight. A few plants have already been established, and the crazy paving approach is being finished off. Note the obvious youth of the "labourers."

Fig. 7 (below) shows the end of the jobs that are the concern of the boys. Nature must now take a hand and, by the increase of the rock plants to cover the harsh outlines of the rockery, produce a monument to the hard work of the boys and the enterprise of the adults concerned in such an excellent form of instruction. The landscape gardener might protest at the rockery, since the rocks might well have been buried deeper in the soil to look more natural, but time will mellow much of the rawness, while the creeping rock plants will satisfactorily conceal the rest.

# Club Formation and Management

*(Continued from page 26, last issue)*

THE Chairman of the meeting may, as pointed out in the last article, be the person convening the meeting, but in many cases it is preferable either to elect a local personage who is disinterested, or it may be left to the several promoters of the scheme to elect one of themselves. In a few cases it is best to leave it to a show of hands among the persons present, but more often than not these are unknown to one another, so that this system is not unattended with difficulty. Nevertheless, it rarely happens that at least one personage is present whose influence and position is such that he may be in a position to prompt the gathering, and in making this suggestion the same procedure is followed as in the other cases, namely, that he formally moves that Mr. X be appointed Chairman. This motion should find a seconder, and on the motion being put to the vote, usually by a show of hands, the gentleman so elected can proceed to take the Chair. If desired, the mover and seconder can escort him there, and in any case, since they are responsible for putting him there, and have so publicly declared that they are willing to help him, and consider him a fit and proper person for the task, they should seat themselves near him.

Occasionally it happens that other persons are also proposed, in which case a vote must be taken. The acting-Chairman can take this by a show of hands, but it usually saves a certain amount of feeling if this is done by a paper ballot. To facilitate the smooth working of the meeting, slips of paper should be prepared against this emergency, and should be promptly handed round, each member present recording his vote. The slips are then collected, and the result announced. If more than two persons are voted upon, the runner-up, as it were, can be elected Vice-Chairman on numbers, and it is rarely desirable to treat second and third suggestions as formal amendments to the first motion put to the meeting. To relieve any one person from suggestions of partiality, five or six volunteers should be taken from the members present to assist in the counting of the returned votes. With the Chairman installed, the business may commence, and the question of the secretary can be formally dealt with. If, as is probable, an acting-secretary has been carrying on for the time being, he should be called upon to read out the formal reasons for the meeting being called, subsequent to which the Chairman calls upon the meeting to elect a permanent secretary. Usually, the acting-secretary's position is confirmed, but a great deal of care should be exercised in the election of the secretary, since he is, in the main, the guiding influence of the society. In fact, he is the society, responsible for its correspondence and reports, consequently its reputation outside; responsible for its activities, outings, and so on, and all too often some individual is more or less forced into the position and proceeds to carry it out haphazardly, albeit to the best of his ability. Club secretaries are born, not made, and when such a one can be found, he is worth his weight in gold to the society concerned. The procedure for the election of secretary and/or the treasurer follows that of the Chairman's election.

It is preferable for the Chairman, Secretary and Treasurer to be seated either upon a platform, or apart from the general gathering.

The business of the meeting then proceeds by the offering and voting-upon of resolutions. For example, the prime mover of the scheme can be called upon by the Chairman to state, as concisely as possible, the reasons leading him to, or him and his colleagues, to draw up the call to a meeting as read out by the secretary. He then resolves "that this meeting is of opinion that it is desirable to establish now an aquatic society." All resolutions must commence with the word "That." The Chairman then makes the request, "Does anyone second that resolution?" On one person seconding the resolution, the Chairman can call for speakers for or against the adoption of the resolution, and here begins the Chairman's difficulties.

*(To be continued)*

# Photographing Pond Life

**By JAMES SMALL, D.Sc.**

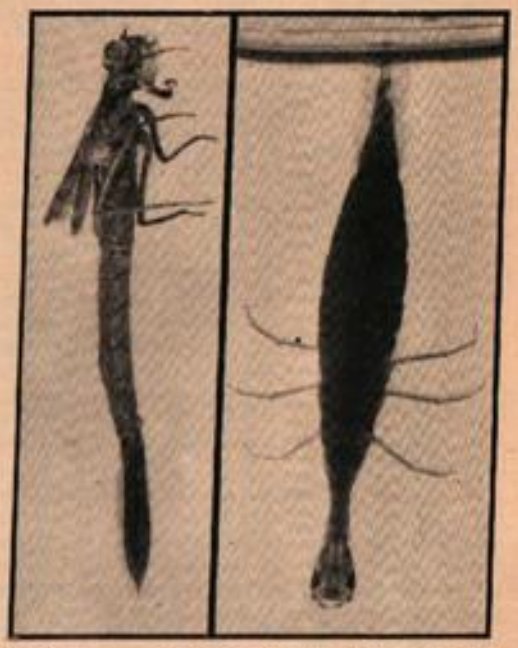
*(Continued from page 32, last issue)*

THE photography of small water animals above the size of a gnat larva raises rather different problems which are solved by some changes in technique.

As long as there is some degree of transparency in the head parts, it may be more useful to continue the use of transmitted light. A larger glass tank, known as a zoophyte trough, can be used; this trough is fitted with a loose piece of glass which is manipulated to keep the object within focusing distance from the front glass. Then the live larva or other object can be further restrained in its movement by wedging match sticks between the two glass surfaces. The object being larger, a lens of longer focal length, up to three inches, is used and the back extension adjusted to bring the whole object well within the bounds of the focusing screen, in order to allow for some movement.

This kind of procedure may be illustrated by a small specimen of the water-beetle (*Dytiscus*) larva which grows to more than two inches in length. The hunting of this material in a pond is almost as good sport as fishing, and manœuvring a specimen into position for a photograph needs more patience still. A film pack is very useful here, as the larva can be watched in the trough and a new film pulled into position quite quickly when a suitable pose is taken up. A succession of poses is almost unavoidable, and at the 3¼ ins. by 2¼ ins. size, another film is not expensive.

These films having been developed, the next stage is the printing of enlargements. The exposures were 2, 3 and 4 seconds with a 60 watt bulb behind ground-glass, but the negatives are all developed so that they are very thin and the results in this case were all fairly satisfactory. The tail gill-plates were in constant movement, but the legs and head were reasonably still. The negatives, being on fine grain material, contain details which do not show readily even on the 10 ins. by 8 ins. scale. An enlargement of the whole subject is made, followed by a still greater degree of enlargement for parts showing minute details. In some ways, particularly for depth of focus, this is preferable to trying for detail with a lens of shorter focus, especially when the subject is alive and liable to move out of sharp focus.



**(Left) Larva of Dragon-fly (Ischnura elegans) showing tail, gill-plates and mouth-parts. (Right) Dytiscus larva showing natural position in the water.**

**Both the above illustrations, and that illustrating the article in the last issue by the same author, have been reduced from 10 × 8 ins. enlargements, in all of which the subjects were just short of 8 ins. in length, and were remarkably clear.**

This greater enlargement can be applied to the Dytiscus to show up the tail gill-plates and the infusorian (*Carchesium*) colonies which infest various parts of this specimen (not visible in the reduced illustration.—Ed.), also

to show the details of the legs with their swimming fringes and the head with its mandibles and surrounding cilia. The specimen photographed differs from the common Dytiscus in having two bifurcated cilia and two unbranched cilia, as well as in having a long thin neck. These enlarged photographs enable the species to be determined long after the specimen has been returned to the pond; in this case the actual species is still under discussion.

Still another way to deal with these larger specimens is to pickle them in dilute formaldehyde or alcohol, which hardens them enough for careful handling. Then the object-holder of the camera is fitted with a small piece of sheet-cork through which two sharp pins are pushed from the back. The object, removed from the pickle, washed and dried carefully, is then impaled upon the projecting pin-points, with a white or black paper background on the cork. In this way a shadowless view is obtained, which gives a very clear print of the object. A dragon-fly larva has enough solidity for this treatment, but the head of a Dytiscus larva is so soft and transparent that a living specimen taken with transmitted light gives better results.

With the shadowless arrangement reflected light is used, and this has to be something much stronger than the 60 watt bulb for transmitted light. Two photo-flood bulbs at about six inches from the object and an exposure of about one second have been found generally satisfactory for most objects. Two seconds should be given if the object is dark in colour. Preliminary adjustment and focusing at wide aperture can be done with a 60 watt bulb.

The dragon-fly larva was taken with a three-inch photomicro lens, two photo-floods, and one second exposure. The image on a fine grain negative yields sharp enlargements beyond the 10 ins. by 8 ins. size. This larva, like that of Dytiscus, breathes by means of tail gill-plates, which show to some extent in a 10 ins. by 8 ins. enlargement, but if the size is pushed up further the serrate edge of these gill-plates and the details of their air-tubes become quite clear in a print, although they are so fine that they may not show well in a half-tone reproduction. The head parts brought to a larger size are much more easily distinguished, especially the "mask" or jointed trap arrangement below the mouth. This is pushed out with a very swift action to capture prey and is then pulled in, holding the capture in position for the mouth to function. At this size the two claws at the extremities of the legs and the jointing of the mask are clearly seen.

Even with all this magnification and subsequent enlargement, we do not really reach true microscopic detail; what we see in the prints can all be seen with a good aplanatic pocket-lens magnifying about ten diameters, but the more we enlarge the prints the easier it is to see the details, so long as enlargement is not carried to the point where the grain of even a fine grain negative begins to show.

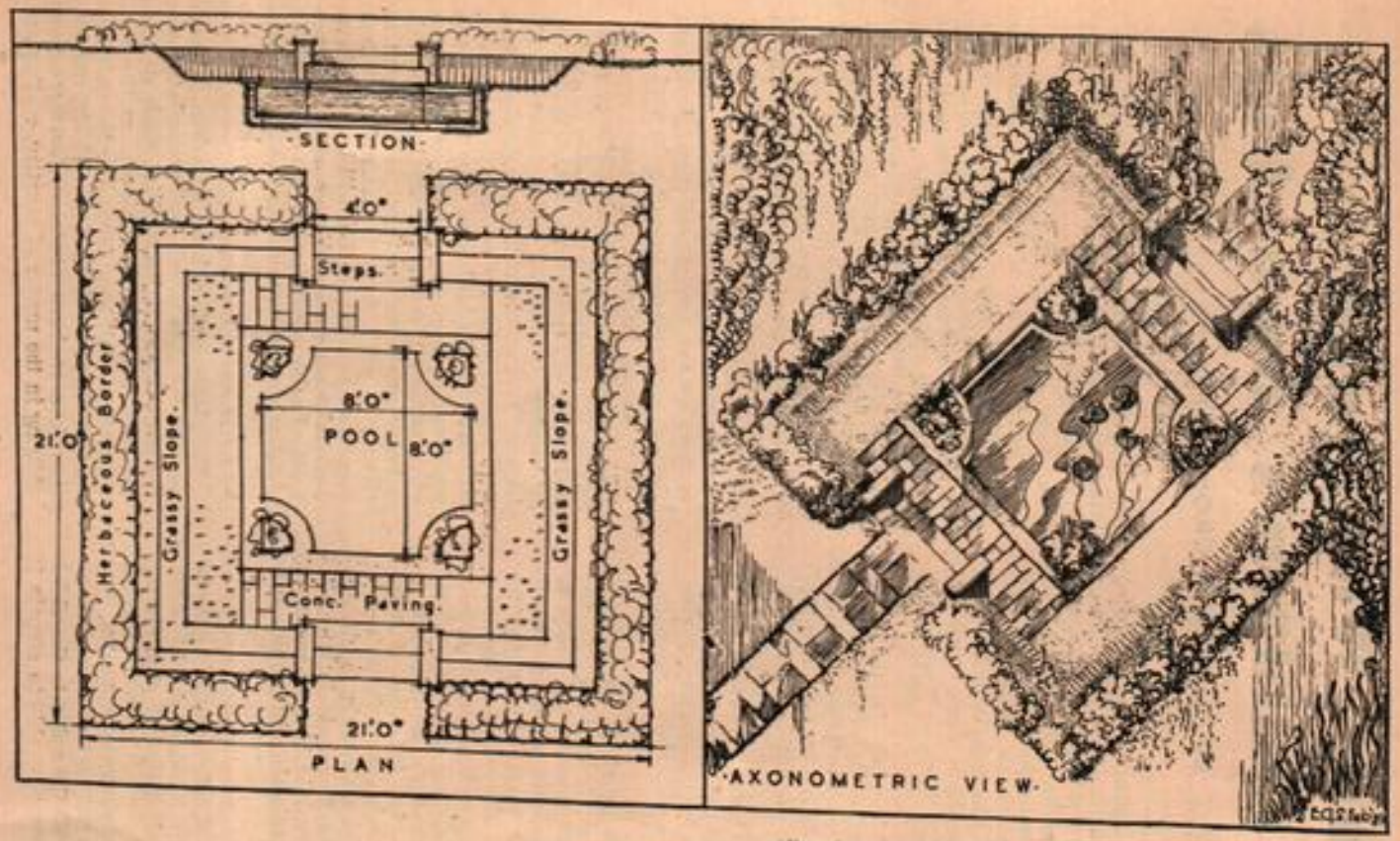
With this technique the aquarist at last has the opportunity of getting permanent records of some of the queer animalcules which inhabit his tanks and ponds. Then he can explain their structure and habits more easily to his visitors and friends.

(In the first article by Dr. Small, in the last issue, on page 31, the illustration, as most readers were quick to discover, was unfortunately printed upside down. Our apologies are extended to Dr. Small for this error, and to readers for having, as one reader put it, "certain objections to standing on my head to see illustrations which, normally, I enjoy as much as I do your most attractive and interesting journal.")

## ANSWERS TO "TEST YOUR KNOWLEDGE" QUESTIONS

1. All except *Fontinalis*, which is an aquatic moss.
2. The Three-Spined Stickleback.
3. No.
4. No.
5. Those of the toad.
6. No.
7. Approximately 115.

From the Annual Report of the Smithsonian Institution it is learned that *Mollienisia latipinna* enters the sea freely, and multiplies exceedingly in the brine ponds about Manila Bay, where it was accidentally introduced. Rivulus and Fundulus species appear to live permanently on the sea coast and in tide pools about Curacao, while it is also mentioned that a Fundulus was taken by the nets of the Challenger (the research vessel) in a mid-Atlantic pelagic haul.




*(Drawings by courtesy of the Cement and Concrete Association.)*

# A FORMAL LILY POND

Having an overall depth of two feet, this formal lily pool, forming a sunken garden, surrounded with concrete pathway and approached by two steps on either side, frequently offers a better method of incorporating a small pool as a feature of the garden than does the informal plant-surrounded pond. Such a pool, planted with one or two specimen lilies such as Escarboucle, Gloire de sur Lot, Brackleyi rosea, etc., and a few submerged oxygenators such as Elodea crispa, can be pleasingly stocked with a few ornamental fishes, and becomes at once a place of infinite attraction in any garden, small or large.

# Aquarium Work and Children's Own Pets

By ELIZABETH CROSS, N.F.U.

NEARLY all children, sooner or later, develop a great desire to keep some creature for their very own; to be quite responsible for the housing, feeding and general well-being of the treasure and to read innumerable books on the subject! This desire to keep a pet is by no means satisfied by general nature work. Children who live on farms surrounded by animals want, just as much as the others, to have a "special" animal of their own.

This desire for pet-keeping is perfectly natural and very desirable. It can develop a sense of kindness and responsibility, punctuality (with regard to feeding, etc.), as nothing else can. The problem is, not how to avoid pet-keeping, but how to achieve it happily and suitably, particularly in towns. Town flats and houses certainly preclude the keeping of many types of pets, but even for the country dweller it is necessary to realise each child's capacities and limitations.

The younger the child, both in actual years and in mental and moral development, the simpler and easier the type of pet needs to be kept. Even very little children like to watch something alive of their own, but for those of, say, eight or nine years of age, anything involving very much daily care is a mistake. So many unhappy experiences have proved that children cannot be expected to always remember; a few tragedies of unfed mice or rabbits, with their cages left uncleaned, and then parents quite reasonably forbid pet-keeping and are loath to permit it later on. Not only that, but the child himself begins to associate the care of animals with unpleasantness, scoldings and a general feeling of difficulties.

These difficulties simply should not be allowed to happen. Neither should adult supervision be needed except to give sympathetic encouragement or advice over reading matter, or help in occasional ill-health. For a grown-up person to feel really responsible for any pet takes away all the value to the child. Naturally, someone must be able to step in if the child is in bed with a cold, for instance, but in such a case the child should give clear instructions for feeding, etc., and the grown-up be merely doing a favour.

The best way of introducing pet-keeping is, I am sure, by means of simple aquariums, a few tadpoles and, later on, more difficult fish and reptiles. Many people may object that fish and such creatures have not the appeal and the charm of the furry animals. In a way this may be true, but the child does not only want the pleasures of "stroking" such as it gets from its toys and perhaps the family dog and cat. It wants to watch, see things happen, see eggs being laid, a few fights take place; in fact, it wants action! All teachers and those who have experience with young children will agree that the study of the animal world is generally more popular than that of plant life (at first) for the very reason that animals are dynamic where plants appear to be static.

In a simple, balanced aquarium, that the child can learn to set up for himself, may go and fish for the creatures to put in, find out which ones get on well together and which ones don't, pet-keeping is reduced to its most simple degree. Feeding is unnecessary, more pond weed may occasionally be needed, more water may have to be added from time to time, and occasionally the owner may decide to give the whole affair a "spring clean." But, and this is important from the small child's point of view, you don't have to remember to feed every day, nothing terrible will happen if you don't take any notice of your aquarium for a week. In this easy manner, you may have the pleasure of some creatures that you found yourself, that really belong to you, but that are by no means a burden.

The pleasure of such an aquarium, without any real worry, is usually quite enough to make the owner an aquarist for life. Such an easy job does not make for laziness; on the contrary, most children develop quite naturally into wanting something more difficult, and will then love to keep newts. Newts are most obliging in the matter of courting, mating and

egg-laying and, while they are best given food regularly, if they are in a fairly large, well-stocked aquarium they can make their own living most of the time.

One of the most satisfactory aspects of letting children keep their own aquariums and such pets as their particular age finds possible is that there is always something fresh to see and learn. Many children who have had the opportunity of keeping other pets, such as guinea pigs, rabbits, etc., have given these up and taken to aquariums simply because they had learnt all they could about their animals, were able to feed and care for them efficiently, and then could not find anything much to do with them.

Many children are interested in reptiles, tortoises, etc., and if a greenhouse or small garden is available some of the older people might be able to keep these as pets. It is important, however, to make sure that any outdoor pets are really hardy and suitable to our climate. English lizards, toads, frogs, slow-worms and grass snakes are all extremely interesting and can provide a great deal of pleasure, but semi-tropicals are naturally more difficult and should not be attempted until some experience has been gained with other creatures first.

The making of a simple garden pond is by no means beyond the capacities of children of twelve and over. A tiny pond of their own, in which various pond creatures can live in a fairly natural state, is a great delight. One small girl dug herself a pond, made some extraordinary home-made concrete (discovering the necessary sand in the woods) and, strangely enough, it proved a great success! For the child who may be allowed a small part of the garden for himself, a small pond, and a little grass plot, well fenced with netting, is quite suitable for experiments in reptile keeping. Such experiments give the chance for much ingenuity in contriving various little "houses," feeding devices, and so on.

The main thing we should remember when giving advice over pet-keeping is to suit the pet to the child and to make sure that the creature will provide sufficient real interest and allow for the child's growth and mental development. Finally, we may remember the social value of suitable pet-keeping. A hobby that is shared by a very varied group of people, that appeals to so many types, is particularly valuable, as it will also appeal to very varied types of children and help them to have a common interest and generally widen their horizon.

## BABY TERRAPINS

(*Continued from page 46*)

a water tank and space for coming on land when they so desire. But this must be placed in a very sunny window, and it is advisable—indeed, almost imperative—to give these little "babies" access to *direct* sunshine (i.e., not through glass, which cuts off the life-giving ultra-violet rays).

When I had to live in a London flat I had a back window-sill (facing S.E.) widened and an arrangement fitted up there with small mesh wire-netting in the front, instead of glass, so that my tortoises and terrapins could enjoy this natural, outdoor sunshine. Care must be taken, however, to avoid draughts, especially if the window be an upstairs one. When the sun had passed I took the terrapins back to their permanent vivarium again—this faced S.W., so they had all the afternoon sunshine there.

Winter heating is a difficult problem. If a part of the staging in a heated greenhouse can be fitted up for the use of these baby terrapins, this will make very suitable winter quarters. A little pool can be made and the "land" part covered with moss or dried bracken, or a combination of both. Failing this, some sort of indoor terrarium must be given over to their use, electrically heated, if possible—otherwise the terrarium, or vivarium can be arranged over a greenhouse heater (oil), but it must not be of the "all-glass" variety in this case.

The water should be maintained at a fairly high temperature, around the 70 deg. line or even a little higher, as it is essential to keep the "babies" feeding if they are not to hibernate. Their winter quarters should receive as much sunshine as possible, otherwise a hundred-watt electric lamp can be arranged over the vivarium to give periodical "artificial sunlight."

Some people—including myself—have tried hibernating these babies in an indoor room where the temperature does not fall very low but is not high enough to induce feeding or activity. My experience has been that the babies come fairly successfully through the winter, but they die off during the ensuing summer. Probably they have become too weakened during their overlong period of hibernation to rally properly.

Our late Editor, A.E.H., kept his with fair success in the hearth during the winter—he had some sort of vivarium fitted up for them and they fed well all the time.

(*To be continued*)

## CLUB DIGESTS

*The Belle Vue A. & P.S.*—During a discussion on "Cold-water Fishes," a member mentioned that on a recent occasion he was called upon at short notice to visit the house of a friend some miles away, in order to give advice on the treatment of three sick goldfish. On arrival, he found the three fish housed in a twelve-inch globe, the sides of which were coated with spawn. The latter had been mistaken for some mysterious sign of illness. This particular member is in the habit of smashing every fish globe he can lay hands on, but on this occasion he was content to have the fish removed to a more commodious tank and the globe left intact. The eggs appeared to be fertile, but some doubt of their likelihood of maturity in the hands of their present owner was expressed by our member. The explanation of the phenomenon was that the three fish had previously been kept in a tank four feet long, in a cool room. The temperature of the water in the globe was higher than that to which they had been accustomed.—J. N. Bernard.

*Welsh National A.S.*—In dealing with show points and the breeding of fancy goldfish, Mr. E. R. Blunsden pointed out that the important features were prominent colour, finnage, and balance. When showing pairs of fishes, the two should be as near alike as possible, both in colour and finnage. The essential features of the Comet were high dorsal and well-spread finnage, for from a judging standpoint the highest points are awarded for finnage. Differences between the Bristol and B.A.A. standards for the Shubunkins were referred to, the colour being described as a discarded artist's palette, bringing in all colours, with blue as a strong background.

Two-year-old fish were found to be best for spawning purposes, a greater percentage of good fry being anticipated at this age than with any other. Varying somewhat with the weather, March sees the commencement of the spawning season, with April and May as the best months, fry born at these times going ahead smoothly and rapidly. The importance of sterilising plants for the spawning aquarium was emphasised, Willow Moss being preferred for the purpose. The tying of the plants to the top of the aquarium, letting them trail in the water, was recommended, as also was the distribution of spawn-laden weed among other tanks to avoid overcrowding with fry. The use of live daphnia was advised against, so far as breeding tanks were concerned, since Cyclops were invariably introduced, these being harmful to the fry.—R. J. King.

## MELANIA TUBERCULATA

(*Continued from page 37*)

sand and soiling the water, or of disturbing plant roots.

Without hesitation you can put these snails in any aquarium, no matter how delicate the plants therein. A peculiarity of these creatures is their periodic disappearance, altogether at the same time, and quite by chance you can occasionally see only the ends of their shells protruding from the gravel. They pull their shells right into the sand. The reason? Maybe the food is scarce on the surface and they look for it in the depths. Anyhow, one day you will find all the animals again altogether at the same time, once more visible, with no account or reason for their action. Climbing on the glasses of the aquarium is never seen, on the plants rarely and never at all above water level. In general I have observed that only by a certain lack of oxygen will these snails abandon the bottom. In a good, illuminated and planted aquarium, with even feeble aeration, occupied by fishes, they remain at the bottom practically always. *Melania tuberculata* is viviparous. At irregular intervals one can detect small (1.5 mm.), colourless miniatures of the adults tracking along peacefully. The youngsters complete the coloration and design of the adult shells when they measure about 3 mm.

A temperature of 20 deg. C. seems to suit them best and even big fishes such as, in my own case, *Barbus everetti*, large Tetras, Cichlids, etc., cannot do them any harm. At the slightest touch the snails retract into their shells, with lightning speed—cover shut to finish! The shell does not form an interesting subject for attack by fishes.

Since the form and colour reminds one of the more attractive marine snails, I consider the animals a splendid addition to the few kinds already known to the aquarist.

I should be pleased to enter into correspondence with a view to the exchange of this species with other tropical species of mollusc.

(Letters will be forwarded to Mr. Lange addressed under separate cover to this office with 2½d. stamps affixed.—Ed.)

# MY TROPIC ISLE

By C. LESLIE CALDER

IT may sound egotistical to refer to the island that our party used as headquarters for a very unorthodox survey of a section of the Great Barrier Reef as "My Island," but always in my memories and recollections I think of it as such. The island I refer to is named on the map Allinson Island. Why, I do not pretend to know. Its nearest neighbour is Dunk Island, famous as the home of the writer "Beachcomber," who lived and died there. The cairn erected by "Beachcomber's" wife is still to be seen on Dunk Island, and after his death she lived there alone for many months before a passing steamer took her off. Before I come to describe more fully life on the island, I had better pick up the threads from a previous issue, where I left you on the last stretch of the Journey down the Tully River. (See February issue, page 400.)

When the actual mouth of the river was reached, a sight presented itself such as I had never imagined could exist. The tide was out and the river "petered out," being divided from the ocean by a "bar" of yellow sand which extended for about two or three miles.

As we had been travelling since early morning, and as it was impossible to make progress towards the island until the tide turned, allowing us to "cross the bar," our thoughts turned to food. My friend and acknowledged leader of the "expedition" seemed to know instinctively how to proceed.

The drag net was taken from the boat to a tidal pool, which measured some 12-14 feet across and 100 feet in length. No sooner was the net stretched across one end of the pool and dragging commenced than the water became a turmoil, and it was quite obvious what was to be for lunch. Hundreds of Garfish could be seen making a frantic, agitated effort to escape the net. These fishes are of the family Hemirhamphidæ and there are many species and types to be found in estuaries and along the Australian coasts. There also exist several fresh-water types. All varieties are very delicately flavoured and are greatly used for culinary purposes. The bodies are very slim and are covered with thin scales. I would suggest as a picture of the type we found in this pool, the coloration of a bleak and the shape approximately, at least as far as body contour, of a baby pike.

The most pronounced feature is, of course, the lower jaw, which is formed in the shape of a spear, the length of which is variable in the different species. In Australia the Garfish is often incorrectly referred to as "Guard-fish." One reason I have heard is that these fish go before shoals of larger fish to form a "body-guard," and another suggestion is that the spear is used as a weapon of defence. Both of these theories are as incorrect as the appellation of "Deaf-adder" given by many Australians to the Death-adder, who try to justify the reptile's incorrect name by stating that the little adder really is deaf. However, that is by the way. The Garfish certainly do move about in very large shoals and are always observed near the surface of the water. When pursued they will leap violently from the water. So varied are the species that certain of them are sometimes mistaken for flying fishes. An enlargement of the pectoral fins enables some of these Garfish types to glide through the air after leaping from the water. The length of the fish taken in our net varied from 8-10 inches, and thus coincided with the size of at least two of the fresh-water types which I had come across in the rivers of New South Wales. It was but a matter of seconds with the drag net to obtain sufficient of the fishes to make a meal. These were cleaned, cooked in fat, and with some "damper" and a billy of tea cooked on a fire made of brushwood, we enjoyed the first meal of the trip. When the repast had ended the tide had come in sufficiently to enable us to proceed on the next stage of the journey.

The equipment was stowed away and late in the afternoon we set out on the journey from the coast to the little island which was just visible.

A stiffish breeze had sprung up, cooling the air to a very marked degree. In this latitude darkness follows sundown with great rapidity; there is no twilight, the merging of daylight to darkness being the matter of less than a quarter of an hour. The engine stopped suddenly, after a mile or so, and on endeavouring to re-start it not a "kick" was forthcoming, and for quite a while we drifted and wallowed in the increasing breeze. For my part I was not too happy or comfortable. My teeth were chattering, partly from the sudden chilling of

the air and partly, I suppose, from tiredness and excitement. All day I had been keyed up, doing things, seeing things, and then—this sudden "nothing." Drifting! At this stage it was discovered that by some accident the oars had been left behind on the river bank where we had stopped for our meal. After much spinning of the fly-wheel, examining of carburetter and other mechanical ditherings, it was found that the petrol feed-tap had been accidentally turned off! Relief and smiles again! One spin and the motor once more burst into its cheerful splutter. Full speed ahead now and just as it got really dark we drew near to the golden beach of the island.

I feel that I must relate the following incident; although it has little bearing on aquatic life it is to me one of the outstanding features of the whole trip.

My companion had instructed me that as the boat grounded I was to jump out into the water and pull the boat up as far as possible and keep the prow to the sea, lest the surf should cause it to swing in broadside and be overturned. Sitting in the boat feeling very cold and wretched, I was dreading the moment that I should have to jump into the water. The more I thought of it, the worse became the prospect. At length the dreaded moment arrived, I heard and felt the boat's bottom touch the beach and, gritting my teeth, I sprang overboard into about 2 feet of water. Instead of the cold shock I had been expecting, I received a shock which was a pleasant one. The water was deliciously, comfortingly warm. I should have known! Elementary geographical teaching returned in a flash—of course, water retains its warmth for a greater period than atmosphere. Trivial though the incident may appear, it stands out in my mind to this day as an event. In a now much happier frame of mind, the boat was beached,

*Photo: Courtesy Director of Australian Trade Publicity.*

"My Island . . . A Stiffish Breeze . . . Darkness Follows Sundown . . ."

the fly rigged over a low branch of a tree, a fire lit and the billy boiled. A smoke, a chat and then with a hole dug in the sand for the hip, we were lulled to sleep by the "gentle roar" of the surf for the first night's repose on "My Tropic Isle."

We were up and doing at daybreak, 4 a.m., and by sun-up, had already taken a good look around our island home. The first thing to catch my eye was an immense turtle, swimming elegantly a few yards out. Such a tremendous fellow, but which of the many species I could not make out. In parts of Northern Queensland there is a considerable industry built around these turtles, some of them being used for food and others for their shells.

This island is not a coral island, that is not a comparatively newly-built up island, but one of the many "mountain islands" which are fragments of a former coastal range. Allinson Island is clothed almost to the water's edge with forest of palm and pine, and a beautiful clear stream was found cascading through tangles of green foliage to the beach of yellow sand. The island is quite small, being not more than three miles in length and approximately a mile across at its greatest width. From a distance the stream itself was not visible, but its effects were manifest, for at this point the vegetation could be observed to be remarkably more dense and strong in colour. There was apparently no animal life, but bird life was prolific. Whole families of birds were to be seen on all sides, many of them new and strangers to me, but the familiar parakeets and cockatoos were present in large numbers. The small lizards and reptiles, so abundant on the mainland, were also apparently absent.

At the water's edge fishes were observed "walking" along on the sand, and as we approached they swam off to apparently re-appear a few yards out, skimming the surface of the water. These proved to be Gurnards, and there are many species of the family Triglidæ to be found in these parts. In all the species the head is encased in bony armament and in some of the species there are bony plates covering the body. The colourings of these Gurnards are as beautiful as they are varied.

Those predominating around the island were tinged with green, blue and golden yellow. The "creeping" on the floor of the ocean is made possible by the enlargement of the lower rays of the pectoral fins. Actually, when we waved off the "creepers" and a few seconds later saw the "skimmers," it was coincidence that the two shoals were in the vicinity at the moment, for the "skimmers" are a different species from the "creepers" and belong to a distinct but allied family which are known as the Flying Gurnard (*Dactyloptena orientalis*). It is an even more pronounced fin development of the "Flying Gurnard" over the "creeping" types which causes them to be often mistaken for the flying fish, as are some of the Garfish types already described. [The true flying fish was not observed, in fact the only occasion that I can recall them was in the Indian Ocean and quite a time after the Barrier Reef visit.]

The sharks of the district had evidently been informed of our arrival, or did they smell fresh meat? For while breakfasting no less than eleven of them paid us a visit. Three of them very obviously were Tiger Sharks and the eleven tell-tale fins above the surface could all be observed at one time. There was no question of seeing a shark and counting the same one *ad lib*. The three Tiger Sharks kept to themselves and came closer inshore than the other eight. In the calm shallows they turned and cavorted, enabling us to distinguish the dark spots and bars on their light-grey undersides, from which colouring they take their name. The Tiger Shark is by no means the largest of the sharks, but is considered the most dangerous on account of its curiosity, which takes it into shallow beach waters. On the bathing beaches in the South it is nearly always the Tiger Shark which snatches the limb of some unfortunate bather. It is my idea that these attacks on bathers are not deliberate or premeditated, but that in the scurry and noise on a busy beach the shark "loses its head," becomes "nervy" and snatches at the first object it sees shimmering through the water.

Three days passed whilst we thoroughly enjoyed our amateurish survey of the island, and then, with a view to experiencing the wonders which were the primary object of the trip, we prepared for the journey out on to the actual Barrier Reef, which at that point lay just a short distance seawards from the island.

*(To be continued)*

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According to the report of the Director of the Aquarium, New York Zoological Society, the European Bitterling, *Rhodeus amarus*, has become satisfactorily established in Woodland Lake, Westchester Country, U.S.A., where it was introduced a few years ago.

# PIONEER AQUARISTS

## *1. Joseph Sinel*

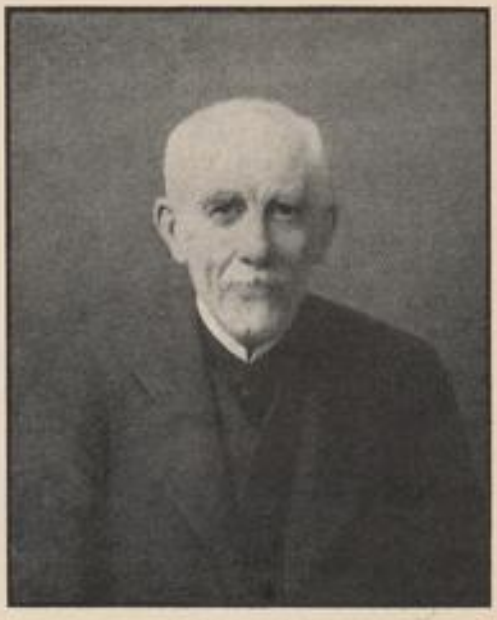
By L. R. BRIGHTWELL, F.Z.S., Member of Marine Biological Society

FROM 1891 there stood for many years, upon the Harve-de-Pas, Jersey, a beautifully-appointed Marine Biological Research Station and Aquarium. It was only seven years younger than the mother station at Plymouth, and was very much needed to cope with the growing demand for material required by the fast-growing band of serious workers investigating our fisheries. That the station eventually fell on evil days may be attributed to its inaccessibility from the mainland, and lack of Government support, without which few such stations can exist. It became a temperance hotel, the tanks converted into bedrooms for a different class of water-drinkers to those originally occupying them! The station owed its being to two men—James Hornell, now superintendent of Pearl Fisheries to the Government of Madras, and the subject of this present brief tribute.

Joseph Sinel was one of the great pioneer aquarists, and a unique figure in many ways. Born of old Huguenot stock in 1844, he made such use of the then very scanty educational facilities as to become manager of the furniture department of a large St. Helier's merchant house.

But his heart was ever with the sea, and all things in it, and when thirty-nine years old he threw up commerce and launched out as a taxidermist. Curiously enough, taxidermy was the "jumping-off" ground for A. D. Bartlett—the most famous superintendent our London Zoo has ever seen. With young Hornell, his son-in-law, he founded the aquarium, and on its dissolution took over the regeneration of the local oyster fisheries, and later the curatorship of the St. Helier Museum.

This collection represents twenty years' continuous work, and is a veritable monument to one man's industry and resource. It contains a complete collection of the entire local fauna, maritime and terrestrial, every specimen—and there are many thousands—being prepared by his own hands. The archæological and prehistoric rooms, and several important works on these subjects, are similarly his work, whilst his "Outline of a Natural History of our Shores" (now out of print) is easily the best



Joseph Sinel

popular survey of our maritime fauna yet produced. The Guernsey Museum similarly owes much to him, whilst all the islands and islets of the Channel group came under his survey. There was little that he missed.

The writer's personal recollections of Joseph Sinel are many and delightful, dating from that halcyon pre-war period when the late Professor Unthank—living image of Conan Doyle's Professor Challenger in the "Lost World"—conducted Easter classes from the Birkbeck, amidst the maritime paradise of St. Clement's Bay. Whenever curatorial duties permitted, Sinel guided us amongst the tortuous waterways and lower reefs revealed at low tide, and at "Springs" the sea receded for a mile or two. An easy place for the stranger to be marooned. Rescues by boat were a frequent occurrence.

Sinel was the nearest approach to a merman humanly possible. He was at this time near-

sixty, and a fine example to those naturalists " who object to wet feet. If a good specimen lay well beyond the reach of longest-handled net, Sinel walked into the sea fully dressed—and emerged, dripping but triumphant. Back ashore, he beamed on the prize, and invariably declared that it did one good to behold it. He was an inevitable companion upon Saturday morning shooting excursions. Then, as now, St. Peter's fish market was gay with piles of fish and molluscs, species rare on our coasts, but common in that almost Mediterranean water. Of these, Sinel's popularity with the Jersey fisherfolk ensured that one got a fair fisherman's worth. Scouts were in his pay on every reef, and at every lighthouse. A devoted shore staff manned the boat he used for dredging and tow netting, and he enjoyed the unique privilege of long stays upon the beautiful island of Herm, then leased to a wealthy princeling.

Whilst always preaching his gospel of the well-appointed aquarium, Sinel insisted still more on the value of field work—and here his methods were nothing if not original. No other naturalist has given so full or accurate account of the " home life " of the octopus. He studied this mollusc on " Whipsnade " lines. Besides keeping octopods in tanks, he confined many in enormous wire cages—veritable flight aviaries—securely anchored in deep rock gullies. To these he repaired when-ever the tide permitted, and so met these much-misrepresented creatures as nearly " on their own ground " as it is possible for an air-breathing human to do.

At night, J.S. descended on us in our beach-side lodgings, and through dense clouds of tobacco smoke talked by the hour, far into the morning, on the previous day's catches, or favourite hunting grounds known to none but him-self, and at times cast lurid sidelights on his nefarious activities. On one occasion he was called in by a local hospital to make a cast of a peculiarly repulsive and distressing ex-ternal growth, which had caused the death of a patient. He worked at this grisly task until long after midnight, then hurried home to get a few hours' rest before filling the moulds and colouring the casts " from life."

" Couldn't sleep a wink between getting to bed and breakfast," he concluded this professional extract.

" So ghastly? " queried a hard-boiled medical student member of our party.

" No," said J.S. simply, " just excitement. So eager to get back to the work again."

That white-hot enthusiasm was very characteristic of Joseph Sinel in everything he undertook. He always maintained that one of the most productive periods for shore work was that brief and tricky interlude when the tide is just upon the turn. One moonlight night he took us out to a gravel reach, fully two miles from the land. We were groping among the stones for nut crabs and other creatures that, stirred by some mysterious instinct, were rising to the surface and making seawards, when a curious thing happened. First one and then another of us thought he was being pelted by his companions—missiles striking us on bowed heads and backs, though each in turn protested his innocence of any horse-play. There was general consternation until Sinel showed us what was happening. Hundreds of a big cockle—Glycemeris—each the size of half-a-crown, and heavy in propor-tion, were struggling up to the gravel surface, and then leaping, several yards at a bound, towards the fast-approaching waves.

At his death, in 1929, Sir Arthur Keith paid a glowing tribute to the genial and tireless spirit which did so much to arouse the now almost universal interest in the world of water.

## HOT GINGER !

That curious aspect of human psychology which demands that our musicians should adopt foreign names, or our menus be printed in French, is very much in evidence in the aquarium hobby. Fishes from any other country but one's own are welcome.

Innes quotes the case of *Notropis hypsclop-terus*, which is most attractive to Americans when introduced as a new importation, but dropped hurriedly when they learn it is American, while our own generally despised Three-spined Stickleback is listed by him as an exotic aquarium fish.

Now T. P. Chen, writing in the latest number of the " Hong Kong Naturalist," says : " Within the last few years aquarium keeping has found many enthusiasts, both in Hong Kong and China. Most dealers and fanciers of aquarium fishes, however, are only interested in imported foreign varieties, although there are quite a number of Chinese native fishes that really will make suitable and interesting pets in the tank. There is a common Chinese saying that ' local gingers are not as hot as gingers from foreign soils.' " And Chen's list includes the White Cloud Mountain Minnow !

## LIVING MICRO-ORGANISMS ON THE SCREEN—(*Cont. from p. 47*).

interest worthy of the Exhibition's first display in its own new home.

### Specimens from U.S.A.

The first trans-Atlantic specimens have just been received by Mr. Ellis.

They include some hundreds of eggs of Artemia, the shrimp indigenous to the Great Salt Lakes, which have been forwarded by an American Aquarist Society. The eggs are found in the caked salt and mud at the edge of the lakes. They have already been put into favourable hatching environment.

North Carolina University sent a tube of encysted Didinium, the organism which preys fiercely on Paramæcium, but the tube, which should have contained millions of the cysts, was broken. Therefore the packing of cotton-wool and the remaining contents of the tube have both been placed in suitable Paramæcium cultures at the laboratory at Shere, where the organisms for the demonstrations are being gathered together. Mr. Ellis states that although Didinium is normally found in this country, neither he nor any of his collaborators has been able to find it, despite thorough searches in likely places for the past three months.

The other work now in hand consists of building up suitable media for a large variety of organisms in the new laboratory that is being established at Earl's Court.

Cultures of Chilomonas are being built up in an infusion of timothy hay, yellow split peas and wheat grains to provide a medium for culturing Euplotes. Chilomonas cultures in egg-yolk-paste are providing a medium for the production of Paramæcium to which the Didinium will later be introduced. Paramæcium is also being raised on *B. coli* cultures, and marine and pond diatoms are being cultured to provide breeding environment for more interesting forms.

Between now and the opening date a number of trial demonstrations are to be given at Earl's Court.

# JAPANESE LOACHES

Subsequent to my recent article on the loaches, a large consignment of these fishes, from Japan, has been imported by the Artistic Aquaria Co. Most of them belong to two species, *Misgurnus anguillicaudatus* and *Cobitis tænia*, mentioned in my article, but among them were also some specimens of what I consider a distinct species of Cobitis.

When seen in life, it is quite a different colour from *C. tænia*, the back being bluish-grey, minutely punctuated, while along the middle of the side is a narrow black line composed of numerous small spots fused together. Moreover, it is a much more elongate and slender fish, with a smaller head and other measurable differences.

This fish was originally described as *Cobitis japonicus*, but as the name was already in use for another member of the genus it was not available, so it was renamed *C. biwæ*, by Jordan and Snyder, in allusion to the fact that it is common in Lake Biwa, Japan.

Subsequently, it has been regarded as a mere variety of *C. tænia*, but I find that, although examples of the latter species from the same localities show great variation, none of them can be mistaken for *C. biwæ*, which can be picked out at once and is, in my opinion, a distinct species.

Incidentally, the Japanese specimens of *C. tænia*, as mentioned in my previous article, have smaller spots along the side than those from Europe, and if they are regarded as a sub-species, they should be called *Cobitis tænia sinensis*.

A.F.B.

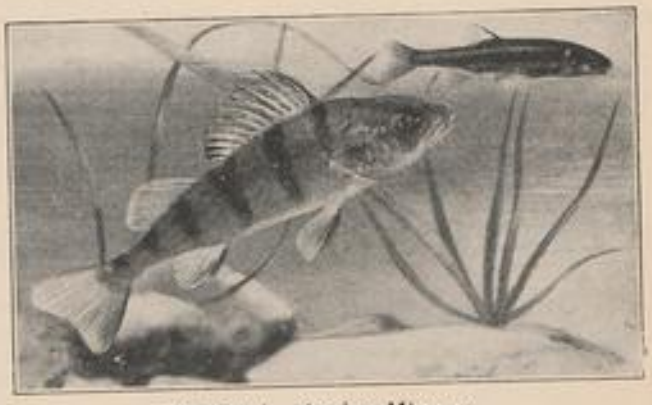
(Top) Cobitis biwæ. (Bottom) Cobitis tænia.

# THE PERCH

By IAN HARMAN

THE Perch is possibly the handsomest of all our fresh-water fishes, both in bold outline and striking markings. Anyone desiring a change from the more ordinary cold-water subjects could do worse than investing in a few specimens of this fine fish.

Being voracious and carnivorous, the Perch cannot be put with any other fish, and so are not suitable for pond or community tank; but there are few more attractive sights to the aquarist than a nicely furnished tank of Perch, and it is well worth the trouble necessary to keep these fish supplied with proper food.



The Perch, chasing Minnow.

It is unfortunate that Perch will not eat artificial food except such kinds as shelled sea shrimps and hard-boiled yolk of egg. Natural foods must be given, such as worms and insects. If you breed Fancy Goldfish a few Perch are useful to dispose of those specimens which do not come up to the desired standard.

The Perch is definitely an intelligent species. I have known specimens take food from the fingers when they have been wild-caught and only a few days in the aquarium. But the Perch is noted for its boldness and rarely takes fright when one approaches the river bank as do the majority of fishes.

In rivers the Perch generally keeps close to the banks, the shoal selecting some special deep hole. On fine days when the water is clear you can often see them in their home, swimming to and fro.

The Perch has a wide distribution, ranging throughout Europe and Siberia. It occurs in the rivers of the Mediterranean and Black Sea, in the Caspian and Lake Baikal. In Britain it is only absent or rare in Scotland north of the Forth. It does not like extremes of heat or cold, though otherwise a hardy fish. It is essential in the aquarium to keep the water temperature low; if it rises above 60 deg. F. the fish soon show signs of distress.

In this country we know the Perch as a river fish, but abroad it also occurs in brackish waters, as in the Baltic, where it spawns in the bays and coastal waters in summer. It was known to the ancient Greeks and Romans, the first account of its habits being written by Aristotle.

In appearance the Perch leaves little to be desired and shows up splendidly in an aquarium, though it is not especially attractive when viewed from above in pond or river. It is rich greenish-brown above, passing gradually into golden white below. A distinctive feature are the transverse dark bands on the sides. These number seven in the young fish, but as it grows some of the stripes merge and usually the adult fish bears only five, counting the forked centre stripe as one. The anal and pelvic fins are bright crimson, the other fins being brown with minute black dots. The eye is a striking feature, the iris being golden yellow.

Perch vary quite a bit in appearance, a hump-backed form being found in certain Welsh lakes. Almost white and uniform slaty-grey varieties are sometimes found, chiefly amongst pond specimens.

On account of the structure of the gill-covers the Perch can live a long time out of water. In some countries where they are sold for food, Perch are taken alive to the market and, if not sold, returned to their ponds in readiness for another day.

During the winter the Perch retires to the deepest available water and remains in a sluggish condition.

The spawning season is in April and May, when the fishes enter the shallows in shoals. Perch will spawn readily in the aquarium. The ova are deposited in long strings or chains generally attached to aquatics or the branches of trees hanging down in the water. A half-pound Perch has been found to contain 280,000 eggs. They hatch out in 18 days at a temperature of 50 deg. F., and the fry then measure 5 mm. in length. For a time they float near the surface.

The Perch is not a large fish, the average weight when adult being 5 lbs.

Do not use a smaller tank than 3 feet, as Perch must have room if they are to be kept in good health. Plant strong-growing aquatics rather thickly around the sides; if the ends are left clear the fish are apt to knock themselves against the glass.

# PUBLIC AQUARIUM NOTES AND NEWS

**BRIGHTON.** *Open daily, inc. Suns.*, 10-5.30. *Ent.* 6*d.*, *Ch.* 3*d.* The most interesting addition to the Marine Section is a "shoal" of about two hundred young herring. Other species recently received are Shad, Thornback Skate, Sand Ray, Ballan Wrasse, Codfish, Pollack, Sea-Anemones (in variety), Nurse-hound and Sea Cat (*Trachinus draco*).

"Octavius" the Octopus has achieved the somewhat unusual feat of successfully negotiating a winter in captivity. Emerging from his self-constructed "dug-out" a few weeks since, he is not only "sitting up and taking notice," but has re-discovered a long-lost appetite. Once again "Octavius" is keenly enjoying his bi-daily meal of living crabs!

**CHESSINGTON.** *Open daily*, 9.30-6.30, *inc. Suns. Ent.* 1*s.* 3*d.*, *Ch.* 1*s.*, *inc. Zoo, Games Enclosure, Circus, etc.* Recent arrivals include some large Veiltails and two three-foot alligators, lately the property of Mr. B. W. Thaler, now deceased, presented by Mrs. Thaler. Known as Spit and Polish, they have been exhibited at many shows and are well known. A strange feature of their behaviour is their consistent refusal to feed when two European Pond Tortoises are removed from the same tank, these two terrapins being notable for the fact that they have lived for several years under tropical conditions, a possibility frequently denied by writers on these creatures.

The tanks are being rapidly overhauled in readiness for the opening of the season and the anticipated Easter crowds.

The 75-foot lily pond has been completed under the guidance of Mr. Amos Perry, who is in entire charge of the gardens, and will shortly be stocked up with plants.

**BLACKPOOL.** *Open daily, inc. Suns.*, 10 *to dusk. Ent.* 1*s.*, *Ch.* 6*d.* (*Suns.* 6*d. and* 3*d.*), *inc. Reptile House and Aquarium.* The tidal pool in the N.W. corner of the Aquarium is well stocked at present with a new lot of gaily coloured Sea Anemones brought from the Menai Straits. There are also varieties of crustaceans and Blennies.

The spring sunshine is having its effect on the water plants in the hatchery tanks, which are brighter than ever, and the fish are in breeding colour again. After a short non-production period the Scalares are acting like March hares and we are expecting to have a spawning soon from several mated pairs.

The Platys are increasing rapidly and the *Colisa lalia* are throwing extra large spawnings.

The Axolotls have been very prolific this year and all the spawnings have done well.

**CHESTER.** *Open daily*, 10 *to dusk. Ent.* 1*s.*, *Ch.* 6*d.*, *inc. Aquarium.* The shoal of young Dwarf Gourami is now growing into splendid fish and will eventually make very good exhibits.

The large pair of *Cichlasoma nigrofasciatum* have once again produced another large batch of young. In another tank a pair of *Betta splendens* have once more reproduced their kind.

Another interesting exhibit to the public is a large collection of Axolotls which have been hatched, and many other varieties of fish breeding continue to make the Aquarium a most interesting place.

*Other Aquarium news held over for lack of space.*

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