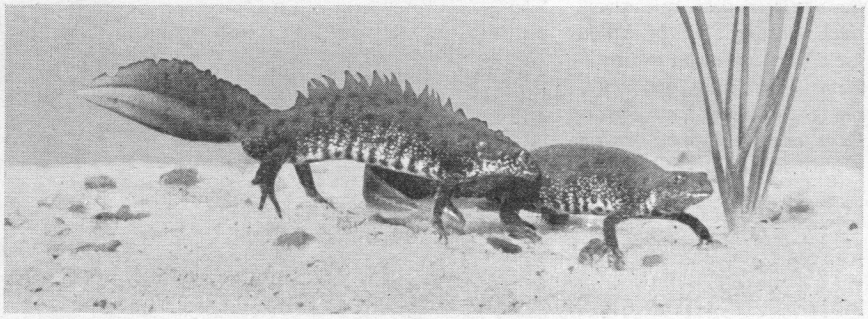
Springtime is Newt Time

by C. G. ASHDOWN

NEWTS are impostors. They parade about looking like direct descendants from the dragons of mythology, but in actual fact are absolutely harmless. Few people dare to keep them, and so they are numbered among the more unusual pets; yet to those who brave the protests of the female element in their household the newt is an interesting creature. It does not harm either fishes or plants, and will breed freely in captivity, the courtship being most elaborate.

Newts are found throughout Great Britain, abounding in most ponds and ditches from March to early September, and are easily captured in a net, by fishing for them with a lively worm tied to piece of cotton, or, a most exciting method, by stalking them from the bank and catching them in the hands. During spring and summer the male is distinguished by a crest which runs along the back and tail, and since the females are fatter and duller in colour, the aquarist should have no difficulty in sexing.



Pair of great crested or warty newts (Triturus cristatus). The male on the left is engaged in the peculiar "dance" observed in springtime, performed prior to the deposition of spermatophores used to fertilise the crestless female

Photo: W. S. Pitt

The species most likely to be caught is the smooth newt (*Triturus vulgaris*), which is about three inches long, with an olive brown back, and yellow and orange sides and underparts with black spots. The male's crest is tipped with red or violet. Our largest newt, the great crested (*T. cristatus*) may be six inches and is not quite so common as the smooth newt. It is much darker in colour, being almost black, and the male's crest is high and serrated. The great crested newt is a lover of the water, and looks particularly fine in an aquarium. Neither of these species occurs in Wales. A third species, somewhat rare, but found all over Britain, is the palmate newt (*T. helveticus*); it grows a mere three inches, and is easily identified by its spotless throat.

Newts eat insects, small tadpoles, grubs, worms, and lice; and in captivity they can be fed on small garden worms and gentles. A pair of newts in my possession ate an average of four or five worms a day, in addition to water lice, caddis worms, and tadpoles. I noticed that the female ate twice as much as the male, but I cannot say if this is the general rule. They will not touch their prey unless it moves, but are easily deceived. Drop a dead worm near a newt, move the worm slightly with a glass dip tube, and your pet will launch himself on the worm with all the fury of a crocodile. Nevertheless, there is no danger in handling the newt, as despite popular belief it cannot bite or sting; neither is the poison exuded by its skin harmful to man—unless taken internally.

Newts like to leave the water at intervals, and being able climbers they will soon escape from a glass tank unless it is covered. You should provide for your pets' needs in this matter by floating a piece of cork or well soaked wood in their tank. A much more attractive arrangement is to build a small island with some rocks and cement.

They take readily to life in a tank, and from March will breed there, the male wooing his mate by dancing in front of her, showing off his coloured underside, and waving his tail and crest. After this, he retreats a short distance, and deposits a small packet of sperms on the sand. Finally, he creates a current with his tail and wafts a secretion towards the female which excites her to pick up this packet with the sensitive cloacal lips. Unlike the frog or toad, the female newt deposits the eggs singly on the leaves of water plants—anacharis and water crowfoot are great favourites—and uses her rear legs to curl the leaf round the egg to conceal it. The eggs hatch in two to three weeks, depending on temperature, and the newly hatched tadpoles are half an inch long with a pair of large, golden eyes, and feathery gills for breathing.

If it is desired to rear the tadpoles, they must be removed to a separate tank containing a liberal supply of weeds. They will metamorphose in approximately four months, the forelegs growing first, which is just the opposite to frogs and toads. Then the young newt leaves the water, and often does not return to it until mature, some three or four years later.

In July, the male's crest will start to disappear, and as the cold weather draws nigh your newts will abandon the water to hibernate. Having no scales to guard against water-loss, newts must have a damp place in which to pass the winter, and suitable accommodation can be provided by placing a layer of earth in an old aquarium, or other water-tight vessel, to a depth of three inches. This should be well wetted. A few large stones are added to form suitable hiding places, and the newts introduced. Such a home must be watered at intervals to replace the moisture lost by evaporation. Perhaps the best thing to do in winter is to return your newts to their native haunts: they are easily caught again next spring.

The aquarist is not confined to the three British species, for many foreign species are available from the dealers. The marbled newt (*T. marmorata*), a handsome green and black species from France and Spain, will interbreed with our own great crested newt; and when the resulting hybrid was first discovered, it was mistaken for a distinct species and labelled *T. blasii*. Another species dwells in the subterranean waters of Texas, and has been pumped up with well water from a depth of nearly two hundred feet.

Keeping and Breeding Axolotls

by

J. LEONARD MONK

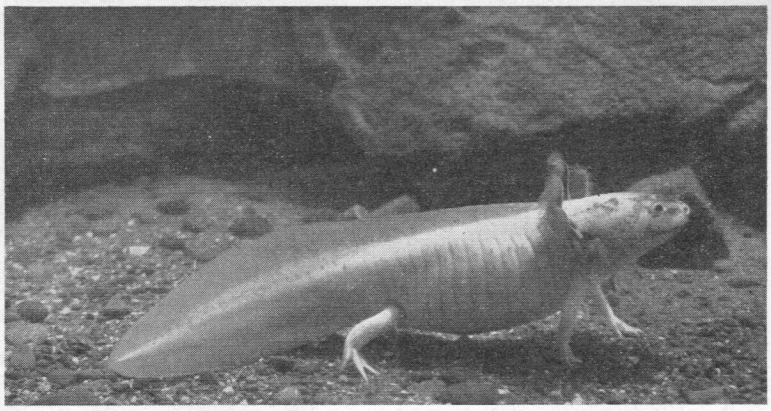


Photo: The Dominion A. & P.

An albino specimen of the larval salamander that never grows up—the axolotl

MANY of us, in our youthful days, with budding natural history instincts, have kept specimens of one or the other of our three English newts and have perhaps followed their life history from the egg to adult stage. If this proved interesting and instructive, a much magnified version can be obtained by keeping axolotls as aquarium pets. There is a paucity of literature on the subject of their care and breeding habits, and a few notes of my own experience may prove helpful.

The mystery of the permanent larval state of the Mexican species (the one with which we are dealing) and the inducement necessary to complete the metamorphosis into the land form of *Ambystoma* is well known to-day, although the riddle was not solved until about 1870, when the Jardin des Plantes in Paris successfully accomplished axolotl metamorphosis. Nearer home, my friend the late Edward Boulenger in 1912 succeeded in producing the same result at the London Zoological Gardens by gradually reducing the amount of water in which the axolotls were kept.

Strange to say, there seems to be no agreement on the size to which they grow in confinement, the estimates varying from six to twelve inches. I have three which are now three and a half years old—two are dark females, the other a white male. They commenced to spawn last year. The following are their respective measurements and characteristics:—

The females can be distinguished from the male by the more rotund bodies; their tails are broader (caused by a better developed median fin) but are shorter than in the male. The male is sleeker altogether and does not feed so voraciously. The dark females appear to be a dense black, but on close inspection they have a rugose appearance and are a deep brown. The young are distinctly a mottled light brown.

	Females	*Male*
Overall length	11 inches	11 inches
Length of tail	6 inches	7 inches
Circumference of body ..	7 inches	5 inches

Despite their size they do not require a great deal of space; mine are quite comfortable in a 24 ins. by 12 ins. by 12 ins. aquarium, but it is absolutely necessary to keep the water fresh and clean by a complete change once a week, wiping the interior of the tank thoroughly with a cloth. In the early days tragedy nearly overtook them; through ignorance of this necessary aquarium attention, a skin disease appeared which was only cured after salt baths, immersion in weak permanganate of potash and eventually weak T.C.P.

It is useless to attempt to hold axolotls out of water as their glutinous-like skin produces a slipperiness worse than the proverbial eel. They are lethargic and move very little unless frightened or when coming to the surface for extra air; if hungry they come to the front in anticipation of their food.

It is well to prevent them having paroxysms of fear, for they could easily come to grief against the sides of their home, therefore I accustom them to handling; this is done every time the water is emptied (to within a few inches). I also whistle to them every time their room is entered, and in recognition they flap their external gills.

Axolotls will attack anything alive. They lie motionless until their prey is within reach, then suddenly they show a surprising alertness and their victim is sucked into their capacious maws—on no account trust them with fish unless for food. They can be fed on garden worms, tadpoles, newts and strips of raw meat. The latter must be presented to them (not left on the bottom). When hungry they will come to the top and take it from the hand but it is quicker to present it in tweezers; these should not be made of metal as often in their eagerness to feed they will bite the metal. I have made a pair with bamboo strips about nine inches long.

My impression is that they prefer raw meat to anything else and during summer will want a meal every other day at least, less often in winter. The commissariat during the summer months is often taxed without a "frig," so the butcher's interest is solicited for scraps.

The courtship of axolotls is in no way boisterous, and spawning takes place at night, sometimes two or three nights in succession. The spawn is extremely adhesive and is deposited round the glass sides and bottom (I do not keep weeds or rockwork in their tank). The first spawn, about 500 eggs, occurred in January in a warm room, the second of about 1,000 eggs, a month later.

Because I saw feeding difficulties ahead at this time of the year, half of the first spawn was retarded in cold water; this delayed hatching exactly one month, by which time a nearby pond provided plenty of *Cyclops*, *Daphnia* and other small life.

The mucilaginous envelope containing the axolotl egg is about ten millimetres diameter, the egg itself about three millimetres. Unlike some amphibians, in which the envelope gradually dissolves to liberate the embryo, the axolotl

develops well within the envelope and liberates itself by its own action. Under normal conditions this takes place in two to three weeks and when first hatched the youngsters have well developed external gills. For the first few months development is rapid, about one inch a month, but by the end of twelve months the average is half an inch per month. The second year's average is a quarter inch per month, and the third's average is one twelfth inch per month, by which time I imagine they have attained maturity.

Rearing the fry in any quantity is fraught with many disappointments. Here are a few necessary precautions:—

At first a shallow pan is preferable, with about four inches of water which should be changed every day, at the same time circulating the spawn well; this also helps to liberate the fry when they are ready to hatch out.

If some of the spawn is seen to be infertile, remove it and any other eggs which show signs of disease. As soon as the fry are released or rather after two or three days when they start to feed, transfer them to smaller receptacles, to make observation easier, especially at feeding time. Change the water regularly.

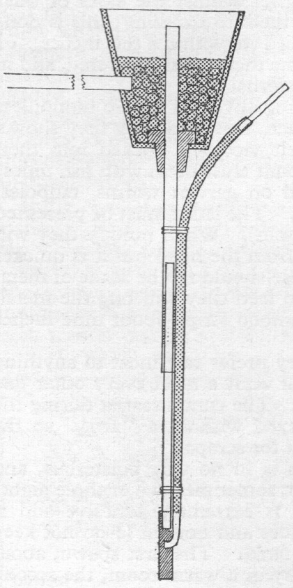
Food at this stage consists of aquatic micro-organisms. To collect these in any quantity a net of coarse muslin with a small bottle tied into the bottom must be fixed up. This is the same instrument that the aquatic microscopist uses but on a larger scale. It is advisable to have a stock receptacle into which the whole of the catch is emptied and from which the daily ration of the smaller insects etc., can be served. What other life remains after the *Cyclops*, *Daphnia*, watermites, etc. have served their purpose, is ready for the next stage of the young axolotls' growth.

If by happy chance plenty of white worms are available, the position is much easier, for these will be all that are necessary for this stage. The alternative is to remove the fry into the stock aquarium in which there will doubtless be a good assortment of the larger water inhabitants, such as blood worms, and other larval worms, planarians, ephemera, the water louse (*Asellus*), the fresh water shrimp (*Gammarus*), etc. Care should be taken to eliminate leeches, large dragon fly larvae, water beetles (some are carnivorous other are herbivorous).

If this aquarium is kept well stocked the youngsters can be left until they are old enough to be fed on small worms and gentles or hand fed on small pieces of raw meat. This must be fed to them, for they will not pick up inanimate objects. It might happen that growth is not equal; this should be watched as larger ones will show cannibalistic tendencies.

The cross breeding of the white and black axolotl or white and hybrid should, according to the recognised results of the Mendelian theory, produce a percentage of whites. So far as I have been able to observe there are only about ten per cent. white produced, and these, for some reason, appear to be more difficult to rear.

Home-made Filter *by* P. G. BAILEY



IN introducing this very efficient and cheaply made aquarium filter, aerator operated, I am giving the dimensions of the one I have made, but, of course, these need not be strictly adhered to. Procure a flower-pot three and a half inches across and four inches deep. Enlarge the hole at the bottom to take a large cork, preferably one with a shoulder, as illustrated. The existing hole can easily be enlarged by inserting a file loosely in it and gently turning, trying the cork in the hole from time to time in order to get a good fit.

Drill another hole in the side of the pot, about half way up. This is to drain away the filtered water. Make the hole large enough to take a piece of three-eighths rubber tubing, which should reach to the other end of the aquarium. A brace and bit can be used for this purpose, but do not use too much pressure, otherwise the pot may break. A piece of adhesive tape round the pot will help in strengthening it during the process.

A hole should now be made in the cork to take three-eighths glass tubing, which should be ten inches long. A red hot skewer can be used to start with, enlarging the hole gradually by turning it with a circular motion until it is the right size. It is advisable first to bind the cork with adhesive tape to prevent splitting; this should be removed when finished. A piece of five-sixteenths glass tubing, nine inches long, which should fit easily into the other glass tubing, should now be inserted and wrapped round with cellophane paper to make it fit nicely, taking care not to leave any paper in the air passage. These tubes, one sliding within the other, can now be adjusted to any length necessary, depending on the depth of the aquarium.

On the bottom of the smaller glass tubing, fix a piece of three-eighths rubber tubing two inches long, and make a crosscut in it to take the air inlet. A piece of wood inserted in the tubing before cutting makes this quite easy. Now take a piece of quarter inch rubber tubing (the sort usually sold for aerators), about eighteen inches long, and insert a small piece of glass tubing in either end. One of these should be bent at right angles in a gas flame. The other end is eventually attached to the aerator pump or to a bellows.

To assemble, place the cork in the bottom of the pot, push through the larger glass tube, then insert the smaller glass tube from the bottom, packing out with cellophane paper. It is now adaptable to various depths. Now place the smaller piece of three-eighths rubber tubing, which has been crosscut, on the bottom end of the smaller tube. Insert the piece of glass tubing which has a right angle bend, into the crosscut and secure to the main shaft with elastic bands.

After inserting the rubber tubing in the *side* of the flower pot fill up to this level with small stones or marbles and on this place a thin layer of cotton wool. The filter is now complete and ready for use. A piece of wood, one foot long, with a hole cut in it to take the pot, will be required to place across the aquarium and support the filter.

When you have a little spare time turn out your junk box and have a go at this novel filter. I am sure you will not regret the time spent in making it and you will save money too, an important consideration in these hard times !

The AQUARIST
AND PONDKEEPER

Founded in 1924 as "The Amateur Aquarist"

THE BUTTS, HALF ACRE, BRENTFORD MIDDLESEX

PUBLISHED MONTHLY

Editor : ANTHONY EVANS

Advisory Editor : A. FRASER-BRUNNER

SUBSCRIPTION RATES

The Aquarist will be sent post free for one year to any address for 19/6. Half yearly 9/9. Canada and U.S.A. $3.00 yearly ; $1.75 half-yearly.

QUERIES

Postal replies are made to all specialised queries accompanied by a stamped, addressed envelope. *This privilege is afforded only to registered readers and direct subscribers.* Subscription forms can be obtained on application. In all cases letters should be addressed to the Editor.

Correspondence with intending contributors is welcomed.

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The Editor accepts no responsibility for views expressed by contributors.

Elworth School, Cheshire, children visitors to the British Aquarists' Festival last month were among those who gave donations to "The Aquarist's" Hospital Aquarium Fund

VOL. XVI No. 3 1951

Editorial

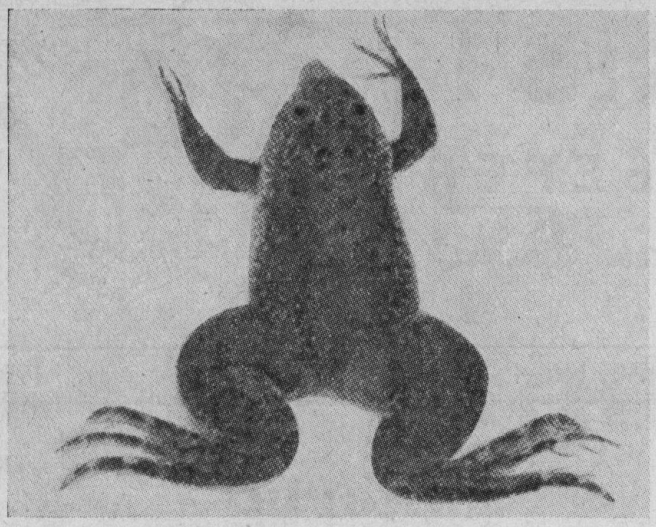
IT is no new departure for *The Aquarist* to raise its voice in defence of the tortoise. From our early days we have agitated for better treatment for these reptiles, with some success in obtaining improvement in transportation to this country, but the fact remains that the tortoise is still the most exploited " pet animal " we have.

Twice already this year have reports been made of finding large numbers of tortoises, dead and dying, jettisoned by persons unknown who had evidently become embrarassed by their unprofitable burden. One batch of these sub-tropical animals turned up on a London bombed site on a bitterly cold winter's day. Many were dead, many more had to be destroyed. Last month 1,500 dead tortoises were found in baskets on the foreshore at Barking. It can be imagined that for every such incident where the numbers of animals involved are of such magnitude to warrant mention in the National press, quite a few others occur that do not receive such publicity.

Just how many tortoises have been imported in the past two years is a figure that cannot be ascertained. Only recently one consignment of 100,000 was advertised. One fact we can be sure—only a minute fraction of the total number ever survives the first winter in this country. Rarely are these long-suffering creatures in good condition when they arrive, and although they are not difficult to keep, their needs and requirements are quite different from those of the usual run of pets and beyond the experience and interests of their average casual purchaser.

What can be the state of their numbers in the countries from which they originate? Is the natural rate of tortoise breeding adequate to meet the inroads made through the years by native collectors eager to supply these doomed cargoes at small cost to themselves? We doubt it. It seems likely that we are witnessing yet another ruthless and senseless extermination of a harmless and interesting form of animal life which because it is without voice, lacks fur or feathers and is quite defenceless, can be traded without fear of interference from authorities usually so active where cruelty to more conventional pets is suspected. Cannot this traffic be stopped before it is too late?

Vitamin Needs of Clawed Toads



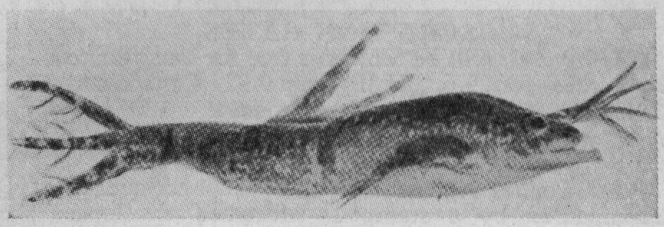
Overgrowth of the lower jaw in young toads is one of the first signs of rickets

RICKETS, a condition involving faulty bone development by young animals and humans as a result of deficiencies of diet, has hitherto been little studied in reptiles, amphibians and fishes, but it has now been described in the clawed toad (*Xenopus*). In a paper published in *The Journal of Endocrinology* (Vol. 7, page 64) two scientific workers, Dr. H. M. Bruce and Dr. A. S. Parkes, have given the results of careful and detailed study of rickets in this amphibian.

In their laboratory-reared stocks of *Xenopus* kept for two years on a horse liver diet, deformities were noticed : toads showed protrusion of the lower jaw, developed humped backs, and trailed their legs behind them in an unnatural manner. When disturbed, instead of swimming quickly away these toads' legs became stiff and transitory twitchings of limbs and bodies occurred. X-ray pictures showed that their bones were bent and obviously fragile, with fractures in the leg bones ; small bones were faint in outline and the pictures generally indicated lack of the mineral calcium within the bones.

Young toads were then grouped and kept on various diets to see what factors were needed to prevent the abnormalities from arising. Although adequate supplies of calcium carbonate (chalk) were given, normal development did not take place unless cod-liver oil was also available. Vitamin D contained in the oil is known to be required for normal bone calcium deposition in humans and also dogs, though other animals appear to grow normally (if there are sufficient minerals in the food) without the vitamin ; *Xenopus* is apparently extremely sensitive to its lack when bone calcification commences at the time of change from tadpoles.

Animal livers are good sources of vitamin but the varied experimental diets showed that responses in growth of young toads differed to horse liver feeds and rabbit or ox liver feeds. Horse liver failed to promote normal growth, for reasons unknown. Best results were obtained from feeding rabbit liver and adding chalk and cod-liver oil to the toads' aquarium water. Alternatively the oil can be given by injecting into pieces of liver fed to the toads.



Side view of toad showing over-developed lower jaw

Rickets evidences itself particularly in young rapidly-growing animals while bone is being formed, and it is important to see that they receive either diets adequately varied to satisfy their needs or to give foods supplemented with vitamins and minerals. These results are likely also to be of application in the rearing of young elegant terrapins, which so often become soft shelled and die in captivity.

Photographs reproduced by courtesy of The Journal of Endocrinology and Dr. A. S. Parkes

X-ray pictures of Xenopus toads: Centre; normal adult male from the wild. Left and right; abnormal skeletal developments in toads reared on inadequate diets. The toad on the right showed the "hump-backed" appearance due to poor calcification of the bones. Multiple bone fractures seen in the left picture arise from the same cause

Wall Lizards

by IRIS MURRAY

WALL lizards are typical Old World specimens of the true lizard family (*Lacertidae*) and there are so many species and varieties that herpetologists have never been able to agree as to the exact number. Colours of these lizards vary—blue, brown and grey, with black and darker markings, and the average size is between six and eight inches.

Wall lizards are widely distributed over Asia, Africa, and in Europe as far north as Belgium and Southern Germany. Like all members of the *Lacertidae* they are carnivorous, living on insects, snails and worms, while some of the larger specimens often turn cannibalistic and feed on their smaller relations. They appear to be fond of sweet food and sugar, and must be kept supplied with water to drink when kept in vivaria.

During the warm or hot sunny days in the Mediterranean area, they can be seen darting over walls or rocks searching for insects. Wall lizards possess digits which have smooth tubercular lamellae underneath, enabling the creature to cling to smooth vertical surfaces. In some south European countries where open air film-shows are given with white-washed walls used as screens, amazing results often occur when two or three curious lizards make their appearance together with a glamorous film-star! They love to frisk about or bask in the sun, but on dull grey days they can usually be found beneath a stone or in a crevice, in a lethargic state.

When the heat of the sun attracts them from their homes, at the first sign of danger they scuttle back to exactly the same spot. If however, they are removed from the locality of their hide-outs, they become decidedly flustered and are easily trapped. In spite of the fact that they are shy creatures, they are curious and this often leads to their downfall. They can be caught comparatively easily by attaching a noose to the end of a rod, and putting it over the lizard's neck. This method has been used in Italy for the past 2,000 years.

The hibernation period is neither long nor deep, and often on occasional warm days in winter, they can be seen basking in the sun. If plenty of climbing space is provided, and they are protected from frost, these hardy lizards will adapt themselves quite well to living in a dry sandy vivarium, feeding on meal-worms, flies and grass-hoppers and becoming quite tame if treated properly.

Lacerta muralis is the common wall lizard most often available in pet shops. Males are more colourful than the females and show black markings as well as traces of blue and green.

Photo: *Lionel E. Day*

Tubifex Troubles

(*Continued from the opposite page*)

fleas " basis. This minute worm apparently attacks the embryo young in the female, causing them to rot away and destroy the parent fish. I don't quite see how this explains my sickly male platy, but maybe he just had a bad hangover. Under this theory the cure appears to be to wash the *Tubifex* thoroughly and frequently, for this parasite apparently dislikes clean water as much as my young son.

So now I wash my *Tubifex* in streams of running water in the bath, a habit which delights my son but horrifies my wife. Then I assiduously chop them into the smallest pieces and feed the fish. No more fatal maladies have occurred since I've been pursuing this policy and I daren't change it in case they re-occur. But I'd be glad to know if there is a chance that one day I will be able to return to the halcyon days of feeding unwashed, complete *Tubifex* to grateful fish, safe in the knowledge that all the time my troubles were caused by too much starchy dry food.

Cedric Watts

Beautiful Gentians

(*Continued from page* 82)

grand in late August and during most of September, and grows in any good garden soil which is retentive of moisture. Like all its friends, it asks for full sun. A species which doesn't present any difficulty at all providing there is plenty of moisture is *G. sikkimensis*. It forms a mass of shoots which may be six inches long and comes into bloom about the end of July; flowers are the typical blue with a white tip.

To end with, there is *G. sino-ornata*, which was discovered by Forrest in Yunnan in 1904. Its undoubtedly the best gentian that has ever been sent to this country. It is easy to propagate, grows well, flowers late and it throws plenty of blooms at that. The colour is royal blue and on the outside of the flowers are broad bands of purplish blue interspaced with yellowy green markings. It likes a rich soil, plenty of moisture and no lime. It flowers with me from September until well on in November unless there is a severe frost earlier.

Mealworms and Flies as Live Foods

by

Dr. J. L. CLOUDSLEY-THOMPSON

THE only way to ensure throughout the year a regular supply of a particular animal, for food or any other purpose, is to maintain a culture. When a " food animal " refuses to breed, or does not thrive in captivity, supplies fluctuate with the seasons and shortages inevitably follow. Such is the case with *Daphnia*. Infusoria and micro worms are easily cultured as food for very small fishes, but few animals other than insects readily breed in captivity, and yet provide suitable food for larger fishes, amphibians and reptiles.

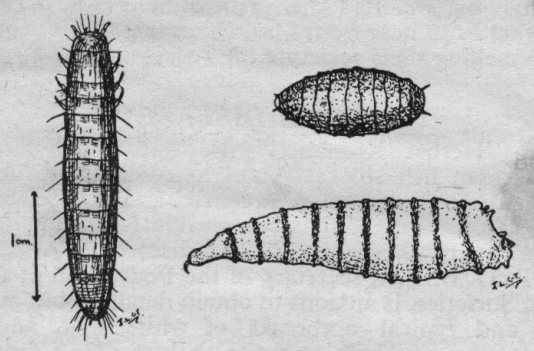
Mealworms

One of the easiest insects to maintain in a culture is the mealworm (*Tenebrio molitor*). All you need is a large biscuit tin with holes punched in the lid, and half-filled with bran or flour. A few mealworm beetles are introduced and soon breed, providing a regular supply of larvae which are particularly relished by lizards, etc. As the insects breed more quickly at higher temperatures, it is advisable to keep the tin in an airing cupboard, or some other warm place. Although the beetles can live for long periods in extremely dry surroundings, they do better if a moist pad of cotton-wool or felt lies on the bran. A large number of adults and larvae are always to be found clustered underneath this pad, and no time is wasted searching for them. If the pad is kept too wet however, so that the bran itself becomes damp, the culture is liable to become infested with microscopic Tyroglyphid mites. These will soon disappear if the bran is allowed to get thoroughly dry.

Maggots

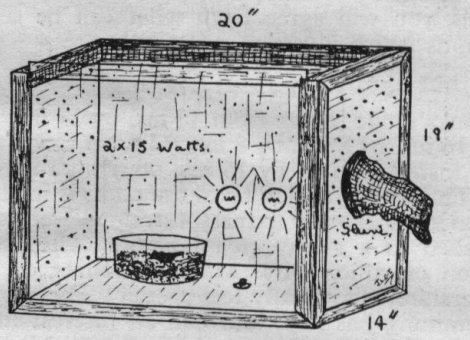
Although they have a tough outer cuticle, blow-fly larvae are readily eaten by small lizards, newts and fishes. In summer all you need to do is to expose a lump of meat or fish—an odd plaice head will do—and within a day or two it will be swarming with fat maggots. These are particularly useful when the soil is dry and worms hard to come by. But to obtain maggots in winter, the flies must be cultured.

For this purpose you must construct a fly-cage. A suitable type is shown in the diagram. The dimensions must not be too small as flies fail to oviposit if they are too restricted and do not fly about enough. The cage is constructed with a wooden framework. The sides and back are of hardboard or plywood, but it is advisable to make the base of thicker material so that it can be scrubbed periodically. The front and top are sheets of glass fitting into grooves in the frame. The latter slides into position first, and cannot be moved until the glass front has been lifted out.



Left: mealworm. Right: larva (above) and pupa (below) of the blowfly.

Two 15-watt bulbs provide light and heat, and the insects can be attended to, without fear of their escape, by means of the muslin sleeve. A knot should be tied in this when it is not in use. The flies are provided with water—a piece of moist cotton wool—and food in the form of sugar, etc. A piece of meat or fish lying on sand in a tongue-bowl or crystallising dish is provided for oviposition and development of the larvae. When these are fully grown, they burrow into the sand and pupate. Unpleasant smells can largely be avoided by using two crystallising dishes alternately, and storing the pupae in a cool place until more flies



An easily constructed fly breeding case lighted and heated by two low-wattage lamps.

are required for oviposition. Thus the number of adult flies and maggots can be kept within required limits. The method described above is particularly suitable for breeding blow-flies (*Calliphora erythrocephala*).

Hafez Method

House-fly maggots (*Musca domestica*) can be cultured most simply on cotton-wool soaked in diluted milk (three volumes milk to one volume water)—a method devised by Dr. M. Hafez. The flies feed on the milk and lay their eggs on the pad. The latter are then transferred to a two-pound jam jar containing a fresh milk pad, and tightly covered with a finely perforated tin lid. If kept at 27° C. (80° F.), fully-grown, healthy larvae are obtained in four or five days. At lower temperatures of course hatching and development take longer. The mature larvae usually collect and pupate at the upper, drier surface of the milk pad, which, by this time, has become blown up into a more or less spongy mass due to fermentation and the tunnelling of the larvae inside.

The emerging adult flies are transferred to the breeding cage to maintain the stock. The cotton-wool pad must be soaked only moderately to obtain the best results : excessive moisture may result in ovipositing flies being drowned, and may also check egg and larval development. Avoidance of excessive numbers of developing eggs in the milk pad prevents overcrowding of the hatching larvae.

The flour moth (*Ephestia kuehniella*) is another insect easily reared ; no doubt many other insect species might usefully be cultured by aquarists to provide constant and abundant supplies of live food throughout the year.

READER'S RECORD:

A Temple of Snakes

HAVING fostered a keen interest in snakes for some 15 years, I was very pleased to have the opportunity in September, 1950, of visiting the famous Snake Temple at Penang. I was returning home after three years in Hong Kong. During our ship's brief stay in port at Penang it was possible to go by car on various conducted tours, to places of special interest, including the Chinese Snake Temple.

After entering our names in a visitors' book and making a small donation to the temple fund, we were conducted over the premises by an Indian attendant. He pointed out to us the numerous live snakes, varying from slender youngsters of about a foot in length, to thick-set adults from two to three feet long, which were lying or leisurely crawling about upon various objects and the interior structure of the temple. These snakes were pit-vipers, belonging to the genus *Trimeresurus*, the species of which may be vicious and always ready to bite, or may be quite the reverse and docile, even when handled.

The snakes in this temple fell into the latter category and several adult specimens were freely, but carefully, handled by the attendant for the benefit of visitors; the snakes proved perfectly docile and made no attempt to bite. In the interests of accuracy, however, it should be added that one of the snakes (which was not handled) opened its mouth and struck when interfered with. With the exception of one or two large pythons, all the snakes on view were uncaged, though doubtless there was a means of preventing them from wandering after nightfall.

It is likely that most, if not all, of the vipers in this temple were Wagler's pit-viper, *Trimeresurus wagleri*, though *T. purpureomaculatus* has also been recorded as a species kept in the temple. G. A. Boulenger in his *Fauna of the Malay Peninsula* (*Reptilia and Batrachia*), 1912, referring to Wagler's pit-viper, says :—" Generally distributed in the Peninsula, and common in Singapore. Lives both on the ground and on trees. Feeds on mammals, birds and lizards. When annoyed, Ridley says, it opens its mouth exceedingly wide, showing its poison fangs, but it is very slow and stupid, creeping away in a leisurely manner. It is quite gentle in captivity. Its bite does not seem to be deadly for large animals."

The accompanying photograph serves to illustrate the gentle disposition of some, at any rate, of the snakes kept in the temple, though only an over-enthusiastic ophiologist is likely to handle live venomous snakes in this manner !

J. D. Romer

Our Readers' Write

(*continued from page* 149)

this can hardly be done, I certainly think Mr. Billings' idea of a displayed plaque or certificate in reliable shops is a worthwhile future project. With your experts' aid I have now got my tanks back to normal, but where I persevered, many another would have given up the hobby as a bad job. They say that experience bought is better than taught—but it can be discouraging.

J. R. BROOKS,
London, S.W.1.

Water Plant Exhibits

MAY I be allowed to register both protest and surprise at such ill-informed and abusive criticism (letter, *The Aquarist*, August), by an unqualified and self-constituted authority ?

When naming a plant, either use the common name or the botanical one, not half and half, such as " common " or " wild *Nuphar*;" why not state the variety—doesn't your correspondent know ? As for the plant being freshly pulled out of a river, pond or canal, I can give him the lie direct. The plant has been cultivated from a two-inch seedling (purchased from one of your advertisers) in a 36-inch tank for nearly two years. Anyone is welcome to come and see it growing. However, I now know from whence at least one dealer may possibly obtain his plants !

Nuphar grows from rhizomes, not corms—just elementary botany, but again your correspondent apparently does not know. As for " fancy names," why not use the common name of creeping jenny when trying to dispose of this terrestrial plant instead of calling it *Lysimachia* ? Still staggering—or tottering (?),

FRANK ARNOLD,
London, E.7.

Misplaced Geography ?

AS a dweller in that Mecca of culture, to wit, Whitechapel, I was not a little interested by Mr. L. R. Brightwell's article " Aquaria Down East " in *The Aquarist* last month, but I rather think that Mr. Brightwell is getting his districts a bit mixed. Nevertheless, as a dweller I am open to correction, as it has been proved again and again that one knows less about one's own locality than an outsider.

Mr. Brightwell mentions the underground railway with museum and library next door in the same line as the Whitechapel Art Gallery. True there is a library next door to both, but I have yet to discover the museum; perhaps it is tucked away in the library building, but if not, I can only come to the conclusion that Mr. Brightwell is referring to Bethnal Green Library and Museum, which is well removed from Whitechapel Library and (probably) " Museum."

Again, he refers to the shopping centre between Middlesex and Wentworth Streets. Now, this is definitely referred to, on Sundays, as " The Lane," and in my many hundreds of visits to this somewhat " Eastern " market

Functions of Amphibian Skin

by DR. E. ELKAN

THE more unfamiliar a subject, the more interesting is it likely to be. My particular pet, the South African claw-footed toad (*Xenopus laevis D.*), though it is kept in an aquarium like a fish, is still unfamiliar to most aquarists. I have only heard of a few cases where my attempts to popularise it have been successful and in those cases the owners of these new pets have certainly derived as much interest and as much amusement from them as if they had bought the strangest and most expensive new coral fish.

To the aquarist *Xenopus* is so suitable because it is an aquatic animal, and although it is not a fish but an amphibian, it lives like a fish in the rivers and swamps of the Cape peninsula. Unfortunately, living in the same environment, it eats fish too, and if you put a toad—unless it be a very young one—into a community tank, you can soon give up counting your fish. Your fish, if they could be asked their opinion of these toads, would unquestionably denounce them as alien pests and intruders ; creatures that have four legs and breathe air should, they would say, live on land and eat slugs. Little would they suspect how many points in the biology of *Xenopus* indicate the past where they and the fishes had a not too distant common ancestor.

When, in those days, amphibia began to go their own way, a few of the new families, having just become quadrupeds and lung breathers, gave up. They did not go on land, they remained aquatic, and in their quality of primitive batrachians, became interesting specimen to evolutionists. Very few animals are to be found along this branch of the genetic tree ; most of them never even reach the zoo, although a pipa toad can occasionally be seen there. We should be grateful therefore that the Cape Province has turned out an inexhaustible reservoir of specimens from one branch of this rare group.

The average member of a " brains trust," when asked to enumerate the main organs of an animal, would certainly include the brain, the lungs and the liver, but would he remember the skin ? I doubt it. And yet, the skin is an

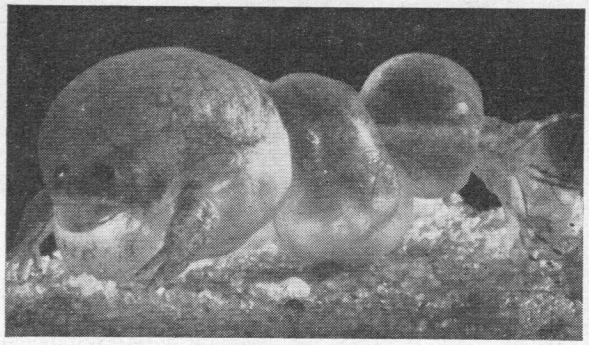


Fig. 1. Young Xenopus toad suffering from hydrops—accumulation of fluid in lymph spaces between skin and body. Cause of the disease is unknown and toads do not recover

organ as important, as irreplaceable and as highly specialised as the others. For the toad as much as for us, the skin is the frontier bordering on the big hostile world. The more messages the skin can receive, decipher and sort out into " beneficial," " hostile " or " irrelevant "—the greater our safety. In warm-blooded animals the skin, as a natural garment, can become of the greatest importanct in temperature regulation. Fish and toads follow the temperature of the water they live in ; their skin has other important tasks to fulfil. The water world is a murderous environment. Everybody eats everybody else—if he can. Whoever wants to live there must make himself as invisible as he can ; aquarists know very well to what length fish go in attempts at concealment. In fact, if we were taken to the natural habitats of most of our brightly coloured pets, we should, most probably, fail to see them. We should certainly fail to discover a *Xenopus* toad at the bottom of a pond and I wonder if there are many storks alive that have ever caught one.

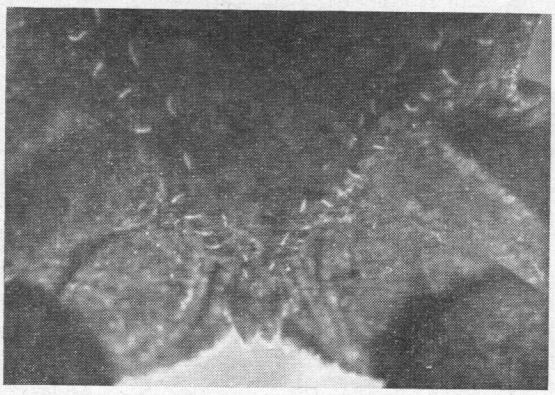


Fig. 2. This view from above of the posterior end of Xenopus body shows the "lateral line patches" in the skin

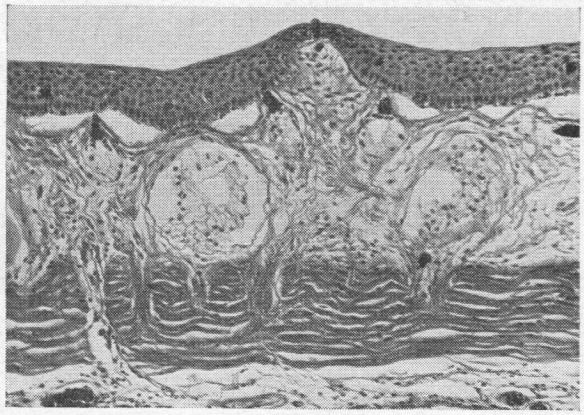


Fig. 3. Microscope picture of a thin vertical section through Xenopus skin, showing, from top to bottom, epidermis with tactile spine, corium spongiosum with mucous glands, corium compactum (consisting of collagen fibres) and the lining of a lymphatic space. The crescentic spaces between epidermis and c. spongiosum have arisen during shrinkage of the tissue

But, living in a South African lake, we must not only keep others from eating us ; we must feed ourselves, we must come to the surface to look for insects, we must come up to breathe, for we have no " Schnorkel " to help us and, before venturing forth from the safe mud at the bottom, we must know if there are large fish or crocodiles in the vicinity. We could, in fact, do with a radar system because our eyes are not of much use in the water. They look upwards only—towards the sky and the insects—and in any case, the water is probably muddy. What should we do without our skin, amazingly adapted to answer all these requirements ? Yes, even if we were caught, all might not be lost yet. Our toad skin can, in a fraction of a minute, make us so slippery, that no hand can hold us, and as for eating us—our inside may taste alright to anyone liking toads for dinner, but our skin is riddled with little sacs full of a distasteful and poisonous substance. We can feel pretty safe within this armour of poison.

A whole text-book could be written on the importance of the skin of an aquatic animal. *Xenopus*, though surrounded by water all its life, never drinks as far as we know. It gets little fluid with its food, yet produces urine containing mineral salts in a concentration higher than that of the water in which it lives. This excretion must be maintained to eliminate, at the same time, metabolic products no longer of any use to the body. But if water and salt are continually excreted and the toad never drinks, where does the supply come from ? It enters through the skin. In addition to its many other tasks the skin is a most perfect chemical filter and regulator, letting in water and salts just in the quantities needed and even letting them out again if conditions should change. Our knowledge of the osmotic regulation of fish and amphibia is still very incomplete, and much experimental work remains to be done in this field.

Even this impressive list of the accomplishments of the amphibian skin would be incomplete if we did not include the ability of colour adaptation. Only few of the terrestrial batrachians have retained or developed the ability to adapt their colour to their moods or to their environment ; *Xenopus* has retained a good width of adaptability and the aquarist can easily devise experiments to show how the toad can vary from a deep warm brown-black through all kinds of black-brown mottling to a brown-yellow, and even to grey when it feels very cold, miserable and dying. All these problems are solved by the skin. Could there be a more important organ ? And should we not like to know how it is all done ? In spite of the labours of generations of biologists, we know as yet very little about the secrets of the toad's skin. A large unharvested field remains for future generations.

If you have ever tried to skin a toad or a frog you will have found that, compared with the skinning of mammals, the task is a very easy one, because for the most part, the skin is not adherent to the body at all. Between the skin and the body there is a space, usually empty but for a little lymphatic fluid, and the skin is only held in place by fibrous septa which carry the nerves and blood vessels to the skin and which divide the lymphatic space surrounding the toad into a number of watertight compartments. How watertight these compartments are can best be shown when something goes wrong with the regulation and the animal suffers from an accumulation of fluid in the subcutaneous space (Fig. 1). In such animals we can, without the use even of a magnifier, study the arrangement of the septa and the lymphatic spaces. It is clear that the toad's skin has an outer and an inner surface. Both have interesting features.

The colour of a normal healthy *Xenopus* toad is that of a brown-black mottled pattern on the back, but white to yellow on the ventral side. Distributed on the head, the back and the abdomen (not on the arms and legs) we see short white lines arranged in rows, and if we compare

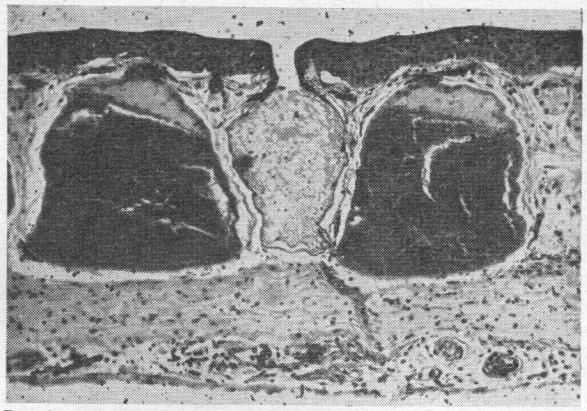


Fig. 4. Microscope picture of vertical section through Xenopus skin showing two full and one empty granular glands

several toads we shall find these white lines always arranged in exactly the same way. Now the coloration of all skin is due to the presence or absence of star-shaped cells (chromatophores) filled with fine granules of coloured pigment. If the cells flatten themselves out, so as to cover as much surface as possible, the animal becomes coloured. If the cells contract, the colour fades. Looking at the white lines on the back of *Xenopus* through a magnifier, we observe that the chromatophores do not invade this territory. I counted the number of these patches in one toad and found there were 264 of them. The figure is of a certain interest, as we shall see.

A look at the underside of the skin provides us with a most attractive picture of the distribution of the skin blood vessels. Since all these little arteries and veins are equally pigmented, their course can easily be followed and the density of this capillary network alone must be taken as an indication of the importance of skin chemistry to the toad. Further than this the naked eye examination cannot take us. From now onwards we need a microscope and—for some features—a good one.

A look at Figures 3 and 4 shows us the main structures making up the toad's skin. Starting from the surface we first find a very fine horny layer covering the epidermis. This is a dense, cellular structure of flat cells, covering the rest of the skin about 10 cells deep. It is loosely attached to the next layer, the dermis or corium which, in itself, consists of two very different layers. The outer one (corium spongiosum) can hardly be called a layer, since it

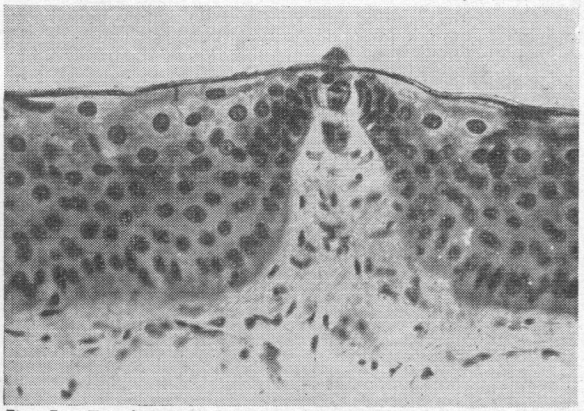


Fig. 5. Tactile papilla and spine seen in vertical section of Xenopus skin magnified ×250

Fig. 6. A vertical section made along a lateral line patch in Xenopus skin, exhibiting a row of five sensory buds (× 120)

consists entirely of skin glands held in place by a loose network of connective tissue fibres. The glands are of two kinds. One, visible in Fig. 3, produces a thin, mucous fluid as soon as the toad is alarmed by an enemy. This makes it so slippery that it is quite impossible to hold in the hand and, by the way, has helped to provide the second part of the scientific name : *laevis*=smooth. The other type of gland (Fig. 4) appears as a large, irregularly shaped sac, full of a finely crystallised secretion. This has been examined by Professor Gunn in Cape Town who found that small doses of it are quite sufficient to poison small mammals.

The third layer, the corium compactum, is purely protective and consists of a dense, thick screen of fibrous tissue (Fig. 3). The fourth layer carries the blood-vessels and nerves and connects the skin to the fibrous septa mentioned before. All these structures can easily be distinguished at low magnification in sections through any part of the toad's skin.

But there remain two other structures, both of great interest and both of utmost importance for keeping the toads informed on changes in the neighbourhood. Firstly the tactile papillae (Figs. 3 and 5). These are the organs through which the toad feels touch and, perhaps, water pressure. At the site of such an organ, the epidermis forms a short compact " spine " which protrudes a little over the surface of the skin. At the bottom the spine is met by a process (papilla) from the corium, which carries very fine nerve endings. These finish between some large nuclei just under the end of the spine and the whole arrangement brings to mind the arrangement in the modern crystal pickups where the movement of the gramophone needle induces small changes in electrical potential in a crystal. Something similar probably happens here but we are still far from understanding how and to what extent nature has anticipated our discovery of the piezo-electric effect.

And finally the most intriguing feature of the toad's skin : the sensory buds. Aquarists probably know that all fish have a lateral line which starts behind the gills and ends midways between the fins of the tail. Also, that this lateral line is of the greatest importance to the fish because along this line lie the organs which enable it to feel and react to the movements of the surrounding water. *Xenopus*, being as aquatic as any fish, has retained these organs from piscine past, but its lateral line has become split up into the short white patches already mentioned, each of which carries 5-12 of these sensory buds (Fig. 2). We understand why these patches could not extend to the arms and legs of the toad. Fish have no arms and legs and there are no sensory buds on their fins. The finding, staining and photographing of these lateral-line-buds needs much patience but with luck a row of them can appear in the field as in Fig. 6 or, at higher magnification, in Fig. 7.

We can then see that these buds are entirely products of the outer skin-layer, the epidermis, whose cells are, in these places, modified to form little cups with a slight central depression. The cups are filled with slender sensory cells each of which ends in a hair so fine that even a moderately good microscope fails to reveal its presence. Nerve endings can be found (with great difficulty) among the base of the sensory cells. Any stimulus touching the hairs of these cells, any slight movement of the water, any vibration set up by a potential enemy is, through this most sensitive apparatus, perceived by the toad, long before it can see what is coming. And its reaction, as soon as the intensity of the stimulus is suspiciously strong, is always the same : down into the homely, protecting mud, down until all tactile papillae signal : " equal contact with mud all around," down until the lateral organs cease to report any water movement, down until the whole complicated radar equipment is at rest again, down until the danger has passed. No U-boat can execute this manoeuvre as quickly as our humble toads and whether our radar and hydrophones are more efficient than theirs must remain doubtful.

Acknowledgement : *The sections from which the photographs Figs. 5-7 were taken, have been prepared by R. W. Murray, M.A., of the Oxford Institute of Zoology.*

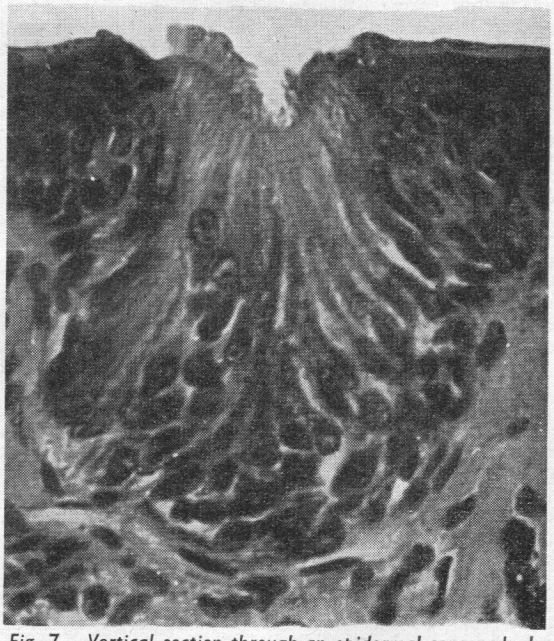


Fig. 7. Vertical section through an epidermal sensory bud to show sensory cells and "hairs" (× 600)

A Worm Infection of Toad Skin

by Dr. EDWARD ELKAN

Fig. 1. Normal lateral line patches of Xenopus. Note that the patches stand out white against the dark skin. The single neuromasts can be distinguished—5-10 in each patch. (× 10)

READERS of this article might do well to look up vol. XVI, pp. 164-166 (November, 1951) of this journal. They will find there a fairly detailed account of the normal structure of the skin of the South African claw-footed toad (*Xenopus laevis*). It is much easier to notice something abnormal if one remembers the normal well. Figure 2 in the article quoted showed the arrangement in the posterior end of the animal of the "lateral line patches."

We are all familiar with the lateral line in fish and we know that this is the seat of important nerve endings which keep the fish informed on water movements and vibrations and, possibly, about its own position with regard to gravity and water currents. It is far less widely known that lateral line organs occur in some amphibia too. They still take the form of lines but these are mostly broken up into patches and are by no means lateral only. But, however many there are, they never occur on arms or legs. There is a ring of them around the eyes, rows of them around the mouth, the chest, the back and the abdomen. Obviously, organs so widely distributed must be of great importance to the toad and we are not surprised to find that the nerve end-organs (neuromasts), of which there are five to ten along each patch, are supplied by nerves coming, not from the spine but straight from the brain. The importance of these nerves must be ranked with those of vision, taste and equilibrium. Without them the toad is as lost as if it were blind.

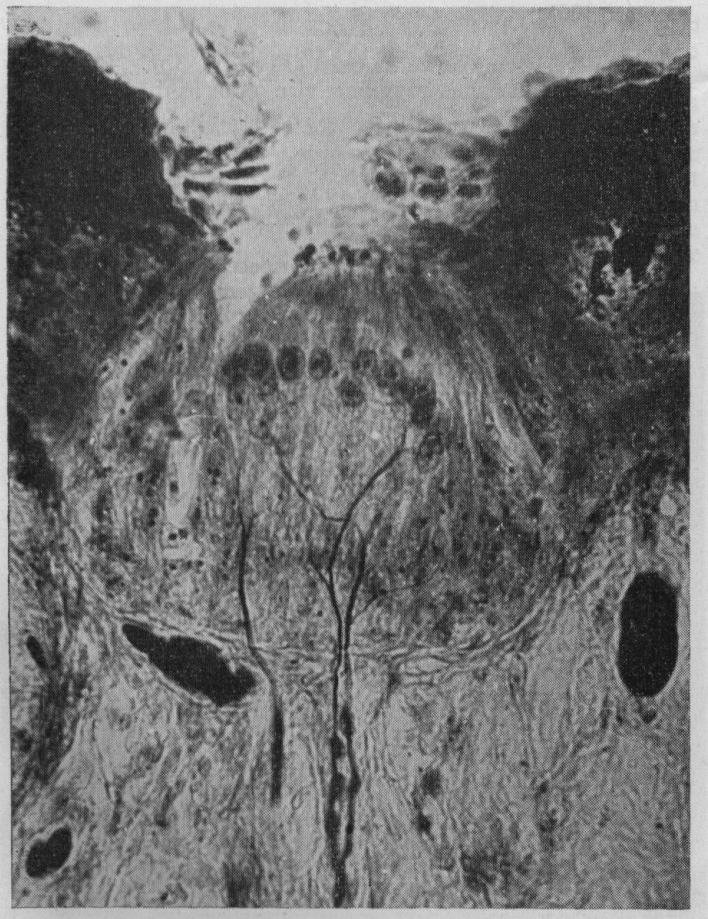
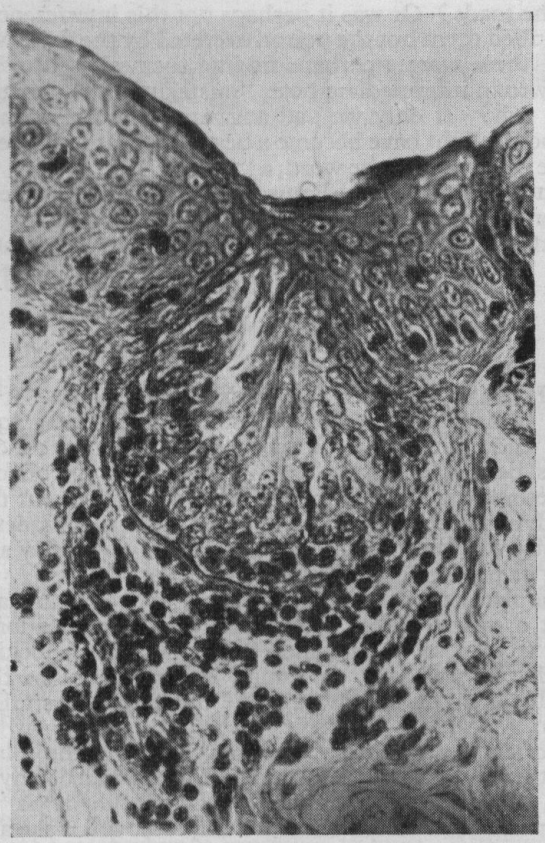


Fig. 2. Section through skin neuromast (sensory bud) of Xenopus, showing nerve fibres supplying the organ. (× 500)

There is no animal in which the normal lateral line patches are easier to see than *Xenopus*. In fact, they are so obvious and characteristic of the creature that they have jokingly been referred to as "suture lines." They do really look like untidy surgical stitches, white against the normally dark brown colour of the rest of the skin, and if you have kept *Xenopus* for a number of years you become used to their weird appearance and you expect to see them as they always are—mud-coloured with white lateral line patches. (Figures 1 and 2.)

I need not, therefore, describe my astonishment when, on looking over my stock of toads one morning, I found one specimen which looked like a photographic negative of the rest: the skin was pale yellow and the lateral line patches coal black. The toad was a fully grown female and had come from South Africa over a year ago. Its fellow travellers looked alright but this discoloured toad was obviously ill. It could not swim properly and had difficulty in coming to the surface. I took it out, very puzzled at what the reason might be for this colour reversion, put the toad into warm shallow water and hoped for the best. But the toad would not eat—always a bad sign in so voracious an animal—and during the third night it managed to turn over on its back, whereupon it drowned because it could not right itself. Three more cases, identical with the first, occurred after that among my colony.

Then the "epidemic" stopped, and I now wonder if I shall ever see such toads again. Not only did they show *every* lateral line patch pitch black, they also showed a line of these black patches running from the anus forward towards the middle of the abdomen where no "lateral" line



admit here that without the aid of friends both in Oxford and at the British Museum I should never have been able to unravel the plot.

The first thing I noticed on putting small pieces of skin under the microscope at low power and looking at the skin from the *inner* (under-) side was that, wherever there were neuromasts on the surface there were round, transparent little vesicles below, distributed, but not connected, with capillary blood vessels of the skin and surrounded by large black chromatophores (Figure 4). This explained the

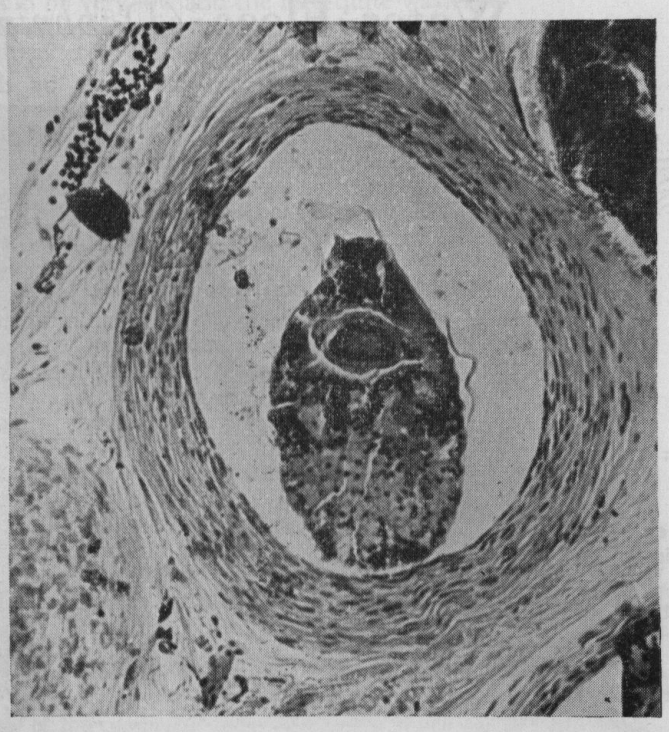


Fig. 8. Metacercaria (larval stage of a fluke worm), coiled up in its own cyst in Xenopus skin. (× 700)

blackness of the lateral line patches but it explained nothing else. What were these vesicles? What did they have to do with the blood vessels? Why did they occur under the neuromasts only? Why were they all of the same size and why were there always approximately the same number (10-17)?

The microscope, instead of offering a solution, increased the number of points that seemed enigmatic. Nor did this unhappy state of affairs change in the least when I looked at the first sections made of this material (Figure 5). Here were the little vesicles. They had thick walls, made of badly staining connective tissue, and an outer reinforcement of chromatophores. Most of them seemed empty. They had no connections with one another nor with any other organ of the skin. All the four toads suffering from this condition died. What killed them?

Particular attention was, of course, paid to the state of the neuromasts, always lying in the immediate neighbourhood of these vesicles, and it was soon found that they were mostly in a bad state (Figure 6). Cells accumulated around them as if to fight a foreign invasion and their own structure showed signs of degeneration with swollen and badly staining cells and large gaps in the lining of the sensory pockets. Some mysterious agent was ruining the toad's sensory organs. It was not a bacterium, it was not a cancerous or non-cancerous growth; it was connected with the little cysts and with the over-production of black chromatophores. It was, indeed, something very unusual and it took many many sections, stained with everything the microscopist's "paint box" has to offer, before the culprit was hunted down. And yet, he was not even very small, he could be plainly seen occupying the centre of many of the

small cysts, enclosed in another, thinner envelope of his own and curled up, resembling the cross-section of a Swiss roll (Figs. 7 and 8).

There he was, or rather, they were, for there was one to every cyst, only in many sections they could not be seen Having finally established them as the villain of the piece we took them to the British Museum for an identity parade, and the answer we got was: a metacercaria of a trematode. A trematode or fluke, goes through many stages of development before it becomes an adult worm. The stage before the last is called a cercaria and it has to enter an intermediate host animal which, when eaten by the "final" host, transfers it to its final destination. My four unlucky toads must have swum through a cloud of metacercariae. But for an unknown reason it took them many months before they fell ill and died.

In the meantime these wormlets had each encysted themselves on the underside of the toads' skin, not even distributed but choosing as their resting place the spots under the lateral line patches. To this the toads skin reacted by trying to wall them off with connective tissue and chromatophores, but in vain. The poison, excreted by the cercariae, destroyed the toads' nervous organs and killed them before they could be eaten by a crane, a pelican, or a crocodile. If these toads had remained in a South African lake, some such animal would certainly have eaten them sooner or later, particularly when they could not properly swim any more. Then the metacercariae would have speedily transformed themselves into mature fluke worms in the final host's intestinal canal; they would have laid millions of eggs which would have hatched along the banks of the lake. The larvae would have found their way into the bodies of snails and, perhaps, again into frogs or fish and so on *ad infinitum*.

And here our detective story ends—for the time being, and like most of these stories it leaves us with many ends not properly tied up. Why did the toads live for over a year in captivity before they showed any sign of disease? Why did the cercariae choose to encyst *only* under the lateral line patches and how did they get there? And, finally: why did the interference with the lateral line organs kill the toads? Or was it perhaps not this interference at all that killed them but the poison excreted by the fluke worms? Were these worms perhaps finding themselves accidentally in a wrong intermediate host, "mistaking" the aquatic toad for a fish? If only we had answers to all these questions our book might have become a best seller; as it is it remains, in the best sense of the word, a "thriller."

Acknowledgement.—Figures 2, 5, 6 and 7 were taken from sections made by R. W. Murray, M.A., of the Oxford Institute of Zoology and Comparative Anatomy.

Dwarf Rush

THIS is a plant for the decorative aquarium. It comes from Japan, the home of so many charming aquatics, and, though it accommodates itself to most conditions, grows best in a bright light in a shallow pot of loam or wholesome garden soil topped with grit to prevent the fish muddying the water. The pot can be easily hidden from view by sinking it in the sand and arranging a few slabs of stone or pebbles around the rim.

The flat, sword-shaped leaves of the dwarf rush average about a quarter of an inch wide by four inches long and grow from a stout rhizome. They stay fresh looking for months on end, and are tough enough to resist the onslaughts of snails and most of the smaller, greenstuff-eating fishes.

Acorus gramineus var. *pusillus*, to give the plant its scientific name, looks well in the foreground of any aquarium, temperate or tropical, and though it is purely ornamental, a well-established clump of it will make a useful cover for livebearer fry. It is easily propagated by severance of the rhizome, but it is unwise to divide the plant until it has reached a large size or has outgrown its container.

A less-common variety has its leaves prettily striped with creamy white or yellow. This plant grows to about eight inches high and does best in temperate conditions. Unless it receives sufficient bright light its leaves will lose their attractive markings and revert to pale, grass green.

J. H.

FRIENDS & FOES No. 10

Water Fleas *(Daphnia)*

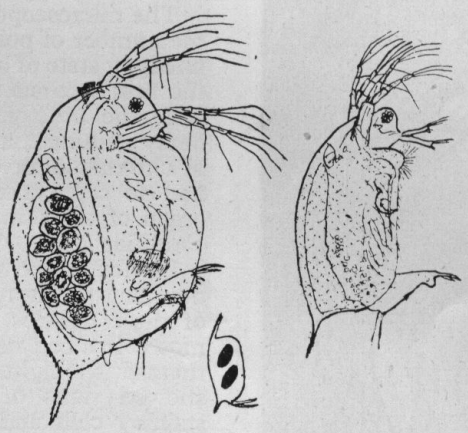
DAPHNIA

PHYLUM:—Arthropoda, from Greek *arthron*—joint, and *podos*—foot.

CLASS:—Crustacea, from Latin *crustaceus*—having a shell.

THE Daphniidae comprise but one family of the tribe Anompoda (with dissimilar pairs feet) in the division Calyptomera (with hidden parts) of the Cladocera (branched antennae). There are seven species, with a number of varieties. Sizes range from one to five millimetres.

Males are produced more frequently than is commonly stated, and are invariably much smaller than the females. Each female *Daphnia* is independent of the male for the greater part of her life, producing frequent batches of partheno-genetic eggs, which are carried round in a special brood chamber behind the body between it and the dorsal extremity of the carapace



Daphnia magna female — Resting eggs (ephippium) — *Daphnia magna* male

(the shell which protects the *Daphnia* vitals).

The eggs develop into perfect baby *Daphnia* within a few days, and are then released into the water by the female. The number in a brood seems to be regulated only by the capacity of the brood chamber, and may be as few as seven in a young female, or as many as 62 in a mature specimen. Within a few hours of giving birth, the female moults and lays a fresh batch of eggs in her new brood chamber.

Once at least in the life of almost every female comes a time when a male *Daphnia* embraces her, and within a day or so afterwards she lays two single eggs. Part of the carapace thickens round these eggs, and goes black. The eggs are moulted and drop into weeds or lie on the mud. They can withstand drying and freezing, and are nature's guarantee of a future generation of *Daphnia*. All species are much relished as live food by fishes, which hunt out every single one placed in their pond or aquaria.

C. E. C. Cole

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APOLOGY

The Committee of the Retail Aquarists Association regret that in the February issue of "The Pet Store and Aquatic Trader" they caused an article to appear on page 18, which stated that the firms mentioned in it were guilty of unfair trading practice, in that they would supply their Wholesale Price Lists and goods to any individual making application. This article was based on incorrect information and the Committee wish to withdraw unreservedly the allegations made and to apologise to the undermentioned firms and to the Publishers of "The Pet Store and Aquatic Trader" for any inconvenience to which they have been put by the article.

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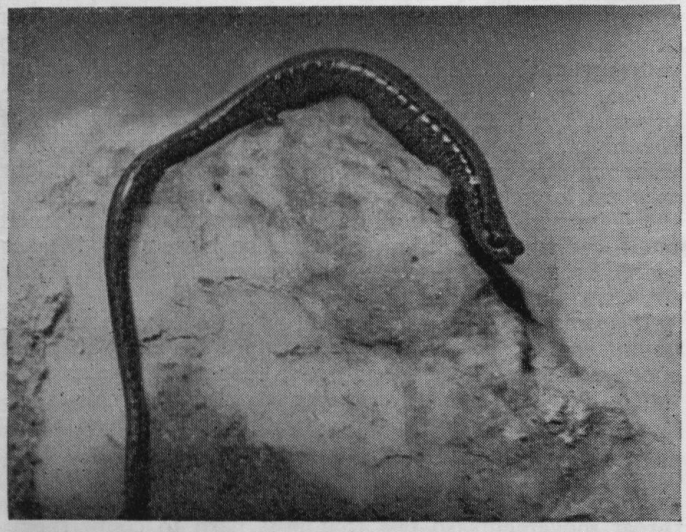
Salamanders Without Lungs

by Dr. EDWARD ELKAN

A LUNGLESS salamander is not a freak or a poor salamander which has lost its lungs through a dreadful disease. Salamanders represent a large group (the urodeles) among the amphibians. In the evolutionary scale they stand between the fish and the reptiles. The fish, in so far as they obtain their oxygen from the water, breathe through gills. Most of the amphibians, in so far as they have gills when young, lose these in the course of their metamorphosis. They then spend their time on land and breathe, like all the higher vertebrates, with the aid of lungs. Yet, of a large group of the salamanders, this is not true. They live on land, they never return permanently to the water, they are true vertebrates and yet they have neither gills nor lungs.

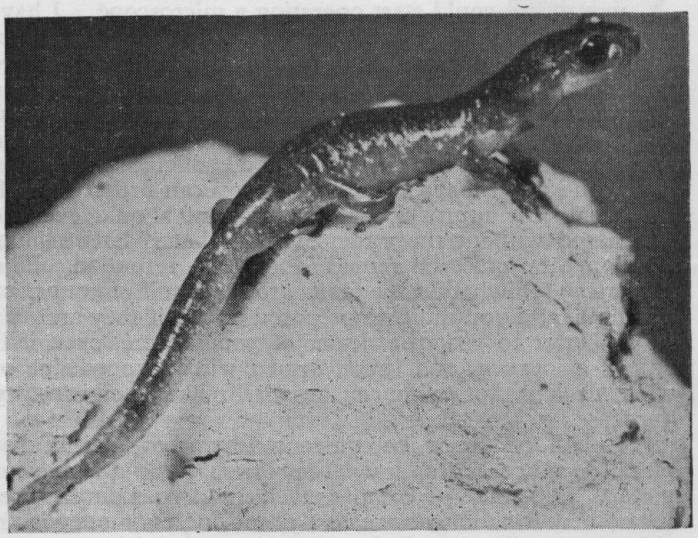
Habitat

Why is it, you may ask, that we have never met such an animal? Our British newts and the well-known spotted salamander certainly have lungs. Where are these lungless creatures to be found? Alas, dear reader, not in this country. The nearest place where some of the lungless forms occur—largely unknown, I am sure, by the local population—is in the Maritime Alps, which extend from Southern France into Northern Italy. There, and on the island of Sardinia, we have the Italian cave salamanders *Hydromantes genei* and *Hydromantes italicus*, two closely allied forms which have no lungs at all. And in the same region occurs an extremely pretty little salamander, the "conspicuous" *S. perspicillata* (because of two bright patches on its head) which has hardly any lungs either. The same can be said of the Corsican *Euproctus montanus* and its near relation in the Pyrenees, *E. asper*. These are the only European forms.



Photos: *Edward Elkan*

American worm salamander Batrachoseps attenuatus—so small it can take shelter in the burrow of an earthworm



Oregon salamander Ensatina escholtzii. This specimen travelled to Britain from Oregon in wet moss within a plastic bag

Why, you might say, should we bother about such comparatively rare animals which we might never see in the flesh? The reason is, first of all, that these European lungless forms represent only a small outpost of a large lungless salamander population in the New World and that it is very fashionable to take an interest in things American. The second reason is that these salamanders could easily be imported and kept in a terrarium here and that they present us with more than one biological riddle.

There are about 170 species and sub-species in North and South America and yet, not one in a thousand Americans will ever have heard of them. All these salamanders are small creatures which live far from the centres of human habitation and are strictly nocturnal in their habits. They can be found in the neighbourhood of water under rotten logs or leaves, sometimes many of them clumped together. When undisturbed they walk leisurely but when disturbed they can run quite fast. In captivity they can be fed on white worms and green fly. Out of doors they eat what small animal they can capture with their tongues. These tongues work, on a small scale, like the tongues of chameleons, and it is a surprising sight to watch a tiny salamander catch its prey at several centimetres distance. Not that they always hit the victim; they miss just as often, and their eyesight seems to be poor in spite of their large, protruding eyes.

Biological Riddle

But the biological riddle they represent is connected with their state of lunglessness. Why, among the other "normal" salamanders, have these forms no lungs and how do they get along without them? As usual in biology no cast-iron answer can be given to either of these questions; the best that we can put forward are the most likely theories to explain the facts. It seems that even those salamanders which have lungs do not need these organs very urgently for breathing, but use them more as a kind of float, blowing them up or releasing air from them according to the depth to which they want to descend. Salamanders living in shallow, fast-running mountain brooks would have little

(*Continued overpage*)

Microscopy for the Aquarist — 4

IN my concluding paragraph last month I said that this month we would start operating a microscope. I have decided to defer articles on this until after I have given some guidance upon the choice of an instrument. Therefore this month we will pay our first visit to a dealer. There are a number of these who send out lists of instruments in stock, but to the novice these lists convey little except to emphasise the great variation in price of the goods offered.

If you know what you are doing you can order through the post "On approval"—no instrument should ever be purchased without the understanding that if latent faults develop they must be remedied or cash refunded. The dealer can tell whether the faults are the result of your mishandling, and you must be prepared to pay if they are. It is far better to visit the dealer of your choice, even it if entails a journey, and there, armed with a knowledge of what to look for, you can usually make a satisfactory purchase.

You will, no doubt, be confronted by a bewildering display of microscopes and accessories, some of ancient vintage, and some of comparatively modern manufacture. Brand new instruments are costly, and, unless money is no object, you will try to find a good second-hand instrument. This may often be obtained for a matter of £10 or thereabouts. Money well spent, for there is nothing which can last so long and give enjoyment so consistently as a microscope. There is one thing you must bear constantly in the forefront of your mind—a microscope is for looking *through*, not *at*. Do not allow yourself to be hypnotised by highly polished instruments of no known name, offered cheaply with a considerable array of accessories—imposing, fascinating, but frequently useless *impedimenta*.

Ignore too, the binocular models. Until some experience has been obtained, the special technique required to manipulate one of these satisfactorily—especially an old model—will add to your difficulties. Do not bother with long-tubed models—the ten-inch body tube has long been discarded, and objectives made for a modern length of 160 mm. (approx. six and a half inches) will never give of their best when used with 250 mm. tubes. Many 160 mm. tubes however, are provided with an inner, sliding tube which enables the length to be increased so that the old objectives can be used with them. This gives you a greater choice of objectives.

Ask the dealer if the threads and diameters of the instruments are standard. There are still in existence many models of no fixed standard, equipped with lenses which cannot be used on any other instruments. I once possessed a microscope of this class, and was perfectly happy with it until an accident deprived me of an essential, but irreplaceable, part. The man from whom I purchased it—a thoroughly reliable chap, took it back for "spares", so that it was not a complete loss, but I had learnt my lesson.

The following firms enjoy a well-deserved, world-wide reputation for first-class craftmanship and reliable service. Should your dealer possess any models by these firms, make your choice from them, and you will not be disappointed. *Any* second-hand model, however, needs careful examination, whatever its maker's reputation, for there is no way of telling what misfortune may have befallen it during its life. Between 1939 and 1945, many a microscope lay buried for months—sometimes years—beneath the debris of a bombed hospital, factory, or laboratory. Others were brought home as loot, or "gifts" for cigarettes, from abroad, by people who did not know how to treat them.

I will tell you more of what to look for next month. In the meantime search for models by any of these firms: Baker (British); Bausch and Lomb (American); Beck (British); Cooke (British); Leitz (German) 170 mm. tube-length; Prior (British); Reichert (Austrian); Spencer (American); Swift (British); Troughton and Sims (British); Watson (British); Zeiss (German).

C. E. C. Cole

Salamanders Without Lungs

(*Continued from preceding page*)

use for such a float. It might, on the contrary, make them too light in the water and increase the danger of being swept away. Having no lungs or reduced lungs might in such circumstances have a survival value. The fact is that many families of New World salamanders eventually left the water altogether and found it quite possible to survive on land with no lungs at all.

Now the readers of this paper are too well trained in physiology and too familiar with oxygenating plants and aerators to imagine that a lungless salamander had perhaps given up the habit of breathing altogether. Breathing means taking in oxygen and getting rid of carbon dioxide. These are two essentials of basic metabolism and without this gas exchange life is impossible. The salamander, however small and insignificant and however sluggish in its habits, is yet alive and consumes oxygen. How does it enter its body? We are so used to see every animal breathe by its mouth (not every animal; what about the insects?) that on observing a lungless salamander making rapid movements with its throat we are only too ready to jump to the conclusion: it breathes through its mouth and absorbs oxygen from the lining of the oral cavity. But, does it? There are serious objections to this assumption.

These animals are small and have, relative to their size, a large surface. They are sluggish in their habits and live in cold, moist places. Why should they make the relatively enormous effort to execute 100-200 vibrations with their throat per minute? And on the other hand they do not always do it. An undisturbed animal often makes no movement at all with the throat but as soon as it is disturbed it starts again. The animal's sight is poor but it has a large organ of smell and a large corresponding olfactory lobe of the brain. How could the organ of smell function if it were not well ventilated? The undisturbed animal might take no interest in its surroundings for the time being; the disturbed animal would be only too interested to smell out the danger. Feeding, it must be remembered, takes place at night, when eyes are in any case useless and only the sense of smell guarantees success.

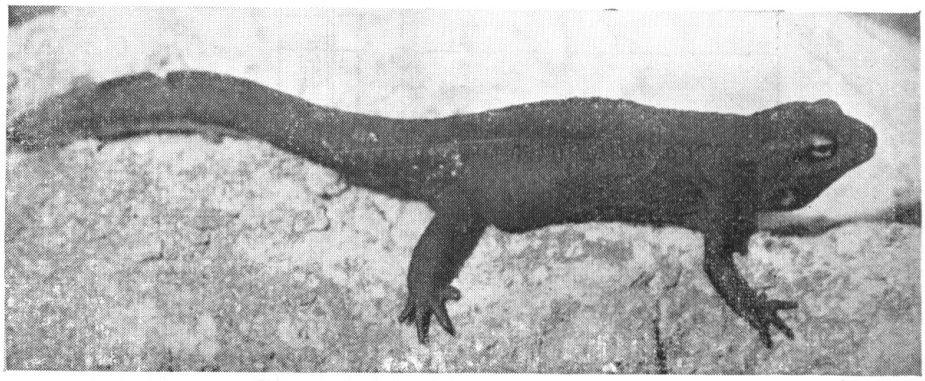
It seems therefore that the throat vibrations should not be interpreted as breathing, the more so since, in most species, the mouth seems no better adapted for the absorption of oxygen than any other part of the animal's skin. It is the skin which, being very thin and always moist, absorbs the oxygen needed and gets rid of the superfluous carbon dioxide. And so we have here a large group of small vertebrates, smelling their way through life with throat movements so fast that it is hard to count them, but without any active efforts at maintaining the necessary gas exchange to balance their metabolism. A very remarkable group of creatures, well worthy of our notice.

The Dog-eyed Chinese Newt

by

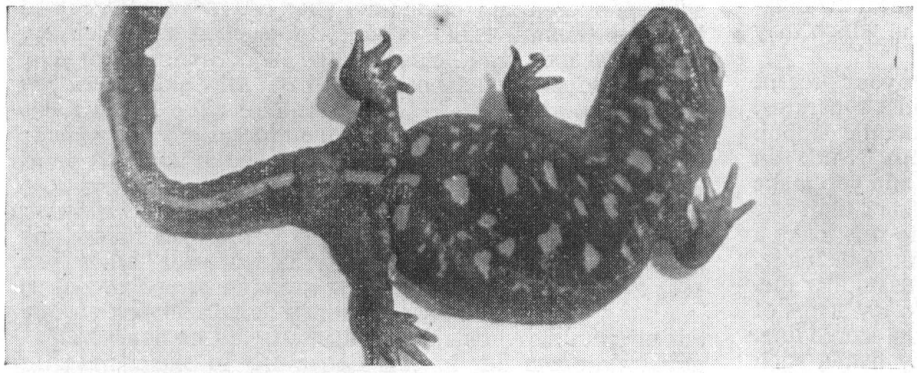
Dr. E. ELKAN

Photographs by the author



SYNOPS CHINENSIS is not one of those amphibians frequently found in dealers' lists. Seeing that it has to come all the way from Hong Kong, its rare appearance need not surprise us, and having made its acquaintance we may even wonder why anybody but a dyed-in-the-wool newt specialist bothers to catch it and to send it on its long and hazardous journey.

The two specimens I have under observation are 5 ins. (127 mm.) long from snout to tip of tail. This is large for a newt. They are chocolate coloured on the back and sides, black with bright orange-red spots underneath. Their eyes well justify their name, they look very much like the eyes of a dog. As companions in one and the same aqua-terrarium my two specimens seem to be extremely badly suited. From the day when I first received them, one decided to take its abode on land, the other in the water, and as far as I know, they never meet. To understand these opposites in behaviour one would like to know the age of the two newts and their rules of behaviour in the swamps of China. Many newts have aquatic and terrestial phases in their lives, but it is surprising to see two of equal size, imported in the same batch, behave in such opposite ways.



Side and ventral views of the dog-eyed Chinese newt are shown on this page

Their feeding habits too are by no means alike. The land-type, who spends all the time sitting under a piece of bark, has a good appetite. Every second or third day I can lift him out from underneath the "cave" by the tail, put him on even ground and offer him an earthworm. Being lifted up by the tail does not worry him in the least. He swallows even a medium-sized earthworm at once.

His aquatic companion seems to be on a slimming diet. If I can make him accept a small earthworm once a fortnight I am lucky. His "pond" is full of *Daphnia*, yet I have never seen him eat one. He holds himself completely submerged, making little movements with his jaw as if he was "chewing" water, and every 10 to 15 minutes he lifts up his head just enough to bring the nostrils to the surface for a breath of air. On one or two occasions he has shown some enterprise by climbing up the glass in the only corner where this was possible because there was the thermometer to give him extra support. Finding he could go no further than the top rim of the tank he stayed there for the rest of the day and then returned to the water. He never made any attempt to leave the water by the "shore" which, one would have thought, would have been much easier than to climb up the glass.

I have not been able, so far, to determine the sex of the two specimens. According to the literature available the two sexes look too much alike to allow for a reliable diagnosis. If they are still alive next spring their behaviour at that time may throw some light on this question. The dog-eyed newt seems to be common on the north-east coast of China. It was first described by Dr. J. E. Gray in the *Proceedings of the Zoological Society of London* (1859), where an excellent drawing of the animal can also be found.

If other herpetologists keep this newt, it would be most interesting to hear how their animals behave so far from home.

A Tidal Marine Aquarium

(*Continued from preceding page*)

nothing more than a reservoir if desired. If this lower tank is shallow the tubing is best arranged as shown in the small-scale drawing so as to make sure there is a good lift. The speed of flow can easily be controlled by a constriction on the siphon tube, but make sure that nowhere in the apparatus is there any metal part coming into contact with the sea water.

One last word of warning. Be careful to see that the inlet of the outflow pipe in the upper tank does not become clogged or the tank will continue to fill. Shellfish and other inhabitants of the tank are apt to crawl over the opening and block it, therefore it is a good idea to have several openings, (such as a rubber bulb with a number of holes in it could provide).

SUSSEX (*Contnued*)

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ceans principally) which prospers there. Here is a valuable indication of a source of food for the aquarium.

Among the five biggest pompadours, two that appeared to move wonderfully well and who became much bigger than the others, could soon be picked out. As they were almost constantly together, it could be thought that they were acting as a true pair. And yet their behaviour lacked the harmony which can be observed in many cichlids. The secondary sexual characters equally gave cause for doubt; if the bigger of the two were the male, it lacked the winding blue lines in the dorsal and anal regions given as a male characteristic in all the American photographs.

This blue pattern is a good sign of sex difference; on the female only the front third of the lower edge of the reddish-brown anal fin shows the spots or blue lines, whereas in the male these lines spread all over the anal fin, and some spots may even occur on the caudal fin. The lateral stripes are another characteristic: they spread over the male horizontally from the head to the middle of the back. These markings are developed very early and allow the determination of the sexes to be done very quickly.

I watched the behaviour of those two fish with much curiosity. One day the smaller of the two appropriated the whole front right-hand corner of the tank, cleaned the putty and started to lay.

False Alarm

The attitude of the bigger fish, which I thought to be the male, was even more surprising: attracted by the smaller one when she was laying, he went nearer to the eggs and started to swim from top to bottom as if he was preparing to fertilise them. But instead of this he swallowed them one after the other and then turned away from the laying site. Once the "male" was away in a corner of the aquarium, the little female returned and started to deposit one or two rows of eggs, and the game with the bigger fish began again. Once again he was driven to the laying site, once again he swam from top to bottom, to finish by eating all the eggs and to go away again. This behaviour was repeated many times, until the female stopped laying.

For a time I had hoped that the bigger fish was a poor-coloured male, and I was therefore very surprised three days later to see my "male" start laying on a large leaf of *Cryptocoryne ciliata*. It was the smaller female who was then waiting in a corner of the aquarium; she also was driven to the laying site and behaved exactly as her partner had three days before.

It was necessary to face the truth that my "pair" was composed of two females. Such "false pairs," which one encounters always among females, are very frequently seen in captivity, principally among the cichlids. Innes has already noted that most of the imported *Symphysodon discus* are females.

As my four other fish were also females, I entrusted two of them, which were ready to lay, to Dr. E. Schmidt, of Frankfurt, who possessed a definite male. In spite of the journey—in a plastic bag, thus avoiding the least injury—the fish started to lay within six days. And then that which one had hoped for but did not dare believe would happen took place: after several tries and at the time of a further laying, the male placed with the bigger of the two females fertilised the eggs and kept watch over them afterwards, without eating them as he had done formerly.

The embryos left their covering after about three days, just as the literature had informed us, and were guarded by their parents exactly as angel fish do. Towards the sixth day, as with many of the cichlids, the young swim freely, but constantly come to attach themselves to the sides of their parents, principally to the female. This behaviour—during the first ten days—has often been observed, the young seeming to "pick" at their parents' sides.

There are several possible explanations. Personally, I would like to believe that there were microscopic creatures (Infusoria) on the skin of the adults, which proliferate there. But it is necessary to consider also other observations which have been made on several cichlids by other people. In some, particularly *Etroplus maculatus*, the young come to the surface of the mother's skin under the pectoral fins to take from it very tiny particles which are invisible to the human eye. One can see that the adult fish seems to ruminate, and fine particles of the chewed food are driven backwards along the body by movements of the gills. Why should the pompadour fish be different?

The fact is that the young pompadours during the first ten days, and this has often been described in literature, cling constantly to their parents' bodies (principally to the body of their mother). It is only after this period that they go away from their parents to seize some small living prey (nauplia of *Artemia* were given primarily).

These statements permit one to foresee the necessity for a microscopic food such as *Paramoecium* in abundance, if the young pompadours are to be separated from their parents, as is the practice with the angel fish. I cannot affirm that such attempts have been crowned with success up to the present. Anyhow, if one can leave the fry with the parents, the results of breeding must be better.

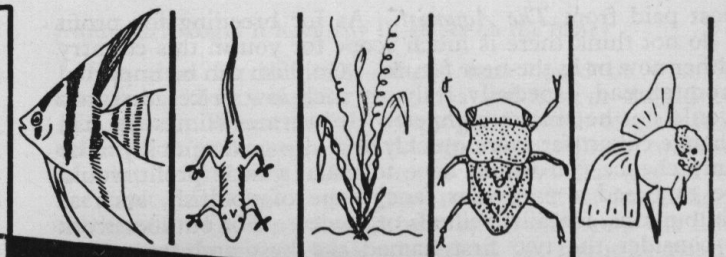
This story of pompadour breeding confirms that the acclimatisation of newly imported fish represents the greatest difficulty. That goes for all fish which have not been domesticated. Mostly, the pompadours either die or become too fat and sterile. The secret for the first reproduction of new specimens lies in the manner of bringing them to maturity.

(Article translated from L'Aquarium et les Poissons)

J. W. Lester

IT is with great regret that we record the death last month of Mr. John Withers Lester, curator of reptiles at the London Zoo, at the early age of 47. Although his main interest was in amphibians, he could truly be described as an all-round naturalist, and in latter years he led a number of successful expeditions to Africa to collect specimens of all kinds of animals and birds for the London Zoological Society. In 1954 and again in 1955 he made expeditions abroad in conjunction with the B.B.C. television service, and as a result of this many more people became aware of his warm, friendly and unassuming personality from the appearances that Mr. Lester made on television. He was unfortunately taken ill in British Guiana last year, and it was that illness which has led to his untimely death. Mr. Lester was always willing to interest others in his own subject; for many years he was an advisory editor of *The Aquarist*, and he was a founder member of the British Herpetological Society. He leaves a widow and four daughters, to whom we offer our deepest sympathy in their loss.

our readers write



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

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

Manufacturers' Apathy

I HAVE noted with considerable interest the recent correspondence on the subject of the F.B.A.S. Testing Scheme for apparatus and instruments. I have also noted, without surprise, the editorial comment to the effect that such a service is already available by *The Aquarist*, albeit badly neglected by most manufacturers.

From my own experience, I am convinced that no such scheme, whether free or charged for, can possibly succeed. This is due entirely to the apathy shown by most manufacturers to any suggestion put forward with the object of improving their products. There are, of course, a few notable exceptions, but on the whole these are found amongst the smaller firms who are still in the "striving" stage, and unable to rest on their laurels.

My firm, whilst admittedly of very little consequence when compared with the giants of the industry, is nevertheless in a very advantageous position to judge the products of others, for the simple reason that 90 per cent. of our business is concerned with the repair of other firms' products. In this, we can observe the type of fault most commonly occurring, and compare the one make with the other. In the light of several years' experience, we can now forecast, with almost complete accuracy, what particular fault is present in any item of well-known make submitted for repair, *before examination.*

To quote a case in point, one very well-known make of heater (and a very good one, by the way) appears to have an average useful life of about two-and-a-half years. By the introduction of a *very small* alteration in the material used for one component, the life could be extended by at least another year, and probably more. One cannot help thinking that the makers must be aware of this, as it is such a simple thing, and one is led to conclude that they consider two-and-a-half years to be good value for money, and not under any circumstances to be improved upon. On the other hand, this heater is in all other respects the best of its type at present on the market, and one cannot but feel that if the necessary improvement were to be made, it would not be long before the public realised that an extra year or so on the average life would make it the best "buy" obtainable. It all depends on the manufacturer's policy.

Finally, as regards the latter, I would say this. About four months ago, my firm circularised a section of manufacturers, to point out that we are in a position to supply facts, I repeat *facts* and not opinions, regarding the types of faults occurring in their particular products after a period of actual use. We also emphasised the difference between the results of actual use by members of the public, and results obtained on the test-bench. For this service we charged a fee, which, although very small, was sufficient to cover our expenses. The results were as follows: number of circulars sent out, 16; number of acknowledgements received, 3; number accepting the service, 2. The two firms who called for our reports immediately adopted the recommendations set out, and have expressed their pleasure at the outcome.

I think further comment would be superfluous.

L. WARBURTON,
Warburton & Company,
Stockport, Cheshire.

Mr. Jack Lester

MANY of your readers will have watched Mr. J. W. Lester showing animals on television and also enjoyed his lectures given to aquarist clubs. They will be grieved to hear of his untimely death. He leaves a widow and four daughters.

The committee of this Society has decided to open a memorial fund and would be glad to receive any sums of money for this, whether from members of the Society or not. The object of this fund wi.l be, firstly, the erection of a small memorial plaque in the Reptile House of the London Zoo; this project has already been approved by the council of the Zoological Society. Any further money will be handed over to Mrs. Lester.

We should be very grateful if you could make your readers aware of this fund. Donations should be sent to the secretary of this Society. No sums are too big or too small for the fund to handle.

J. F. D. FRAZER, *President*
MONICA GREEN, *Secretary*,
British Herpetological Society,
c/o Zoological Society of London,
Regent's Park,
London, N.W.1.

Keeping Tubifex

I READ quite frequently in aquatic magazines about *Tubifex* being difficult to keep, only a few days seeming to be the average period for keeping them alive and then apparently only under constant running water. This rather surprises me, because I can keep *Tubifex* for 2-3 weeks and could probably keep them longer if the supply did not run out.

The method I employ is to put them in a bucket immediately I arrive home and give them a good swill under the coldwater tap (ours has quite a pressure, which is an