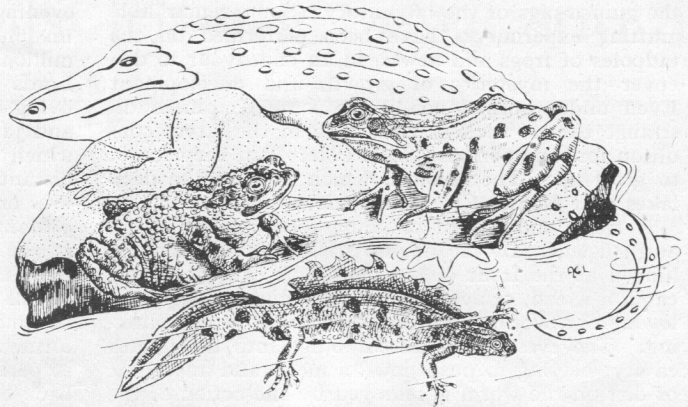


"Sitting on the Fence"

Amphibians, the link
Between the True Fishes
and Birds and Mammals

By Alfred Leutscher,
B.Sc.



Modern Frog, Toad and Newt, with extinct Giant Salamander
of the Coal Forest period

WERE an entirely new animal, hitherto unknown, placed in the hands of a biologist, he could, with the knowledge at his disposal, make an examination, and predict with considerable accuracy its peculiar habits, and even the kind of surroundings in which it might be found. This is because wild animals are each adapted to a specialized way of living, which fits them for the ceaseless struggle for existence which is going on around us to-day. All this has been carefully studied since the day, some fifty years ago, when Charles Darwin startled the world with his famous Theory of Natural Selection.

It is now believed that life originated in the water, and from there evolved on to the land. One successful branch of life is that of the vertebrate animal, which possesses an internal skeleton of which the many-jointed backbone forms the main support. These animals are to-day very numerous, and the history of the vertebrate animal can be traced from simple, fish-like creatures, still living, through the true fishes to the Amphibia and reptiles, and culminating in the birds and mammals. Some people like to think that we follow on in this evolution, as a highly specialized mammal.

At all events, here is a definite evolution from water to land, and it will be noticed that among the Amphibia the border-line has been reached. This name, Amphibia, which comes from two Greek words meaning a "double-life," is well illustrated by the peculiar life-history of a well-known British amphibian, the Common Frog. This little animal starts its life as an egg, passes through a larval stage, the tadpole, and finally transforms into an entirely different adult. This tadpole, with its aquatic life, swimming tail and gills for breathing in water, reminds one of a fish. The adult frog, on the other hand, has well-developed limbs and air-breathing lungs, more closely resembling a true land animal.

It is a fact that adult frogs are powerful swimmers, and that some Amphibia manage just as well with a swimming tail, but both are capable of life on the land, and may be found in damp surroundings, under stones, logs and vegetation. The Common Frog is rarely found far from water, for two important

reasons. First, it is obliged to enter water at each breeding season, in order to produce its offspring. The eggs would simply dry up out of water, as would the delicate gills of the tadpoles. Until it metamorphoses the baby tadpole is imprisoned in the pond in which it was born. Secondly, a frog's skin is smooth and soft, having no protective covering of scales, feathers or hair, as is seen in reptiles, birds and mammals. Too much exposure to sunlight or dry surroundings would prove rapidly fatal, causing a quick death from desiccation.

The moist skin, however, is of great value in supplementing the frog's breathing system. Having only a three-chambered heart, a certain mixing of purified and used blood cannot be avoided. Skin-breathing, in fact, is so efficient that frogs prevented from inhaling normally can exist for many weeks by this method alone. Some will even winter at the bottom of a pond, under tons of water.

If one closely watches a live frog or newt on the land, a continuous moving of the throat will be noticed. This is the animal's way of breathing. Since the frog has no diaphragm or rib-box, abdominal or chest breathing as we perform it is impossible. Instead, the throat, supported by cartilage, acts as a force-pump and drives air into the lungs. A newt, rising to the surface to obtain a fresh lungful of air, reminds us that these animals must breathe atmospheric air even when breeding under water.

The eggs of Amphibia are coated with a layer of jelly substances and are laid singly or in masses. This jelly, however, is not intended as food for the tiny egg which is already well supplied with nourishment by the mother. It is rather for protection, and may even buoy the eggs to the surface, bringing them closer to the life-giving rays of the sun. As the frog's eggs float as a mass of spawn on the pond, the curved jelly surface around each egg may even act as a lens, which concentrates sunlight, and therefore heat, on to the little embryo within.

Each egg-cell which is fertilized by a single, active male cell, secreted in countless numbers as a pale cloud into the water by the male, starts off a life-development about which a good deal is known.

The frog and its eggs, easy to obtain and rear, are the guinea-pigs of the laboratory. Some remarkable grafting experiments have been performed on the tadpoles of frogs and newts, in an endeavour to discover the mysteries of growth and development. Even under normal conditions some Amphibia do strange things, such as remaining in the larval condition for long periods. Like Peter Pan, they forget to grow up. The Axolotl, which lives in the deep lakes near Mexico City, is a famous example.

A frog's method of catching food is both rapid and efficient. By means of a sticky, flexible tongue, hinged at the front of the mouth, it can accurately catch a worm, or even an insect in flight. The swallowing of a worm is assisted by convulsive eye-blinking. The eyes, when closed, bulge into the mouth cavity, helping to push down a meal, and any slime or dirt on the worm is removed by the action of the fore-limbs. Newts on land may also use their small tongues to catch a meal.

The songs of frogs and their allies are made up of a variety of croaks and pipings, and as one sits

quietly at a pond's edge during spring and summer evenings, the frog-chorus takes one's mind back in imagination to a period some hundred and fifty millions of years ago, when giant Amphibia, then Lords of Creation, peopled the earth. The largest living amphibian is the Giant Salamander of China and Japan, but even this is dwarfed by the monsters which wallowed and croaked in the swamps of the distant coal forests which we see reflected in our fires on winter evenings.

Many of these creatures, "sitting on the fence" at the border-line between life in the water and life upon the land, were, like Humpty Dumpty, destined to fall the wrong way, with disastrous results. They became extinct, but some linger on to-day, in smaller form, as representatives of a strange world. This is perhaps fortunate for us, because otherwise the back-boned animals might have disappeared altogether. Reptiles would never have had a chance and mammals, in their turn, could never have claimed a birth-right. In fact, you and I might never have come into being at all.

Pond Precautions this Winter

By the Aquarian

WEATHER experts tell us that we need not expect another winter like the last for many years to come. Be that as it may, we should be prepared for protracted spells of frost. It is appreciated that small pools of shallow water situated in exposed positions are more susceptible to frost than large deep pools in a sheltered position. In this country, the temperature seldom if ever drops so low that it will freeze running water. The lesson then for the pond-keeper if he wants to keep his pond free from ice is to keep the water moving. This can be done in several ways.

The most obvious is to install a small pump. Several brands are marketed and run quite cheaply off the household electric supply and pump anything between 100 and 300 gallons an hour, which would be ample for the average garden pool. The water should be lifted a foot or so and allowed to cascade back again into the pool. A fountain is not very suitable as it is liable to become frozen round the jet itself.

In most circumstances, an electric immersion heater of, say, 100-watt capacity will prevent the whole of the pond freezing over. Apart from the heat generated, the heater will set up convecting currents of water, the rise and fall of which are sufficiently strong to prevent ice forming except under the very hardest of frosts. Perhaps the simplest precaution of all is the installation of an aerator. The ordinary rubber diaphragm type is quite suitable with two air outlet extensions. In order to get the maximum movement of water, coarse, porous blocks should be used.

To the mechanically minded, a modified form of windmill might suggest itself. Winter is usually a season of winds, and a well-balanced model should

catch enough wind to keep the pump perpetually moving. The agitation of the water would be produced by a propellor of the correct dimensions submerged to a depth of two inches.

The cheapest and most effective method observed was by the use of a piece of rubber tubing and a ligature. This was so effective that a small pool of under 200 gallons remained ice-free throughout last winter. The layout was simple. A house cistern of 60 gallons capacity was purchased cheaply and erected in a toolshed adjacent to the pool. A small paraffin lamp placed under the cistern was of the car radiator heater type and burned eight days at one filling. The top of the cistern was covered by a board. A piece of rubber tubing extended from the bottom of the cistern to the bottom of the pool. The size of the tubing was a little larger than ordinarily used for aerating aquaria.

A small hole was cut into the tubing just where it left the cistern and a metal clip or ligature placed just above the hole. The syphon was started and as the water ran down into the pool it took in air from the hole. A fine adjustment of the ligature ensured a fast flow of the water with the maximum amount of air. As set up it ran for two days before the cistern required refilling.

One last word on wintering fish outdoors. The annual loss of fish through the winter is as much through unhealthy water conditions as through the effects of freezing. If it has been at all possible to give the pond a good clean out during the autumn, the benefit will now become obvious. Goldfish in particular will come through better in an unplanted pond that has been scrubbed out than in a planted pond that may be polluted.

Animals with a Double Life

How Amphibia are Classified in Six Recognized Orders

By "Reptilius"



White's Tree Frog

Photograph by [W. S. Pitt]

A HERPETOLOGIST, expecting a visit from a Dutch friend, asked him to bring over some Salamanders. The friend duly arrived, with a jar-full of Common Newts (*Triturus vulgaris*), which are called "Salamanders" in the Dutch language. The moral of this true tale, which prompts the writing of this article, is that we should appreciate and make more use of the scientific names of our pets, if we are to have a closer co-operation between ourselves and our overseas friends. Like the hobby for which WATER LIFE caters, such names are for international use, and ought to be used regularly.

The name *Amphibia* was first used by Linnaeus to cover an odd assemblage of more or less aquatic creatures, such as whales, crocodiles and frogs. Later it became restricted to those animals intermediate to fishes and reptiles, and was given the rank of a Class. It can be defined as "those cold-blooded vertebrates with soft, naked skins and three-chambered heart; an egg minus shell produces an aquatic, gilled larva, with swimming tail; the creature, by metamorphosis, produces limbs and air-breathing lungs." There are, of course, exceptions. Some *Amphibia* are born late, even on land, others never metamorphose, and many are short of limbs. Our Common Frog (*Rana temporaria*), however, shows all the main features.

Of the six Orders of *Amphibia*, three are now extinct. In the distant Carboniferous Period an Age of *Amphibia* grew up, largely of the Order *Labyrinthodontia* (so named from the structure of their teeth). These salamander-like creatures, some of them giants ten feet long,

eventually died out with the advent of the Age of Reptiles. Another Order, the *Leptospondyli*, also became extinct, but is thought to be the ancestral link with a modern Order, the *Gymnophiona*, or *Apoda*. These queer, legless, tropical animals, like large earthworms, are rarely seen because of burrowing habits. Known sometimes as *Coecilians*, a peculiar feature of some of the two hundred or so species are the tiny scales in the skin.

A third extinct Order, the *Phyllospondyli*, are the supposed ancestors of most modern *Amphibia*. One, the *Urodela*, or *Caudata*, retain their tails throughout life. Urodeles, of about two hundred species, are placed into five Sub-Orders. The *Cryptobranchioidea* are the most primitive, being semi-larval and contain the largest, existant amphibian, the aquatic Giant Salamander of Japan and China (*Megalobatrachus japonicus*), which grows to five feet. The American "Hellbender" (*Cryptobranchus allegheniensis*) is much smaller. The Sub-Order *Proteida* are permanently gilled, and includes the curious little "Olm" (*Proteus anguineus*), which lives in subterranean waters in the Eastern Alps. Blind and minus pigment, it has tiny limbs. The "Mud-puppy" (*Necturus punctatus*) of N. America is coloured and more sturdy in build. The Sub-Order *Meantes* are the "Sirens," which retain their gills, and are without hind limbs. *Siren lacertina* is the "Mud-eel" of south-eastern U.S.A.

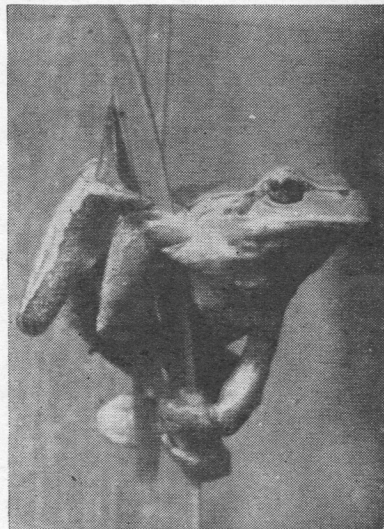
The *Ambystomoidea* is the Sub-Order of American "salamanders" containing a well-known genus *Ambystoma*. The famous axolotl is a permanently gilled



Albino frog spawn found by G. Andrews at Coley, Reading. Left: Hatching, with some embryos prematurely shaken out of the albumen. Centre: 3-5 days after hatching (eyes appearing and obviously pigmented; trace of pigmentation evident on 5th day in dorso-lateral region). Right: 8 days after hatching

larva found in the deep lakes near Mexico City. It breeds as a larval form, and will sometimes metamorphose in captivity. The biggest Sub-Order is the *Salamandroidea*, a varied group of three Families. The family *Plethodontidae* are newt-like, mostly American, although *Hydromantes* (old name, *Spelerpes*) is a European genus of this family which is found in the Southern Alps. The family *Amphiumidae* possess lungs but retain a partial gill. The "Congo-eel" is *Amphiuma means* of Florida, growing up to three feet.

The *Salamandridae* is the most popular family with the hobbyist. It includes the European genus *Salamandra*, such as the Spotted Salamander (*S. salamandra*) and the black Alpine Salamander (*S. atra*) of the higher altitudes. *Euproctus* and *Pleurodeles* are other genera represented in Europe, but best known is the genus of newts, *Triturus*. Apart from the three "home" species, the Crested Newt (*T. cristatus*), the Smooth Newt (*T. vulgaris*) and the Palmate Newt (*T. helveticus*), vivarium keepers will no doubt be familiar with the Marbled Newt of Spain (*T. marmoratus*) and the Alpine Newt (*T. alpestris*). The handsome Japanese Newt (*T. pyrrhogaster*) was



Green Tree Frog
Hyla arborea

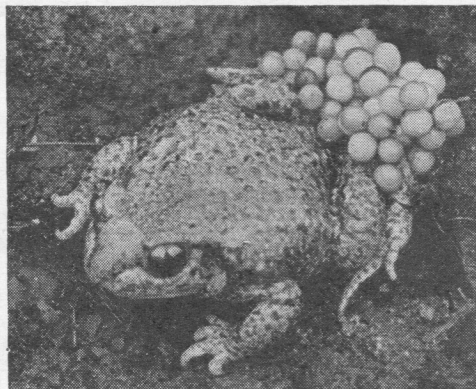
Photograph]

[W.S. Pitt

also common here before the war. Many more species of *Triturus* occur along the western seaboard of the U.S.A.

The last, and biggest, Order are the *Salientia* (also called the *Ecaudata* or *Anura*). Comprising some two thousand known species, these amphibians lose their tails when adult, have well-developed hind legs, and a short backbone which extends as a spine, the urostyle. They are the Frogs and Toads, the noisy members of the world of Amphibia. Many *Salientia* use their tongues to catch food, and the young are tadpole-like. The five Sub-Orders are classified mainly according to the structure of the backbone, but for our purpose we may consider them in their Families under three main divisions:

First, the *Aglossa*, which have no tongue, and are the most primitive. The best-known family, the *Pipidae*, includes *Xenopus* and its allies, which need no introduction. *Xenopus laevis*, is the renowned "Clawed Frog." The ugly "Surinam Toad" (*Pipa*



Male Midwife Toad with Eggs
Alytes obstetricans

Photograph]

[W.S. Pitt

Sub-Orders are grouped under the *Arcifera* (no ribs, protractile tongue and coracoid bones of the shoulder girdle overlapping), and contain the family *Bufonidae*, a dominant group of toads. The British Common Toad and Natterjack Toad (*Bufo vulgaris* and *B. calamita*) and the Continental Green Toad (*B. viridis*) are examples. The so-called "Tree Frogs" are really a closely related family of toads (*Hylidae*), having adhesive suckers on fingers and toes. America and Australia are their chief homes, although one species (*Hyla arborea*), the "Green Tree Frog" is European. The family *Pelobatidae* are digging toads. *Pelobates fuscus*, is the Continental "Spade-footed Toad," which has a spur on each hind leg.

Certain more frog-like families are grouped under the *Firmisterna* (no ribs, a protractile tongue and coracoids which unite in the middle of the chest). The family *Ranidae*, mainly Old World, include our three frogs, the Common and Edible species (*Rana temporaria* and *R. esculenta*) and the esculenta-like *Rana ridibunda*. This is the large Marsh or Laughing Frog of the Romney Marsh area of Kent. *Rana arvalis* is the Agile Frog, found on the Continent.

Largest of all *Ranidae* is the Goliath Frog of W. Africa (*Comrana goliath*), which can grow to a foot in length (excluding limbs). The "Bull-frog" (*R. catesbiana*) is America's largest species.

The family *Polypedatidae* are the Old World Tree Frogs (excluding *Hyla*), having suckers. They are thought to be derived from the *Ranidae*, as the *Hylidae* are from the *Bufonidae*. A large tropical family, the *Microhylidae*, are known as the "Narrow-mouthed Toads," and are related to frogs. The family *Leptodactylidae*, common in Australia, are frogs which include the "Flying Frog" of the genus *Rhacophorus*, which has parachute-like hands and feet.



Natterjack Toad
Bufo calamita

Photograph]

[W.S. Pitt

pipa) hails from South America. The developing young are carried in the skin of the mother's back. A closely related family, the *Discoglossidae*, agree in having ribs, but possess a small, rounded tongue which, however, is non-protrusible. Some European species are *Alytes obstetricans*, the little "Midwife Toad," so-called from the habit of the father, which carries the egg-strings wrapped over his hind legs, the "Fire-bellied Toad" and "Yellow-bellied Toad" (*Bombina bombina* and *B. variegata*) which have a habit of exposing their bright underparts in striking defence attitudes, and *Discoglossus pictus*, the "Painted Frog" of S.W. Europe.

Further families from various

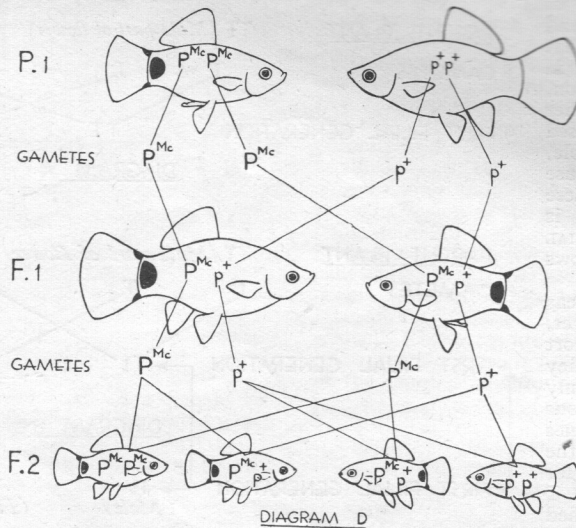
approx. 24,000 plants you would expect approx. 6,000 of them to be short and the other 18,000 to be tall.

If a particular character depends on one gene only as in the above example, we obtain a 1 : 2 : 1 ratio in the second generation if we cross a plant or animal FROM A PURE LINE WITH THE DOMINANT CHARACTER with another plant or animal FROM A PURE LINE WITH THE RECESSIVE CHARACTER. The ratio of 1 : 2 : 1 is very important.

We will consider one more example. In Platies, the "MOON COMPLETE" MARKING (P^{Mc}—Fig. 23) is dominant to No MARKING (p⁺). Diagram D shows the whole process. As before all fishes in the first generation have the dominant character, but in the second generation, one out of every four (male and female) has the recessive character, and three out of four (males and females) have the dominant character.

So far we have seen:—

1. There are often two kinds of plants or animals that are similar in appearance; one breeds true and



the other does not.

2. You cannot tell the ancestry of most animals or plants just by inspection.
3. If you cross two animals or plants and lose a desired character in the first generation, there is at least a chance of that character appearing in subsequent generations.
4. Genes are responsible for particular characters and retain their identity from generation to generation. They do not blend and produce an intermediate character.

These four facts, and many more, should be written up in every breeders' fish house. They are not the result of a lot of theoretical speculation which does not work out in practice, but they are the result of a theory based on practical experience.

* * *

In Part I, the gene Y fell off the chromosomes in Fig. 13. Please insert them on your copy for future reference.

Amphibian "Peter Pan"

Five-inch Long Tadpole of Edible Frog (*R. esculenta*)

DELAYED metamorphosis is not unknown in amphibians, and we hear of tadpoles that do not metamorphose at the usual stage. Last September I was collecting specimens for study at a well-known colony of the Edible Frog (*Rana esculenta*) in Surrey and noticed hundreds of tadpoles in all stages of development.

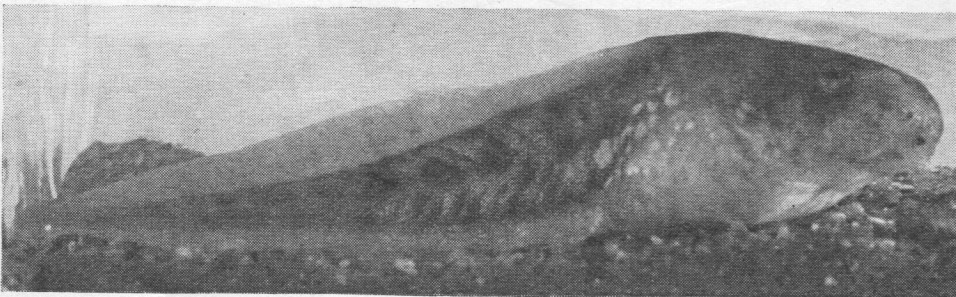
The creature illustrated was secured with sundry others amongst the weeds growing near the edge of the pond. Its size was at least five or six times the average. When caught, its overall length was about 4½ in, the maximum width and depth of the body being about ⅞ in. The rudiments of the hind legs were visible as tiny black bones at the base of the tail. The spiracle is easily seen on the left side and its function in underwater

respiration is clearly visible as a stream of muddy water is puffed out when it is feeding on chopped earthworm.

The lateral line appears as a thread of gold which looks like fine stitching and extends from the nostrils over the eyes just behind which it divides; the upper part reaching to the base of the tail on the back, the lower half to the middle of the base of the tail. The colouring is brown on top, shading to cream on the belly, and the whole of the body is suffused with a greenish tint that glistens under certain lights. The tail is almost transparent with a few dark patches and the vertebrae are plainly visible.

The tadpole is kept in a glass jar painted green on one side to reduce strong light rays. There is decayed plant matter on the bottom, among which it browses. A number of large *Planorbis* snails scavenge uneaten food, and *Tubifex* worms help to keep the sand pure.

For food it has finely chopped meat and earthworms, "Bemax" and a dried food which appears to contain biscuit meal. The tadpole is very sluggish, spending most of its time on the bottom or hanging perpendicularly with nostrils just clear of the surface, although all respiration of atmospheric air appears to be done with the mouth.—D. O. CARR.

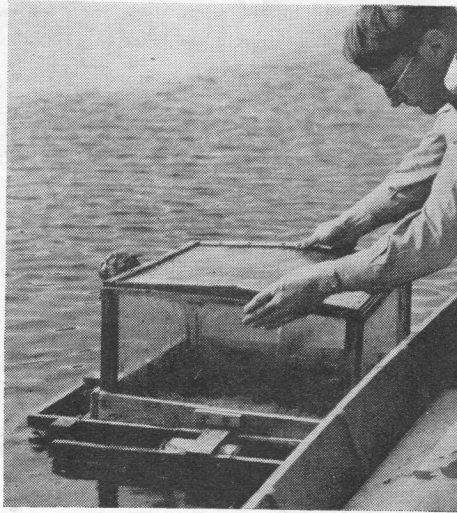


This life size photograph by Norman H. Adams showing the frog tadpole found by D. O. Carr, was taken some time ago. The creature has since grown to a length of five inches.

ical substances, e.g., ammonia and nitrates, required by plants for their growth takes place in natural conditions entirely at the mud surface and hardly at all in the water itself. Research is also being carried out on the factors which restrict the multiplication of bacteria in natural waters, for it is a strange fact that water from, say a lake, kept in a small container, even if the latter is sterilized, will develop a bacterial population more than ten times in excess of that found in the lake itself. This investigation may have great significance for aquarists.

Animal Life

The larvæ of insects such as Mayflies, Caddis Flies and Stone Flies form such a large portion of the food of some freshwater fishes that it is important to anglers and fishery boards to be able to identify them accurately. Unfortunately, although the adults of these insects can be readily identified, it has not been possible until recently to determine with certainty the identity of all the species of larvæ or nymphs. At Wray Castle, large numbers of larvæ have been reared in the laboratories to an adult stage: no easy matter, for many of them are from fast-flowing rivers and die rapidly unless kept in well-oxygenated water. At a result of this work it is now possible to identify most of the insect larvæ of im-



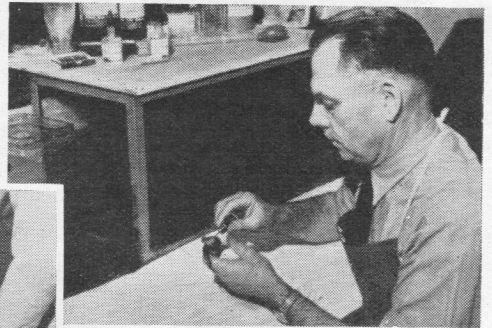
Moored in stretches of water under investigation, floating cages, similar to the one illustrated, are used to trap aquatic insects on their emergence from the pupal stage

portance to those concerned with fishery problems. Keys of most of the groups are published in the Association's helpful series of Scientific Publications.

Naturally, much research has been carried out by the Association on fish themselves—their food, rate of growth, spawning, and other matters, so that a fairly complete picture of some of our principal freshwater fish has been built up. It is of interest that during the war years when, although the work of the Association was carried on, its accent was on food production, a scheme was sponsored for trapping small perch from Windermere and canning them. Altogether nearly one hundred tons were trapped—a not inconsiderable addition to the country's wartime larder.

Many other aspects of the Association's work could be mentioned, but perhaps enough has been said to indicate the type of investigation that is being carried out at Wray Castle. Brief details of the researches are contained in the Report issued yearly, while fuller reports on certain aspects are contained in the excellent series of Scientific Publications which are issued from time to time. Of particular interest to coldwater fans is Scientific Publication No. 3, "The Food of Coarse Fish" (price 1s 6d), and No. 12, "The Coarse Fishes of Britain" (2s).

Experiment with *Xenopus laevis*

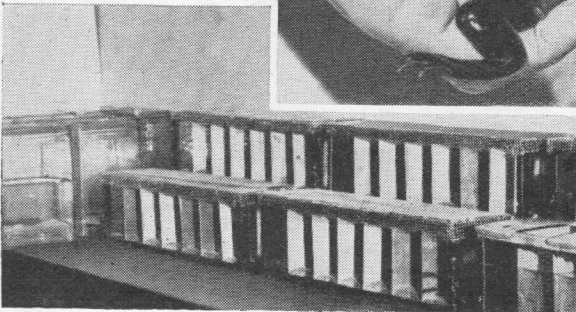


The upper and central photographs show Lt. J. E. Cook injecting the fluid to be tested into the dorsal lymph gland. A number of the isolation tanks are seen in the lower illustration.



Discovered as recently as 1936 this unusual test for pregnancy has caused widespread interest. Lt. J. E. Cook, U.S.N., recently imported into the United States 2,000 female Clawed Frogs (species *Xenopus laevis*) and the majority are housed in the Washington Aquarium of the U.S. Fish and Wildlife Service.

The fluid for testing is injected into the female *Xenopus laevis* and, if positive, the frog deposits eggs in four to eight hours. Although the test is not always strictly accurate it is considerably more rapid and simpler than somewhat similar tests carried out on rabbits. After injection the specimen is isolated in a small glass vessel for one day and at the expiration of this period may be returned to the community tank. Only a few weeks' recuperation is necessary, after which the frog can be used for a further test. M. LORANT.



Propagating Clawed Frogs

By A. Sloet tot Everlo
(Holland)

THE West-African Clawed Frog (*Xenopus laevis*, Daudin) which inhabits rivers and swamps of West, South West, and East Africa, is a species of frog which lives almost exclusively in water. When it comes on land, as it does occasionally, its movements are most clumsy, since it cannot hop like the Common Frog or waddle like the Toad.

On each foot it has three little claws, from which it derives its name. The legs are extraordinarily long in comparison with the body, the latter measuring only $2\frac{1}{2}$ to 3 inches, whilst the legs attain a length of $3\frac{1}{2}$ to 5 inches. The colours are not very striking. The back is dark brown or muddy green with a network of black, the belly is white or off-white and the inside of the hindlegs yellowish.

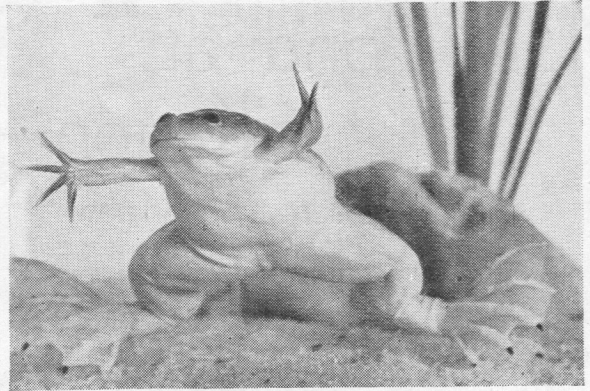
The front legs are comparatively small. During the mating season dark-coloured copulation discs appear on the inside of the legs of the males, who generally remain smaller than the females. Whereas the females have three folds of skin, surrounding the anus, the males have no such folds, so that the sexes can, through this distinguishing feature, be readily identified. The webs are almost colourless, and extend to the extremity of the toes; the little claws are black.

Two very small eyes, on top of the head, protrude only slightly. The pupils are black and surrounded by an orange-coloured iris. Under each eye is a feeler, which, however, is almost indiscernible in this particular species.

The Clawed Frog is not difficult to keep, as ordinary room temperature suffices. Fluctuations in temperature from 15° to 25° C do not have an adverse effect. Heating is therefore not essential, provided care is taken that the temperature does not fall below 5° C. Even at this low temperature it is still very lively. Its food consists of worms and meat. If, during severe weather, no worms are obtainable, it can be fed on meat, cut into small strips or chopped fine.

Propagation of this amphibian in its native country takes place between July and September (the rainy season). Although in captivity it will only spawn under very favourable conditions between May and September, a way has been found after very careful tests, to make it spawn every four or six weeks.

The *Xenopus* is injected into the spinal membrane with gonadotrope hormone, obtained



Clawed Frog (*Xenopus laevis*)

Photograph]

[W. S. Pitt

from the blood serum of the cerebral appendix (hypophyse) the secretion of a gland in the head. The male and female are injected simultaneously, as an outcome of which pairing and spawning will take place within 24 hours. If a six weeks' interval is kept between two spawnings, approximately 15,000 eggs may be spawned during the propagation period.

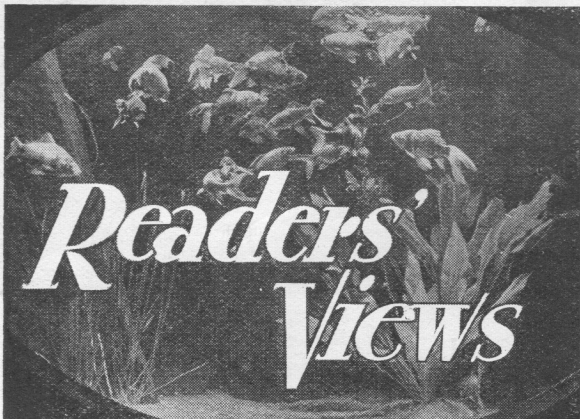
The eggs hatch after two to three days at a temperature about 20° C. For three to four days the young are suspended from the leaves of plants by means of a thin thread. During this period they do not feed. After approximately four days the membrane of the mouth turns about 180 degrees, thus freeing the mouth opening. It is only then that the young begin to take food. This consists of floating algae and flagellates. As the latter are very difficult to obtain, a substitute has to be looked for, and, fortunately, is found. It consists of nettle-leaves, well-dried and pulverized.

The larvæ or tadpoles swim in a peculiar manner, namely, with the head obliquely downwards. When well fed they attain a length of about $2\frac{1}{2}$ inches within five to six weeks, after which the metamorphosis takes place starting with the front legs. Compared with our indigenous frogs the metamorphosis of the *Xenopus* is completed in a remarkably short time, approximately 15 days. Thereafter they need meat in the form of small worms, such as *Tubifex*, *Enchytraë*, Bloodworms and, if possible, also *Daphnia*. If abundantly fed, preferably three times a day, these young amphibians will reach maturity in eight to 10 months.

In Holland we have been fortunate enough to obtain some specimens from the manager of the Copenhagen Aquarium in Denmark. Attempts will now be made to induce them to propagate, and, should our efforts meet with success, we will arrange for

Footnote: An account of a natural spawning of *Xenopus laevis* was published in the August, 1947 issue of WATER LIFE and it was reported in the October issue that a pair of these creatures spawned in their tank whilst being exhibited at Wimbledon show. A further report was made by Mr. E. R. Parizy in the December, 1947 issue. We shall be pleased to pass on to our Dutch contemporaries accounts of natural spawnings, or of successful spawnings through injections, which readers care to send to us.

interested parties to receive one or more couples. Further details about this will be published later on. Some people have already bred these amphibians. Will they please inform us of their experiences?



N.Y. Aquarium Photograph

Letters on subjects of general interest are invited from our readers. They should be kept as short as possible and written on one side of the paper only. The Editor is not responsible for opinions expressed by correspondents.

ZEBRA-STRIPED CICHLIDS

SIR,—In reporting on the above in the April issue of WATER LIFE I overlooked Mr. N. Baker's article on *C. nigrofasciatum* in the same publication of October 24, 1939, and I thank Mr. Dunbar for the correction.

There appears to be some doubt at Belle Vue on the correct nomenclature of the species brought over from Copenhagen, but with memories of the controversy over *C. biocellatum*, I prefer to await the final classification by an authority more qualified than myself.

The Belle Vue Cichlids have been well distributed throughout Northern England, and since my April report and the reference to disposition, I have been taken to task by a Leeds Society member whose young Swordtails have disappeared at an alarming rate. Most Cichlids in the aquarium are, of course, safer with their own kind.

The following personal experience may be of interest:—Eleven young Zebra Cichlids ranging from three-eighths to half an inch were brought from Belle Vue in December, 1947. On the basis of previous experience with Cichlids, it was assumed that a naturally mated pair would be obtained from this number. They were fed exclusively on live food, chiefly white worm and crushed earthworm, and were accommodated in a normal planted 2ft×1ft×1ft tank. As half-inch fish they had a fascinating habit of turning over relatively large pebbles in their search for food. This was achieved by pushing with the head combined with strong action of the pectoral fins. An interesting example at an early age of the evolutionary progress of Cichlids.

Even growth up to one inch was obtained by feeding in different sections of the tank at the same time, but the smaller fish were well able to take care of themselves. At this size sexual sparrings were observed, and seven fish were distributed, leaving two pairs, the female being the smaller fish in each case.

All four fish were now placed in an unplanted tank 36in×15in×15in, with a piece of rock 12in high at each end. This rock, pur-

chased before the war, as "Yokohama stone" had several suitable cavities, and each fish soon staked a claim. Three flat stones were also provided. With heavy feedings of earthworm the fish grew fast, and the thick mulm on the base of the tank was left to provide sufficient infusorian food for the anticipated fry. The rock refuges prevented that bullying which is common to Cichlids as sexual development increases.

In the middle of April the two larger fish were obviously intending to spawn in the shadier part of the tank. They were in full colour, the blue-black bars being very pronounced, with a diffusion of blue into the lighter parts of the body. The other two fish were now removed, though even at this stage there were no sustained attack on the interlopers. There was certainly not the ferocity of *C. biocellatum* at the same period of mating, but the fish were smaller, being slightly over three inches in length.

From the introduction into the larger tank, the fish were highly nervous, at feeding time dashing out of the holes in the rock, snatching up the food and returning quickly. Gravel excavations now commenced behind the rock, the flat stones being ignored. For greater observation, the other rock was removed. After a fortnight the male was found at the other end of the tank, and any approach to the female resulted in chastisement. Though the larger fish, he was scared, and the rock was returned as a refuge.

About 40 fry were now observed, about a week old, closely guarded by the female. At this stage they were able to take screened *Daphnia* and *Cyclops*. Upon any approach to the tank the female shepherded the fry towards the rock, and in a minute no fry were to be seen. Usually she simply pointed her head to the youngsters, agitated the pectorals slightly, and the fry responded in a small stream.

Recently reading of the expedition from the Woods Hole Oceanographic Institution, Massachusetts, on noises made by fish, I am curious to know what system of communication exists between female and fry at the approach of danger. The male was purposely left in the tank to complete the experiment.

And now the sequel. Within a further 10 days the fry were moving freely round the tank; in one day all but three disappeared, presumably eaten by the male. Plenty of food was available to him in the normal way. This followed a similar experience with Jewel Fish (*Hemichromis bimaculatus*), after which approximately one hundred fish were successfully reared by removing both parents after hatching. On the other hand both male and female of *C. biocellatum* can safely be left with the fry. The three surviving fry are thriving in the normal way.

The more experience I have with fish, the less is my inclination toward dogmatism, as so many factors affect their behaviour under aquarium conditions. I should like to hear more of Mr. Dunbar's experience with his fish from America, or the views of any other reader.

Leeds.

C. GRAHAM.

PROPAGATING CLAWED FROGS

SIR,—I read the two contributions on *Xenopus laevis* D. which were published in the June issue of WATER LIFE, and since one of your correspondents asks for information I am enclosing two papers on this subject. You will see from these that the usefulness of *X. laevis* for pregnancy diagnosis was discovered by Hogben in 1931 (not 1936). The injection is made into the dorsal lymph sac or the peritoneal cavity.

The method of injection illustrated puts too much restraint on the animal. It has recently been found that this lowers its blood-sugar level and so impairs its efficiency. I have done well over 10,000 tests within the last ten years, and I find that by far the best method is to catch the frog quickly in a ½in mesh net, inject through the net and then transfer the animal into the test jar.

As for feeding tadpoles, it is doubtful if the nettle powder method, developed by Gasche in the Ciba Laboratories in Basle, has any real advantage. I have found that tadpoles can equally well be brought up on either blood, liver emulsion or national dried egg. Emulsified eggs obtained from other toads serve equally well. In the case of the nettle leaves, the tadpoles probably subsist on the infusoria which develop in the infusion. No *X. laevis* of mine have ever reached maturity in ten months—two to three years would, I think, be nearer the truth.

Your Dutch contributor mentions that heating is not essential provided the temperature does not fall below 5 deg C. In my experience, the food intake below 19 deg C. becomes very sluggish, and as 22-24 deg C. is the optimal temperature, heating is necessary.

I would draw readers' attention to "*Xenopus laevis*, A Bibliography," by H. Zwarenstein, Sapaika and Shapiro, published in 1946 for the University of Capetown by "The African Bookman," which contains 305 items dealing with this subject.

Pinner, Middx.

E. ELKAN, M.D.

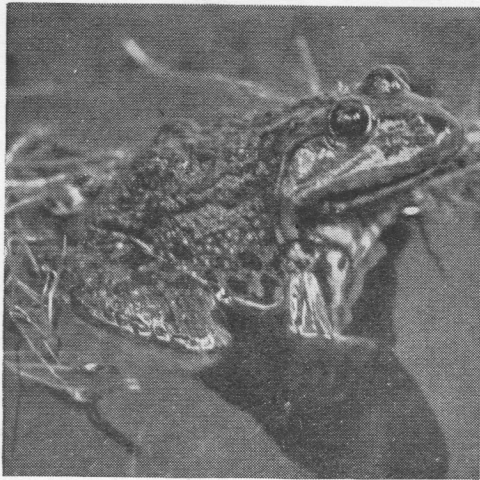
[The two papers referred to, one written in November, 1947, and the other in March, 1946, by Dr. E. Elkan, have been forwarded to Mr. A. Sloet tot Everlo.—Ed.]

First National Aquarium Exhibition

(Continued from page 387)

hobby. We also met Mr. R. G. Mealand and Mr. Fraser-Brunner.

The National Aquarists' Society deserves full marks for the unqualified success of their bold venture. So many were the helpers that it would be impossible to mention all. Let us merely say that the hard work by Kathleen Cooke (general secretary), Mr. L. B. Katterns (exhibition secretary), Mr. J. Carnell (president), and Mr. Sermon (vice-president), together with that of the rest of the committee and members, resulted in a good show, in excellent publicity for the hobby, and in setting seal to the fact that, as its name implies, the organizing society is formed and works on a national basis.



Female *R. ridibunda* basking on the edge of its home in the waters of Romney Marshes.

ON numerous occasions during the last summer an amphibian, popularly described as the Bull-frog, has appeared in the news. On further investigation by members of the British Herpetological Society, who are interested in these animals, this so-called "Bull-frog" was turned out to be none other than an old friend, the Edible Frog.

The Edible Frog (*Rana esculenta*), which is much at home in the ponds and dykes of the Continent, has been with us at least since 1837, when it was liberated in the Broads area of Lincolnshire. It has to-day disappeared to a large extent from Anglia, but is thriving in other localities closer to London, especially in Surrey. I know also of a colony near to my home on the borders of Epping Forest in South Essex.

R. esculenta has also been recorded in the area known as the Romney Marsh, bordering Kent and Sussex. Mr. E. P. Smith acquired twelve Hungarian specimens which he set free in his garden pond at Stone-in-Oxney, East Kent, during the winter of 1934-5. By 1937 he discovered specimens fourteen miles away and during the summer estimated that his frogs were covering an area of 38 square miles. During 1946 and 1947 Dr. Malcolm Smith, President of the B.H.S., made close observations on these frogs, described by Mr. E. Smith as *R. esculenta* (Hungarian variety). Indeed, they were of Hungarian origin, but found to be

The Laughing Frog

— A Welcome Visitor

Attempt to Establish *Rana ridibunda* from Hungary Meeting with Success

By Alfred Leutscher, B.Sc.

(Photographs by Peter Green)

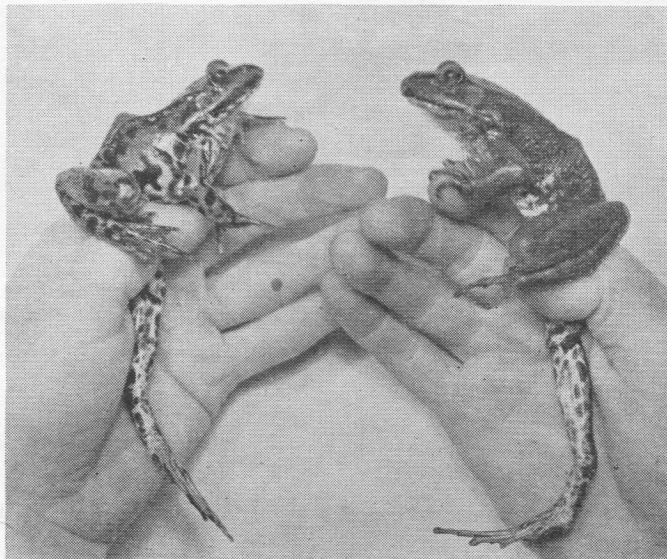
quite a distinct species, known as the Marsh Frog (*Rana ridibunda*).

This big relative of the true Edible Frog is a monster when fully grown and very similar in habits. It is essentially aquatic although, like the latter, is fond of squatting in the sun at the water's edge. It then takes on the most vivid hues, varying from a bright emerald green to a deep, metallic bronze. The dorsal stripe may or may not be present. Its underparts are white and similarly marked to the Edible Frog. The skin is a little more warty. The female specimen shown in the illustration measures nearly a foot with hind legs fully outstretched and has a body length of nearly four inches. Mr. Smith records a leap of 4ft 9in.

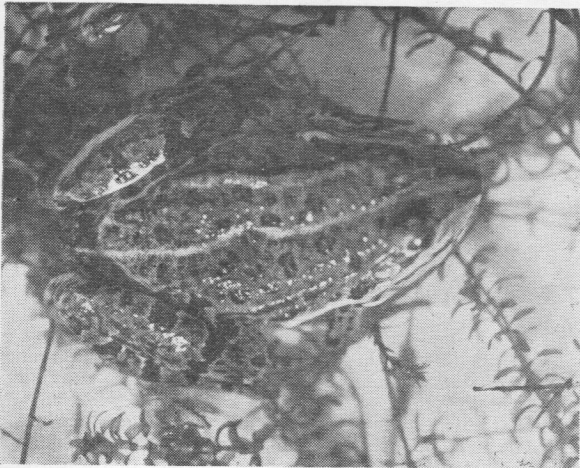
During a recent visit to the home of the Marsh Frog I happened to pick a sunny day, and on walking along the dykes which help to drain the Marshes I disturbed these frogs in their hundreds. There was a continuous succession of leaping bodies, as each basking individual dived for the protection of the water.

On the Continent the distribution of *R. esculenta* covers the western countries from Southern Sweden in the north to Southern France and Italy in the south, and eastwards to a longitude across West Russia. It is overlapped here by *R. ridibunda* which continues eastwards to the Urals and Persia, perhaps even farther, and has a sub-species in Southern France and Spain. This is thought to occur in North West Africa as well. The Edible Frog was first described from Germany and the Marsh Frog from a locality along the northern shores of the Caspian Sea.

As a vivarium pet both these frogs are a little too large for



Male Marsh or Laughing Frog (right) and female Edible Frog for comparison. The former species is usually darker and more warty.



Dorsal view of the Edible Frog (*R. esculenta*), to show the markings and distinctive vertical stripe.

comfort, and small specimens are usually kept. They live well indoors if given sufficient water and provided with a landing platform. A covering is essential. They do best in the garden pond, especially where there is an opportunity for sunbathing. They become real objects of beauty, not unlike glossy, china ornaments.

To my knowledge the Marsh Frog is not aggressive and will not molest larger fish. A collection of roach, dace, carp and perch have lived in amity with some of these frogs in my friend's pond during the last year. Minnows which he sometimes introduces seem to disappear, but I suspect the perch. Small fish and fry, however, are bound to suffer as the gastronomical feats of the Marsh Frog are remarkable. One of my specimens kept in an aquarium for observation has swallowed minnows, sticklebacks, pond-snails and roin worms. Even the tadpoles and young are not safe. This may be the reason why there appear to be no Common or Edible Frogs in its breeding grounds.

Marsh Frogs catch their food below the water, on the land and from the water surface. One reason why Mr. E. Smith set free his Hungarian specimens was to try and keep down the mosquito population. Mosquitos which can carry malaria still occur in the Marshes.

The croak of the male is similar to that of the male Edible Frog, which earned for itself the name of "Whaddon Nightingale" in Lincolnshire. Magnify this call (readers who have heard a full chorus of Edible Frogs will appreciate the din) and the bellow of its big relative can become almost overbearing at night. Small wonder that the Romney Marsh farmers and inhabitants have on occasions organized shooting parties to try and eliminate this disturber of the peace! Females, which have a softer croak, are the better to keep in the garden pond unless one wishes to retaliate on unpleasant neighbours! In moderation I do not dislike the song of the Marsh

Use of the Microscope (Continued from page 67)

gated. Some watch-glasses are flattened on the convex side and these have the advantage of remaining steady.

For transferring pieces of weed to and from the troughs a pair of forceps (No. 8) will be required, whilst a number of pipettes (No. 9) or dip-tubes will be needed for transferring smaller creatures to and from the live-boxes or glass slips. Larger creatures such as aquatic worms and small insect larvæ are best handled by a camel-hair brush (No. 10).

Frog. I have used an alternative name for it in my heading, a name suggested by Dr. Malcolm Smith which, I think, is most apt. When I gently squeeze my tamed male specimen, the vocal sacs are distended and it responds with a delightful chuckle.

Will *Rana ridibunda* succeed in establishing itself in this country? We cannot say for certain, since animals which are introduced do not always settle down to new surroundings which on the surface look similar to their native home. They flourish for a while, then die off. The Edible Frog population, for instance, has fluctuated considerably. Mr. E. Smith mentions that his Hungarian frogs were very numerous at the start and then showed signs of decreasing. He ends his paper by saying "I believe my thriving colony is on its way to such semi-extinction."

To-day, however, it is definitely on the increase and spreading. Let us hope that the ranks of the Marsh Frog will not be decimated by the activities of collectors, as may be the case with the Edible Frog in Lincolnshire. With already such a poor selection of Amphibia in this country, a newcomer like the Laughing Frog is always welcomed.

Readers' Hints and Tips

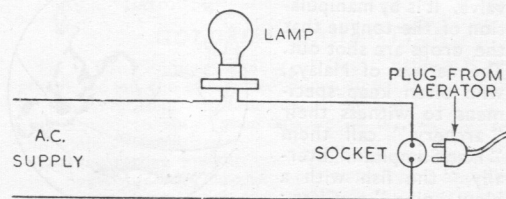
(8) Aeration Control

I RECENTLY fitted an "Angel" streamline aerator to my 24in x 12in x 12in tank and found that the volume of air was, in my opinion, too much for one diffuser so I looked for a method whereby I could regulate the air bubbles to a gentle, steady stream.

This, I realized, could be done by restricting the air to the diffuser and so increase the load on the aerator diaphragm, or by by-passing some of the air away from the diffuser. I considered this latter method wasteful and the former undesirable and decided to experiment by limiting the power to the aerator.

To do this, I wired in a lampholder so that it could be connected in series with the aerator supply. The lamp that I found most suitable to use was one of 25 watts rating. With a 15-watt lamp the aeration was too gentle for the size of the tank, and with a lamp with a wattage in excess of 25 watts the aeration was too vigorous.

The advantages with this method of control are a saving in the amount of electricity used for aeration and more silently operating apparatus. This method of control should be suitable for any machine working on the "Angel" streamline aerator principle but would not be suitable for an induction motor driven machine which must run at a fixed speed.—J. Neale, Birmingham.



(10s 6d is paid for all published hints and tips from readers.)

Chameleons

— Their Keeping, Feeding and Management

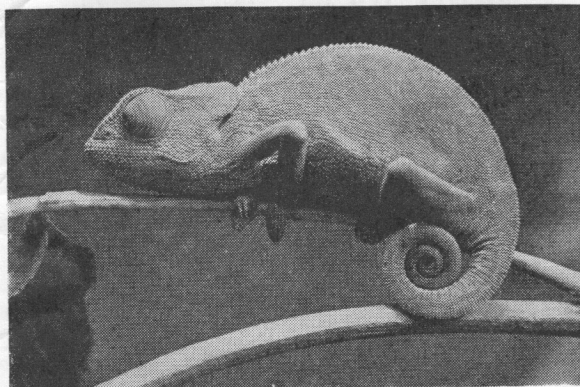
By Robert Jackson, F.Z.S.

SINCE the war a number of Chameleons have been imported into this country, many by Service men returning from the Middle East, but few appear to survive and information on their requirements and management may be of value. The writer imported his first Chameleons from Casablanca in 1937 and was successful in keeping two specimens for twelve months. Since that time many have passed through his hands, of various species, but he seldom hears of vivarium keepers who have exceeded this time. These lizards require more attention than the usual species. This disadvantage, however, is heavily outweighed by their interesting feeding mechanism, grotesque appearance and, quite important, their inability to escape.

There are about fifty species of Chameleons, occurring mainly in Africa, and also in Arabia, India, Ceylon and Madagascar. One of the African species is also found in Southern Spain. Anolis lizards of the New World, frequently referred to by American dealers as Chameleons, are not true Chameleons but arboreal lizards with well-developed colour-changing powers and similar habits. They make good vivarium subjects and can be kept successfully with other lizards.

A 24in×12in×12in aquarium can be adapted to form a suitable vivarium for two Chameleons with a body length of from three to four inches. The temperature must be kept at approximately 70° to 80° F and foliage with slender branches provided. Chameleons are awkward on the ground and obviously out of place. The vegetation must be sprayed with warm water daily as these lizards are found in regions where foliage is abundant and are reliant upon rain and dew for moisture in their natural state. In the vivarium, however, they will occasionally drink from a flat dish.

Feeding is simple. Sixpenny-worth of maggots from the local fishing-tackle shop will last about a fortnight.



[Photograph]

[C. L. Carter

Specimen of *Chameleon dilepis* owned by the author

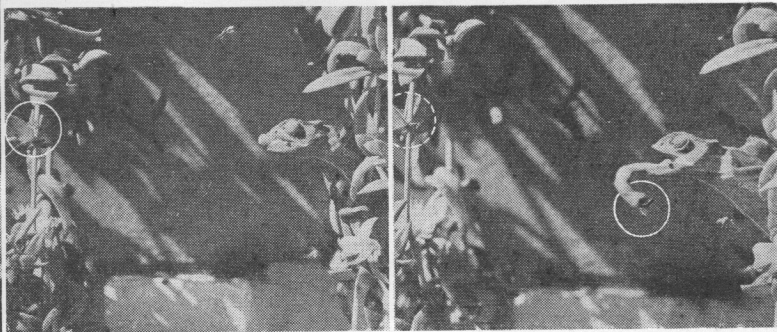
They will probably be eaten from a dish or flat stone, but are preferred when they have pupated and hatched into flies. A change of diet should be offered in the form of spiders, earwigs, grasshoppers and similar creatures.

There is no possibility of mistaking a Chameleon on sight. The body is compressed and covered with small granules, the tail is prehensile and the head is provided with an extension at the back which gives the appearance of a hood. The feet are modified to form two opposing groups of toes making a grasping organ like a pair of pliers. The eyes are large and prominent and function independently.

Perhaps the most remarkable feature of the Chameleon is its feeding mechanism, consisting of an extensile tongue, club-shaped and adhesive at the tip, telescopic and elastic at the base, where it fits over a thin bony projection. This tongue is capable of being rapidly ejected a distance of four to six inches for the purpose of catching the flies and insects upon which the Chameleon feeds. I have observed with Chameleons



[Photographs]



[Keystone

A docile looking Chameleon is seen resting on its owner's hand in Durban, South Africa. The second picture shows it ready to take a fly and the third immediately after the victim has been caught. The circles show (i) the fly partially hidden by a leaf and (ii) the fly adhering to the Chameleon's sticky tongue

feeding in my vivaria that before the tongue is ejected the mouth is slightly opened and the tip appears to be pressed against the roof of the mouth. This would lead one to suppose that the adhesive is passed to the tongue before each ejection, and that the end is not permanently sticky. Another interesting characteristic of the Chameleon is its independent eyes, and the writer has noticed on every occasion when he has observed these lizards feeding that both eyes are focused on the victim. It is apparent that on these occasions binocular vision is essential for judging distance. They never make the mistake of throwing the tongue before being within range, although, admittedly, they sometimes miss, but this is usually due to a sudden movement of the victim at the precise moment at which the Chameleon decides to feed upon it.

The Chameleon is the traditional example of animals which undergo colour change for protection, and its powers in this respect are usually greatly exaggerated, as they are equalled by Anolis and Agama lizards, and possibly the Iguanas. Colour changes range between dark brown and brilliant green, and are caused by chromatophores in the lower layers of the skin. Each of these chromatophores has either black, red or yellow pigment granules, and the movement to and from the skin of these granules produces the colour of the moment. The action appears to be involuntary. Changes of light and temperature produce a much more marked response than environment. The historic joke concerning a Chameleon being placed in a Scotch plaid and its subsequent bursting, was not the product of a systematic herpetologist.

Freshwater Algæ in the Green and Blue-green Groups

Range of Simple Plant Organisms Which Includes Varieties Characteristic of Animal Life

THE Algæ are a very large group of simple plants most of the members of which are aquatic. The great majority of them are marine and the larger ones are well known to everyone as "seaweeds." There are, however, many freshwater forms and most aquarists and owners of garden pools are at least familiar with some of the mass-effects produced when large numbers are present in the water, such as "green water," "blanket-weed," "water-bloom" and the bluey-green coating which sometimes smothers their aquarium plants. The individual plants, being mostly of microscopic size, are, however, little known to the average amateur and so in succeeding articles in this series the commoner kinds of freshwater algæ will be described and illustrated.

Without going into the details of classification it can be said very briefly that algæ are divided into four main groups—the Green Algæ; the Brown Algæ; the Red Algæ; and the Blue-green Algæ. The Brown and Red Algæ, being almost exclusively marine are outside our present scope and attention will be confined to the other two groups.

Many algæ consist merely of a single cell; others form colonies of cells which may take the form of a hollow sphere, a flat mass or a thread-like filament. Multiplication takes place in several ways and the reproduction of these organisms is very complex. In some cases it takes place by the simple process of a cell dividing to form two or more new organisms. At other times two cells come together and unite resulting in the formation of what is called a *zygospore*—a form of resting spore which can withstand drought and frost, and only germinates when conditions are again suitable. The presence of algal spores in all water

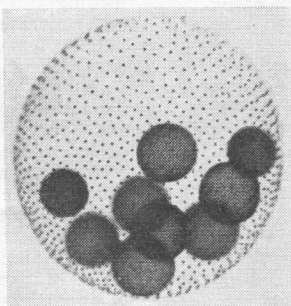
and also possibly in the air explains why these tiny plants suddenly appear in any body of water which is left to stand, such as a new garden pool or aquarium.

All algæ contain the substance chlorophyll, the green colouring matter of plants, although its presence may be masked by the other pigments which give the various groups their characteristic colours of blue-green, brown or red. By means of this chlorophyll, like the higher plants they can break down under the influence of sunlight the carbon dioxide in the water and release the oxygen for the benefit of the animal life. This property is well seen in spring when the masses of "blanket-weed" in a pond are buoyed up at the surface of the water by trapped oxygen bubbles which the plants have themselves produced.

In addition to using the carbon from the carbon dioxide to form starch, algæ also obtain food by absorbing through their cell-walls other chemical substances dissolved in the water—the nitrates, bicarbonates and phosphates—and the great importance of algæ in nature is their ability to change these simple chemical substances into living matter and so provide one of the first links in the complicated food-chain of larger freshwater creatures.

Any sudden increase in the supplies of these simple chemical substances, particularly if accompanied by an increase in the light falling on the water, whether it be in a lake, reservoir, pond or aquarium, will result in a large increase in the algæ, for with abundant food supplies they reproduce rapidly. In natural lakes the number of algæ present in the water increases enormously in spring and early summer under the influence of more sunshine and the augmentation of the nutrient salts in the water by supplies

By John Clegg, F.R.M.S.



Volvox, one of the plant-animal organisms, showing nine daughter cells, each of which will, later, burst through to enjoy a separate existence.

The Baby Amphibian Grows Up

By Alfred Leutscher, B.Sc.

AT the time of the year when the aquarist is concentrating on the rearing of his fish-fry, to a similar degree the vivarium-keeper is in the throes of breeding, and since most of his specimens come from temperate lands the families arrive thick and fast. Where the two hobbies meet is in the aquarium, for with breeding-Amphibia water is necessary in the earlier stages.

The Modern Amphibia, apart from a small, lesser-known group, the legless *Apoda* or Cœcilians, are divided into the tailless *Anura* (Frogs and Toads) and the tailed *Caudata* (Newts and Salamanders). Their development, apart from minor differences, is similar. Both groups normally lay their eggs in water, from which larvæ hatch into gilled, and as yet, legless tadpoles with swimming tails. At a later stage, by metamorphosis, lungs and legs are developed, when they take on the characters of their parents. Until this happens they require special care and attention.

Let us take as an example of the *Anura* the Edible Frog. This breeds in May or June. The adults pair, and as each female lays her mass of "frog-spawn" it is fertilized in the water by the male. The protective, jelly-like covering rapidly expands with water, and the eggs within start to grow.

Last year I collected some spawn and isolated an egg. In an egg-cell can be noticed two areas, the upper "animal-pole" (black in the Common Frog, brown in the Edible Frog) and the larger "vegetative-pole" (whitish in the common species and pale-yellow in the edible kind). This pale area often gives rise to the belief that the eggs have not been fertilized, and are going bad. In the egg under observation the two areas were clearly visible on May 26th. It was 1½ m.m. in diameter (Fig. 1B).

Very soon the cells of the animal-pole begin to spread over the pale area, which is made up of yolk-cells. In this way the animal grows around its food, as it were,

and the yolk comes to lie within the body, in the region of the future stomach. By May 29th the baby had a definite shape, in which the tail region could be seen. It was now 3 m.m. long (Fig. 2B). On June 3rd the external gills were visible and the curious sucker, which precedes the opening of the mouth, had formed (Fig. 3B). It was then 6 m.m. long, and had hatched. It spent most of its time hanging on to the glass or the plants by its sucker. By June 8th it was quite lively, swimming here and there, and had well-developed external gills, eyes and a mouth. The sucker had diminished considerably. The buds of the hind-legs were just visible (Fig. 4B).

At this early stage the tadpole is a vegetarian, and feeds almost continuously on the algal growth which covers plants and stones, or which floats in the water. I provided this by allowing the small tank to mature in strong sunlight until it looked unsightly with algae, but made an ideal feeding-ground.

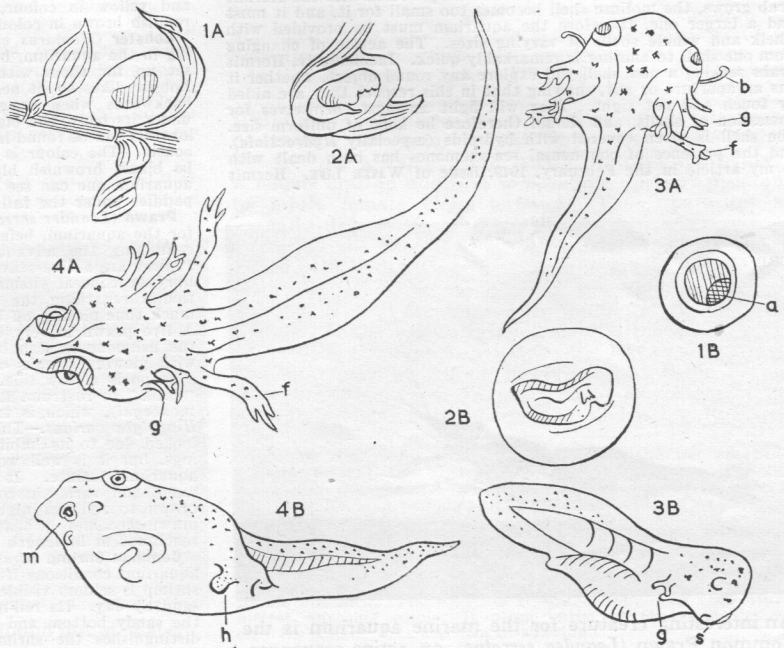
At the same time that I was observing this tadpole I watched the growth of a baby newt. This will serve as an example of the *Caudata*. My female Palmated Newts were spawning at the time, laying their fertile eggs separately on the leaves of *Elodea*. I chose an egg which was laid on May 25th. It was 1 m.m. in diameter (Fig. 1A), and embedded in its jelly covering which was attached to a leaf. By May 28th embryonic development could be seen and there was a distinct tail. It was then 2½ m.m. long (Fig. 2A). Two days later the baby was wriggling in its egg-membrane, and finally broke through on June 2nd.

Sketch 3A shows the tadpole on June 3rd, already with its external gills and fore-limbs. It was now 9 m.m. in length. The curious "balancers" between the eyes and gills should be noted. These are used by young newt-tadpoles in place of a sucker for anchoring on to plants, etc. Another point is the shape of the youngster, which resembles that of its parents at an early age, unlike the "polly-wiggle," as I have heard the tadpole of the frog called. By June 6th (Fig. 4A) the newt-baby was fully active whenever disturbed. The young should be reared on Infusoria during the early stages.

EARLY STAGES OF GROWTH IN AMPHIBIA

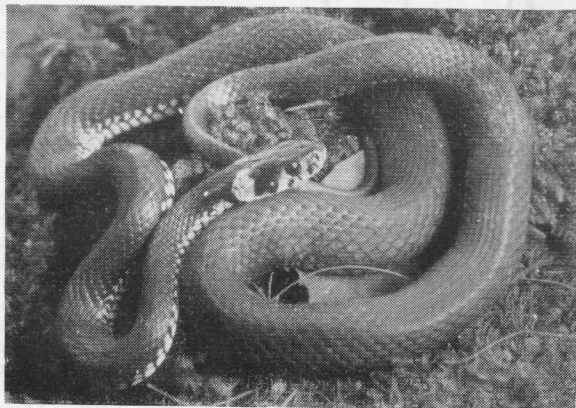
Palmated Newt 1A - 4A
Edible Frog 1B - 4B

b . . . balancer g . . . ext. gills
f . . . fore-limb s . . . sucker
h . . . bud of hind-limb
m . . . mouth



European and American Snakes Suitable for the Vivarium

— By Robert Jackson, F.Z.S. —



Photograph] [Peter Green
Grass or Water Snake (*N. natrix*)

THE snake population of Europe is close at hand and reasonably familiar, although Great Britain has only three serpents, two of which are suitable for the vivarium. In the United States the field is much greater and I have to confess that my experience has not covered all species. I therefore propose to confine myself to those American snakes which have actually lived in my collection.

The commonest snake kept in captivity in Great Britain is the Grass or Water Snake, usually *Natrix natrix*, although *N. viperinus* and *N. tessellata* are often sold under the same name. The European Water Snakes feed almost entirely on amphibia and fish, fur-bearing mammals never, in my experience, being taken, although one must be careful never to be dogmatic regarding the feeding habits of snakes.

Changed Conditions Favourable

Serpents with similar habits and requiring the same conditions from the U.S.A. which I have had from time to time in my collection, include the Banded Water Snake (*Natrix sipedon*), the Garter Snake (*Thamnophis sirtalis*)—the most abundant American snake, a good captive and one which frequently produces a brood of living young—the beautiful miniature Ringed Snake (*Diadophis punctatus*) and the Red-bellied Water Snake (*Natrix kirilandii*). We often deplore the fact that our own snake population is rapidly being exterminated by the impact of our civilization upon the countryside, but the last named snake, *Natrix kirilandii* has actually increased in the U.S.A. since the pre-pioneer days. No mention of this serpent was made by any American herpetologist until 1891 and its abundance now, even near built-up areas, points to the fact that the clearing of the land has resulted in the creation of suitable living conditions and food supply.

Like our Water Snake, *Natrix natrix*, *N. kirilandii* loves the vicinity of pools, water meadows and water courses and is seldom found in forests. He, of course, is named for his red belly, his other main colourings consisting of four longitudinal rows of black blotches on a light brown ground—subject to variation. My specimens have never exceeded 18in each. Another snake

I have mentioned is the American Ringed Snake. This slim little creature seldom grows to more than 15in, is grey in colour with brilliant orange belly and yellow collar. An important point from the vivarium-keeper's point of view is the readiness with which the American Water Snakes feed on earthworms.

The genus *Elaphe* has representatives in both continents which are suitable for the vivarium. One of the best known in Europe is the Aesculapian Snake (*Elaphe longissima*), a docile snake with a classical history. It feeds well on young mice and is inclined to be arboreal.

The Four-lined Snake (*Elaphe quatuorlineata*) is my favourite European snake. It is handsome, docile and a ready feeder. It is unfortunately difficult to obtain. The Chicken Snake (*Elaphe quadrivittata*) of the U.S.A. is a similar serpent but smaller. The Corn Snake (*Elaphe guttata*) of the south-eastern U.S.A. is most handsome with crimson blotches, bordered with black. Its favourite food, as with the other *Elaphe*, consists of small rodents and birds.

Another European snake commonly imported is the Dark Green Snake—*Coluber* (formerly *Zamenis*) *viridiflavus*. I mention this reptile, not because it does well in captivity, but because continental dealers have them in great quantities during the spring and they are sent in big numbers to the U.K. They are used extensively in Zoos as the food for those snakes which insist on a diet of their lesser brethren, in particular the Hamadryad (*Hamadryas hannah*). The Dark Green, when adult, is a black spectacular fellow, but an indifferent feeder and usually ready to bite the hand that feeds it. Its American cousin, the Black Racer (*Coluber constrictor*) is a similar snake but larger, more agile and more likely to feed in the vivarium, which must be large. He resents being handled. In this connection I would mention that all the snakes I am writing about, with the possible exception of *Elaphe quatuorlineata* dislike being played with by their owners and passed around at Aquarium Society Meetings, Shows, etc. In my opinion, the Pythons and Boas are the only snakes which grow accustomed to this kind of treatment.

Setting Up the Vivarium

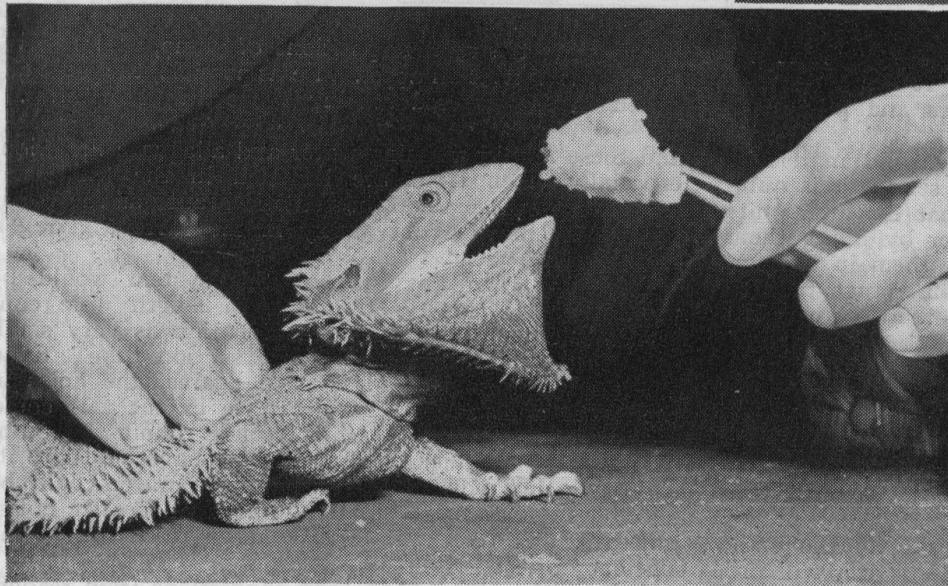
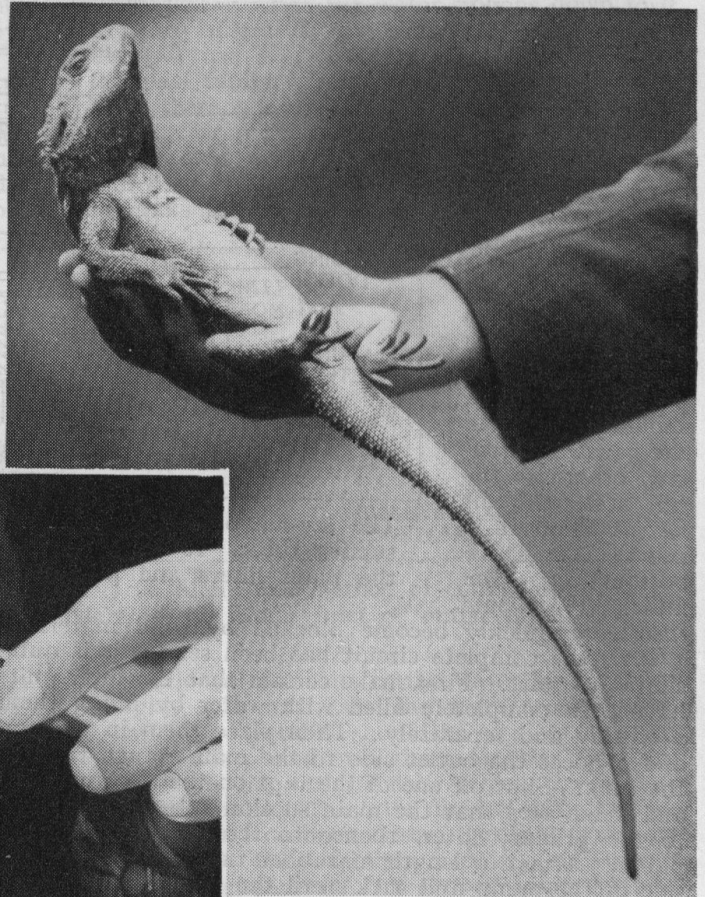
A vivarium for Water Snakes should have a water hole about one-third its total area. It should be furnished with rock and bark and well planted with ferns and moss. The snakes will usually take their food in the water. American serpents should have a large flat rock on which their worms can be dropped. Avoid sand.

The *Elaphe* and the Colubrids require drier conditions with a water hole about a quarter of the area of the vivarium. Plenty of rock and tree branches should be used as these help the reptiles to cast their skin. Here again, avoid sand. It frequently sticks to the prey while feeding and finds its way between the snake's teeth—each grain a potential canker.

Those who regard the feeding of live mice to snakes as cruel will find they will be taken just as readily freshly killed. Strange to relate my Royal Python refuses live mice but feeds instantly when the prey is offered dead.

Australian Lizards

Several Well-known Species
Among Recent Importations



Two views of the Bearded Lizard (*Amphibolurus barbatus*). Top, in its keeper's hand and, below, with gular pouch distended when being fed with a piece of banana.

WHEN writing on suitable reptiles for the vivarium their availability at that time is, of course, important. At the present moment regular shipments of spectacular Australian lizards are arriving in Great Britain.

Live-stock dealers, large stores and many pet shops frequently have them on show, or can secure them at short notice. In order to ensure that the reptiles arrive in good condition it is necessary for them to be flown from Australia. This means a high price, but persons can console themselves with the fact that the creatures have not had to stand a sea voyage.

The Monitor family is well represented in Australia and Gould's Monitor (*Varanus gouldii*) and the Lace Monitor (*Varanus varius*) are available from time to time. Juvenile specimens make excellent pets and become very tame. Monitors eat a certain amount of carrion in the wild state (one of the few lizards which do) and as a result they will take horsemeat from a dish very readily in captivity making them most convenient lizards to keep. They also take small mammals, amphibia, birds and eggs. All food can be fed dead.

These lizards lay about twelve eggs in shallow holes scratched in the ground. The young are nearly a foot long at birth and, like most young reptiles, are brightly

coloured. I have never heard of Monitors breeding in captivity, however. They need a roomy vivarium with plenty of water for bathing and drinking and are gross feeders, cleaning out having to be done frequently. The vivarium should be so designed to make this operation simple, and peat makes an excellent floor covering for these creatures.

Lesueur's Water Lizard (*Physignathus lesueuri*) is a handsome, dragon-like creature with crest similar to that of the South American Iguana. He requires plenty of space and water with a good supply of insects, including cockroaches and mealworms. This is not an animal for the small vivarium but, given the right conditions, he is a remarkable exhibit with a fierce prehistoric appearance. When running at speed his front legs are clear of

the ground. The hind legs are strong and muscular and, if your specimen escapes in the suburbs, the sight of one of these agile lizards will seriously disconcert passers-by. I am informed by the head keeper of reptiles at the London Zoo that their specimens feed on raw meat in a like manner to Monitors. My own specimens have never been so accommodating, probably because they are "birds of passage" and never have had time to settle down before being distributed to other collectors.

The Bearded or Jew Lizard (*Amphibolurus barbatus*) is a well-known Australian reptile similar, at first glance, to a large, fat *Agama stellio*. The beard is a gular pouch, capable of great distension. This dis-

By
Robert Jackson, F.Z.S.

(Illustrations by Fox Photos)

tension, by the way, is produced muscularly and is mechanically connected with the opening of the mouth. Like all the *Agamidæ*, it is capable of considerable protective colour variation, which frequently takes place when the lizard adopts its threatening attitude, inflating its body and extending its beard. Unfortunately, as the lizard becomes more tame it displays less frequently. In the case of new arrivals which have displayed angrily, I have taken the opportunity to insert a few tasty morsels in the open mouth. These are invariably swallowed and the lizard subsequently feeds normally. They take mealworms readily, also garden worms, insects and young mice. Plenty of sunlight or artificial light must be provided and as much vertical living space as possible. The eggs, laid in February or March, number about half a dozen. Here again I have no record of breeding in captivity.

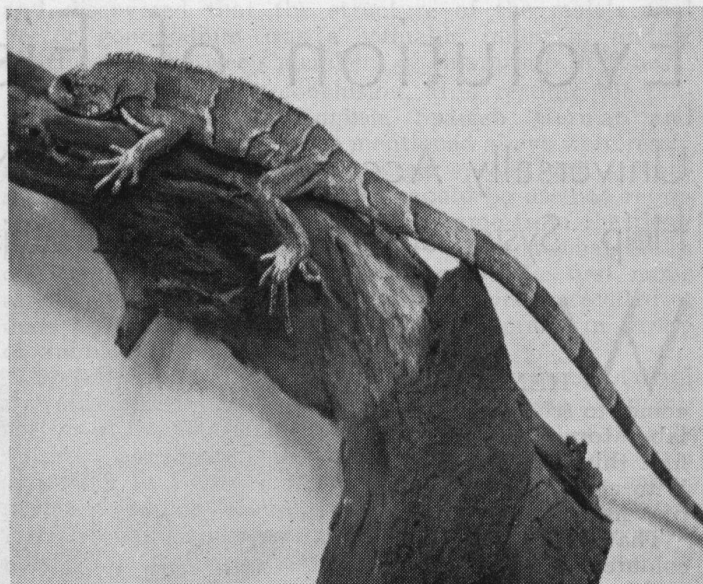
Recently Imported Skinks

The species of Skinks make up the most important family of Australian lizards. They are good vivarium inmates and feed readily, being particularly fond of fruit. They become very tame and are capable, if necessary, of going for months without food. Some species have a very thick tail which acts as a reserve supply of nutriment. The Stump-tailed Skink (*Trachysaurus rugosus*) is a grotesque lizard of largely vegetarian habits feeding in its native land on blackthorn berries, toadstools and wild currants, etc., according to the season. In captivity it appreciates bananas. Its appearance is rather like a pine cone and it is known locally as the Shingle-back. The young are produced alive, two at a birth, and each individual is half the length of the mother. They will breed freely in captivity. The Great Skink (*Egernia major*) has also been found to be a great fruit eater. He is bad-tempered compared with other Skinks, and I recently received a bite from a large specimen which has prompted me to treat the species with more respect. This species is very handsome with a thick body like polished oak.

The Blue-tongued Skink (*Tiliqua scincoides*) is a well-built lizard of amiable disposition, steely grey in colour with transverse bands of brown and yellow. Its tongue is sky-blue and is protruded and withdrawn a great deal when the reptile is being handled; the startling colour always causes a great deal of comment. We have found that *Tiliqua scincoides* feeds readily from the hand a few hours after flying half-way round the world. This lizard can be strongly recommended.

Arrivals Expected

Cunningham's Skink (*Egernia cunninghami*), named after Alan Cunningham, the botanist, is a long-tailed, spiny Skink, brown in colour, with transverse dark brown markings. None has, to my knowledge, been shipped to England since the war, but supplies are likely to arrive at any time. This reptile is very liable to dig



The South American Iguana, the crest of which is comparable with that of Lesueur's Water Lizard.

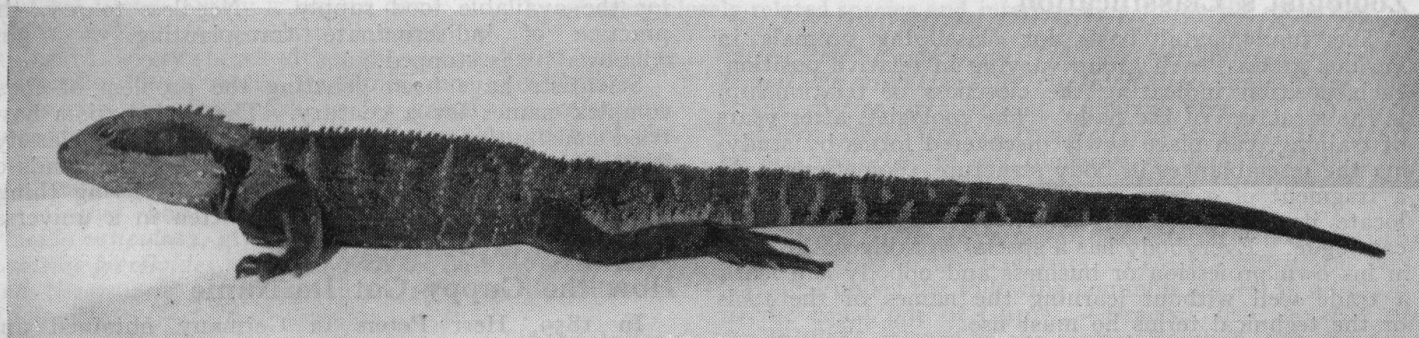
its way under any loose rocks in its vivarium. Loose sand and stones should never be supplied. This comment applies to all the Skinks. They dig themselves away out of sight in a very short time, and one usually has to wreck a tastefully set up vivarium in order to secure one of the inmates. Rocks used should be heavy with flat bases in good contact with the floor. Shallow stone chippings or peat make good floor coverings. Plants will be flattened or dug up.

Temperature Fluctuation Desirable

All the reptiles mentioned will feed throughout the year if kept reasonably warm; about 70 deg to 75 deg F. during the day, with a drop to 65 deg F. at night, is permissible, and, I am inclined to think, beneficial. Artificial light should be provided by means of standard electric light bulbs. Tubular heaters are quite satisfactory for heating, but the reptiles must be protected from direct contact with them. Heat thrown down from above is probably better but more difficult to contrive.

It will be obvious from the foregoing notes that Australian lizards make interesting and instructive subjects for the vivarium. There is much still to be learned about them and I would be glad to hear of any experiences which readers have had with these interesting and intelligent creatures.

Advice on constructing and maintaining indoor and outdoor vivariums is given in detail in "Hardy Reptiles and Amphibians" (No. 2 in the WATER LIFE series of handbooks, price 1s 6d, by post 1s 8d from the publisher).



A fine specimen of Lesueur's Water Lizard (*Physignathus lesueuri*). This species should only be kept when extensive living quarters are available, for it is only then that they can fully utilise their strong limbs and be seen to advantage.

REPTILES

Wall Lizards, Green Lizards, Grass Snakes, European Whip Snakes, Green Tree Frogs, Salamanders, Bearded Lizards, Lesueur's Water Dragons, Monitors, Tortoises, European Terrapins, Australian Snake and Side-necked Turtles, Alligators, Iguanas, Anolis Lizards, Giant and Blue-tongued Skinks.

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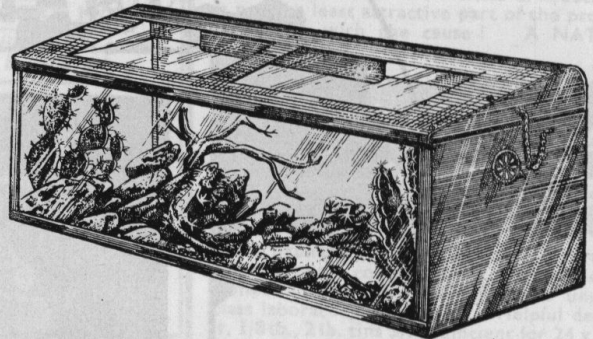
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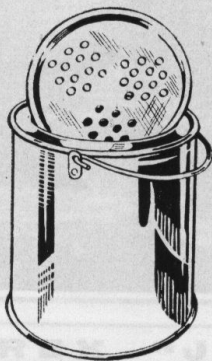


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Introducing the Sungazer

— By —

Alfred Leutscher, B.Sc.

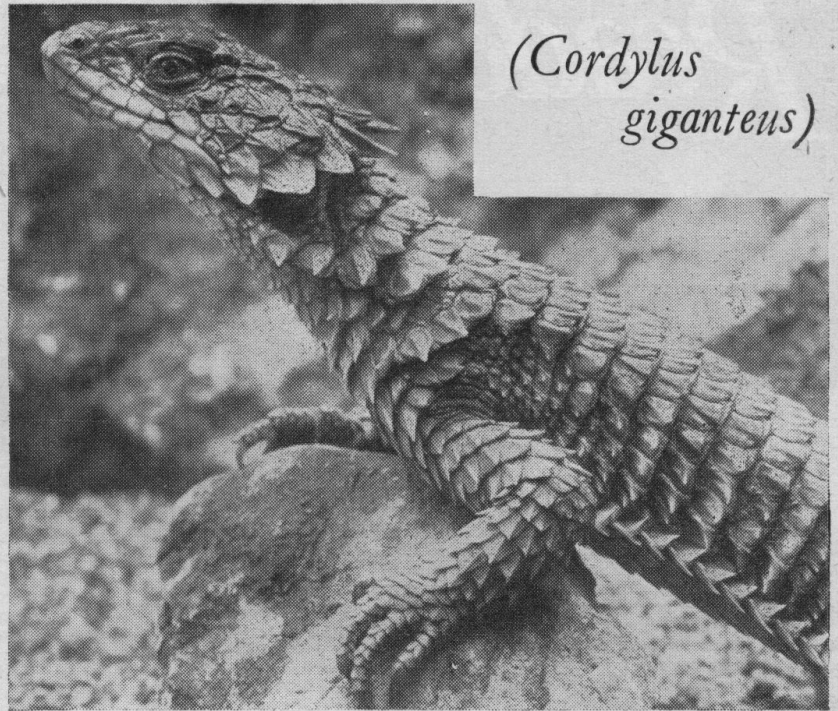
It is encouraging to find a steady increase in the variety and numbers of reptile importations in the last year or two. In Britain the hobby of vivarium-keeping, which is becoming increasingly popular, is limited to a very restricted number of native species, so that, for greater variety, the vivarium keeper must look further afield. It is in the countries of the Tropics, which are the main stronghold of these cold-blooded, scaly creatures, that he finds his greatest selection.

Among recent importations from S. Africa has appeared a strange lizard which seems to be the last word in scaliness. Known as the Girdled Lizard, of the Genus *Cordylus*, it has the makings of a true-to-life dragon, both in appearance and surroundings, as if it had stepped from the pages of the picture-book.

These lizards are found in the open veldt of S. Africa. The largest of the eighteen or so species is the Great Girdled or Lord Derby Lizard (*Cordylus giganteus*), which can grow to 34 cm. in total length, and is found mainly in the Orange Free State. The name of *Zonurus derbianus* given to it by Gray is now usually dropped by herpetologists.

This lizard is heavily armoured on its upper surface by regular rows of scales. These are flat on top of the head but are otherwise strongly keeled and each has a strong, spiny projection pointing down the body. They vary in length but are larger behind the head, the front border of the ear-hole and on the tail. The much softer underparts are covered with smoother scales or plates.

The colour is some shade of yellow or brown, usually palest on the snout and darkest on the head. The underparts are a straw yellow. There may also be dark patches of brown on the body. Known in its native home as the "Sonkyker," which is Afrikaans for Sungazer, the Lord Derby lizard has earned its name from a peculiar habit of facing the sun. Emerging from its underground retreat, usually a hole in some rocks or the burrow of a rodent like



(*Cordylus
giganteus*)

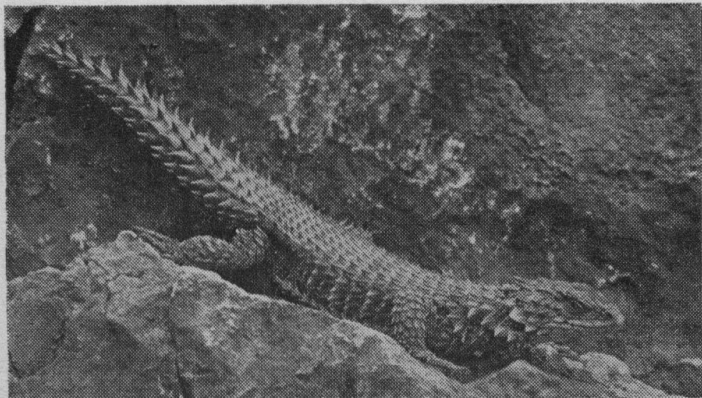
the sand-rat, it seeks a little promontory, such as an ant-hill or stone. Then, with head and fore-quarters raised on its fore-legs, it gazes unblinkingly at the sun for hours on end. As the blazing orb slowly transcends the heavens the lizard's body rotates to follow its course. In such a setting as this, of arid waste and blazing heat, the Sungazer and its allies personify the very last word in reptiles—or dragons. One almost expects to see smoke leave their nostrils!

Yet these little creatures are entirely harmless, the scales being there for protection. As if aware of the weakness of its defence—i.e., the soft underparts, a Girdled Lizard will struggle when placed on its back. Otherwise it is quite docile, rarely biting. Some species, so it is said, will even grasp the tail in the mouth and roll into a ball of protective spines.

A variety of insects and other small animals are taken as food, and I have known this lizard to eat soft fruit. Bearing in mind that we would be keeping it under conditions far different from its native habitat, every variety and choice of food should be offered to maintain a healthy specimen. Animals can usually be relied upon to take what is good for them.

In the vivarium, which should contain dry earth or sand, with a small water dish handy, the Sungazer should settle down contentedly, provided that summer heating and plenty of light is maintained. A rock, on which it can climb and bask, could be placed near an electric light hanging over the vivarium, which also provides heat. Better still, on every suitable occasion, this lizard should be placed outside in the natural sunlight, the hotter the better. It will take any amount of it.

The sexes of the Girdled Lizards are very similar. The male is usually the smaller and has a thicker tail, which is also longer in proportion to its body-length. Although I have never heard of these lizards breeding in this country, the enterprising vivarium-keeper might care to attempt it. In S. Africa it mates in late spring, the mother producing a family of, usually, two babies which are about 12 cm. long at birth.



Photographs]

[Lionel E. Day, F.R.P.S., A.I.B.P.

The armoured scales on the upper surface of the Sungazer (*Cordylus giganteus*) give this harmless lizard a prehistoric appearance, although they are only used as a protective device.

Complete Metamorphosis in Axolotls

Occurrence at Fovant, Wiltshire, Recorded in Diary Form

By Dr. R. C. C. Clay

(Photographs by Lionel E. Day,
F.R.P.S., A.I.B.P.)

ON July 1, 1949, I purchased two adult Axolotls in Southampton and placed them with a small American Catfish (*Ameiurus nebulosus*) in a glass tank—14 × 14 × 12in. The water was from my garden pond. I planted a few *Vallisneria* and some Canadian Pondweed (*Elodea canadensis*) in the tank. By July 3 the Catfish had disappeared, and one of the Axolotls looked unduly fat!

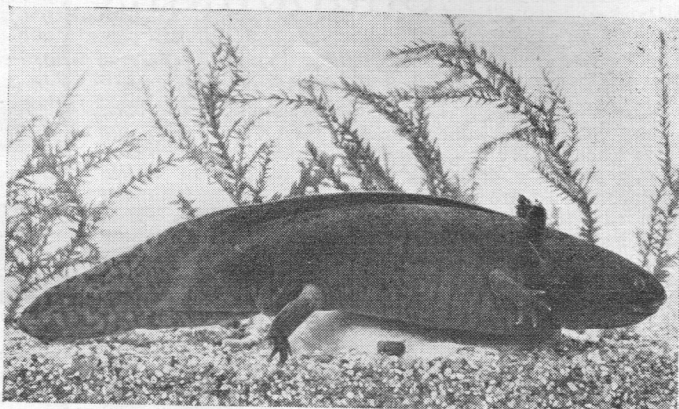
Both Axolotls were now placed in a standard tank—18 × 9 × 9in, with a few rocks and no plants, and the water was kept up to the rim of this container. The Axolotl which had eaten the Catfish refused all food until November 9, after which time it took a small earthworm each day, as the other one had done since July. On occasions they were given shreds of the tough, skinny meat intended for my ration. All this time the water level was kept constant and, whenever they lost appetite, the water was changed. Instead of pond water, tap water from the village supply was used. This is untreated water from a small reservoir, very soft and with some iron rust in suspension from the old pipes.

Both Axolotls led a normal life until March 2 of this year. The following extracts from my diary complete the story.

March 2. The Axolotls, which have not been eating for some days, started to shed their skins in shreds.

March 10. Very many shreds of skin were present on the bottom of the tank. One of the Axolotls took a worm.

March 13. The gills were shrinking, the eyes beginning to bulge, the caudal fins receding and the feet looked somewhat different. It was now realized that metamorphosis was taking place, and so the water was lowered



Normal "black" Axolotl showing the prominent gills and small eyes.

to 6in and sloping rocks placed in the tank to enable the Axolotls to climb up to breathe air if they desired.

March 14. One Axolotl remained for over an hour with its nose out of water.

March 23. Both Axolotls took a worm. The slightly larger one—the one which had not eaten the Catfish—appeared to have finished shedding its skin.

April 17. There was a quantity of skin shreds in the tank. Water depth was still 6in. The creatures now moved differently. Instead of gliding on their feet they moved with their bellies touching the sand, and their legs seemed to be "double-jointed," and of little use. The gills had disappeared. There were now definite eyelids over their bulging eyeballs. At this stage they remained motionless and made no struggling movements when picked up and held out of water.

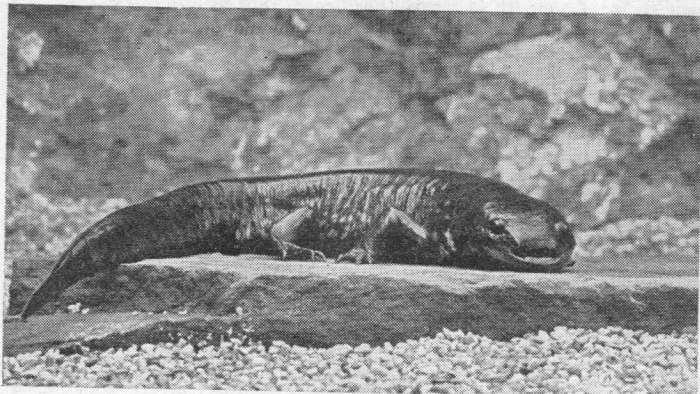
April 19. They shed glove-like casts from their feet.

April 24. Both were now very spotted on the underparts. They remained motionless almost all day. One of them was eating a worm or two each day. This one appeared to have finished shedding its skin, and its body was completely lustreless. Its eyes were open and it seemed to have both upper and lower lids. This Axolotl definitely saw objects and followed a moving hand with its head, whereas, when it was a typical Axolotl, it had little or no vision in its small, beadlike, lidless eyes. The one which made a meal of the Catfish still had closed eyes and refused food. It threw off a few shreds of skin each day.

May 24. The Axolotl which ate the Catfish had now finished shedding its skin, the last traces coming from its face. The eyelids were still closed and it continued to refuse food.

May 26. Both specimens were now eating. At the beginning of July both Axolotls became fully terrestrial and they then appeared to prefer to remain on dry ground for the greater part of the day.

These Axolotls were not given any thyroid or pituitary gland and, until metamorphosis was far advanced, they lived in water 9in deep. Their food consisted of earthworms and shreds of lean meat. Why metamorphosis took place, and why it happened simultaneously in both of them, is a mystery. There is another remarkable fact. Both are now of equal size and look plump, yet one refused all food for over four months after eating the Catfish and became so emaciated and weak that it could not stand up. The same one had been slower in shedding its skin. I now have six young Axolotls—this time from Bristol—and they have been placed in a larger tank with similar water but 12in in depth. It will be interesting to see if they behave in the same way. If metamorphosis takes place, it would appear that the public water supply of the village might have something to do with it.



One of Dr. Clay's metamorphosed Axolotls. The gills disappeared, the eyes developed and the complete skin was cast in the process.

Ambystoma or Siredon?

History and Habits of a Pet
Albino form of Axolotl described
by Alfred Leutscher, B.Sc.

A STRANGE name has been given to an equally strange member of the Amphibia which is known to scientist and pet-lover alike—the Axolotl. Named in this way in its native home in Mexico the word is derived from the ancient Aztec, Nahuatl. It means “a water-beast.” It is truly the Peter Pan of the water-world for, retaining all the characters of a larva and remaining in water, yet it matures with growth and is capable of producing offspring. This is a somewhat unusual state in Nature and is known as neotony. The Axolotl is the perfect example.

One day, through an accident, it was discovered that even the Axolotl can grow up. The story goes something like this: “In 1864, during the Mexican War, Marshal Forey sent to the Jardin d’Acclimatation 34 live Axolotls, of which six (five males and one female) were presented to menagerie of the Jardin des Plantes. This unique female soon laid . . . a great number of eggs which hatched into animals resembling the parents and, in their turn, reproduced. . . . Some time later it was observed that numerous individuals born from the previous generations, began to change their colour and form, their sombre dress being covered with very light patches, the dorsal crest disappearing and the upper tail-crest diminishing. The eyes acquired lids, the gills and the slits between them disappeared, the palatine teeth became modified—in short the Axolotl transformed itself into a salamander none other than *Ambystoma tigrinum*, already known for a long time. . . . As the Museum distributed a great number of specimens it was not long before the Axolotl became common in the aquarium, as it is to this day. It is a belief that all the living specimens in Europe are the descendants of the small collection in Paris in 1864.”

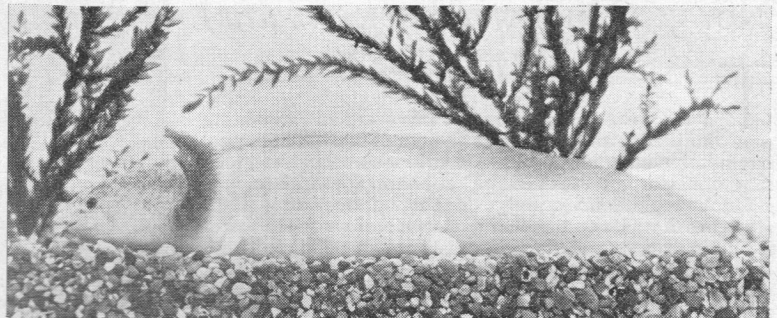
The above is a translation, quoted from G. A. Boulenger's book “Les Amphibiens,” which was written in 1910: recently some doubt has been cast on the parentage of the Axolotl, not in a legal sense of course, but as regards its true status in classification. There is in the New World a Family of Amphibia, called the *Ambystomidae* (the letter “l” in this name is now omitted) or Blunt-mouthed Salamanders, which contains about 17 species, of which 15 occur in N. America. A number of these metamorphose in the normal way but quite a few remain in the axolotl state. Closely related to *Ambystoma tigrinum*, and looking very much like it, is a species called *Siredon mexicana*. Which, then, is the true parent of our pet axolotl? To complicate matters it is believed that these two can hybridise. The matter can only be settled by a careful genetical test, that is to say, by experimental breeding

and a careful investigation into the chromosome-pattern of both larva and parent.

Nevertheless, I like to think that my own Axolotl is in direct descent from the Paris collection and sometimes feel tempted to make it change into the adult by deliberately repeating the accident of allowing the water of its home to gradually evaporate. This is not easy as the gills reduce to a certain size but never quite disappear, and the poor animal cannot quite make up its mind whether to leave the water or not. A simpler way is to feed the larva on a preparation of thyroid extract.

The lack of thyroid secretion, which is prevented by some unknown cause, is believed to be the reason for the permanent larval state. It is not unknown in newts. This discovery, helped in no small way by experimental work on the Axolotl, has been of profound interest and importance to medical science. A lack or excess of glandular secretion, such as that of the thyroid, is known to cause many deformities, both physical and mental, in animal as well as human.

My specimen, which is the albino form, is an average Axolotl about 6in in length. Some grow to 10in. It is a pale, creamy white, having pink eyes and bright, crimson gills. The flattened head has a blunt snout and the plump, rounded body has traces of vertical grooves along the flanks. There are four pairs of gill-slits separating three pairs of external gills. The limbs are short and powerful, having four fingers and five toes. A low, straight-edged



Photograph]

[Lionel E. Day

Creamy white in colour, with pink eyes and scarlet gills, the Albino form of Axolotl contrasts strikingly with the dark-coloured specimens.

crest runs along the upper and lower edge of the strongly compressed tail which is about half the total length. The skin is finely granulated and there are no eyelids.

Normal specimens which are found wild in the deep fresh-water lakes around Mexico City are a deep purplish-brown and are more common in captivity. Why don't they grow up? Apart from the thyroid abnormality there are two possible reasons. Living in deep water with plenty of available food they are just as happy where they are. Secondly, an emergence on to a dry and rather barren land is discouraging. Consequently in the struggle for existence they are far better off in the water.

To say that Tom, as we call our pet (I named him after the little boy in Charles Kingsley's “Water Babies”), is a pig would be putting it mildly. He would gobble up anything if I let him. For the sake of his health I feed him only twice a week on a mixed diet of earth-worms and raw meat, which is sometimes varied with occasional live water-shrimps, insect grubs, tadpoles and even a small newt or two. His eyesight is poor unless the food can be seen above, when he snaps eagerly at a meal. I can feel the jar of his teeth as they contact the forceps or rasp against my finger.

The position of an Axolotl's eyes prevent it from seeing downwards, and any food which settles on the aquarium

floor might easily be overlooked. It is a good point to use light-coloured gravel or sand against which unwanted food can be seen before it pollutes the water. The depth of water is about 9in and one corner of the tank is banked with loose rockwork into which Tom can retire. Disliking bright light he usually sulks in hiding during the day and emerges at dusk. On the top of the rocks, just clear of the water, is spread a layer of moss on which, one day, I hope to find a transformed pet.

I have long since given up all idea of planting aquatics since they are invariably uprooted the next day. A few sprays of *Eloëa* float in the water to give a bit of colour, and will come in useful at spawning-time should I acquire a mate. There is no reason why adult Axolotls should not breed. The mature male may be recognized by its more swollen cloaca. Axolotls, which are said to become mature in one year, may breed at any time. This can be encouraged by a semi-starvation diet and by cooling the water. The water should be drawn off an inch or two and replaced with fresh from the cold tap, an operation to be repeated daily for about a week.

Courtship of the male is a clumsy affair. He lays his

cone-shaped spermatophore, with a cluster of active spermatozoa at the tip, on the aquarium floor. This is later taken up by the female. She lays her eggs in small, pale-brown clusters, not unlike frog-spawn, among the plants, on the stones or loose on the sand. This is best removed, to prevent cannibalism, and placed in a shallow container of well-matured water. After hatching, in a day or two, the young can be reared with little trouble, in the same way as newt-babies, on a progressive diet of Infusoria, Mikro-worm, small then large *Daphnia* and finally small pieces of meat and tiny earthworms. They develop rapidly from $\frac{1}{4}$ in to $\frac{5}{8}$ in at six months.

A number of deaths among Axolotls have been reported this summer, probably on account of the high temperature. They are more at home in cool surroundings and have been known to live quite well out-of-doors, even hibernating under the ice in garden-ponds. Specimens kept for ten years or more are not uncommon.

In Mexico the Axolotl is eaten and considered a delicacy. Even with the present meat ration as it is I doubt whether our Tom will share such a fate. My wife would never allow it!

Aquatic Plants

No. 9. Duckweeds (*Lemnaceæ*)

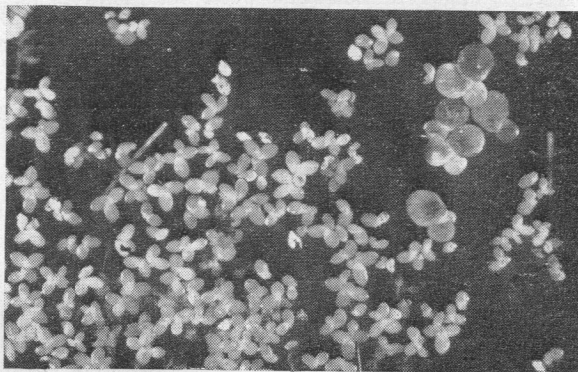
By Hydrophile

THE Duckweeds, or "Pond Scums" are an interesting group to the botanist although the pondkeeper whose pool has become smothered with a continuous carpet of green may consider some other epithet more appropriate.

Duckweeds flourish only on the surface of shallow stretches of water and appear to thrive best when the water is rich in organic matter as, for instance, in ponds fed from farmyard manure heaps. It is very noticeable, too, that when waters are covered with duckweed they are often remarkably clear and the introduction of these plants to evil-smelling garden pools is often a satisfactory way of purifying them.

The "leaves" of duckweeds, or fronds as they are more correctly called, are in reality short pieces of flattened stem, from the centre of the underside of which the roots hang down into the water. Budding takes place throughout the spring and summer, new fronds arising from slits in the sides of the old ones, from which they break away.

The commonest of our five species is Lesser Duckweed (*Lemna minor*) with fronds about a quarter of an inch across. The Greater Duckweed (*L. polyrhiza*) has much larger

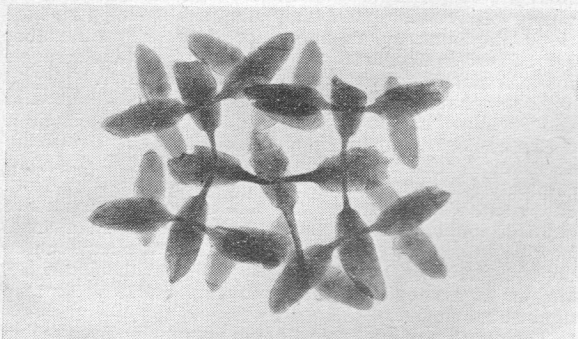


Two species of Duckweed, the Lesser (*Lemna minor*) and, on the right, a few fronds of the Greater (*L. polyrhiza*).

fronds, sometimes nearly an inch across and a further distinguishing feature is the large number of roots which hang down into the water. The Gibbous Duckweed (*L. gibba*) has quite different kinds of fronds from the two preceding species—thick and almost hemispherical on the underside. When looking at a mass of this plant in the net, these fronds resemble small pearls. *Lemna (Wolffia) ariflora* has the distinction of being our smallest flowering plant for its fronds are no larger than a pin head and look like particles of floating green dust.

The so-called Ivy-leaved Duckweed (*L. trisulca*) differs from the rest of the species in living totally submerged, just below the surface, obtaining all its gases and salts from the water. The individual fronds are not really ivy-shaped but are elliptical, each bearing a lengthened portion like a stalk. The ivy-leaved appearance occurs when two new fronds are developing from an old one. It is of interest to note that in the intercellular spaces of this plant a minute green alga *Chlorochytrium lemnae* is found but there is no evidence that it derives anything more from the association than a place to live.

The tiny flowers of the Duckweeds are borne above the water level and are believed to be pollinated by insects. Flowering is but rarely observed, however, and the method of vegetative reproduction is the principal mode of multiplication. While some species, including *L. minor* are to be found on the surface of ponds nearly all through the year, others, such as *L. polyrhiza*, produce special shoots in autumn which carry the plants over the winter.



Photographs] The submerged *L. trisulca* ("Ivy-leaved,") [John Clegg

Outdoor Reptiliaries

Habits of the Adder Observed in a Naturally Planted Enclosure

— By —

A. Leutscher, B.Sc.

THE aquarium-keeper usually has little difficulty in feeding his specimens, although he may not always succeed in breeding them, but the vivarium-keeper is not always so lucky. Some of his charges are temperamental and just will not take food. Their breeding is often a great rarity. A reptile which is very temperamental with regard to feeding, is the European Viper or Adder (*Vipera berus*), although I have had the good fortune of both feeding and breeding this beautiful snake.

In some cases, as I discovered, the outdoor vivarium known as a reptiliary is the only answer. Lucky is the hobbyist who can afford the space, time and labour to build one! Cost is not excessive, merely the price of the bricks and cement.

The word vivarium appears in English literature as early as 1600, in the following quaint passage—"That swimming Colledge, and free Hospitall Of all mankinde, that cage and vivarie of fowles, and beasts." The word, which is derived from the Latin root *vivus* (alive or living) was also applied to what we now recognize as a pond or even an aquarium, i.e. a water enclosure for fish. In the law of the early 17th century we are told that a vivarium "signifieth Parks, Warrens, and Pischaries or Fishings."

The usage of the word is to-day usually restricted to a place or enclosure in which living reptiles and amphibians may be kept. A fine example of the reptiliary which attracts a good deal of attention can be found just within the main gate of the London Zoo. This was built to house a collection of reptiles native to temperate climates, in particular the Adder. Specimens of the Green Lizard, Dark-green Snake and Grass Snake may also be seen, but the Adder usually predominates.

A reptiliary can be looked upon as a natural outdoor environment enclosed by a wall which restricts the wanderings of the inmates. The latter is essential and, at London Zoo, this consists of a reinforced concrete wall with a smooth, vertical, inner surface. This terminates at the top in a ledge, which juts inwards, and below in a shallow trough, where water is circulated. Thus a moat is created around the central island. On this small trees, bushes, a variety of rock-plants and other flowers are planted. A continuous trickle of water meanders as a little stream across the island, widening here and there, into small pools and ending in the moat. In the centre is a system of underground cavities, with a main entrance in the shape of a cave which is overhung by a flat rock. It is here that the adders may be found, coiled in a heap on their bedding of hay during the warmer days of early spring, taking full advantage of the



[Photographs]

[L. E. Day

View of the Reptiliary constructed in the London Zoological Gardens where species of snakes and lizards abound.

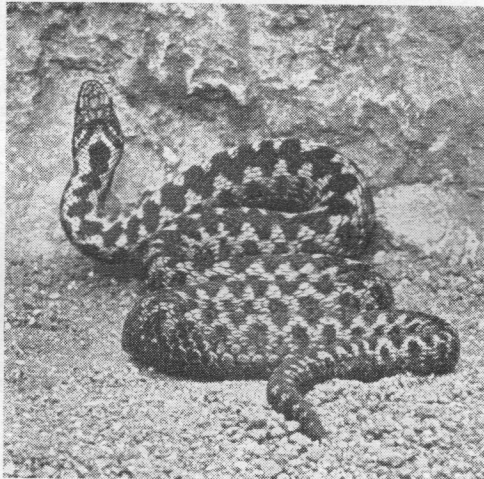
(Photograph by courtesy of the London Zoological Society).

sunshine after their period of winter hibernation.

Under these conditions reptiles enjoy the full benefit of natural light and sunshine, and can be provided with room for exercise, and living prey which is set loose on the island. This is sometimes necessary for specimens which will not take dead food.

Some years ago I was able to keep adders in good condition in a garden reptiliary, to the extent that they fed regularly, and even produced young. By constructing a

hide it was possible to observe their habits and movements, especially on summer evenings after sundown when they became particularly active. It is on summer nights that they hunt their natural prey of mice and voles, preferring the daylight hours for basking. They even retire if the sun is too hot. Sometimes my reptiliary would appear to be devoid of life and movement by mid-day and throughout the afternoon. On one rare occasion I watched the stalk and kill made by an adder. A mouse had emerged from a hole one evening, and after running about it commenced to brush its fur. Shortly after this a flat head appeared from behind a rock some feet away, and an adder began a slow, stealthy glide towards its prey. To my surprise it followed the wavy trail of the mouse exactly. It would appear that



A fine specimen of the Adder (*Vipera berus*) showing the distinctive zig-zag marking characteristic of the species. This line is not always unbroken.

Unusual Asian Egglayer

Peculiar Spawning Process of Medakas (*Oryzias latipes*)

By J. Stott

IN the Medaka (*Oryzias latipes*) we have a fish which is not only interesting in its breeding habits but is also attractive and easy to keep. It is capable of tolerating a wide temperature range, extending from 45 to 82 deg. F., if changes occur gradually. The most satisfactory temperature is around 68 deg. if this is raised to 72 deg. when conditioning for breeding.

The shape of the fish is not unlike that of the Zebra fish, except that the dorsal fin is situated further back towards the caudal base and the tail is not forked. Colouring is a greenish-yellow and there is rich flecking with orange towards the dorsal aspect with the under-parts silvery tinted. The male is slimmer in the body and the female's pectoral fins are smaller. When kept under good, healthy conditions a mature fish is around 1½-1¾ in. in length, the male being the slightly shorter of the two.

Being of peaceful temperament specimens are suitable for community tanks and look well when housed with fish about their own size. When in company with Rosy Barbs, Zebras, Bloodfins and Pearl Danios they complete the picture in fine style.

Varied Diet Desirable

Feeding produces no difficulties, they will accept most of the usual foods but, of course, as with most fish, variety in diet is necessary for tip-top condition.

When breeding is intended, conditioning should consist of live foods in variety, such as chopped earthworm, White Worm, *Tubifex* and the like. The tank in which it is intended to breed the species should be three-quarters filled with mature water at a temperature of 72 deg., and planted with thickly bunched *Myriophyllum*.

Select the pair of Medakas and place them into the prepared tank keeping them separated with the usual dividing glass. Then commence the conditioning which,

under normal circumstances, should be completed in about a week when the male will be eager and busily paying court through the glass and the female heavy with roe and responding to his attentions. Remove the dividing glass late in the evening and spawning should begin the following morning. It will be seen, when spawning occurs, that the eggs do not fall as they are expelled by the female but, instead, they adhere in a cluster around the anal region of the female, where they remain for two or three hours, during which time fertilization takes place.

Laying of the Eggs

Later the female begins to swim in and around the *Myriophyllum* plants and, as her under parts contact the leaves, the eggs are brushed off to become attached to the foliage. Although the Medaka is considered to be reasonably safe with the eggs this is not always the case and it is recommended that immediately the eggs are clear of the female the pair should be removed from the breeding tank. During the time that the eggs are being deposited there is no fear of egg snatching provided the *Myriophyllum* is thickly bunched.

At the breeding temperature suggested the fry hatch in about 14 to 16 days. Infusoria should be fed by the drip method after the first 48 hours have elapsed. Feed this for a week then supplement with powdered egg yolk for a further two weeks. At the end of the third week, if good growth has been maintained, the powdered egg should be replaced by Mikro worms. Six weeks later *Daphnia* and chopped White Worms may be fed when the growth should become rapid. With the fry about four months old and, therefore, on their way to maturity the temperature can be dropped to 68 deg. F. and a full diet be given. Maturity is reached at about six to seven months and fish are ready for breeding by the eighth month.

Outdoor Reptiliaries

(Continued from previous page.)

the snake was working by scent, as these creatures will do in order to follow one another.

Suddenly the adder noticed the mouse and, with head raised, moved straight towards it. Moving stealthily, and by sight, it gradually came within range and prepared to strike by forming its coils. This was done with wonderful muscular control as it drew its body forwards and kept its motionless head aloft. As if to belie the popular belief that a snake fascinates its victim the mouse continued with its toilet, completely indifferent to the lurking menace.

The strike was over in a flash and the mouse was dead in two minutes. It was then swallowed by the adder in the peculiar way that serpents have. Another rare experience was an eye-witness of the strange "adder dance," which is the preliminary to courtship and mating. The adders were out in force one afternoon and I was attracted by the way in which one or two, taken to be males by their brighter markings, reared their bodies in upright positions and swayed to and fro (similar to an eastern dance). On occasion one struck at another but there was no actual biting. Later, I watched a male

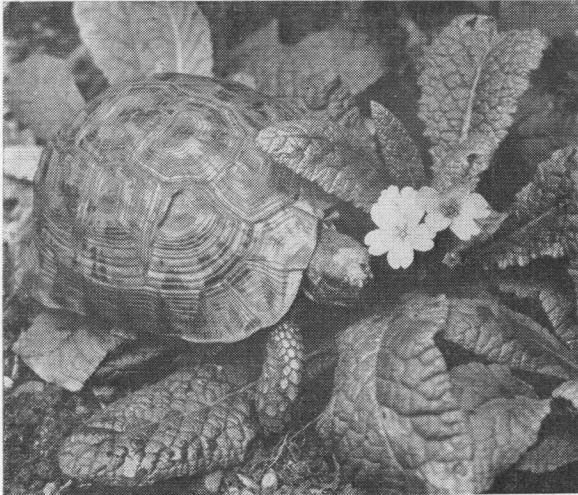
pay court to a female by gliding over her body, caressing it with his tongue, and attempting to entwine his tail with hers.

There was an exciting day when baby adders were seen in my reptiliary. The mother lay nearby, her body reduced to normal size and the skin in folds following the birth of her brood of young. The young snakes now moved actively among the plants and stones. Here seemed a fine opportunity to test the legend that the adder harbours her young from danger by swallowing them.

I showed myself, but nothing happened. Incautiously I leant over and picked up one baby, a prettily marked creature about 6in. long. It immediately hissed and struggled, biting viciously at my bare finger. The tiny fangs were so small that the skin was not even scratched. One thing I learnt was that an adder, even on its birth day, is fully capable of caring for itself!

It is because of such interesting discoveries as these, about the fascinating ways of serpents and other reptiles, that the building of a reptiliary is well worth the labour. The reward is healthy specimens and a greater store of knowledge, two things which should be the main aim of all conscientious vivarium-keepers, and aquarists, apart from the pleasure which their allied hobbies may give them.

Tortoises and Terrapins for the Home Vivarium



New Series of Articles Covering Their Care and General Treatment

Introductory Notes Describing Some Distinguishing Characteristics

By A. Leutscher, B.Sc.

(Drawings by the author)

WITHIN the last year or two there has been a steady increase in the number of tortoises imported into this country and many people are now deriving much pleasure from keeping and observing the habits of these quaint little creatures. Also, sad to relate, many owners are mourning the loss of their pets which have died in some mysterious way.

The reason is partly given in the following quotation, which I have taken from the Introduction to the booklet in the WATER LIFE series (now out of print), entitled "Land and Water Tortoises"—"although they (tortoises) are bought with the best intentions in the world for their welfare, a lack of knowledge of their organization, habits and requirements usually leads to insufficient food of a proper nature, neglect, and finally death at the onset of cold weather."

This article is the first of a short series of contributions designed to help the beginner in making a better acquaintance with his novel pet—the tortoise.* Firstly, what are tortoises?

They are members of the Order of reptiles, known as the *Chelonia*. These creatures have jaws which are hooked but toothless, being covered with a horny beak. The body is enclosed in a bony case, of which the upper half, the carapace, is composed of five series of fused, bony plates. It is firmly united to the backbone and ribs underneath. The lower half, or plastron, is made up of paired bones and may be fused to the carapace along the sides of the shell or united by a ligament. Over the plastron and carapace is a covering of horny shields which can be seen as an outer skin. This is shed and replaced from time to time. It is similar in arrangement

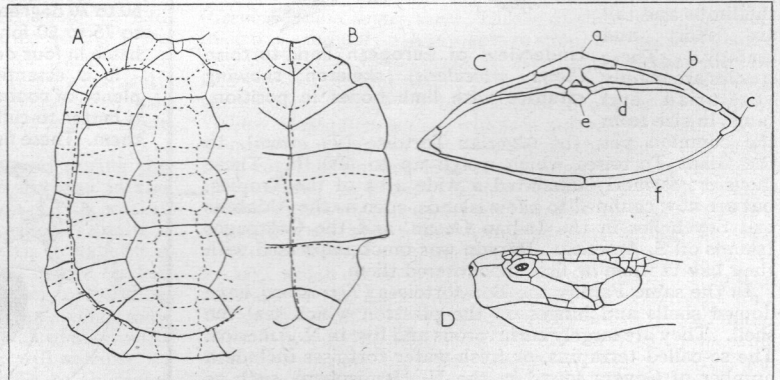
to the plates, but the shields do not correspond with them either in size or number. The inner series are called the neurals, then come the costals, and the marginals form the border.

This hard "shell" of the tortoise serves as an ideal "house" and protection for the occupant, which has merely to withdraw its head and tail into the front and hind openings and guard the body with its scaly limbs. It does so when alarmed, when asleep or when in hibernation. Having no need to turn away from danger it is slow-moving, proverbially so, and in any case is prevented from going at high speed by the weight of its shell.

Even so the tortoise reaches its destination eventually and its way of life has proved to be one of Nature's most practical, yet most remarkable, experiments. Fossils show us that tortoises have changed very little since earliest times. They were on this earth over 200 million years ago. That is to say, this ancient line of reptiles roamed the earth even before the extinct Dinosaurs.

Being reptiles, tortoises are cold-blooded and are some of the most long-lived of animals. A Giant Tortoise, according to reliable records, is said to have reached an age of 150 years.

Modern tortoises number about 300 species and are divided into two main groups—the *Pleurodira*, in which



Parts of skeleton and head of the Algerian Tortoise (*Testudo graeca*). A., carapace and B., plastron (thick lines denote borders of outer, horny shields and dotted lines those of underlying bony plates). C., section of skeleton :—a., neural plate ; b., costal plate ; c., marginal plate ; d., rib ; e., vertebra and f., plastron. D., head, side view, of *T. graeca*.

* Note.—To avoid confusion it should be mentioned that in America and some other parts of the world the word "turtle" is used for all types of chelonian—e.g., land-turtle, fresh-water turtle and sea-turtle. In Britain the practice is to use the term "turtle" only for the marine species.

the head is withdrawn by a lateral twist of the neck, and the *Cryptodira*, where the neck retracts in a vertical plane. The former occur in Africa, S. America and Australia. The Arrau Tortoise of the Amazon Basin (*Podocnemis*) is of economic importance, and the eggs are collected in great numbers for the oil. The curious Matamata of Brazil (*Chelys fimbriata*) has a flat body and aquatic habits. Feather-like appendages on the head and neck are said to attract the fish on which it feeds.

In the *Cryptodira* there are three divisions, two of which are of passing interest. One is represented by a single species, the Leathery Turtle (*Dermochelys coriacea*), which is marine and is the largest existing chelonian. The body may reach a length of 7ft. and weigh over 1,000lb. There is no carapace or shield covering, but, instead, a leathery skin which is quite separate from the skeleton.

In the second division the carapace is soft, flat and rounded and does not quite cover the body so that the ribs protrude from underneath. The whole skeleton is covered with a soft skin minus shield. One Family, the *Trionychidae*, includes the N. American Soft Tortoise (*Trionyx ferox*), which has a pointed snout and sharp-edged jaws for crushing shells. Large individuals can be a nuisance, even a danger, to bathers.

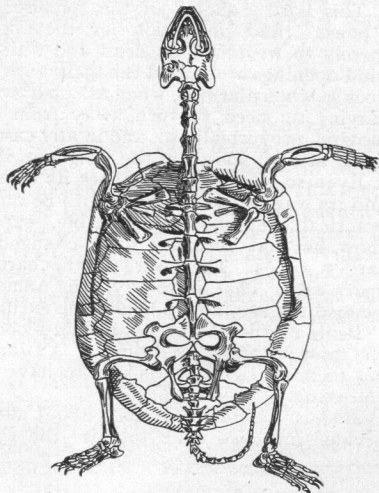
The third division of the *Cryptodira* is our main interest. It includes the typical tortoises and turtles. All of them have a well-developed bony shell covered with shields. There are many Families. The *Chelonidae* are the true marine turtles, which have flattened carapaces and paddle-shaped limbs. The best known are the Hawksbill Turtle (*Eretmochelys imbricata*), from which is obtained the "tortoise-shell" of commerce, and the edible Green Turtle (*C. mydas*) which provides the turtle-soup.

Another well-known Family of many species is the *Testudinidae*. In the typical land forms (Genus *Testudo*) the carapace is domed and the limbs and tail are short and stumpy. These species are mainly vegetarian and range in size from

the common pet, the Algerian Tortoise (*T. graeca*), to the Giant Tortoises which weigh up to 500 lb. These monsters formerly inhabited a wide area of the Tropics, but are now confined to a few islands, such as the Aldabras and Seychelles in the Indian Ocean, and the Galapagos Islands off S. America. Darwin was much impressed with their habits when he first encountered them.

In the same Family the Box-tortoises (*Terrapene*) have domed shells and hinges on the plastron which seal the shell. They are largely carnivorous and live in N. America. The so-called terrapins, or fresh-water tortoises include a number of Genera found in the N. Hemisphere, such as *Emys*, *Chrysemys* and *Pseudemys*.

Descriptions, habits and care of the main types which come within our hobby will be dealt with in this series.



Underview of European Pond-tortoise (*Emys orbicularis*) skeleton showing carapace with limb bones in position.

Know Your Fishes

No. 13. Chanchito (*Cichlasoma facetum*)



Photograph]

[W. S. Pitt

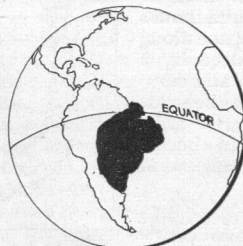
In addition to its native name of Chanchito, this well-known Cichlid also enjoys the common nomenclature of Brazilian Zebrafish, with the alternative of Chameleon Fish, and at one time was known not as *C. facetum* but as *Heros facetus*. Typically aggressive looking, it has an appropriate common name for "Chanchito" (which is also applied to a number of other fishes found in the same areas) is said to mean piglet, in reference to its shape, although, contrarily, the Latin specific name indicates attractiveness.

It is not the most colourful of the Cichlids and, in fact, the colour often varies in a number of specimens in a single importation. Further, the colour is liable to change from time to time according to the mood of the fish and its environment. The body and head are bold and broad. When in full colour the latter shows several dark vertical bands contrasting with the dull body colour which ranges from light green to dark brown. When the fish is in breeding condition, the bands appear particularly vivid and sometimes the body assumes a golden tinge. At the same time the usually plain fins develop a red or orange hue.

Pairs of equal size should be given large, separate quarters if spawning is to be encouraged. Place a few inches of compost in the tank and embed some flat stones in it on which the eggs will be deposited and then carefully protected by the parents. The eggs are often moved to cavities in the sand or to another rock. When selecting pairs, the males and females can be distinguished by the larger fins of the male, especially the dorsal and anal, and the red eyes of the female. Plants in the breeding tank are likely to be uprooted.

The Chanchito is hardy; temperatures as low as 60 to 70 degrees F. are suitable but should be increased to 75 to 80 for the best breeding results. The young hatch in four or five days and swim freely in six to ten.

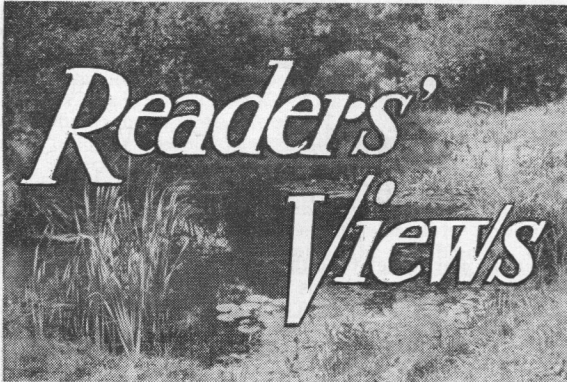
It is essential to provide these young fish with plenty of room if they are to develop properly and it is better to cull the spawning rather than overcrowd them. These fish will reach maturity at nine months.



Habitat: Brazil and Argentine

The Chanchito is an omnivorous feeder but especially appreciates chopped earthworms, White Worms, gentles, snails, small fish and shredded meat.

Class: Pisces
Order: Percomorpha
Family: Cichlidae
Genus: *Cichlasoma*
Species: *C. facetum*



The Editor is not responsible for opinions expressed by correspondents.

PARAFFIN OIL TREATMENT

SIR,—In the December issue of *WATER LIFE* doubts were expressed as to the effects of paraffin oil treatment on young or weak fishes. It may be interesting to readers that last year I had about 3 dozen, 6 week old Veiltails affected by gill flukes. I used the paraffin treatment for 5 seconds and managed to cure all the fish except one.

The important question may be whether the paraffin retards growth? At eight weeks my Veils were healthy and strong, several at least 1½ in. long. To my mind, it is inadvisable to overdo the treatment with young or weak fish.

Portsmouth,
Hants.

J. L. ALLEN,
Member, Goldfish Society
of Great Britain.

REACTIONS TO OLYMPIA SHOW

SIR,—It is not unusual for shows to be criticised and I am sure that the recent Olympia exhibition at which *WATER LIFE* was responsible for the aquaria section will be no exception to the rule. There may be a tendency for the cons to outweigh the pros so, at the risk of being considered crossgrained, I would like to highlight the latter.

Firstly, I would like to thank the promoters for displaying the coldwater fishes as they are justly entitled to be displayed. It is the first time that I have seen single coldwater fish entries to the tune of nearly two hundred entries all housed in 24 × 15 × 12 or 24 × 12 × 12 in. tanks. The only fishes that were at the surface were those in the overplanted or overstocked furnished aquaria tanks. Secondly, from the coldwater enthusiast's point of view, the classes were well chosen and all varieties scheduled were ably represented both numerically and in quality. Thirdly, the fact that the staging of the exhibits did not go as smoothly as it was intended should not blind us to the fact that the pre-show organization left nothing to be desired.

The fact is that hiring out aquaria for exhibitions is not an easy proposition. There is only one organization that has been

Zonation of Aquatic Plants

(Continued from previous page.)

the growth of trees such as the Willows and the Alder, and no background for an artificial pond is more delightful and yet more natural than one or two trees of this type which can thrive under moist, but not wet, conditions.

All these zones (except the totally submerged one, of course, which can be imagined in the open water) may be noticed in the illustration taken last year at Wicken Fen in Cambridgeshire. The plant zones described in this article are not static communities of plants but are constantly changing and are always tending to dry up the pond. The more submerged and floating plants there are the more debris collects around the bases of the swamp vegetation.

willing, so far, to accept an order for up to 1,000 tanks on loan at an economic figure. Transporting, installing, dismantling and storing large numbers of tanks and the requisite staging is a major operation and must not be confused with a society show where labour is plentiful and often the tanks are the society's property. As every show secretary knows, an event may be organized down to the last *Daphnia* but there is always that last minute hitch which can be overcome only after colossal efforts by the devoted few. *WATER LIFE*'s Show was no exception to the rule and I am quite sure that the hold-ups will not be repeated next year.

In spite of the counter attractions that the more established Bird Fancy provided both in area and number of exhibits, there was no question as to which section had the greatest patronage by the public. The interest in the furnished aquaria remains undiminished and I feel sure the next step must be to give some sort of furnishing to the tanks of single fish entries. It was a great occasion for the Provinces as well as the Home Counties and many distant friendships were renewed.

A glance at the list of winners shows that the awards were distributed fairly evenly over a great number of exhibitors which in turn proves that no one person or persons has a stranglehold on the hobby. On the contrary, new names are already appearing and the older hands will have to look to their laurels.

Finally, if the opinions of the tropical fishkeepers are divided, the coldwater members will certainly endorse an open show organized by *WATER LIFE* in December. Which rather points a moral, or does it?

Woodmansterne,
Surrey.

L. C. BETTS.

SIR,—May I express my appreciation of your gesture in returning entry fees to those exhibitors who were unfortunate in being unable to bench their fishes at your recent show?

We hope that this year we shall not be disappointed in the same way.

Bristol 5.

W. HOWARD.

MAINTAINING TERRAPINS

SIR,—I have read with interest your remarks regarding the maintenance of Terrapins in an aquarium but, writing from practical experience of keeping this type of reptile for some years, I disagree with your instructions.

First, they should be fed once a day, at least, and, if possible, each meal should differ from the one before it. Young specimens can (and mine do) eat their own weight in food each day. As one who has fed Terrapins over a long period, I would hesitate to advise the use of forceps for giving flies or maggots. These creatures grab their food with considerable force and, their "aim" not being very good, they could damage their mouths against the hard metal. I prefer to feed them from the fingers or to place the food in the water in their quarters.

Secondly, while I agree that the water should be kept clean I do not think that changing it once a week would be sufficient. I find it necessary to make a change once every day, and twice when using raw meat, fish or earthworms in the diet. Daily cleaning is essential; for instance, the slightest fouling of the water can cause eye trouble, especially in some of the American species. To help keep the water clear, it is better to give the raw food in very small pieces than to let the Terrapins pull large portions to shreds.

Thirdly, removing the Terrapins to separate quarters at feeding times is, I suggest, of little use with newly-purchased

The swamp plants themselves push out towards the open water zone by means of their long rhizomes and, in time, raise the level of the bottom still more. This gives more foothold for the marsh plants which in turn, by providing more humus, produce conditions suitable for the growth of water-loving trees and other shrubs. This regular succession is constantly going on in all natural waters, usually unheeded because it is so gradual and our life span is so short. In some parts of the country, however, it is easier to see the effect of this ecological succession of vegetation and Wicken Fen is one of the best. To a lesser extent, however, the same changes take place in our own small ponds and garden pools and a knowledge of the principles involved will enable us so to control the conditions so that any one zone does not become dominant or, worse, that the pond does not dry up!

specimens as they do not like being disturbed or watched when feeding. I have never seen any specimens eating green food but the addition of Duckweed and *Elodea* to the adults' quarters last summer started them "courting."

The above comments are based on my own findings. Terrariums should only be bought if the purchasers are prepared to give them the full attention they require.

Colindale, (Mrs.) MONICA GREEN, F.Z.S.,
London, W.9. Member, British Herpetological
Society.

NEW DWARF WHITE WORMS

SIR,—I was most interested in the last issue of *WATER LIFE* and I am hoping that it will be possible to get a sample of the new Dwarf White Worms. I already have Mikro and normal White Worms but the new Dwarf White Worms would be most useful to me when breeding some of my delicate *Aphyosemions*. I always fear introducing into my breeding tanks Cyclops or small copepods which very often attack the small fry or eggs.

In the same issue, reference was made (on p. 297) to Dropsy in Tropicals. My opinion is that true Dropsy cannot be cured; it is that last stage of an internal disease, generally of the liver. If the "dropsy" appears to have been cured it means that the fish only suffered from constipation. I recently had an enormous black *Sphenops* with all her scales standing out. This was cured in 48 hours after a feed of "Enzyme Food."

About "mouth fungus," I had tried all sorts of different preparations without any success: recently I had a specimen of *Aphyosemion sjæstedti* affected. Reading in "The Aquarium" (U.S.A.) that menthionate would cure this, I tried swabbing the fishes' mouths once with it. It acted marvellously and a week after the fish was normal.

Garches,
S. & O., France.

(Dr.) O. GIRARD

IMPROVING THE PLATY

SIR,—The remarks made by Mr. H. A. Nichols, of California, are most interesting and publication of them will, I am sure, increase the appeal and interest regarding Platies. However, I must differ with his remarks in some respects.

I cannot agree that "space, time and money" are wasted on the specimens of Platy currently available; while we all agree that they are for the most part not of the best possible quality, the chances of bulk imports of the wild stock needed are so remote that we must try to improve the existing stock to the best of our ability. When the wild specimens are finally obtainable we can really do things, but until then we must do the best we can with the stock at present in our possession.

Possibly the American stock is in a worse state than ours. This appears to be the case, if we read between the lines of Mr. Nichols' letter. There are some good strains of Platy in my own district and we have been importing some Dutch-bred stock which for the most part are very helpful in improving our strains. The Reds from Holland are very near the old pre-war standard—rich mahogany-red males and quite well coloured females. Some of the Blacks are good, too. There is plenty of hope for good Platies even without the help of wild specimens.

The "cockeyed hybridization attempts" referred to by Mr. Nichols have been the means of creating many really beautiful strains of Platy, notably the Wagtails, Bleeding Hearts and Tuxedos, and I personally feel that these newer hybrids are a most welcome addition to the general tropical scene.

The production of a "Swordtail Platy" by line breeding *Platypacilus xiphidium* would have to include hybridisation to get any sort of colour into the species, assuming that the wild type has only dark green and black coloration. To become popular the fish would have to possess a brighter colour than even the best wild specimen. This is purely theoretical, of course, and I am open to correction on this point. However, I must thank Mr. Nichols, for his most interesting comments.

Nottingham.

TOM C. SAVILLE

CONTEMPORARY PRESS COMMENTS

Reviewed by L. W. Ashdown

THOUGH the newcomer may regard the use of Latin names for tropical fish as an unnecessary refinement, the older fancier realises their value in preventing confusion. I was reminded of this when reading through the December issue of *THE AQUARIUM* (U.S.A.) in which is featured *Hyphessobrycon rosaceus*, alias Black-flag Tetra. In this country the species is commonly known as the Rosy Tetra, but I have heard the term Belgian Flag Fish used. This is one of the occasions when we can be thankful for Latin names and it recalls to mind a conversation heard in the shop of a local fish fancier. One lady, seeing some Black Mollies (*M. sphenops*) in a tank called to her companion "... look, black fish." Her friend, not to be outdone, replied, "Yes, they're called Black Marias—or something!"

To return to Mr. Innes' account of *H. rosaceus* in *THE AQUARIUM*. The species has proved difficult to spawn in the U.S.A., although a number of persons have been successful in this country, yet its unusualness ensures that it will always have devotees willing to go to some trouble to achieve success. A well-developed mature male is a fish of unusually brilliant colour, the black of the large dorsal fin contrasting with the deep pink of the body. It is not a shy species and a specimen will display in open stretches in an aquarium although it shows a preference for the company of fish of its own species.

Mr. Innes recommends a medium-sized tank for breeding, maintained at a temper-

ature of 75 deg. F., and suggests that one end should be planted with a thicket of fine-leaved plants. The pair quiver side-by-side during fertilization and when the eggs have been laid the adult fish should be removed. Three days elapse before the fish hatch and for a few days enough *Infusoria* will be available in the mature water of the tank but after this time *Infusoria* must be supplied. Sifted *Daphnia* and Brine Shrimps may be given as the fish develop. For adult fish occasional feeds of live or meaty foods (such as finely shredded raw fish) are recommended.

THERE are few more controversial subjects than that of aquarium water. It is usually discussed with the welfare or breeding possibilities of the fish in mind and rarely considered in relation to the plants. This latter point is discussed by Mr. W. Bertholdt in an article appearing in the November issue of the *AQUARIUM JOURNAL* (U.S.A.), however. Plants which are prolific in hard water (i.e., water containing a quantity of dissolved salts) are listed and include the Water Sprite *Ceratopteris thalictroides*, Amazon Sword Plant (*Echinodorus intermedius*), *Vallisneria* and Hair Grass (*Eleocharis*). Those aquatic subjects showing a preference for soft water include *Ambulia*, *Cabomba*, *Ludwigia*, the Cryptocorynes and *Myriophyllum*. When the nature of the available water supply is known this list can prove handy but Mr. Bertholdt also gives some information

concerning the modifying of excessively hard water to a less extreme medium. This may be effected by adding a quantity of rain water which should be introduced gradually. At least 72 hours should elapse between each introduction but periods of one week are preferable. These operations should be continued until no more than two-thirds of the bulk of water is rainwater. Proportions less than this are frequently sufficient—one-third to one-half usually proving adequate. Mr. Bertholdt warns that galvanized tanks are unsuitable for collecting rainwater and points out that glass containers are innocuous although those made of wood or concrete are satisfactory, if well seasoned. Distilled water may be used in place of rain water, but in either case, the addition of one level teaspoonful of salt to each gallon of freshly introduced water is recommended unless the water already in the tank has an excessive mineral content.

AS announced in our last issue a new magazine in the French language appeared at the end of last year. We have now had the opportunity of perusing the first issue of this attractively produced journal, which is published in Belgium under the title of *NOTRE AQUARIUM* and have no hesitation in recommending it to our French-speaking readers. Among the lengthy articles in this January issue is one on the tropical aquarium, another on Swordtails and their hybrids and a third on *Barbus partipentazona*, in which is listed the differences between *Barbus partipentazona*, *tetrazona* and *sumatranus*. The quality of this initial number augurs well for future editions.

Readers' Hints and Tips

(20) Outdoor Vivarium Enclosure

A VERY simple but effective enclosure for tortoises or terrapins can be made from pieces of strong wire netting used for the "Morrison" indoor shelters. The sections of netting are cut in half lengthwise and the protruding wires are pressed into the ground. The pieces are joined by small wire rings at the corners. Painted dark green these enclosures are quite unobtrusive. For the smaller amphibia and reptiles the enclosure should be lined with fine mesh wire netting protruding at the top and the bottom for about 2in. The top part may be bent back at an angle to prevent the animals climbing over the edge and the bottom part should be buried in the ground.—Dr. R. Heller, Hounslow.

(10s. 6d. is paid for all published hints and tips.)

77-79 deg. F. and a tank 18 × 10 × 10in. is large enough. It has been found that they like clean, fresh water at a depth of 5in. A coarse shingle, which has been boiled and thoroughly washed, is placed in the tank to a depth of about 1½in. to enable a clump of fine-leaved plant such as *Myriophyllum*, *Cabomba*, *Nitella* or *Ambulia* to be planted at one side of the tank. After having been separated and

conditioned with chopped Earthworms, White Worms and *Daphnia*, the male and female fish are placed together. Try to ascertain when they first start to spawn so that they may be taken out about four hours later. As a rule they do not eat their eggs while they are spawning but will devour most of them in a very short time after the spawning has been completed.

The baby fish start to hatch out in three days, but as they are very tiny they are difficult to see. Being so small, and having such minute mouths, they are not able to take large foods. Like most Barbs they are bottom feeders and we have found that a little dried egg and milk put in butter muslin and swished in the tank until a fine cloud is produced makes an ideal food. After a time, it sinks to the bottom. In addition, some very fine Infusoria dripped in slowly every day until the babies are able to take a larger food is helpful. Mikro-worms can be fed to the fry when they are two weeks old.

Mikro-worm is a fish food which anyone can propagate and it can be fed to most young tropical fish at a fortnight old prior to introducing them to small *Daphnia*. Barbs are rather slow growers, but once they take White Worms and chopped Earthworms they make rapid headway.

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THIS spring the writer is looking forward to two especial pleasures. The first is the blooming of a new Water-lily added to a varied collection, and the second is the flowering for the first time of some Japanese Irises (*I. Kämpferi*), grown from seed. The lily is that outstandingly beautiful *Nymphaea escarboucle*, which was seen blooming in a nursery last year. It is a fairly vigorous grower requiring an area of approximately 4 sq. yds. and a depth of water between 18 and 24in. Its distinguishing feature, of course, is its colour which gives it a claim to be one of the most brilliantly coloured lilies under cultivation. It has been described as a bright vermilion-scarlet and, if it can be grown where the sunlight penetrates the large well formed blossoms—in a raised pond for instance, this colour description is no exaggeration. It is true that *Nymphaeas* are not particularly cheap nowadays, but when one considers the years of pleasure that one of these lovely plants will provide, the price is not really high.

Some Iris seeds were sown on a reserve border three years ago. They had been collected from the old plants towards the end of October and planted immediately by covering with about a ¼in. of fine soil. Germination in the following spring was very good and the young plants were transplanted at the end of each season so that they had plenty of room to develop. By this year most of them have attained flowering size. They have been planted about 1ft. away from the water's edge so that their tough roots are within easy reach of moisture, yet not actually immersed. The soil used is a fairly heavy loam with leaf mould added, for these Irises are gross feeders and appreciate a rich medium; indeed, in their native country, they are grown in sewage. This raising of one's own plants from seed is always a fascinating business and, when the time comes for the buds to unfold and

Seasonal Tasks for the Enthusiastic Pondkeeper and Water Garden Owner

reveal their rich and varied colourings, there is an added interest from the possibility of a new form of the plant appearing.

Towards the end of April, that handsome member of the Buttercup Family, the Globe Flower (*Trollius*), makes a fine show with its rounded blossoms that are so aptly named. Both the lemon-yellow (*T. europæus*), and the orange *Trollius* hybrid, known as Orange Globe, types can be grown. The former makes a fine cut flower when mixed with Bluebells or some sprigs of the powder-blue *Ceanothus*, both of which are out at the same time. Globe Flowers do best in a heavy soil, in fact, some of my best plants flourish in pure clay. The same applies to the other Buttercup, popular with the pondkeeper, the Marsh Marigold (*Caltha palustris*). This, of course, is a wild plant but it is every bit as showy as any cultivated aquatic subject with its rich green foliage and bright golden saucer-shaped flowers. There is a double form (*C. palustris* var. *plena*), whose golden-yellow frilly blossoms appear a week or two before the usual form.

Mention must be made of a plant which is an old favourite, not only on account of its beauty, but also for its quaintness. This is the Umbrella Plant (*Saxifraga peltata*) which bears no resemblance whatever to those little cushion-like plants beloved of rock-gardeners. *S. peltata* is a strong and vigorous subject which likes a marshy spot next to the water. Here, in early spring, it will send up a thick hairy stem to a height of 2 or 3ft. topped by a slightly rounded mass of tiny rose-pink flowers. When these have faded the leaves push up from a thick rootstock of rhizome, the stem of each being attached to the middle of the underside of the leaf similar to a nasturtium. This is not all, however, for in autumn these same leaves make a fine show with their patchwork colouring of crimson and gold which reflects in the water of the pond.



Drawing by E. W. Richardson showing the inflorescence of *Iris Kämpferi*.

Tortoises and Terrapins for the Home Vivarium

(2) Species of Land Tortoise

By A. Leutscher, B.Sc.

ALTHOUGH of no scientific significance the heading for this article is convenient in that it sets apart those creatures of the Order *Chelonia* which are entirely terrestrial. Most of them, large or small, come within the large Family, the *Testudinidae*, and, in particular, the Genus *Testudo*.

This Genus contains some forty species which occur in all warm countries with the exception of Australia and some of the nearby islands. The carapace is dome-shaped and firmly united to the plastron, and the stumpy feet are without webs. The claws are fixed and the tail short. They are chiefly vegetarian in diet.

Most existing species of *Testudo* are smallish, of a size similar to the popular pet, the Algerian Tortoise (*T. graeca*). Some, like the Giant Tortoises, are of great size and can weigh up to 500 lb. One specimen, a Marion's Tortoise (*T. sumeirei*) brought from the Seychelles in the year 1766, is said to have lived with certainty for 150 years. It is supposed to hold the record for old age of any modern animal.

Remaining Giant Tortoises

The Giant Tortoises which at one time inhabited most of the continents are now reduced to mere remnants in certain islands of the Indian Ocean, such as the Aldabras and Seychelles and the Galapagos islands of the Pacific, where Darwin as a young naturalist was impressed by their size and habits. Big as they are these tortoises are dwarfed by an extinct monster found in India, the fossil shell of which measures 8ft. in length.

Europe possesses four species of *Testudo*, all confined to the south and chiefly to the Mediterranean countries. Horsfeld's Tortoise (*T. horsfeldii*) is found around the Caspian Sea and in N.W. India. The Marginated Tortoise (*T. marginata*) is a Greek species. The Greek Tortoise (*T. hermanni*) occurs in the Balkans, Italy, S. France, certain Mediterranean islands and parts of its eastern shores.

The most widely found is the Algerian Tortoise (*T. graeca*) and this is the common tortoise of the pet trade. It occurs wild in N.W. Africa, Spain, the Balkans, Asia Minor, Transcaucasia, Syria and Palestine, Mesopotamia and Persia.

It grows to about 12in. (30cm.) and has a strongly domed carapace, without a ridge, and only a slightly serrated hind border. The plastron is flat in the female and concave in the male, and has a slightly moveable posterior lobe. The tail in the male is longer. Scales in the forelimbs are large and there is a spur-like tubercle on the back of each thigh—hence the alternative name of Spur-thighed Tortoise. The arrangement of shields is as follows—neurals 5, the last one broad; costals, 4 pairs; marginals, 24, with a single shield over the tail (see sketch in introductory article, last issue of WATER LIFE). This tail shield is curved in the male and flat in the female of this species.

Colour Pattern of Shell

The general colour of the shell is an olive-brown, which is much brighter in the young, with each shield edged in black and marked with irregular dots. Incidentally, the shell of a tortoise can be improved by rubbing occasionally with olive oil. It should *never* be painted or varnished in any way, as this can upset its growth.

The Greek or Hermann's Tortoise (*T. hermanni*) agrees with the above description, with the following minor differences—the tail ends in a horny spur, the carapace border is smooth and the leg-scales smaller. There is no thigh tubercle and the marginals number 25, there being a double shield above the tail. The colour is mostly yellowish with a central dark spot on each shield.

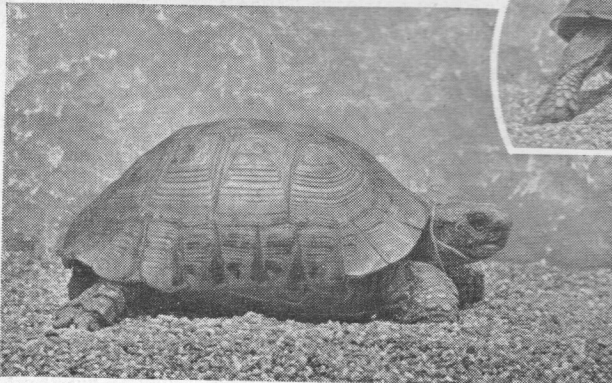
Horsfeld's Tortoise is dark in colour and has only four claws to each foot. The Marginated Tortoise, more truly indigenous to Greece than the so-called Greek Tortoise, has a flange-like, serrated margin to its hinder carapace.

All these four species have similar ways of living and are quite hardy in our climate. They enjoy sunshine and avoid damp or ain, retiring at such times, and also at night, by digging or pushing underneath rocks and vegetation. They are not very active, yet can travel surprising

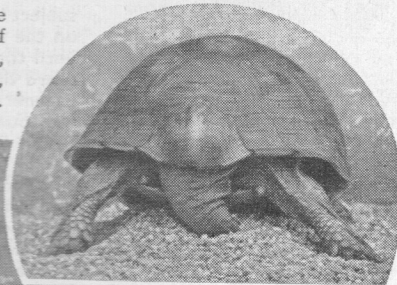
distances in search of a mate or new feeding grounds. Natural food consists of soft plants and fruit.

In captivity the following foods may be given—lettuce, young cabbage, dandelion, clover and rose-leaves, sliced carrot and tomato, and any ripe and sweet fruit. Bread soaked in jam may occasionally be tried. A supply of food should be available at all times, since tortoises have large appetites. Fresh water in a shallow dish, set at ground level, is important. Occasional olive-oil, linseed or grated cuttlefish bone should be mixed with the food in order to assist shell growth.

The Algerian Tortoise (*Testudo graeca*) which is the species most commonly imported into this country. The illustration (above) shows the characteristics for sex differentiation. In the male the plastron is concave, the tail is longer and the tail shield, curved.



[Photographs]



[L. E. Day

(Continued next page).

The tortoise can be allowed the freedom of the garden, provided there are no escape holes. If well fed it will do little damage to the garden plants. Place the food in the same spot every morning so that it gets used to finding it.

A low fence of wire netting, about 2ft. high, will restrict movement, but in this case a shelter must be made available into which it can retire during rainy and cold spells, also a drinking dish should be at hand. In my enclosure is a patch of sand, on which my tortoises like to lie and bask. It is also available for the female, should she wish to lay eggs.

The Algerian Tortoise usually breeds in late spring in the wild. The males court the females in a strange fashion by butting them with the shells and uttering loud hisses. This noise can be heard some distance off, and in our garden has even attracted the attention of the neighbours. Sometimes males fight one another, even biting in their endeavours to dominate one female. To mate a male clambers on to her back, applying his cloaca to hers by pushing his tail under her shell. Later the female lays her dull white, spherical eggs, about 3½cms. in diameter, in a hole in soft earth or sand, which she excavates with the hind legs. They may number from 4-12 and they incubate in 3-4 months. The babies measure 4cm.

Eggs are frequently laid in this country, but may prove infertile. An attempt to hatch them can be tried by removing them to a box containing some dry earth. They should be placed in exactly the same position as they were laid, i.e. without turning. Cover them to a depth of about 2in. and place in a warm, sunny spot with a sheet of glass over the box. In bad weather utilize a linen cupboard.

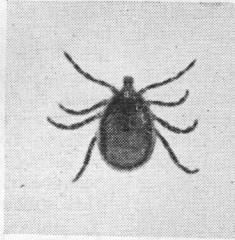
Baby tortoises must be handled with care as their shells are soft and still growing. They are best reared indoors, or

at least in warm surroundings, and fed on young and soft plants. To my knowledge no baby tortoise has ever been successfully reared in this country.

Hibernation usually commences about October. The tortoises become sluggish and stop feeding. Some will sleep quite well under a pile of leaves in the garden, but in case there should be severe frost it is advisable to place them in a box of dry leaves or hay, which is stored in a dry place, free from draughts and maintained at a normal temperature. The Garden shed is a good place, but *not* the garage or coal cellar, because of fumes in the one place, and dampness in the other.

With reasonable care a pet tortoise will live to a ripe old age in a healthy state. Twenty to thirty years is quite common. The record for a Greek Tortoise is 90 years and, for an Algerian Tortoise, 120. Of the latter, Gilbert White's famous "Timothy" lived for 54 years. The widely held belief that the age of a tortoise may be told by the number of rings on the shields is a fallacy.

These remarkable animals have few parasites. The harmless tick is one. Because it looks unsightly it may be removed by applying a drop of petrol and removing with a pair of tweezers. Worms are sometimes found in their droppings. A sprinkling of worm-powder, as used for puppies, can be mixed with the food and will help to clear this trouble. Slime and blood in the excreta indicates intestinal trouble, in which case warmth should be provided and a dose of-castor oil given. Fast breathing and froth at the nose and mouth usually means a chill, even pneumonia. Warmth again is beneficial, and plenty of drinking water. Cases of blindness should be watched. This may be caused by a fungus attack of the eyes. Bathe in boracic solution and apply zinc ointment.

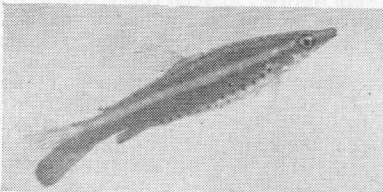


The tick found on tortoises.
(Magnif. x 6)

— Know Your Fishes —

No. 14. Pencil Fish

(*Pencilbrycon auratus*)



[Photograph]

[Kathleen Cooke]

The presence of an adipose fin serves to distinguish members of the Genus *Pencilbrycon* from the several *Nannostomus* species with which they are sometimes confused. Both Genera belong to the Characins. The *Pencilbrycons* known to aquarists are *P. auratus* (sometimes known as *P. trifasciatus* and commonly known as the Pencil Fish), *P. unifasciatus* and *P. eques*. A characteristic of the Pencil Fish is that, like *P. unifasciatus*, it swims with its head up, the whole body being at an angle of 45 degrees. *P. eques* swims in the more orthodox horizontal fashion.

Pencilbrycon auratus grows up to nearly 2in. in length and is slimmer than the other species, the head and mouth being more pointed. The body is long and cylindrical and varies in colour. The back in different specimens may be of a light golden brown or a darker coffee colour. Pronounced lateral stripes are present.

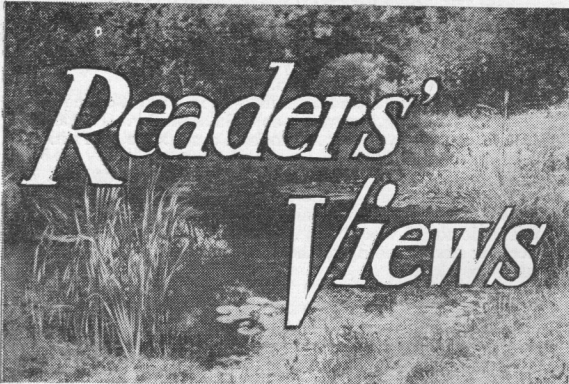
The first, which is brown, extends from the nose to the upper part of the caudal fin, next comes a light golden stripe and then a broader black band which extends into the lower lobe of the caudal. Under this band is a row of black dots. The dorsal fin is small and has no distinguishing feature. The anal fin is brown in colour and has a red spot just below the body line; in the male it is convex at the outer edge and, in the female, straight.

The Pencil Fish has been bred but it is not an easy subject to get to spawn. The single eggs are deposited on the undersides of plant leaves where they remain until they hatch out in about 48 hours. The parents guard the eggs and are said not to eat them but some breeders advise the removal of the parents as soon as the young have hatched out.

This fish, which comes from the Amazon Basin and British Guiana, is peaceful and makes a pleasing addition to a community collection. It likes a normal temperature of approximately 70 to 72 deg. F. which must be raised to 80 deg. or higher for a successful spawning.

Dried foods are taken but a more varied diet is necessary to keep specimens in good health and colour, particularly when it is intended to breed from a selected pair. Scraped meat, shredded liver, small shellfish, live Brine shrimps, freshwater shrimps, *Daphnia* and most other small live foods including White Worms and Mikro-worms are relished. Chopped earthworm can be offered. Plentiful supplies of Infusoria should be available when the young first hatch out.

Class : Pisces. Order : Ostariophysi. Family : Characidae. Genus : *Pencilbrycon*. Species : *P. auratus*.



The Editor is not responsible for opinions expressed by correspondents.

IMPORTING TORTOISES IN WINTER

SIR,—The members of the British Herpetological Society, indeed all animal lovers with a knowledge of tortoises, are viewing with some concern the autumn and winter importations of these creatures which have recently arrived in this country. The species mainly concerned is the Algerian or Spur-thighed Tortoise (*Testudo graeca*) sometimes erroneously called the Greek Tortoise. Its native home lies in the countries bordering the Mediterranean Sea, and most importations come from N. Africa.

Tortoises, because of their cold-blooded state, are forced into a torpid condition at low temperatures which, during the colder months in their natural lives, is called a hibernation. This brings about a profound physiological change in their metabolism, during which the body temperature falls, the heart beat slows down and breathing practically ceases. Little energy is used and no growth takes place.

To disturb this winter sleep, by moving the animal or raising its temperature, can be dangerous and often leads to death. The tortoise may even refuse to eat when so awakened. When active, food is just as vital to it as to any other animal. The risk of an early death in a tortoise imported during its normal hibernation is, therefore, very great, and it is gratifying to see that many dealers and importers are now refusing to enter into this winter trade of tortoises.

Unfortunately, some have been entering this country during the winter months. Readers can help to stop the practice by refusing to buy these popular pets of children when they are offered for sale except in warm weather when they are active.

It should be the first duty of any person who keeps animals, whether fish, dogs, cats or tortoises (for which there is always a ready sale), to see that these pets are not subjected to any unnecessary hardship or suffering. In this instance the tortoise problem is as vexed a situation as the Goldfish bowl controversy.

British Museum, ALFRED LEUTSCHER, B.Sc.,
(Natural History), Hon. Secretary,
London, S.W.7. British Herpetological Society.

LUMP SULPHUR AS FUNGUS CURE

SIR,—I have read within the past year or two of the use of lump sulphur in tanks and ponds as a preventive of fish fungus. I am employing this method in my pond and have been doing so for a long time. No fungus has attacked my fishes.

Your readers who have experienced such trouble may be interested in the appended extracts of notes by a Mr. J. L. Norton from a 1914 issue of a Birmingham newspaper.

Smethwick, W. DOWNES,
Staffs.

"The remarks under Nature Notes regarding fungus and goldfish are interesting, but I note that your correspondent has omitted the only known and sure cure for this troublesome disease, which is most contagious, almost acquiring the nature of an epidemic if not quickly attended to when it first makes its appearance. The disease is presumably due to insufficient aeration or oxygenising of the water and the remains of food or decaying vegetable matter. Whilst permanganate of potash tends to obviate it, neither this nor salt is a sure preventative or cure.

"When the disease is of some standing and the fins are largely eaten away, and leprosy holes appear in the body of the fish, it is sometimes possible to cure by cleaning the sores with a piece of wadding dipped in strong brine and gently wiping the fish over from the gills to the tail, being careful not to permit the strong brine to get underneath the gills and also taking particular

care to avoid the sensory-line; that is the curved line of dots appearing about half-way down the fish and extending from the gills to the tail fin. When this is touched it causes the fish extreme pain.

"After cleansing, make a solution of sulphate of copper (ordinary blue stone) just sufficient to make the water a bright coloured blue, and immerse the body of the fish into this, stroking or smoothing over the body with the fingers, taking the utmost care to avoid any of the solution creeping under the gills. It is a somewhat hazardous performance and few fish other than carp species or the tench can withstand it, as it removes the mucus; that is, the slimy stuff with which the fish are covered.

"For a preventative of the disease, an extremely weak solution of sulphate of copper put into the tank, one part in six million, is unfailing. A piece of blue stone the size of a small hazelnut in an ordinary 8oz. bottle is quite strong enough, and five spots of this stock solution in 50 gallons of water is quite sufficient and even this is almost too strong when the fish are not inured to it, and it is better to commence with a smaller amount. I have usually put three spots into a tank 5ft. long x 2ft. wide x 15in. deep. Previous to its use, I lost hundreds of fish, but for the last ten years, during which time I have been using it regularly I have not been troubled at all. Incidentally, the frequent changing of the water, using ordinary Corporation water, appears to conduce to fungus."

NEW DWARF WHITE WORMS

SIR,—I was very disappointed at the failure of the British Museum to identify the worms, cultures of which were sent to this country from Sweden, as reported in your December issue. My own observations while breeding the worms, during the last 15 months, lead me to the belief that they are all of one species which is akin to the nematodes. Some of the reasons for coming to this conclusion are:—(1) They all attain the same size under good conditions; (2) their external appearances under the microscope are identical; (3) they are all livebearers; (4) the conditions under which they prosper are more like those enjoyed by Mikro than White Worms.

Of course, it is possible that by some process of selection these new worms, some of which I am now growing, have become a pure culture. I can only say that they are, to the best of my belief, just the same as those I originally received from Mrs. Morten Grindal in October, 1949.

Romford, Essex.

A. E. FALKUS.

PARAFFIN OIL TREATMENT

SIR,—The reference by Mr. L. W. Ashdown to the treatment of fish diseases by the use of paraffin oil is interesting, as only a few weeks ago I was treating tropical fish in this way.

At the time, I had a very bad outbreak of White Spot in a community tank, containing Tiger and Half-banded Barbs, Black Widows, Siamese Fighters, and a number of others. Not wishing to risk the more expensive fish, I decided to try the oil on Zebras, Guppies and Swordtails, using the Quinine treatment on the rest.

Consequently, four Red Swords, two Zebras, a pair of Guppies and a pair of Red Fighters were immersed (individually) in paraffin oil, warmed to the correct temperature, for a period of ten seconds. They were then placed in a tank containing Calico Fantails, no other being available.

Within three days of the treatment all signs of White Spot had disappeared, and not one fish had died. The other fish, treated with the more usual remedy, died within twenty-four hours.

From this I have drawn the conclusion that paraffin oil may be used on some tropical fish, at least provided due caution is taken.

One further word of interest. The surplus oil from the net will leave a film of oil over the clean water, which if not removed will cause the fish to suffocate. My method of removing this film is to draw several sheets of newspaper over the surface.

I know of one other case where tropical fish have been treated with paraffin with no losses. These were fine specimens of Rosy Barbs, and all were cured.

London, W.10.

C. H. W. EDMONDS.

ATOMIC ENERGY AND WATER LIFE

SIR,—Atomic energy has entered the field of aquaria research with more peaceful prospects than it offers in other spheres. The increasing use of minute amounts of radioactive material in modern nature study has enabled biologists to make a closer study of the food requirements of molluscs or shellfish and other lowly animals, and also to study the effects of radiation upon the fish themselves.

At the fisheries biological laboratory at Beaufort, North Carolina, Dr. Walter A. Chapman and his associates have been receiving minute amounts of radioactive chemical substances from the Atomic Energy Commission's Isotope Division at Oak Ridge, Tennessee, and using them to find what types of microscopic food are selected by oysters and other shellfish living in their marine aquaria. Organisms supposed to be the food of

oysters are grown in water containing radioactive chemicals which these creatures digest and absorb. The activated organisms are then fed to experimental oysters in the aquarium tank and the nutrients, which are digested and incorporated into their tissues, can then be determined chemically and by radiation measurement. The object of these studies is to learn more about the best natural foods to give oysters for their growth and fattening on the Atlantic coast.

Studies during the atomic test explosion at Bikini in 1946 revealed that fish in Bikini Lagoon, which measures twenty miles by ten miles, became radioactive, and for a time sea-going fish caught outside the lagoon were radioactive. Dr. David Bradley thought that the great dilution factor in the sea reduced any great danger of migratory fish carrying radiation far from Bikini, but these observations on radioactive fish have shown that the world's fish would be affected were they subjected to similar experiments.

Liverpool 15.

ERIC HARDY, F.Z.S.

PLACING THE PLATY

SIR,—On looking at a back number of *WATER LIFE*, I came across the article entitled "Fishes in All Their Variety." I noted that the classification of the Platy was:—Order *Microcyprini*, Class *Neopterygi*.

In the article "Evolution of Fish Nomenclature" which also appeared in *WATER LIFE*, the classification for the same fish was given as Order *Cyprinodontiformes*, Class *Telostomi*. Both of the articles refer to the Phylum *Vertebrata* but a zoologist told me the other day that the Phylum should be *Chordata*.

The systematists tell us of Orders, Classes, etc., but never give us any reasons why these exist or how we may tell in which group we should place a specimen. Perhaps someone will contribute an authoritative article or articles to help us understand how we can determine the correct position of our aquarium fishes in relation to each other.

I was reminded of the above articles when perusing Mr. Saville's first contribution in the series "Improving the Platy" which seems to me to cover the subject lucidly and fully. I would, however, like to know just where our Platies come in the scheme of things.

London, S.W.

PHILIP MARSHALL.

BREEDING FROM WAGTAIL PLATIES

SIR,—You recently referred in *WATER LIFE* to the development of the Wagtail Platy.

One of the members of my club (Welling A.S.) who bred some Wagtails, found in one brood that he had several fish which were not Wagtails. He passed some of them to me and I recognized them as Golden Comets with red dorsal fins.

They were kept in isolation. I inter-bred them and the interesting thing is that although, so far, very few youngsters have been produced, they are all Golden Comets. I had expected a further type reversion.

So far as I know, the original Wagtails have not produced any further examples of these throw-backs.

Welling,
Kent.

S. H. BUTLER, F.Z.S., F.R.H.S.

METAMORPHOSIS OF AXOLOTLS

SIR,—I read the article by Mr. Alfred Leutscher on the complete metamorphosis of Axolotls in the October, 1950, issue of *WATER LIFE*, and thought you would like to know that I acquired eight Axolotls about 3in. long.

One of them, when it had attained 5in. in length, changed into the *Ambystoma* stage, emerging as a Salamander. It was kept with the other seven young Axolotls in a 24 x 12 x 12in. tank with the water 9in. deep.

Six of the remaining Axolotls have grown to about 9½in. long and the seventh 10½in. I also have two white ones about 9½in. long. As yet I have been unable to breed them, although I am hoping to do so. I would be glad of any further information on the keeping and breeding of these interesting creatures.

South Croydon,
Surrey.

W. J. SOMERS.

(Mr. Somers' letter was shown to Mr. Leutscher who has made the following observations:—"I am most interested to learn of this metamorphosis. I take it that the gills have disappeared and the animal is now out of water. From the size given by Mr. Somers it sounds as if he has a very fine collection and there is every hope that they will breed. Some of the remarks in my article may assist. I am afraid that Axolotls are rather unpredictable creatures. Change of water may help, even a change of scenery. Most deaths among Axolotls are due to overheating. They prefer cool surroundings."—Ed.).

JUDGES AND THEIR RESPONSIBILITIES

SIR,—My opinion is that when asked to judge any class in any show you are duty-bound to award a First Prize to the best in the class, even though it may be a poor specimen. It is, after all, the best one exhibited in that class and, therefore, entitled to the top award in the class offered by the promoters.

The difficulty which arises when a judge is faced with exhibits of low quality could be abridged, I think, if judges always recorded the points given to the leading exhibit in every class. These points should be marked by the show officials on the tank label for the public to see and on the prize card for the exhibitors' information. These tasks would not be too onerous and they would permit all concerned to know the judge's assessment of the winning exhibit's true value.

Westcliff-on-Sea,
Essex.

C. J. SAUNDERS, B.Sc.

SIR,—I would like to voice my opinion in a very few words. As in all competitions, the prize should be given to the very best exhibit. There may be a better one in Timbuctoo; there may have been a better one that died—but if they were not exhibits at the show their existence could not, or should not influence the judge.

The prize is due to the best fish in its class and to withhold the prize on the grounds that the standard is low is entirely wrong.

What would happen were we tell the F.A. Cup winners they cannot hold that trophy because the quality of the play was poor and a better team won last year?

Birmingham 21

A. A. BEARDSLEY.



HENDON SOCIETY REWARDED

Mr. P. R. Chapman, secretary of Hendon A.S., receiving from the Mayor of the Borough His Worship's trophy for the most meritorious exhibit at Hendon Borough Show. The Mayor was greatly impressed by the standard of the display and he offered the trophy to be competed for each year. Hendon A.S. had the honour of winning it for the first time with a section which many acclaimed as being the most attractive of the whole exhibition.

Tortoises and Terrapins for the Home Vivarium

(3) European and American Terrapins

By A. Leutscher, B.Sc.

FRESHWATER tortoises, or terrapins as I prefer to call them since this name is of American-Indian origin and North America is their chief home, are smallish, aquatic tortoises which grow to an adult size of 6-12in. The carapace is flattened, as are the feet which have webs between the flexible digits, and these terminate in long, sharp claws.

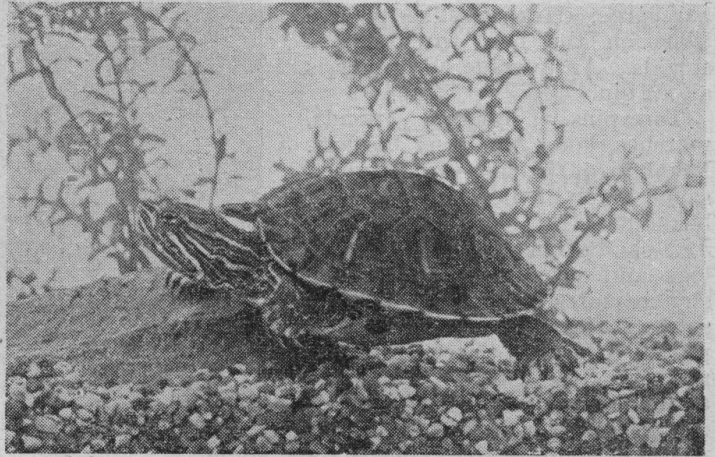
In adult specimens the male can usually be distinguished by its longer tail and the position of the cloaca, which is situated beyond the shell opening (it is within the shell in the female). The male is usually of smaller size. The young terrapin has a very long tail in proportion to its body, and in many species the carapace is strongly keeled.

Europe has only three species of terrapin, of which the European Pond-tortoise (*Emys orbicularis*) is the commonest to be seen in the pet shops. It is widely found throughout Central and S. Europe, N.W. Africa and W. Asia. The carapace is a deep, reddish brown with yellow flecks and the skin is black with numerous yellow spots, especially on the head. The other two, the Spanish Terrapin (*Clemmys leprosa*) and Caspian Terrapin (*C. caspica*) are more local, as is suggested by their names. Their general colouring is brown and olive respectively. Both can produce a peculiar smell from scent glands in the cloaca.

All three species will live well in our climate and soon become tame enough to feed from the fingers, which is perhaps a compensation for their sombre colours.

For real attractiveness of colour and markings the N. American terrapins can hardly be excelled. There is a choice of some dozen species, of which only a few, however, reach this country at the present time, and then only at odd intervals. I will mention the three most likely to be encountered.

Firstly, the Elegant Terrapin (*Pseudemys scripta*). This is very widespread and has well-defined races, of which



[Photographs]

[L. E. Da

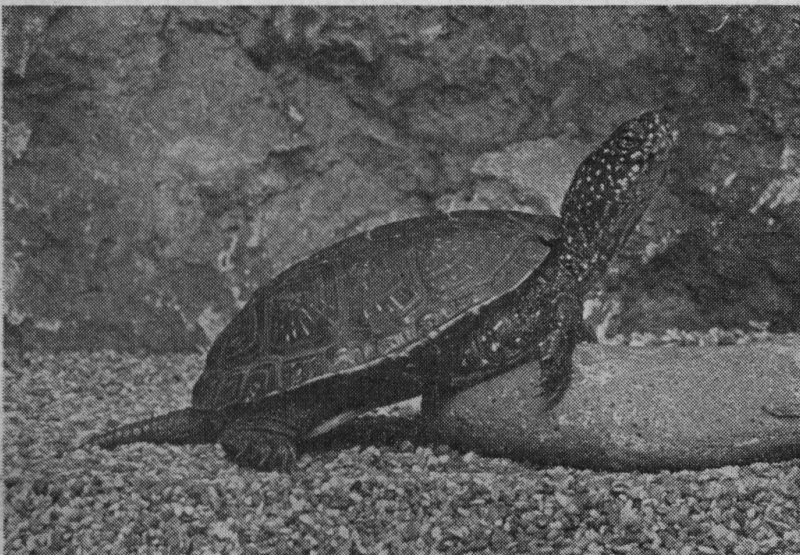
Troost's Turtle, a young specimen of a variety of Elegant Terrapin (*Pseudemys scripta*), one of the American species with attractive colouring which sometimes arrive in this country.

Pseudemys scripta troostii is the best known. It occurs in the S.E. States and is known there as Troost's Turtle. It is one of the most popular pets sold in the American stores.

The flattened carapace is brownish, with darker brown and black marks and yellow stripes on each shield, and a yellow band across each marginal. The plastron is yellowish, with a dark spot on each shield. The soft parts are deep green with longitudinal yellow stripes. On the sides of the head each upper stripe includes a blood-red patch just behind the eye. Across the latter is a dark, horizontal line. Those sold in the shops are mostly young. They have a keeled greenish carapace with darker, concentric green and yellow rings on each shield. The red patch behind the eye is very conspicuous. The adult of this species grows to about 8in.

Equally common in America, and as widespread, is the Painted Terrapin (*Chrysemys picta*). It has four races, of which the form occurring in the Central States (*Chrysemys picta marginata*) has recently appeared in our shops in limited numbers. The carapace is dark brown, even blackish, with a yellow dorsal stripe and yellow marks on the costals. The marginals are red, each with a curved black mark. The plastron is yellow, sometimes tinged with rose, and has a symmetrical dark area along the middle line. There are three red bands along the neck, one passing to the chin and one to each eye. The young have bright red bands and a keeled carapace. This species may grow to about 6in.

A third species recently imported is one of the Map Terrapins, called *Graptemys pseudogeographica*. It is the Mississippi Map Turtle found in the vast, upper reaches of this famous river in America. The carapace is a dull olive or brown with a conspicuous network of greenish and yellow lines. There is a toothed keel down the middle.



Hardy and easy to tame the European Pond-tortoise (*Emys orbicularis*) is known to have been an early native of Great Britain.

The plastron is yellowish, with a complicated but symmetrical dark pattern along the middle line. The skin is dark olive with numerous fine, longitudinal yellow stripes. The eyes are thrown into relief by the bright yellow pupil and a yellow neck stripe which curves below it, giving the creature a bespectacled look. Colours and markings are very bright in the young. The keel has large, dark saw-like projections on the first three centre shields. An average adult size is about 6in.

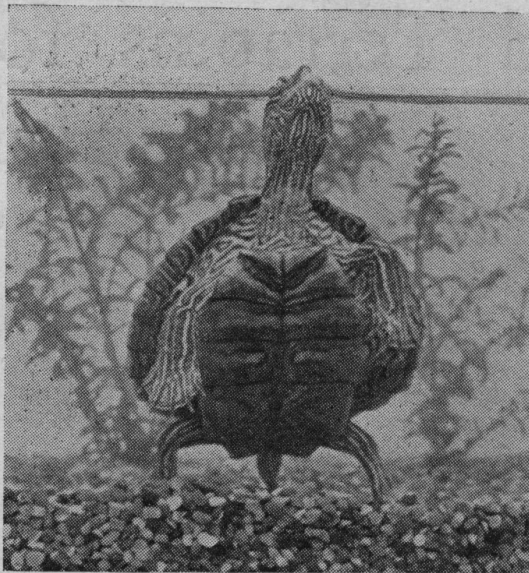
Terrapins inhabit ponds, marshes, lakes and river borders. Members of the species mentioned spend much of their time on land, basking in the sunshine on mud and sandy-banks, or on floating logs and vegetation. They are shy creatures and quickly dive for safety if disturbed. At night they usually retire to water, but may remain active as they often feed at this time. Hibernation, by about October, is in soft earth, into which they burrow, or in the mud beneath their watery home.

Contrary to a widespread belief these terrapins are not exclusively carnivorous. To a diet of small water animals, especially crustaceans, water-snails and fish, they will add an occasional meal of soft water plants. In captivity they may be given almost any small water animal, fish, Earthworm and bits of raw meat. If they can be encouraged to eat lettuce or water plants so much the better, as these will greatly help to satisfy their large appetites. Food, incidentally, is usually taken in the water.

Outdoor Vivarium Requirements

Terrapins may be kept with land tortoises quite safely, but the enclosure will need a higher and securer wall, preferably with a ledge, as these chelonians are expert climbers. They will also require a shallow pool in which to retire and feed, and a rock or two on which to bask. A sloping branch will give them something by which to climb out of the water.

It need hardly be added that if terrapins are placed in a pond containing defenceless animals, such as fish, the latter



Photograph]

[L. E. Day

The American species Mississippi Map Turtle (*Graptemys pseudogeographica*) which has map-like markings on shell and soft parts.

will suffer. A terrapin catches its prey in the mouth, tearing it to pieces with its sharp claws. This may lead to pollution as the wasted bits of food accumulate, a point which must be watched closely. Some terrapin owners prefer to feed their charges in a separate bowl, returning them to the enclosure after each meal.

Adults will usually live quite well out-of-doors the whole year round, hibernating in the mud of their pool. With youngsters there is a certain risk attached to this, especially with American species, since most of those for the pet trade are caught in the warm southern regions. After experience in losing a number myself I now keep them inside the house. The five I possess live in a large glass bowl in a sunny window. The water is only 3in. deep, and there is a small rock island in the centre. During reliable spells of sunshine the bowl stands outside during the day but always comes in at night.

The water contains clumps of *algæ*, which the babies occasionally eat and under which they like to hide when resting. Occasional bits of crisp lettuce are dropped in as food, with a variety of animal matter, such as tiny Earthworms, bits of raw fish and meat, and small water creatures such as *Asellus* and *Tubifex*. If the dull weather is prolonged, a bulb of low wattage is switched on just above the bowl to keep them active and contented. Such a bowl is not unattractive on a table in the drawing room during the winter months. To keep the water fresh and clean it is changed every week.

Breeding of terrapins sometimes proves successful in captivity. The courtship, usually in the water, is an active affair in which the male chases his mate, sometimes butting her or biting the exposed parts. The males of some species will stretch out their forelimbs, and rapidly vibrate the tips in a curious fashion, so that the claws literally "tickle" the head of the female, as if to excite and arouse her interest. As with the land tortoises the male clambers on to her back to mate.

European species breed from early spring into the summer months. The American terrapins usually delay their breeding until June or July, probably on account of the more severe winters. The female excavates a shallow nest with the hind feet in soft earth, usually near water, in which she lays, on average, 6-10 dull-white, oval eggs. They are about 3-4cm. long.

Breeding Possibilities

The chances are that the European Pond-tortoise will be the easiest to breed in this country since our climate is similar to that of its natural surroundings. It did, in fact, once live wild in Britain. The eggs hatch in about four months into small black creatures about the size of a two-shilling piece, measuring about 5cm., of which the tail comprises a good half.

Ailments, apart from chills, are few. A vitamin deficiency through lack of sunshine may cause a form of rickets. Lack of calcium may affect shell-growth. This can be overcome by adding scraped cuttlefish bone to the food or giving bits of raw fish containing bone, or crushed water snails including the shell. Eye complaints should be treated as for land tortoises.

Terrapins can live to quite a considerable age. A record for the European Pond-tortoise is 120 years.

WATER LIFE Glossary of Terms

GUPPY.—The popular name applied to the Livebearing Tooth Carp *Lebistes reticulatus*. This species belongs to the Family *Poeciliidae*. It has been variously called *Poecilia reticulata* (1859), *Lebistes poeciloides* (1861) and *Girardinus guppii* (1866). The specific name *guppii* was given by Albert Guenther in honour of the discoverer, Dr. Lechmere Guppy. Even after the species was correctly classified as *Lebistes reticulatus* in 1913 the popular name of Guppy continued to be used and it is to-day the generally accepted anglicized name for the species.

HIBERNATION.—A period of dormancy in animals which normally occurs during cold weather. Most reptiles and amphibia hibernate and a number of fish species, particularly in open waters, become completely or partially dormant during the winter months.

INDIGENOUS.—Applied to organisms native to a particular district in contrast to those which have been artificially introduced.

Second Series (Continued)

Tortoises and Terrapins for the Home Vivarium

(4) American Box Tortoises

By Alfred Leutscher, B.Sc.

THE name Box Tortoise is given to a Genus of American chelonians, known as *Terrapene* (old name *Cistudo*), in which there are certain outstanding peculiarities. The main one is the hinge across the plastron of the shell which divides the latter into two lobes. These can be moved in such a way that the front and hind openings of the shell become entirely sealed when the tortoise withdraws its extremities.

Another characteristic is the dome-shaped carapace, which gives the animal an appearance similar to a normal land tortoise. On the other hand the feet are terrapin-like, being flattened, webbed and provided with sharp claws. Box Tortoises have a hooked beak and are both vegetarian and carnivorous. In their movements they seem to prefer the land to the water and are looked upon as a group of terrapins which are reverting to the land.

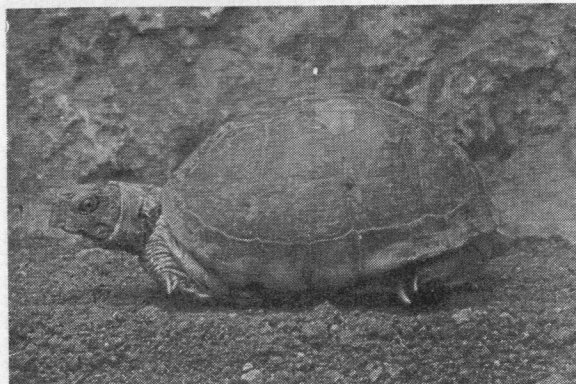
Five Species in the Genus

Terrapene is a small Genus of five species, two of which are native to N. America and three to Mexico. Of these the Common Box Turtle (*Terrapene carolina*), which we call the Carolina Box Tortoise, is the best known. There are four recognised races, which cover a wide area of the Eastern U.S.A., from the Gulf Coast and Florida, through the Mississippi Basin to the Great Lakes, and eastwards to the Atlantic coast.

The typical sub-species *Terrapene carolina carolina* has a domed carapace with a median low keel and a smooth border. It is deep brown with much variation in pattern, but usually with conspicuous yellow spots and stripes on the larger shields. The blackish plastron has yellow markings. The soft parts are marked with yellow and orange on a brown background. The average size of an adult specimen is from 5-6 in.

Sexes are very similar, but like many chelonians the male has the longer tail with the cloacal opening outside the edge of the shell, a more flattened carapace and a hollow in the plastron. The carapace of the young has a prominent keel which is marked with yellow. The rest of it is brown with a distinct yellow spot on each costal shield. This sub-species is shown in the photographs on this page.

The Carolina Box Tortoise is chiefly a woodland dweller, preferring the glades and open spaces among the trees, but it occasionally lives on hillsides. It sometimes occurs in very dry places but is more usually found in swamps,



Photograph]

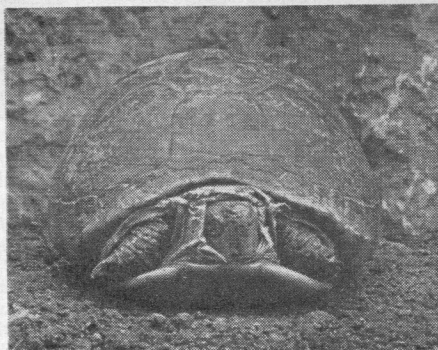
[L. E. Day

Sub-species, (*Terrapene carolina carolina*), of the Carolina Box Tortoise (*Terrapene carolina*). The colouring is variable but this sub-species has a domed carapace with a median low keel and smooth border.

river beds and near ponds or lakes, especially in the dry summer spells when it sometimes congregates in great numbers. It swims well and frequently dives in the water when alarmed. At normal times it is a solitary creature, moving about in daylight, or basking in the sunshine. During the night it retires under logs and vegetation. In these general habits out of water it agrees with ordinary land tortoises which were covered in the second instalment of this series (April-May, 1951 issue).

Hibernation in Winter Months

Hibernation is from about November to April, or later in the warmer south and, at the beginning of this period, the burrow is shallow but becomes deeper and deeper as the tortoise digs further into the ground with the onset of winter. On emergence from hibernation the males quickly seek out the females, and sometimes fierce fights ensue. Even the females suffer as their ardent pursuers butt and bite them relentlessly. Sometimes an eager male finds himself in an embarrassing position when his beak or a



PROTECTIVE DEVICE OF BOX TORTOISES

Two stages in the withdrawal of the head and fore-limbs of the Box Tortoise. Left: The head being retracted. Right: The hinged plastron entirely covering the aperture through which the limbs and head have been withdrawn.



leg becomes fast as the shy female shuts her shell, and for a moment he is rendered helpless!

In June or July the female prepares her nest by digging a shallow pit with her hind feet in the soft woodland earth. In this she lays an average of four, oval, white eggs, about $3\frac{1}{2}$ cm. long. In about three months these hatch into babies 3 cm. long.

Study of marked specimens has suggested that this tortoise keeps to a definite territory and that each individual displays a certain amount of "homing" instinct.

Varied Diet in Natural Habitat

The diet of the Box Tortoise is omnivorous, and includes a host of animals and plants, such as insects, worms, slugs, fish, carrion and various soft plants and fruit. Toadstools are said to be a favourite and, since the tortoises are sometimes eaten as human food, cases of food poisoning may result. In captivity they will take, in addition, pieces of raw meat.

The other N. American species is smaller though it is the much more attractive. It is the Ornate Box Tortoise (*T. ornata*) and occurs more to the west, from the State of Texas in the south to Wyoming in the north and eastwards across the Great Plains to Illinois. The carapace is domed with a flat top, and is coloured a reddish or chocolate brown with bright yellow spots and stripes which form radiating patterns from the top centre. The plastron is very dark with a variegated pattern of yellow lines. The average adult size is about 4-5 in.

It is essentially a lover of dry, sandy localities, either in hilly country or on open prairies. Here it may be found, sometimes in great numbers, moving about or feeding in the early morning and late afternoon, and usually retiring from the hot sun at mid-day. Food consists chiefly of insects, especially grasshoppers, and soft fruit and plants. This species rarely, if ever, enters water. Hibernation is

from October to about May and is of longer duration than that of *T. carolina*. It is also deeper in the ground.

Box Tortoises sometimes hiss aggressively and even attempt to bite, but this is not considered dangerous in spite of the hooked beak. They are used to a warm climate but will stand our summer climate provided that there is not too much bad weather, particularly rain. Outside they may hibernate by digging into soft earth, although it might be wiser to allow them to do this in a box. The box can then be placed in a dry sheltered spot such as a garden shed.

The outdoor enclosure, which must have a wall over which they cannot climb, should contain a shallow pool in which they can swim on occasion. A stretch of dry sand will serve as a sunning place and also as suitable ground in which the female might lay eggs. Box Tortoises will live quite well with ordinary land tortoises and will eat similar greenstuff and soft fruit with the addition of worms, raw meat and fish. Slow-moving insects, which find their way into the enclosure, will probably be caught by them.

Longevity in Box Tortoises

There are records of Box Tortoises which have lived for over 100 years in America. As with some of the other species mentioned in the previous articles of this series, they appear to have a long, and charmed, life which makes it all the more sad when we keep them as pets, only to have them succumb at an early age. Sometimes the cause of death is a mystery and, provided that the creature's needs are satisfied and that adequate and suitable food is given, there is no reason why one's pet should not live a happy and contented life. In striving toward this ideal it is the writer's earnest hope that the foregoing remarks will be of some aid to tortoise lovers, young and old. This fascinating creature demands so little of our time that it deserves the best attention we can give it.

Mr. M. Manal Visits Britain and Tells of



Fishkeeping in India

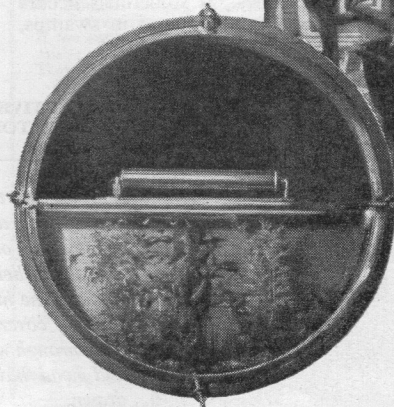
THERE is a vast potential following of the hobby in India and the Aquarist Society of India, with headquarters in Bombay, is expanding rapidly. It publishes a bulletin, buys apparatus, foods and fishes for its members and holds regular meetings. The driving force behind this society is the secretary, Mr. M. Manal, who is anxious to see that beginners are started off on the right lines. Mr. Manal arrived in London by air, at short notice, a few weeks ago and WATER LIFE was able to help him to see the strength of the hobby here. In company with

the Editor, he visited Mrs. Kathleen Cooke's fishhouse at Twickenham and also saw the equally impressive fishrooms which contain Mrs. W. M. Meadow's large collection.

A few hours were spent at East London A. & P.A. show and he was not only pleased at being welcomed publicly but was highly complimentary about the impressions he gained of the show's high standard. Talks with officials and individual aquarists followed. Instead of returning direct to India, a tour was made of continental countries, based on an itinerary drawn up by WATER LIFE, when French, Swiss and German aquarists were contacted.

Back in Bombay, Mr. Manal has written his appreciation of the large variety of fishes and plants he saw during his journey and mentions that the species of fish which he brought with him to England as gifts were the cause of equal pleasure. The visit served to show that Indian and European fishkeepers have much in common and we hope that the contact will prove mutually beneficial.

Eastern Influence
in Tank Design



Two aquariums of unusual design. The upper one is in the home of Mr. Manal. The one on the left, in the style of a port-hole, belongs to one of his friends.

required and so other methods are used, which include pre-flight saturation in oxygen (often mixed with one of the inert gases such as helium or argon) since the elimination of nitrogen does much to overcome this condition.

Having explained the cause of "bends" and the nature of the bubbles, we must see how this applies to fish. When water is heated it becomes less dense; since it is less dense it exerts less pressure at a given depth than when it is cold. Hence a considerable sudden rise in temperature will give a sudden drop in density and reduced pressure; consequently the condition is such that the body fluids of the fish will start to bubble.

This condition must, of necessity, only arise under certain circumstances, such as when the aquarium is relatively small, say less than eighty gallons, or even in a small exposed pond where the depth is less than about fifteen inches, since greater volumes of water will heat up more slowly allowing

the fish to become gradually adjusted to the reduced pressure. These figures should not be taken as "tried and proven facts" and are used only to indicate that small shallow volumes of water heat more rapidly when exposed to the sun's rays than larger and deeper ones. It is the rate of rise, rather than the comparative increase of temperature, which brings about the condition in the fish.

Since we know the cause, the cure is simple. Allow a trickle of cold water to flow through the tank at the rate of about one gallon per minute, this will cool the water and increase its density and, in due course, the bubbles will be reabsorbed into the body fluids. When this condition is observed, apply the treatment without delay as the fish will be suffering and it may even prove fatal. Do not remove the fish to an aquarium containing cold water as the shock may kill them. I have effected a number of successful cures of this condition, but I must admit that I found the cure long before I understood the cause.

Phenomenon of Hibernation

Various Aspects of the "Winter Sleep" in Cold-Blooded Creatures

By Alfred Leutscher, B.Sc.

THE word hibernation is a familiar one, both to the Latin student and to the layman. It figures in the writings of Julius Caesar and where he recounts his campaigns through Britain and Gaul he often speaks of legions "taking up their winter quarters". Hibernation comes from the Latin, *hiberna*, meaning "winter quarters".

In its modern usage this word has come to mean a condition of winter sleep, rather than merely spending the winter in a particular situation, and the emphasis is on the act of sleeping. The zoologist implies this but is cautious in his use of the word as a scientific term where animals are concerned. The fact that some animals, such as the squirrel, badger and bear, may sleep for days on end during a cold spell does not necessarily mean that they are hibernating. Often, their tracks may be found in the snow.

Only Occurs Under Wintry Conditions

Hibernation is much more than a mere sleep during the cold season and it can only take place in lands where winter conditions prevail. Most animals which live there have no choice in the matter, and are forced into hibernation during a normal winter. This is because they are "cold-blooded". All invertebrate animals, and all vertebrates except mammals and birds, are cold-blooded.* The temperature of their bodies is the same as, or very little above, that of their surroundings, and it varies with it. This is important since the process of life, called metabolism, is controlled largely by temperature.

The metabolic rate of life is greatest at high temperatures and slowest, almost at a standstill, at low ones. There are limits to this. A temperature over 100 deg. C. seems fatal to most animals, when the proteins of living tissues congeal, and at freezing temperature or below, life cannot be sustained for very long. Fish and amphibians will sometimes survive in ice, but only for short periods.

As winter approaches the cold-blooded animals become less and less active as their "rate of living" slows down. Finally they become quite torpid, often huddled up in attitudes of sleep and usually hidden away in some retreat. The heart beat slows down, there is little or no movement, and respiration almost ceases.

Hibernation is, in effect, a compulsory act in the cold-blooded animal (the dormouse and certain other warm-

blooded animals also hibernate but are curious exceptions), and it is interesting to note that there is often a fixed routine in the animal's behaviour before it settles down to this condition. One obvious act is the effort made to go into hiding. Many insects crawl away into nooks and crannies, and are not seen again until spring. Among freshwater fishes there is a tendency to retire into deeper water and, as it were, "hole up" in a hollow in the pond or river bottom. Some fish, such as the Tench, Carp and Eels, may even burrow into the mud or plant debris. This is certainly the case with some amphibians. In Britain the Common Frog, and frequently the newts, will burrow into the bottom of the pond or ditch, from which they are sometimes dug out during clearing and ditching operations. The fact that they are able to survive under tons of water without suffocating suggests that their rate of respiration is very low. What little dissolved oxygen is required by the frog is respired through the skin, which in Amphibia is naked, often moist, and acts as a kind of third lung.

British toads, on the other hand, prefer a place on the land for hibernation. The Common Toad finds a hole in a wall, a flower-pot, pile of rubble or even a cellar, where it is sometimes found in mid-winter, whilst the Natterjack digs a tunnel into the soft ground, or sand, in the areas where it lives. Snakes and lizards burrow into heaps of debris and vegetation, such as woodpiles, brick dumps and piles of hay and leaves. Winter dens of snakes are sometimes exposed to view, and in them tight balls of the serpents are found (Rattlesnakes in America and Adders in Britain), the creatures having come together prior to hibernation.

Advantages to the Creature

This going into retirement has certain advantages in tiding the animal over the cold winter months. Firstly, any risk of sudden temperature changes, which may occur in exposed places, is avoided. In a hole in a wall or log, or below ground, the temperature is much more stable and rarely reaches the danger level of zero. Those animals among invertebrates with an aquatic stage somewhere in their life-history usually hibernate in water (e.g. insects). There, in winter, is a temporary prison when ice lies on the

* The correct term for this condition, as used by zoologists, is poikilothermous (from the Greek, *poikilos*—various; *therme*—heat.)

surface, but a safe one. The bottom water will not fall below 4 deg. C., its maximum density, unless the whole pond freezes up, which it rarely does.

Another danger from exposure, coupled with that of freezing, is desiccation. Water is vital to life, especially in a hibernating animal which cannot go in search of it and is continually drawing upon its own resources. In its place of hiding the air is still and humid, even at low temperatures.

Thirdly, retirement means safety from enemies at a time when a hibernating animal is asleep and cannot escape. Fourthly, food is at a premium during the period. Nectar and plant juices are no longer available to the vegetarian insects. These creatures and other invertebrates, the food of the carnivores such as the frog, lizard and newt, are themselves asleep.

It is a paradox that the more severe the winter, the safer is the hibernating animal. It is well hidden, whereas the active, warm-blooded mammal or bird is the one which suffers from exposure to cold and lack of food. The mild winters are the danger periods for the winter sleepers. Lured into the open on a warm winter day they become active for a while. Butterflies and bees emerge into the winter sun, snakes bask at the surface and frogs swim about in the water. This awakening is only temporary, for there is a sudden frost and many a reveller is caught in the open, only to die from exposure.

A late spring frost can also be dangerous to air-breathing animals which hibernate in water. Frogs, newts and insects become active at the first signs of spring and their rate of respiration increases. Suddenly the source of oxygen supply (i.e. the atmosphere) ceases as a layer of ice forms on the surface. The demands for oxygen, which were slight during sleep, are now far greater and the animal suffocates. This may explain the high number of deaths among frogs and toads, and even fish, where ice forms in late spring. Dead bodies may be seen in hundreds after a late thaw, as was the case after the late winter of 1946-7.

One important influence which a winter has on many plants and animals occurs at the egg or fruit stage. Botanists and horticulturists know that a period of rest is necessary before a seed can develop. In Britain this usually occurs during the dormant winter period. No less important than the rest is the low temperature to which the seed is subjected as it lies in the earth. Among aquatic plants there are many which produce so-called "winterbuds", or turions. These fall from the main plant, which dies away, and rest on the pond bottom. A spell of low temperature is required if they are to develop into healthy plants. Aquatic animals, such as *Daphnia*, produce "winter eggs" in autumn. This is the result of a sexual act between the female, and the male which only appears at this time. The winter egg can resist the rigours of cold, and will not hatch until it has done so. A classic example among insects of this necessity to hibernate is found in the silk-worm moth. If the egg (which normally passes through a winter) is kept warm it fails to hatch.

Hibernation also has an important influence on the sexual cycle of some cold-blooded animals. The reproductive act is part of a mechanism which is so adjusted to the life of a particular animal that its baby is brought into the world at a time of year which is most favourable to its survival. This

is usually in springtime. One can appreciate the reason for this—a season of plenty, with long days and mild temperatures. It is the cause which is still a puzzle. What is it that stimulates the breeding behaviour at a particular time of year? People who breed amphibians from year to year are aware that a newt, which normally hibernates, will fail to breed if not allowed to do so. Male newts, which spend an active winter in the warmth of an indoor aquarium, will fail to produce their crests and the females will show no desire to lay eggs. If already out of water they may even refuse to enter it at the breeding season. Anatomical dissection of frogs in late autumn will show that they are already in full breeding condition—the sex organs are ripe and the fat bodies swollen with reserve food. The clasping reflex of the male is present and yet, if placed together, a pair will not mate. Pairing and egg-laying only occurs where the frogs are allowed to hibernate. The author has had similar experience with Sticklebacks. Here again, if they were kept indoors at warm temperatures throughout the winter, the males showed no desire to build a nest.

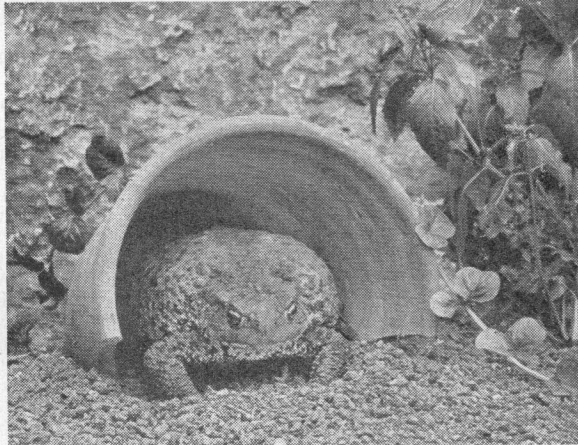
It is believed that some external stimulus is necessary to start the chain of events which culminate in the breeding act. At the floor of the brain is a small but important gland—the anterior pituitary. This secretes a powerful chemical

hormone which is discharged into the blood stream. This awakens the sex organs to activity, thereby bringing about a physiological change which is so striking that for part of the year the animal, especially the male, takes on an entirely different mode of life. Colour, sexual adornment, behaviour and many other characters are greatly affected, and the stimulus which leads up to this may well occur in hibernation.

Because of the above many readers who keep specimens of fish, reptiles and amphibians which normally hibernate, are faced with the annual problem of what to do as winter approaches. It can be stated that in most cases no harm will come to

the creatures if they remain active during winter, as will be the case if they are kept indoors at a warm temperature. In this case, however, they must be fed throughout that time. Those kept outdoors will hibernate naturally, the fish in their ponds (where ice forms this should be broken), and the amphibians and reptiles in their reptiliary, in cracks and holes, in leaf-mould or under other suitable cover, away from frost. Newts, terrapins and frogs will even bury into mud and debris under water. Land tortoises are best stored away in boxes containing dry leaves or hay.

The important point is that if successful breeding is to continue, the animals in question must be allowed to rest, at least for some weeks, at low temperatures. Of all cold-blooded creatures it is probably the Goldfish which has so far produced the most constant and satisfactory results in the sphere of breeding. It would be interesting to hear what the Goldfish breeders have to say to the following questions. Do they keep their breeding stock under natural conditions during winter, by placing them in outdoor tanks or ponds, or by allowing the fish-house to cool down? Alternatively, is heat maintained throughout winter so that the fish, in effect, live through an everlasting summer? In other words, is hibernation encouraged or not and, more to the point, which method produces the better results at breeding time? My personal view is that nothing can better Nature where she is allowed to take her natural course.



Photograph]

[L. E. Day

Common Toad (*Bufo bufo*) newly awakened from hibernation.

I also see you have *Neolebias* species for sale in London. I do not believe that a *Neolebias* has ever set fin in Montreal.

I have been in the hobby since childhood, and that is more than twenty-five years. At present I have eleven aquariums and a mixed collection including batches of *Badis badis*, *Barbus tetrazona*, *Panchax lineatus* and *Tanichthys albonubes*. I would welcome letters from fanciers who would like to have information on the hobby in Canada, and especially about native Canadian fish.

6255 Sherbrooke Street, W, L. W. HAYTER.
Apartment 3, Montreal, P.Q.

POND BUILDING FOR THE AMATEUR

SIR,—I have read Mr. T. Brown's series of articles on pond building with interest and am building a pond along the lines suggested. May I, however, ask him to explain further why he recommends using sand only for the first year on the bottom of the concrete pond?

I layered the ledges and part of the bottom of my first pond with loam and I have always been troubled, except in early spring, with dull-coloured water, apparently full of suspended material. This material (I am not sure whether it is floating algae or just mud) adheres to the plants, which lose their fresh appearance and partly rot away.

There is a considerable growth of algae on the concrete sides and on stands below the surface. The algae at the lower levels appears to be dirty, apparently because of the suspended mud. There are, however, two curious exceptions here. A red closely-grained and smooth stone is never affected by the algae, which I find very difficult to remove from other large stones below water. The other exception is the north wall of the pond, where there is no ledge. Here the algae is negligible.

The pond is 3 ft. 6 in. deep at one end (north) and the water is clear enough for 12 in. down. Goldfish, Rudd, Orfe, a big Carp and a few large Minnows are healthy and happy in this pond and appear to find plenty of food. Can Mr. Brown suggest a way of reducing the suspended mud or the excess of floating algae.

Aberdeen. J. BEATTIE.

(The above letter was shown to Mr. Brown, who writes:—"The trouble seems to be algae in suspension and it may be that the large Carp are stirring up the loam in their search for food. There is nothing you can do to rectify this, except wait until the pond matures and rectifies itself. It takes about three years for it to become fully matured, when the stationary algae overcomes the suspended matter, and the water becomes perfectly clear. Do not be tempted to use any chemicals or take any drastic action as this phase will right itself.

I advocate sand as a bedding medium for the first season because the pond has not matured and the new loam will give off gases with which the pond, being new, is unable to cope. This condition often upsets the fish, causing outbreaks of Fungus and Tailrot. As I remarked in my article, Water-lilies and other subjects which need loam can be planted in pots and introduced into the pond during the second or third season."—Ed.)

OBSERVATIONS ON AXOLOTLS

SIR,—In the October-November, 1950 issue of WATER LIFE I described the complete and simultaneous metamorphosis of a pair of Axolotls, and could give no reason for this action, since they had not been fed on thyroid gland nor had the level of the water been gradually lowered.

The water in their tank was always 9 in. in depth. This water was changed only when it became too cloudy. The tank was lined with an inch and a half of fine sand and there were a few rocks. It was noticed that the Axolotls were in the habit of coming frequently to the surface to "pop" air after the manner of newts. Their food chiefly consisted of Earthworms with an occasional fragment of meat.

When the tank was cleared out after the metamorphosis had taken place, the sand was found to be in an exceedingly dirty condition—due probably to the excreta of the Axolotls having been augmented by the soil normally found in the intestines of the Earthworms they had eaten.

The six Axolotls (8½–9½ in. in length), which I have at present, show no inclination to metamorphose. They live in a tank bare of sand, rocks and plants, and the water is



Photograph]

[J. Topham

The Matron of the War Memorial Hospital, Shooters Hill, Woolwich, accepts a set-up tropical fish tank for the Children's Ward from the chairman of the Shooters Hill A.S., Mr. W. Key.

changed every two or three days, when all excreta is removed. They never come to the surface to "pop" air. A slight restlessness on their part is an indication that the water requires changing. They each eat three or four Earthworms a day, and no meat. On very warm days several blocks of ice are floated on top of the water.

I have come to the conclusion that my former pair of Axolotls metamorphosed because, owing to the saturation of their water with waste gases and the scarcity of oxygen, they were forced to come to the surface very frequently for mouthfuls of air, and so developed their rudimentary lungs at the expense of their external gills.

There is one very great difference between an Axolotl and a Salamander. Whereas an Axolotl can suck in with one action a four-inch worm from a distance of an inch from its mouth, a Salamander has no suction power at all. Having grasped a worm a Salamander shakes it down its throat by violent side-to-side movements of the head—preferably under water.

Only one of my Salamanders is living. The other one died from the effects of heat after being left in a south window during the whole of a very sunny day. The remaining Salamander has grown, eats two earthworms a day, and makes a faint croaking sound at times.

Mr. Higginson refers to the regrowth of lost limbs in Axolotls (WATER LIFE, June-July, 1951 issue). This is a very common occurrence in all reptiles. Sometime ago I was given two Axolotls without any feet at all. Very soon the limbs grew to normal length and then feet developed. One of them made the mistake of growing five fingers on a front foot! Usually they have five fingers on the rear feet and four on the front feet.

Fovant,
Wilts.

DR. R. C. C. CLAY.

SIR,—The letter from Mr. H. W. Higginson on the "Adaptability of Axolotls" in the June issue of WATER LIFE was of great interest to me. I have a pair of white Axolotls which were sent to me by rail from a dealer in Sussex. I was disappointed to see on their arrival that one of them had, as I thought, a deformed front leg. The leg was very short and appeared to be shrivelled. They arrived on February 21 and now the leg is almost normal though not yet as long as the normal one.

This has all happened so slowly that I never really realized the change until I read Mr. Higginson's letter, as I had no idea that such a thing could happen. I shall now write to the dealer and ask him what had happened before he sent the Axolotl to me.

Deal,
Kent.

M. D. BROWN (Miss).

European and American Salamanders

Reputed to be Omens of Evil, these Creatures
Actually Make Attractive and Harmless Pets

By Alfred Leutscher, B.Sc.

(Illustrations by L. E. Day, F.R.P.S., A.I.B.P.)

I REMEMBER the first time I ever saw a living salamander. Until it moved I was at first inclined to believe that I was looking at a small china ornament, brilliantly painted in a coat of glossy yellow and black. Was this the notorious animal I had read about, which could live in fire, which was poisonous to the touch and was an omen of death even to look upon? The lustrous black eyes which gazed mildly at me through the pet-shop window seemed to belie this evil reputation.

This species is called the Fire Salamander in Germany where it is quite common and country people still believe in its death-dealing powers. I have seen it quite frequently up in the Hartz Mountains which is the homeland of Germany's Father Christmas. This is a district of mountains, fir trees, picturesque costumes and houses which give a mediaeval atmosphere quite in keeping with this legendary creature.

Possible Origin of the Myth

One possible explanation for this strange belief in the salamander's fire-resisting powers may be due to its habits. It retires from view during daylight by hiding in undergrowth, under rocks and stones, or in holes in fallen timber. Logs collected as firewood sometimes contain a hidden salamander, and when the wood is placed on the fire one cannot blame the little animal wanting to crawl away from the sudden heat. Its presence in the flames, which are certain to consume it, would be sufficient to strengthen the legend.

Slow-moving and harmless, there is yet something about its brilliant colours which give the salamander a dangerous appearance. Actually, the only risk occurs when an enemy picks it up in the mouth, as happens when an attack is made. When the salamander's skin is irritated a poisonous fluid is secreted which is highly unpleasant to the taste, and most enemies will immediately release it. The poison is sufficient to kill a mouse if artificially injected.

This amphibian, the European or Spotted Salamander (*Salamandra salamandra*), has a wide distribution in Europe and has been split into a number of races according to locality. Those I saw in Germany were mostly of the striped kind, many with yellow as the dominant colour. Others, as found in France, may have the yellow patches or stripes reduced to round spots where black is the main background.

The European Salamander is terrestrial, rarely entering water in which it is a poor swimmer, except to produce young. It is slow and deliberate in movement, lives in seclusion and, when exposed, is given immunity from attack by its bright coat. Naturalists call this pattern the warning colours of Nature. The wasp also has them. After dark or rain it goes in search of prey, such

as slugs, Earthworms and slow-moving insects, grabbing these in its mouth and sometimes shooting out its short tongue after the fashion of a frog.

Mating is a clumsy, though lively, affair. The male, which is recognised by a more swollen area around the cloaca, pursues a mate and attempts to clamber on to her back. There is no actual embrace and sometimes the female in her struggles to resist his advance will throw him off. After such preliminaries the male deposits a spermatophore on the ground nearby. I have seen these objects in my salamander case. They are small, cone-shaped and gelatinous in texture, each containing a mass of spermatozoa. A female will cover one and apply it to her cloaca, so that the active sperms ascend into her body.

Birth of the Tadpoles

No eggs are laid, and at the time of birth the mother enters water of a pool or stream. Here she rests, half in and half out, in the attitude of taking a hip bath. At intervals the gilled young, which are not unlike sturdily built newt tadpoles, are born. Some may still be enclosed in their transparent envelopes. Soon they are clear of these and spend the time resting in shallow water, snapping at small water life as it comes within range. In captivity they will grow well on *Daphnia*, *Enchytraeus* and *Tubifex*. At first they are dull in colour, the bright pattern of the parents only appearing at metamorphosis, which occurs about three months afterwards. The baby salamanders which I have successfully bred this summer are now five months old, about three inches long, and perfect miniatures of their mother.



Underwater picture of a European Salamander larva (*Salamandra salamandra*).



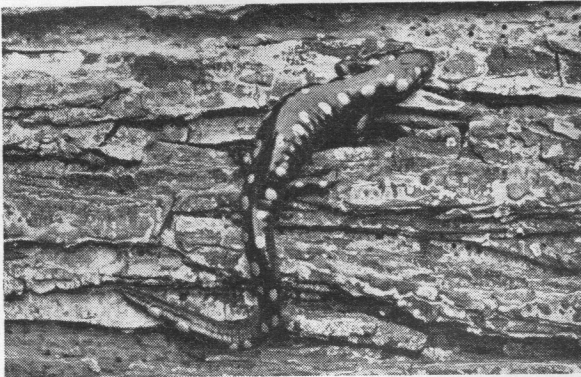
The largely terrestrial European Spotted Salamander (*Salamandra salamandra*) of which there are a number of races.

Breeding habits in Nature are not fully known, but most young seem to appear in late spring and summer. In captivity they may arrive in any month (a friend's salamander once gave birth on Christmas Day). The families can arrive in embarrassing numbers, about 30 is an average, but up to 60 is not uncommon with a full-sized adult of about seven inches. A remarkable

instance of a salamander breeding has been recorded when two families were produced by the same mother with an interval of two years in between. This must have occurred from one mating before the female was acquired, since the owner kept it apart the whole time.

The other European species is called the Alpine Salamander (*S. atra*). This is confined to the mountain ranges of the alpine countries and Albania, at altitudes between 800-3,000 metres. It is a smaller, more slender species, about five inches when adult, entirely black and even more strictly terrestrial than *S. salamandra*. Normally only two young are born at a time, and these are fully developed at birth, having already grown their lungs. Actually, there are many more conceived as embryos, but they are sacrificed as food to the twins which, in fact, behave as parasites within the mother's body.

These two species of salamander are cousins of our British newts, belonging to the same Family, the *Salamandridæ*. The term salamander, however, has travelled



The American Spotted Salamander (*Ambystoma maculatum*). Yellow spots in two rows are present on a blue-black background.

abroad with the English speaking language, and is now applied to a number of other species. The largest, the Giant Salamander (*Megalobatrachus maximus*), is found in the hill streams of China and Japan. It can grow to five feet and is caught and sold as an article of food. Salamander-like monsters, which lived in the distant days of the Carboniferous Period over 200 million years ago, grew up to ten feet.

North America is the main home of modern salamanders. One of the largest Families is called the *Ambystomidae*, or Blunt-mouthed Salamanders, to which belongs the famous Axolotl and its adult form, the Mexican Salamander

(*Siredon mexicana*). An account of this species recently appeared in these pages (WATER LIFE, Vol. 5, No. 5). The Family has, in all, about 15 species in N. America, of which two have lately been added to my collection. The friend who sent them over says they are common in the damp woodlands around his home in New York State. One is called the Spotted Salamander (*Ambystoma maculatum*). It is about six inches long, and not very unlike our European Salamander. The upper half of the body is a deep, bluish-black, and the lower half and undersurface of the limbs, a pale slate colour. Round, yellow spots occur in two, more or less regular, rows down each side of the back. The other, Jefferson's Salamander (*A. jeffersonianum*), is about the same length but more slender. On the sides of its blackish body can be seen faint bluish markings.

These two species differ from the European salamanders as being entirely aquatic during the spring breeding period. In March or April they make for pools and shallows in a similar way to British newts. The males court the females and spermatophores are deposited. Later, eggs are laid, not in the way newts do it, i.e. by pressing an egg to the leaf of a water plant, but in small clumps of spawn after the fashion of frogs. Each spawn-mass may contain from 20-50 eggs. In all, from 100-200 eggs are produced. The gilled larvæ develop and feed in a similar way to newts, and leave the water at metamorphosis, about three months after hatching.

At breeding time the Spotted Salamander may resort to a massed display of courtship, called the "nuptial dance". In a letter to me my American friend writes: "The night we collected the *Ambystoma* for you we observed a 'nuptial dance' of *Ambystoma maculatum*. About 60 individuals were in an area of shallow water about two feet square. They writhed and tumbled about one another until the water fairly boiled. They came up often for gulps of air. The males were actively engaged in the deposition of spermatophores. This phenomenon is quite well known but not often observed". These newcomers to my collection were at first shy and retiring, but now come out in the evening to feed readily on slugs, small worms and pieces of raw meat. By transferring them to water next year I hope to achieve success in breeding them.

The largest Family of salamanders is called the *Plethodontidae* or Lungless Salamanders. These are small and slender, devoid of lungs and usually without gills when adult, respiring through the moist skin. Some enter water to lay their eggs and others deposit them in cavities in the ground, or in hollow tree trunks. Over 50 species are known in N. America, which goes to indicate what a paradise this great continent must be for the salamander lover.

Salamanders are fascinating little creatures to study, and give little trouble in captivity. They are long lived, and I recently heard of a case of a European Salamander which has been kept in this country as a pet for 25 years.

Spawning Siamese Fighting Fish

(Continued from page 297.)

at the end of the tank farthest away from the nest. By the time the babies are free-swimming the lettuce will have created a certain amount of Infusoria. Apart from this, cultures should be prepared well before the mating takes place. Old banana skins, potatoes or dried lettuce will do or Infusoria cultures may be purchased from one of the well-known dealers. I do not care for the drip-feeding method. I much prefer to have the culture in jam-jars and, having brought the temperature up to the same as that of the water in the tank, by placing the jar in a bowl of warm water, I pour the contents into the tank. This can of course be overdone but if discretion is used I find it much the better way. I have found that with this method I can give the fry Mikro-worms even during the first week.

I use soup plates for the culture of Mikro-worms and if pieces of wood about an inch thick and 1½ in. wide are

placed in the culture the worms will make their way up the sides of the wood. On the top of these large pieces of wood are placed about six wooden match sticks. These become covered with worms which can be fed directly into the tank. If about six or more plates are used Mikro-worms can be given at least four times a day. As the water in the tank is still only about six inches deep I find that the plants are an added benefit inasmuch as they stop the worms from sinking to the bottom too quickly. The fish can the more easily find them if the swivel lamp is directed over where the worms are introduced.

In the second week I feed Brine Shrimps and I find the best method of hatching these is in shallow glass dishes. The larger the surface the better.

I should add that as soon as I have taken the adult male fish away I introduce about a dozen snails which help to clear up any waste matter including the eggs of the unhatched Brine Shrimps. At the end of a month the young fish can take mashed garden worms and dried food.

Seaside Aquarium and Reptiliary

Varied Collection of Fish and Reptiles in the Lido Aquarium and Reptile House, Margate

By C. H. W. Edmonds



Mr. Kenneth Smith handling an Australian Carpet Python and N. American Pine Snake two exhibits in the Margate Reptiliary.

Photographs by Sunbeam Photo Ltd.

A RECENT holiday on the south coast enabled me to pay a visit to the Lido Aquarium and Reptiles House at Cliftonville, Margate, where I found Mr. Kenneth Smith, who is managing the establishment during this season for Messrs. Robert Jackson Ltd. (Naturalists), of Timperley, Cheshire.

Kenneth Smith, who is a naturalist and animal collector, promptly made me feel at home and, when it was discovered that we were both members of the British Herpetological Society and very interested in fishkeeping, I was given the free run of the establishment. Within a few days I was helping him in maintaining the collection.

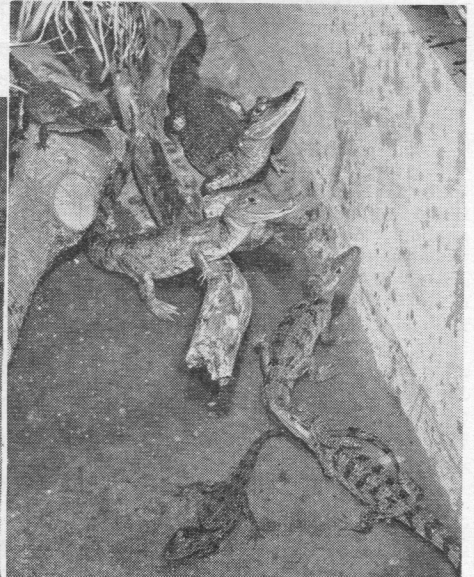
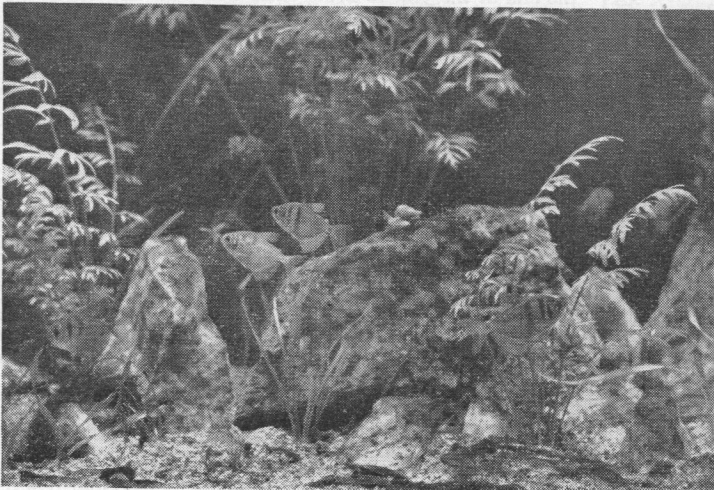
The exhibits consist of coldwater and tropical fish, reptiles, birds and other animals. The Aquarium is arranged behind panelling, presenting only a front view to the public. Each tank has two labels, illuminated from behind, one giving the name of the exhibit and habitat and the other, general information and habits. Each class of fish is maintained separately, making it much easier for the tyro and expert alike to identify and study any particular species. Fish which catch the eye are Albino Swords, Perma-black

Mollies, and a collection of the Cichlid family. One pair of Dwarf Cichlids were, at the time of my visit, swimming proudly with a brood of babies, and they attracted a great deal of attention. Neon Tetras are on view in good numbers, and there is also a fine shoal of Angel Fish. Some of the finest coloured Flame Fish I have seen make a beautiful picture, while Pearl, Dwarf and Croaking Gouramies, Black Widows (more fine specimens), *Burbus schuberti* and Glowlight Tetras, all combine to make a good show. There are also Siamese Fighters, Bloodfins and Sunfish, as well as the commoner tropicals.

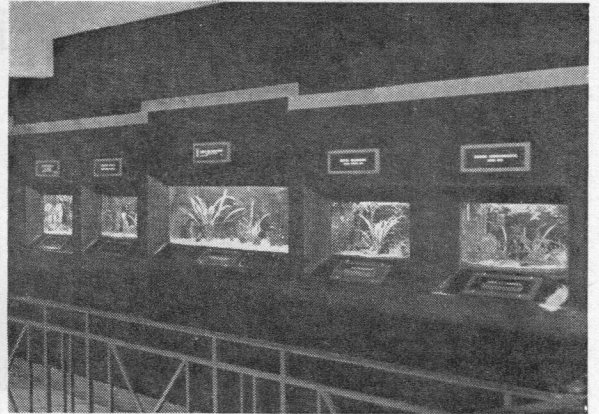
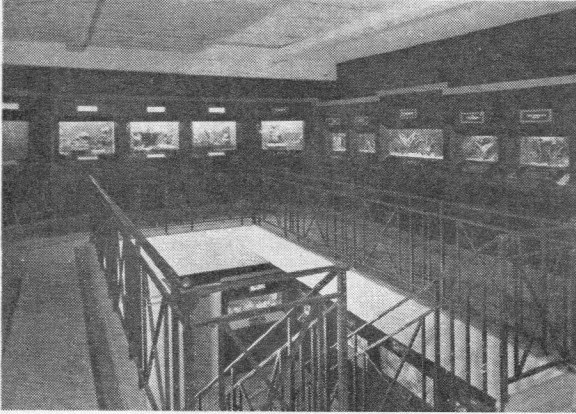
Behind the scenes are found more tanks, for isolation and breeding. Although Mr. Smith is really too busy to do much fish breeding, he has succeeded with a few Cichlids, Mollies, Swordtails etc., but Siamese Fighters have so far refused to co-operate. He is assisted in the Aquarium by young Patrick Topham, who also finds time to collect specimens for the marine tank. Like many other public Aquariums, this one is troubled by Blue-green algæ but painstaking care and attention by Patrick Topham renders this almost unnoticeable to the viewer.

Shubunkins and Hi-goï provide the main coldwater exhibits and a tank of six-inch Goldfish lends itself well to the surroundings. A large Catfish is on display and, I am told, it feeds readily on whale meat and garden worms.

(Continued on next page.)



Left, the aquarium containing Black Widows at the Lido Aquarium. Right, some young Spectacled Caiman specimens wait for a meal in their enclosure. These are two very popular displays in the Lido establishment.



Two views of the second floor of the Lido Aquarium showing the arrangement and labelling of the many aquariums.

The only marine tank does not give much trouble and it has an aerator and filter working continuously. Fresh sea water is supplied frequently, the sea being so very near, and mortality is kept low. Sea Urchins, Starfish, Rock Gobies, a Blenny and two small Eels occupy the tank, but probably the most interesting inhabitant is a large and lively Three-bearded Rockling. Prawns and anemones are also included.

Tame Lungfish Exhibit

An item of considerable interest is an African Lungfish, which takes food from the hand. Its queer fins raise many excited comments and questions regarding this fish are frequent. Fire-bellied Toads and Marbled Newts are included among the exhibits, in addition to African Mud turtles and Snake-necked turtles. The Snake-necked turtles are well worth watching at feeding time, when their long necks are raised above the water to follow the feeder's hand. They occasionally snap at a careless finger!

Moving upstairs into a new wing (opened this season) which houses most of the reptiles, and some mammals, one first comes to cages containing monkeys. One is a very

cheeky Weeper Capuchin named "Bimbo", and in the next cage are two Buttikofers White-nosed specimens. The monkeys cause much amusement and are firm favourites with visitors. On either side of the new hall are reptiles, including an Indian Cobra, which Mr. Smith and I had the doubtful pleasure of moving to its new quarters. African Puff Adders, American Copperheads and Kirtland's Tree Snakes comprise the list of venomous species. A fourteen-foot long Anaconda ejected parts of its last jungle meal—hundreds of Tree Porcupine quills—soon after arrival. The Emerald Tree Boa makes a beautiful splash of green amid brown branches and a group of Pythons form a nice colour pattern in adjoining cages. These are Carpet, Diamond, Royal and African Pythons. Australian Blue-tongued and Stump-tailed Skinks, Asiatic or Schlegal's Gharials and a Nile crocodile are on show in natural surroundings, while at the extreme end of the new wing the Spectacled Caimans enjoy a spacious and well built beach and pool.

A great attraction to visitors is a Himalayan Panda, not to be confused with the Giant Panda, by the way. Near the Panda are several Palm Civets, Mongooses, and a large Porcupine. Sometimes one hears above the chatter of the monkeys, the shrill cry of the parrots, and the raucous noise of a Band Aracari, a member of the Toucan family.

Mr. Smith was hoping to be off to the tropics again before the end of the year to bring back more rare and interesting animals. He is hoping to collect rare fish that he believes exist in areas of Guiana which have seldom been penetrated.

I thoroughly enjoyed my experiences at the Margate Lido establishment, and feel sure that other aquarists visiting the resort will find much to interest them in this well-managed Aquarium and Reptile House.

CHRISTMAS PRESENT SUGGESTION

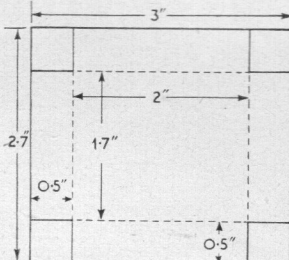
ARE you wanting to buy a gift for an aquarist friend this Christmas? Nothing would be more appreciated than copies of some, or all, of the booklets in the WATER LIFE series. Modestly priced, they form a valuable addition to the library of any fishkeeper, whether a beginner or experienced fancier. Written by recognised experts in their own fields the handbooks cover a wide range of subjects. Each is profusely illustrated. The titles are "First Steps in Aquarium Keeping" (2/-), "Hardy Reptiles and Amphibians" (1/6), "Live Foods for Aquarium Fishes" (1/6), "Garden Ponds" (1/6), "Aquatic Insects" (1/6), "Marsh Gardens" (1/6), "The Goldfish" (2/-), "Tropical Fishes" (2/-), "Pond and Stream Life" (2/-)—now ready, "The Terrarium" (1/6). All prices are excluding postage. Obtainable from newsagents and booksellers, or direct from WATER LIFE, Dorset House, Stamford Street, London, S.E.1.

Readers' Hints and Tips

(24) Home-made Worm Chopper

TO make this device cut a rectangular piece of tin by means of scissors to a size of 3 in. \times 2.7 in. Shorten the length and breadth at the four corners by cutting out square pieces 0.5 in. \times 0.5 in., as shown in the illustration. Then bend the tin along the lines shown by the dotted lines and turn the edges at right-angles so that the whole is then in the form of an open box. Paper may be gummed at the four corners so that the edges are closed. The box is then filled with pitch, previously heated so that it is viscous. Nine old safety-razor blades, with their sharp edges uppermost, are next introduced so that they are 0.2 in. apart and are parallel with the shorter sides.

On cooling the pitch solidifies and the blades and sides of the "box" are held firmly. This gadget is excellent for cutting and shredding Earth-worms.—K. C. Joshi, B.Sc., D.Tech., India.

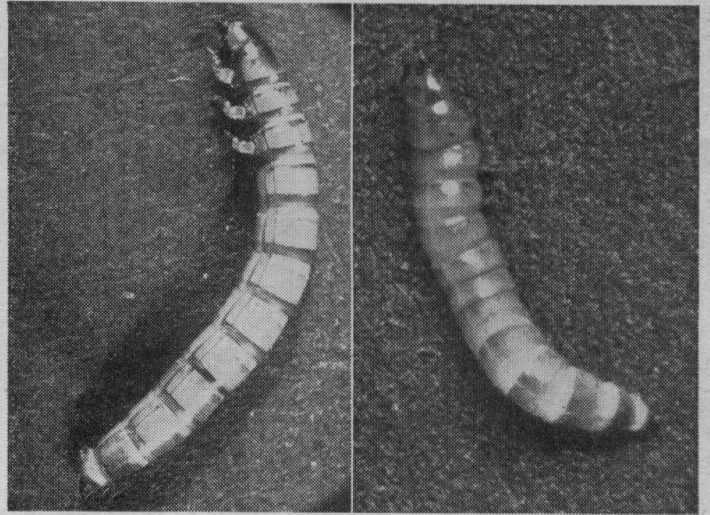


(10s. 6d. is paid for all published hints and tips.)

Larvæ of a Stored Grain Beetle

The "Little Worm," a Species of *Alphitobius* Closely Related to the Common Mealworm, Which Forms a Useful Addition to the Diet of Fish and Reptiles

ALL keepers of insect-eating birds, fishes and reptiles, are well acquainted with the Common Mealworm, (larvæ of the Stored Grain Beetle (*Tenebrio molitor*)). Whilst this creature has proved very useful I believe that most persons have had experience of its drawbacks which are four-fold. Firstly, particular care is needed when culturing as the cultures are liable to go "wrong," unless they are given the best of food and daily attention. The second point against the Mealworm is the large size to which the larvæ grow; half their life they are too large for ordinary use, yet they must be kept to reproduce and maintain the culture. The last two considerations are toughness of the skin and the short time the larva survives if removed from the culture



Left, Larva of the Common Mealworm ($1\frac{1}{8}$ in. long).
Right, Larva of the so-called "Little Worm" ($\frac{3}{8}$ in.).

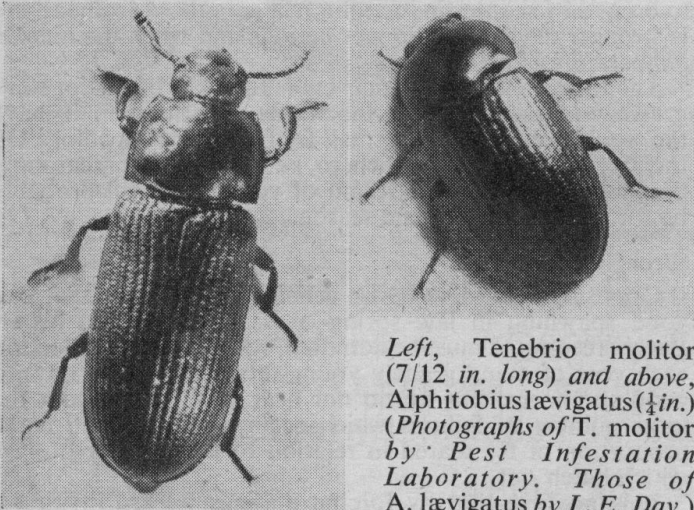
grass meal with moist newspaper. Some of the cultures were in such moist and foul material that when opened they gave off a strong smell of ammonia but all of them flourished.

The containers were varied:—National Dried Milk tins, some with only one small hole punched in the lid, others with a cloth covering, and biscuit tins, old sweet jars, etc. covered similarly to the milk tins. In fact, any container may be utilised provided it can be covered.

The reproduction is far greater and much quicker than that of the Common Mealworm and the larvæ live far longer if placed in water. The skin is softer and the young are so small that I have successfully reared young viviparous lizards on them.

The method I use when feeding Little Worms to my animals is to shake some of the culture, with the medium, into a small porcelain dish. Any adult insects are removed and then the dish is placed in the cage or vivarium. In the case of the young lizards I used an old potted-meat dish, removed all the large larvæ, and allowed the dish to stay in the vivarium without any attention for three weeks when it was only necessary to add some more culture.

— W. BUNTING, F.R.E.S.



Left, *Tenebrio molitor* ($7/12$ in. long) and above, *Alphitobius laevigatus* ($\frac{1}{2}$ in.) (Photographs of *T. molitor* by Pest Infestation Laboratory. Those of *A. laevigatus* by L. E. Day.)

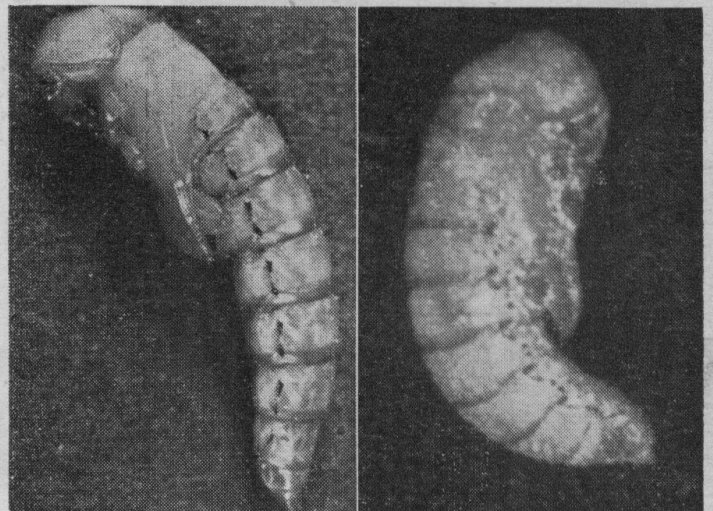
medium and placed in a damp dish or feeding trough.

The food I wish to introduce is the larva of another type of Stored Grain Beetle which is an *Alphitobius* spec. It has none of the faults of the Mealworm and, in my opinion, outclasses all the Mealworm's good points.

The relative sizes of both insects are roughly:—

	Beetle	Larvæ
Mealworm ...	$7/12$ in.	$1\frac{1}{8}$ in.
Little Worm ...	$\frac{1}{4}$ in.	$\frac{3}{8}$ in.

Alphitobius spec. or, as I call it, the Little Worm is an exceptionally hardy insect and can be cultured under almost unbelievably adverse conditions. I cultured them for some time and had them in the following mediums, all of which were flourishing and had increased successfully throughout the winter at normal room temperatures:—in bran dust, both moist and very dry, after it had been used for mealworm culturing; in sour chicken meal scraped from the bottom of a chicken's trough and in the same medium with newspaper added and kept moist; in pig-growing meal, both dry and with newspaper added and kept wet; in the mixed litter and waste from around a horse feeding trough; on old pieces of brown bread with newspaper added, fairly dry; on grass meal, plus potato peelings and on



Left, Pupa of the Common Mealworm and, right, of the "Little Worm". Size is midway between that of beetle and larvæ.

three pairs of the resulting young *Rivulus* have been accepted by the London Zoo Aquarium.

On September 27 I air-mailed a consignment of forty eggs to Hedley Marlton of Durban, S. Africa. His subsequent report informed me that the container water temperature on arrival (October 3rd) was 80 deg. F. and this was due to the fact that at this time the weather was exceptionally hot. The water also seemed to have gone sour. This may well have been caused by extreme heat during the latter period of transit. However, two fry had hatched but were both dead. The remaining eggs, upon examination—with the exception of two—appeared to have embryos and were placed in a container as per my previous instructions but they were fully opaque by next day. It is my intention to continue egg shipments to South Africa, but now the snag of varying climatic conditions arises for whilst London's warmest season, and therefore safest for egg travel, is from April to September, at Durban it is normally the reverse.

Other aquarists may be considering making some experimental overseas egg shipments, so perhaps a few additional details may be of interest. It will, of course, be realised that the actual incubation period of eggs somewhat restricts the range of species. With regard to packing, a thick glass screwcap tube, four inches long with a capacity of one and a half fluid ounces (Imperial measure) was used. When placing eggs in the tube it is advisable to exclude any pieces of plant, owing to the danger of these rotting and thus fouling the water. The tube was wrapped in a layer of cotton wool and enclosed in a stout paper envelope or cardboard box.

To the best of my knowledge there are no import or export restrictions for England, S. Africa or U.S.A. The usual Customs Declaration form should be clearly inscribed "Aquarium Fish Eggs" and state scientific classification of species. There is still much to be learned about this interesting subject of overseas egg shipments before it can attain international usage.

Selecting Lizards as Pets

Résumé of the More Important Families
and the Characteristics of Their Members

By Alfred Leutscher, B.Sc.

ABOUT a hundred years ago Professor Richard Owen coined a name for certain prehistoric reptiles. They are well known to most people from their large fossil skeletons seen in museums. He called them the Dinosaurs or Huge Lizards (from *deinos*—large and *sauros*—lizard). Some of them were indeed mighty in size. In one respect this name is unfortunate, for it suggests that Dinosaurs might have been the ancestors of modern lizards. This is not the case. When the Dinosaurs died out between 50 and 60 million years ago, they left behind no descendants. At about that time, and from different ancestors, the modern lizards came into being so that today they form one of the youngest groups of reptiles. Compared with the ancient line of the tortoise and of the crocodile, the lizard family-tree is a short one.

In classification today the modern lizards, or Sauria, form a Sub-order of the Order *Squamata*, which also includes the snakes. It may seem puzzling that creatures so widely differing as snakes and lizards should be linked in a single Order. Yet, in spite of this, they have very much in common. No easy distinction can be made, for there is no snake-like character which does not occur somewhere among the lizards.

Defining a Lizard

Our definition of a lizard, therefore, must be composite. So far as the majority of the 2,500 living species are concerned we may say that lizards are scaly, cold-blooded vertebrates which have rather short bodies and long tails (in contrast to snakes), well developed limbs, moving eyelids, a flat, notched tongue and an ear opening. Unlike all snakes most lizards have the two halves of the lower jaw firmly united. This limits the size of their prey.

There are twenty Families of lizards living today and, of all the groups of modern reptiles, they are the most variable. From the smallest, only an inch or two in length, they range in size to one of the Monitors, called the Komodo Dragon, which can grow up to 12 feet. In this introductory article some of the better known Families will be mentioned, with



Photograph]

[L. E. Day

Common or Viviparous Lizard (Lacerta vivipara), one of the species native to this country. Specimens measure up to seven inches in length.

particular reference to the kinds which are usually seen in zoos or vivariums.

The most typical lizards make up a large and well-known Family, the *Lacertidae*, containing over a hundred species. They are Old World in distribution and well represented in Europe, where most of them fall within the Genus *Lacerta*. Two of these are British, *Lacerta agilis*, the Sand Lizard, and *L.vivipara*, the Common Lizard. Others found in Europe are the Green Lizard (*L.viridis*), the Wall Lizard (*L.muralis*) and, the largest, the Eyed Lizard (*L.lepida*).

Another Old World Family, lizard-like in appearance but of a larger size, are the Monitors (*Varanidae*). They occur in Africa (where they are often called Leguaans), India and S.E. Asia. The Komodo Dragon (*Varanus komodiensis*) lives on one or two islands in the East Indies. *Varanus* is the only Genus in the whole Family. Monitors in Australia are called Goannas, a misleading word which is a corruption of Iguanas, a name for an entirely different Family of lizards confined mostly to the New World (Family *Iguanidae*). Many Iguanas are vegetarian, good climbers and adorned with a frill-like growth along the back and tail. Both Monitors

and Iguanas are eaten as food and their skins are used in the leather trade.

Certain active little lizards, known as Geckos (Family, *Gekkonidae*), are provided with flattish bodies and sucker-like devices on their fingers and toes, enabling them to climb vertical surfaces. As in snakes their large eyes are covered with transparent lids. They can make sounds with their tongues. Many Geckos are nocturnal, coming out in the evenings to catch their insect prey. Because of their usefulness in this respect they are encouraged to live in houses in their native countries.

By contrast the Agamid Lizards of the Genus *Agama* are fond of sunlight and dwell among rocks, often in dry places, in tropical countries of the Old World. Like Chameleons their power of colour change is considerable. Unlike most lizards, Agamas cannot relinquish their tails. In another Genus, *Draco* (called the "Flying Dragons"), a parachute-like device can be used for gliding in the air. Australia has two strange lizards which are relatives:—*Moloch horridus*, the Moloch Lizard, is covered with sharp, spiny scales, and the Frilled Lizard (*Chlamydosaurus kingi*) with a collar of skin which it can erect. It can also run on its hind legs. This pair, together with the Agamas and "dragons" are some of the varied forms in the Family *Agamidae*.

Widespread Distribution of the Skinks

Numbering over 600 species the Skinks (*Scincidae*) are very widespread, and an important group of lizards to the herpetologist because of their extreme variation in shape and limb structure. They range from typical lizard forms with well developed limbs, to snake-like species without external limbs. This is of interest from an evolutionary standpoint, as it suggests a way in which the snakes may have reached their present-day serpentine form.

In a similar way the members of the Family *Anguidae* vary from the typical lizard form to the snake-like "slow-worm", such as the third lizard found in Britain, the

Readers' Hints and Tips

(25) Treating Ice-bound Ponds

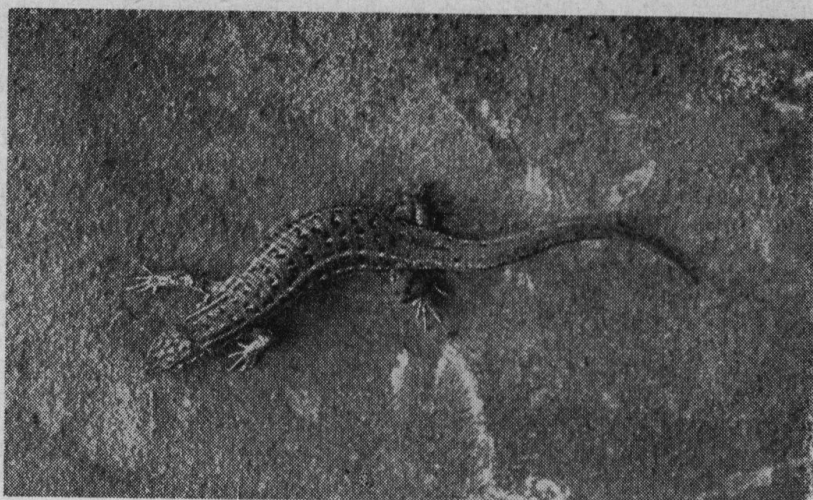
DURING winter the possibility of garden pools freezing over is extremely great, particularly in the north. If the pond is covered with ice for only a brief period, little harm is likely to come to its inhabitants but, if the freezing is severe and no method is adopted to counteract it, the loss of all the fishes may result.

Breaking the ice by hand may give the fish concussion and, in any case, it is of little use, as within an hour or so a thin sheet of ice has once again sealed off the water from the atmosphere.

The following method is recommended to reduce the risk of fish losses to a minimum. Fill a tin with hot water and rest it on the surface of the ice where it is known that there is at least a foot of water beneath it. The heat from the water will melt the ice, leaving a neat hole the diameter of the tin. Shift the tin and hot water to the other side or end of the pond and make another hole in the same way.

Insert a piece of rubber hose through one of the holes and siphon off sufficient water to leave a space of two or three inches between the bottom of the ice and the surface of the water. No further freezing of the water will occur, and a circulation of fresh air will be restored to the surface of it. Foul gases will again be able to escape from the pond and as healthy a condition as possible is ensured.—C. E. C. Cole, Ilford, Essex.

(10s. 6d. is paid for all published hints and tips.)



Photograph]

[L. E. Day

The Sand Lizard (*Lacerta agilis*), a species native to England but of localised distribution. It may grow up to a length of eight inches.

Slowworm or Blindworm (*Anguis fragilis*). These resemblances of some lizards to snakes are unfortunate, for many are killed by the ignorant. This is a pity since lizards are very useful creatures to mankind as they destroy large numbers of insects and other pests.

Although normally confined to zoos, a Family which deserves mention is the *Helodermatidae*. It contains the only venomous lizards in the world. There are two species, the Arizona Lizard or Gila Monster (*Heloderma suspectum*), which is brightly marked with reddish orange patches on black, and the Beaded Lizard (*H. horridum*). The latter occurs in Mexico and Central America. Its head is entirely black, and on the body the black dominates the yellow. These lizards have a bulldog-like grip when biting. Fat is stored in the tail.

Eighty Chameleon Species

Lastly, and perhaps the most peculiar of this diverse group of reptiles, there are the Chameleons (*Chameleontidae*). Of the 80 or so species, the majority are found in Africa and Madagascar. They are arboreal, harmless creatures which move about slowly, relying on their powers of camouflage for protection. The tail is prehensile and the tongue is used for catching prey in a similar manner to that of the frog.

Occasionally newts or salamanders, when on land, are mistaken for lizards. This need not arise since newts are amphibians, having naked skins. In lizards the skin is always scaly. There is no visible gilled stage in lizards and the fully developed young creature is produced on the land, either from an egg after an incubation period, or at the moment when the egg is laid (ovoviviparous).

The Merits of Lizards

Lizards make interesting and engaging pets. For reptiles their intelligence is high and they will show signs of responding to their owner by sitting on a hand or climbing on the clothing. Hearing is good and some lizards can be trained to answer a call or whistle. Food, in the majority of cases, need not present any difficulty, as most lizards have catholic tastes and will eat a variety of insects and other small animals. Some also feed on fruit. Variety in diet, coupled with a minimum of sunshine, is important to health and helps to keep up a lizard's resistance to disease.

In the series of articles which follow, some of the lizards suited to vivarium life will be discussed and dealt with in groups, according to their different habits and requirements. Suggestions will be given regarding their proper feeding and care.

not mind this new introduction. After the pair had fanned the eggs for about 36 hours the infertile ones turned white but these were very few; only about 10-15 could be seen.

The fertile eggs hatched in 52 hours at an average temperature of 80 deg. F. The eggs were laid on Monday and on Wednesday, at about 6 p.m., I could see that the young Angels had hatched out. The parents were now very busy cleaning the leaves of the *Aponogeton*. On Thursday morning the pair took mouthfuls of young and sprayed them on a selected leaf of *Aponogeton*. They had to take great pains as many of the young that were being sprayed did not adhere but after several attempts the parents succeeded in fixing them on the leaf.

Transfer of the Young

In about two hours of very strenuous work the parents had transferred all the young from the glass plate to the leaf. The young on the leaf appeared as a vibrating jelly-like

mass. Three hours later the young were brought to another leaf but this time I observed that they adhered quickly and did not give the parents much trouble. This process of transfer from one leaf to another went on for about four days.

At the end of the fourth day I observed that the young had absorbed a large quantity of the yolk sack and I could see their tiny pectorals quite distinctly. Some even got dislodged from their location and attached themselves at another point. At this stage I found the parents a little lax in their duties and, as the young were devoured by the parents on the previous occasion, I removed the adult pair on Sunday evening. The next morning the young were free swimming. I fed them on newly-hatched Brine Shrimps and they devoured the miniature crustaceans very eagerly.

The fry were then a week old and I could see the slight development of the dorsal and anal fins. They were nearly 300 in number and in about a week were able to tackle chopped *Tubifex*.

Selecting Lizards as Pets (2)

Viviparous, Sand, Eyed, Green and Wall Lizards—
European Species Which Will Thrive in Reptiliaries

By
Alfred Leutscher, B.Sc.

BECAUSE of their cold-blooded state the Class of reptiles, which includes the lizards, are best suited to warm surroundings. It is in the tropics that they occur in greatest numbers and variety. There are, however, a number of lizards which can exist in temperate lands where winter conditions form part of the seasonal cycle. During such a time the lizards go into hibernation.

Such is the case among the majority of lizards found in Europe. Specimens appear from time to time on the market and, if in good condition, they may be purchased with the reasonable assurance that they will thrive in captivity. This is because the average climate in Britain approximates to that of their native homes. They may even live the whole year round in suitable outdoor surroundings.

The best represented Family in Europe is the *Lacertidae*. Two species occur in Britain. One of these is probably well known to the reader, who will meet it on a sunny day when taking a walk over a heath or a common, or discover it in a woodland glade or country lane basking on a log or stone. This is the Common or Viviparous Lizard (*Lacerta vivipara*), so called because its litter of about five young is born alive

(ovoviviparous). Viviparous Lizards are very widespread, and are found in most of the northern half of the Old World, from the Alps and Himalayas to within the Arctic Circle, and from the coast of Europe to China. In Britain it is recorded from all counties on the mainland. It is the only reptile native to Ireland.

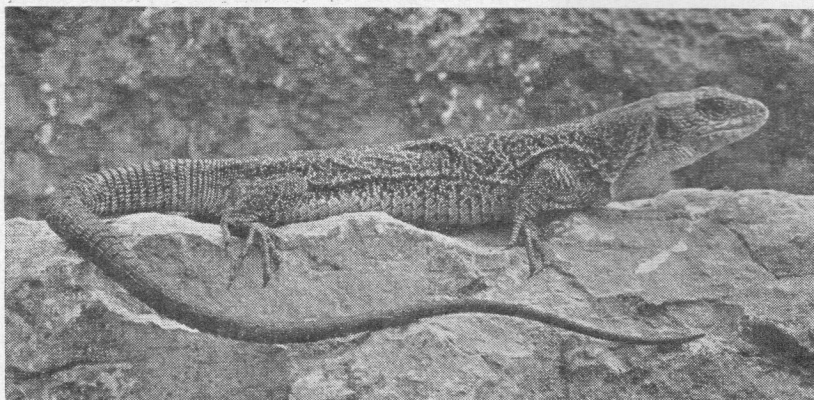
The colour is most variable, females usually being of a pale shade of brown or grey with light underparts. The males, in the breeding season, are much darker and have bright spotted bellies and a greenish lustre to their skins. The one-inch babies, which are almost jet black, can be seen in July or August.

Habitat of the Sand Lizard

Growing to seven or eight inches, the larger Sand Lizard (*L. agilis*) must now be considered somewhat rare in Britain. Two of its main strongholds are the sandy coasts and heaths of Dorset and Lancashire, where it may be seen in the sand dunes and the heather. Its size, stoutish body and rows of "eye spots" along the flanks are some of the features which make it recognisable. The handsome male is readily detected from the brownish looking female by its bright green sides and underparts. This lizard lays from 5-10 oval eggs with soft shells under stones and logs, or in soft earth. After an incubation of about three months the young hatch out about August or September.

Because of its scarcity in this country it is the sincere wish of all reptile lovers that the native Sand Lizard should be given protection and not removed from its wild haunts. Specimens may be had from the Continent where they are far more common. It ranges from the Atlantic coast to Russia, and is very common in the coastal sand-dunes of Holland and Belgium.

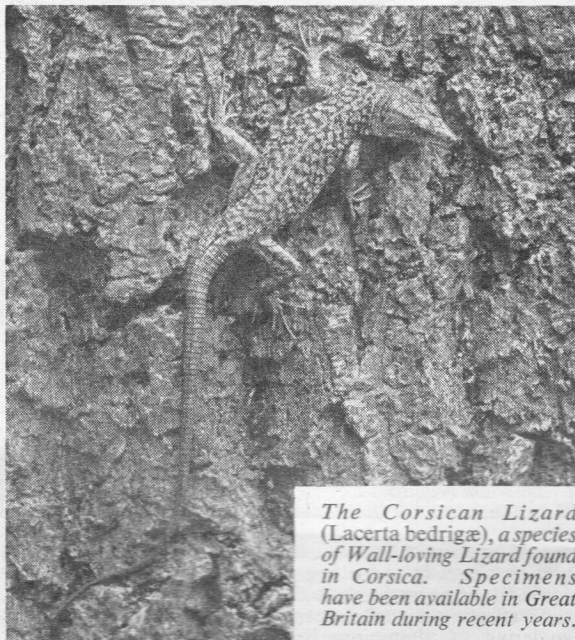
Restricted to the warmer south western part of Europe—in S. France and Spain—is a large, handsome relative from the same Family; this is the Eyed Lizard (*L. lepida*). Including the tail (when



Photographs]

[L. E. Day, F.R.P.S.

One of the largest lizards found in Europe is the Eyed Lizard (*Lacerta lepida*). A point in its favour is that it will take sweet fruit, dead mice and raw meat very readily.



The Corsican Lizard (Lacerta bedrigæ), a species of Wall-loving Lizard found in Corsica. Specimens have been available in Great Britain during recent years.

uninjured) it can measure up to two feet in length, even three feet in exceptional cases. This beautiful lizard has a finely beaded skin of green, marked with black spots, which often form open rosettes. Along the flanks, especially in the males, are bright blue markings. Adult males can be distinguished by their larger heads and swollen cheeks. The Eyed Lizard is an egglayer, and the clutch of 6-10 eggs hatches out in mid-summer. This lizard is an excellent climber, and is best kept by itself as it will not hesitate to attack and devour a smaller lizard. My specimens will eat fully grown dead mice and strips of raw meat. Fruit, and anything else with a sweet taste, is also eaten.

Large Adult Size

Another large European species is the Green Lizard (*L. viridis*). About eighteen inches is a good adult size. It is a uniform bright green or yellowish colour, sometimes marked with longitudinal stripes, especially in juveniles. It occurs throughout S. Europe, from the Balkans to Spain, also in the Channel Islands. It may sometimes be seen in S. Devon in this country, where it was introduced in 1937. About a dozen dull-white eggs are laid in late spring.

A third European lizard which is frequently imported is the so-called Wall Lizard. It should be stressed that this name is loosely applied to a number of species which show a fondness for living in rocks and on walls. The most widespread European species is the Wall Lizard (*L. muralis*), which is so variable that it has been divided into as many as 14 separate races. Many of these occur in isolated islands in the Mediterranean. Its range is Central and Southern Europe, and includes Jersey in the Channel Isles. Adult size seldom exceeds six inches. The head is narrow and pointed and the digits are long and slender. Colour and markings vary greatly, as may be expected from its wide range. Darker lines which run down the body are a common feature.

The above five species provide a sufficient range from which to build up a small stock of lizards. They will live together as a single harmonious community. In the case of the larger ones it is

best to select young specimens. Under indoor conditions the site chosen for their home should be near a window through which sunlight penetrates. The vivarium can be made, to an individual design, out of wood or metal, with a glass front and ample ventilation. For the latter a few "windows" of fine wire netting or perforated zinc are ideal. An aquarium with a tight fitting lid of zinc netting will do equally well.

The contents should be as dry as possible. Any dampness can lead to skin complaints. On a base of dry earth and sand, lay out some clumps of dry moss, bracken or heather, and here and there place some flat pieces of bark and small piles of rockwork under which the lizards can retire at night. A sunken dish of clean, fresh water will be ample for drinking purposes. As a refinement, and to tide over any periods of dull weather, a suspended electric light bulb, inside the vivarium, will provide a substitute for natural warmth and sunshine. If some stones or bark are placed underneath, the lizards will lie out in their "sunning" attitudes, with bodies flattened against the stones. The bulb should be out of their reach, or screened with wire netting, because some lizards, like snakes, will attempt to rest against this source of heat. In so doing they appear to be insensitive to the heat burns which can result in sores and blisters.

In maintaining healthy lizards there are two things to bear in mind. One is a varied diet. To the well-known Mealworms should be added more natural food, such as the common garden insects and other small livefoods. Flies and their maggots, earwigs, woodlice, caterpillars and other grubs can all be found in the average garden. Spiders and grasshoppers are greatly favoured. In addition, soft fruit will sometimes be eaten.

The other essential is that a minimum amount of direct sunlight is available. This is important in the maintenance of a proper vitamin balance. The outdoor enclosure is the obvious answer, and this should be used wherever possible. The usual walled reptilary is not always practicable, but there is a good substitute which can be cheaply made and does not take up much space. It is a square box frame of fine wire netting with an open bottom. This is portable and can be placed in a sunny spot on the lawn, or among the garden plants. Shelter from hot sunlight and rain should be provided, as well as a drinking dish. In such surroundings the lizards are partly self-supporting, as many creatures will enter the cage from the outside. This kind of cage, tastefully painted, forms an attractive decoration to the garden, and is a continuous source of interest to the owner and visitors.



The Wall Lizard (Lacerta muralis) has a wide distribution which includes Jersey in the Channel Islands. Its outward appearance is variable and for this reason the species has been divided into 14 different races.

When it is intended to keep dead fish for any length of time the best preservative is alcohol (spirit). Absolute alcohol or spirits of wine is inconvenient to procure (as its issue is controlled) and expensive. Methylated spirit is, however, equally satisfactory although the mauve colouring makes observation of the specimen in solution unsatisfactory and it must be temporarily removed for detailed examination. Commercial "meth" contains 95 per cent alcohol and the solution should always be kept tightly stoppered as the alcohol content is volatile and also hygroscopic (takes up water from the atmosphere); both these factors tend to dilute the preservative solution unless tightly stoppered and the rim sealed with adhesive paper.

Formalin as a Preservative

Alternatively, formalin (Formol) may be used. It has some disadvantages—it makes specimens dry and brittle and destroys colours, particularly blues, greens and yellows. Its advantage is that its cost is small as it should be strongly diluted before use.

Small specimens may be immersed in a 60 per cent solution of "meth" or 5 per cent solution of formalin, as soon after death as possible. After three days they may be considered "preserved" and can be taken out of solution and examined for short periods. Large specimens 4 in. long or more should be injected with preservative, via gullet or vent, to ensure that the preservative reaches the stomach and alimentary canal; they may then be placed

in a 65 per cent solution of "meth" or 3 per cent solution of formalin and maintained in this for 72 hours when the solution should be thrown away and replaced by "meth" of 95 per cent alcohol content or a 5 per cent formalin solution.

By using a dilute solution of 65 per cent "meth" or 3 per cent formalin initially followed by a change to a stronger solution (95 per cent alcohol content "meth" or 5 per cent formalin), shrinkage and drying may be very much diminished.

When ordering formalin remember that the strength of commercial formalin comprises 40 per cent formaldehyde. Hence a 5 per cent solution of formalin contains only 2 per cent formaldehyde.

In an emergency undiluted brandy, whisky, gin or rum will form a sufficient preservative for two or three days, or longer, dependent on the ambient temperature and the airtight efficiency of the stopper in the container.

As labels are always liable to come off bottles, it is advisable to write data in indian ink on parchment labels and place these in the containers with the specimens. Alcohol rots ordinary paper after a time and formalin dissolves ordinary ink or pencil marks—hence, for safety, use indian ink and parchment paper.

For more specific methods of preservation of specimens, the interested naturalist should procure a copy of the Natural History Museum (S. Kensington, S.W.7.) pamphlet "Instructions for Collectors No. 3."

Selecting Lizards as Pets

(3) Species of Tropical Iguanas, Anolis Lizards, Monitors, Girdled Lizards And Mastigures Now Available in Gt. Britain

By Alfred Leutscher, B.Sc.

(Photographs by L. E. Day,
F.R.P.S., A.I.B.P., A.P.S.A.
and Fox Photos)



Starred Agama or Stellion's Lizard (*Agama stellio*).

ELSEWHERE in this series I have mentioned that lizards occur in greatest numbers and variety in the tropics. In these areas the climate is more favourable to reptiles which obtain their body warmth from the surroundings. Food, especially insects, is also in greatest abundance in these parts.

As in the aquarium hobby, there is now a tendency in the vivarium fancy towards the keeping of tropical species. In spite of the difficulties and expense of importation it is gratifying to note an increase in supply of, and demand for, the exotic lizards which are now coming into the country. They are being imported slowly from places as far apart as tropical America, Africa, India and Australia. Some of these lizards, which have appeared on the market lately, will be discussed in this article.

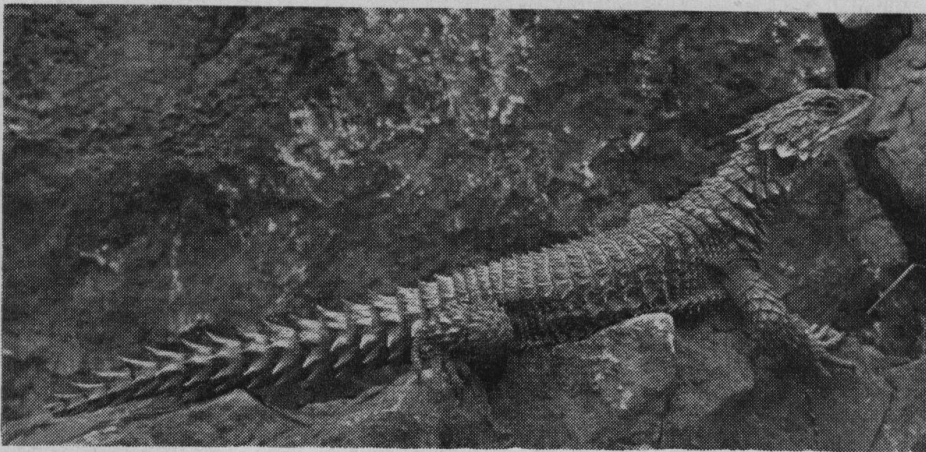
From Central America a number of large lizards, called Iguanas, have reached Britain since the war. This Family, the *Iguanidae*, has about 300 species, mostly American, which in many cases are caught for their skins and eaten as food. A typical example is the Common Iguana (*Iguana iguana*), from Mexico. This handsome lizard is an excellent climber and feeds on fruit and soft plants, for which its

teeth are well adapted. The first tooth of a fossil Dinosaur ever discovered looked so similar to that of an Iguana that the prehistoric reptile was thought to be an ancestor, and given the name *Iguanodon*. Many Iguanas have a frill-like crest along the back and a pouched throat which can be inflated to intimidate an aggressor.

American "Chameleons"

The true Iguanas can grow up to four or five feet in length whereas their near-relatives, the *Anolis* lizards, are much smaller and more slender. They are often called "chameleons" in America, because, like the true Old World Chameleons, they have considerable powers of colour change, and the digits have similar adhesive qualities which enable them to climb vertical surfaces. One species which is regularly imported is *Anolis carolinensis*. This lizard is about six inches long and an expert climber. Specimens I

(Continued next page.)



Lord Derby Lizard (*Cordylus giganteus*). This unusual lizard is native to the dry veldt area of Africa where it rests on rocks and faces towards the sun.

have kept could change from a pale brown to a vivid green in a matter of minutes. These lizards are mainly insect-feeders but will also eat soft fruit.

Also belonging to the *Iguanidae* are some extraordinary lizards called Horned "toads", because of their squat body shape and their manner of catching insects on the tongue. Specimens are occasionally sent over, such as the Texas Horned Lizard (*Phrynosoma cornutum*). Its six-inch body is covered with spiny projections, which are partly protective against enemies, but may also help to prevent loss of moisture since these lizards live in dry desert regions. Horned Lizards have a peculiar habit of ejecting blood from the eyes when handled.

Not to be confused with Iguanas are the Monitors or so-called "warning" lizards of the Old World (Family, *Varanidae*). The scientific name is derived from the Arabic, *ouaran*, meaning "a lizard", which was confused with the English word, "warning". The idea of calling them Monitors is derived from an early belief that they always hissed a warning on the approach of a dangerous crocodile. To add to this confusion in identity, Monitors are sometimes called Leguaans in Africa, and Goannas in Australia.

Monitors comprise a single Genus, *Varanus*, and vary in size from a few inches to nearly 12 feet. Young specimens, about two or three feet long, are handsome creatures and the Water Leguaan or Nile Monitor is a good example. This species (*V. niloticus*) occurs in Africa, from the Cape to Egypt, in localities near water. It avoids dry country and, when alarmed, will dive into the river or lake. It swims well and catches fish, crabs and mussels, besides various small mammals and birds on land. It will also raid crocodiles' nests for the eggs. It is said to lay its own eggs in the ground near the nests of termites. The baby Monitors feed on the termites before making for the water.

The general colouring of a young specimen is a yellowish-brown above, paler below, with dark grey cross-bars over the back. The head is striped with yellow and the tail is barred with black and yellow. Vivarium specimens usually thrive on a mixed diet of meat, (fish and dead mice) and become quite tame. A wild adult, about six feet in length, is a powerful adversary with a severe bite. It uses its compressed tail like a whip lash and

it can inflict a painful wound on a man's leg. Monitors have remarkably long tongues which are rounded and forked like those of snakes.

Restricted to the veldt country of Africa, and living among rocks in dry surroundings, is a strange Family of lizards called Zonures. These are the Girdled Lizards (Family, *Cordylidae*) whose little bodies are covered with sharp-pointed spines making them look very much like miniature Dinosaurs in armour. The largest species, the Lord Derby lizard (*Cordylus giganteus*), has appeared from time to time in dealers' windows. It feeds on various insects, and occasionally on plants.

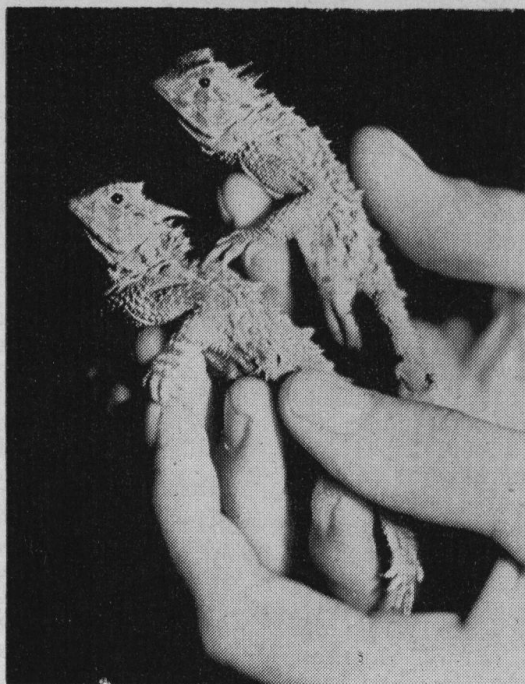
In Africa this lizard is often called the Sungazer, because of a habit of resting motionless on exposed rocks with its head pointing upwards towards the blazing sun. A more detailed account of the Sungazer is given in the WATER LIFE issue for August, 1950.

Another Family represented by imported specimens is the *Agamidae*. The 200 or so species have a world-wide distribution in the tropics of the Old World. They are mainly ground lizards with flattened bodies. From N. Africa and the Middle East comes a Genus *Uromastix*, the members of which are called the Dhabb Lizards or Mastigures. The Egyptian Mastigure (*Uromastix aegyptii*) is the most frequently seen and appears to do well in captivity. It is a vegetarian and prefers soft plants and fruit. When water is poured on to the finely-scaled skin it is absorbed rapidly and the skin is soon dry again. This lizard is somewhat sluggish in movement. The Starred Agama or Stellion's Lizard (*Agama stellio*) is much more active and has a more slender body. This species feeds mainly on insects.

One of the main requirements for these tropical lizards is warmth and the best temperatures are between 75-80 deg. F. In a small vivarium an electric light bulb may be sufficient, but in large cages a commercial heater element will be needed. This can be suspended near the roof or buried in the soil. In all cases there should be adequate insulation and a screen over the heat source to prevent injury to the inmates from burns. A bulb, inserted into a cocoa tin, or an element surrounded with a metal screen, gives off much better radiation. An alternative is to cover the case underneath with metal sheeting and allow the flame of a small spirit lamp to play on it.

The vivarium contents must be dry, as dampness may lead to skin complaints. Branches will be required for the Monitors and Iguanas, with plenty of loose sand for Agamids, Zonures and Horned "toads," in addition to rocks under which they may hide. A drinking dish should be placed in a corner.

The type of vivarium depends on personal preference, expense and available space. A converted aquarium, with a ventilated cover, is the most labour-saving arrangement. One can also procure from second-hand shops, or at sales, ready-made vivariums in the form of show cases. A little ventilation is all that is required. Readers with tropical fishhouses or permanently-heated rooms have the heat already laid on.



Photograph] [Fox
Horned Lizards being handled. On occasion these creatures eject blood from their eyes.

Selecting Lizards as Pets

(4) Slow-worms

By Alfred Leutscher B.Sc.

(Illustrations by Lionel Day, F.R.P.S., A.I.B.P., A.P.S.A.)

THE Family *Anguidæ* is sometimes spoken of as the Slow-worm Family and is typified by our well-known British species which is frequently mistaken for a snake. In point of fact these creatures are true lizards, although in many of them the extreme attenuation of the body and loss of limbs has given them a serpent-like appearance. It is believed by some authorities that these forms are following the same line of evolution taken by the snakes. However, all the seven Genera of the *Anguidæ*, which are represented by about 40 species, have the true lizard type of head with fixed jawbones, and the lizard pattern of head scales. They also differ from snakes in having movable eyelids.

The most lizard-like forms occur among those found in tropical America. In one Genus of about 19 species, called *Gerrhontus*, the limbs are well developed and the general body shape is not unlike that of a skink. Colours are dull shades of brown and the largest species grows up to one foot. Also found in America, including parts of the United States, are a few species of the curious Genus *Ophisaurus*. These lizards are often called "Glass Snakes", and in appearance are not unlike large Slow-worms. In the Old World there are only two species. One is *O. gracilis*, found in N.W. India, and the other *O. apodus*, which occurs in S.E. Europe. The last-named is called Scheltopusik. It can grow up to three feet.

The Scheltopusik occasionally appears for sale in this country, and usually makes a good vivarium inmate. Insects of all kinds are eaten. In the wild it will catch small mammals and other lizards, and search for nestlings. Although quite harmless the bite it may occasionally give is powerful, and it is used to good advantage when crushing the shell of its favourite food—snails. The anatomy of the Glass Snake is interesting in that, as in Pythons, the skeleton shows traces of hind limbs.

In this country most of us are familiar with the little Slow-worm or Blind Worm (*Anguis fragilis*), so named



When picking up a Slow-worm care is necessary as the tail is very fragile and may easily become detached.

scientifically from the ease with which the tail can break off. The common names are a little misleading and were probably chosen on account of its worm-like appearance, and the fact that when it is discovered under stones or logs it may be torpid from the cold and its eyes closed in sleep. When aroused, however, it can become most lively, and the eyes will blink in an intelligent fashion.

The Slow-worm does exceedingly well in captivity and I would say, without hesitation, that any parent who wishes to encourage a care and love for the "wild" pets (i.e. apart from dogs, cats, etc.) cannot do better than select a Slow-worm for even the youngest child. The choice of a Slow-worm will do much to dispel the wide-spread aversion to anything which is worm-like or snake-like.

The home for our Slow-worm need not be elaborate, but must be escape proof because of this creature's fondness

for pushing its head into holes and cracks and passing through with ease. A wooden box with a sliding glass front and some ventilation "windows" of perforated zinc will do nicely, or simply an accumulator jar or small aquarium with a firmly-fitting frame of perforated zinc on top. The Slow-worm is fond of burrowing in loose soil, so the floor of its home should be lined with a good supply of loamy soil or leaf mould, about three inches deep, which is kept slightly moist. Some moss can be laid on top, also a flat stone or piece of bark under which the pet can hide.

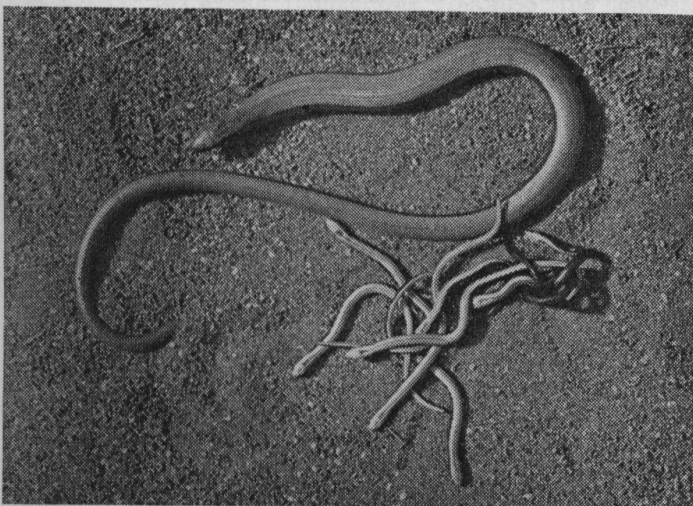
Slow-worms do not normally enter water and are indifferent swimmers. They do, however, like an occasional drink, so a flat drinking dish must be available, out of which they will lap water with their notched tongue. Food may consist of small Earthworms, the smaller slugs, and small snails from which the shell has been removed. Some specimens will also take small pieces of raw meat which are slowly moved in front of the head.

Shyness Soon Disappears

When used to its surroundings the Slow-worm will come out of hiding if hungry, sometimes being visible all day long, and will retire at night or if the weather is cool. Any movement will attract its attention and it will move forward to investigate. If the object is edible, say a slug, the Slow-worm will turn its head to eye it from different angles and taste it a number of times with its tongue. When satisfied with the inspection, the mouth opens and the prey is seized with a slow, deliberate bite, then gradually swallowed. Many tame specimens will take a meal from one's fingers, and one I had would even bite at my little finger if I moved it about. The Slow-worm's bite need cause no alarm as it is only a slight nip and is seldom used on humans.

The pet may at first be shy, but will soon submit to handling. It has an interesting habit of entwining its tail through the fingers in order to obtain a firm grip on one's hand thereby preventing a fall. Children are usually delighted with this pet, which will cling tightly to a little hand and remain quiet for many minutes until returned to its home. They should be taught to handle it gently so as not to damage the tail.

Slow-worms with fractured tails are a frequent occurrence
(Continued next page.)



The young of *Anguis fragilis* have a silvery or delicate pale gold colour above with a black marking on head and body.

even in the wild. The tail appears stumpy and may have regrown, but it will never reach its former size. If it breaks in captivity there need be no cause for alarm, and the broken stump will soon heal. In a perfect specimen the tail may be longer than the body. This is a characteristic of lizards for, in snakes, the tail is very much shorter.

Anguis fragilis occurs widely throughout Europe, and is found in most parts of Britain, with the exception of Ireland. It favours quiet places along hedge banks, field borders beside copses, woodland glades and the sunny sides of walls. Undisturbed places, like pieces of waste ground, village churchyards and railway cuttings sometimes contain large colonies of Slow-worms.

Average specimens grow to about one foot with undamaged tails, but can reach an overall length of eighteen inches. After pairing in early summer the female produces a litter of about 6-10 young which have developed as embryos within her body. They "hatch" out of transparent envelopes at the point of emergence, and these births usually take place in August or September. The babies are pretty little creatures about 2½ in. long. Above they are of a silvery or pale-gold colour with a dark diamond spot on the head which extends along the back as a dark line. The underside

is blackish. They can be reared on tiny slugs and worms.

Colour in the adults may vary. In some it is greyish, in others a pale or dark brown, and some individuals are a rich copper-brown or even red. The sexes can usually be distinguished by the following differences:— the male has a more distinct neck region and may be scarred with bite-wounds received in fights with rival males. The female, normally larger and possibly swollen with young, often has pale and dark stripes along the back and flanks. These stripes are thought to be retained from the juvenile pattern.

A most attractive variation, called the Blue-spotted Slow-worm, may occasionally be found. Scattered over the body are a number of scales coloured a bright blue. This variety is much more common on the Continent, and in Britain occurs mostly in the southern counties.

The Slow-worm's skin is covered with small, uniform, tightly-fitting scales which give it a smooth, polished appearance. This enables it to twist and turn with ease in the undergrowth, and tunnel into the earth without damaging the skin.

Much pleasure may be derived from this engaging little pet, and it need hardly be added that the Slow-worm is the gardener's best friend, and should never be killed.

"Velvet" and Allied Diseases

By C. van Duijn, Jnr., A.M.Tech.I. (Gt. Britain), F.R.M.S.

THE disease to be dealt with in this article has come to our knowledge only in recent years, the causative organism being discovered by Jacobs in 1946. However, it is not to be concluded that the disease did not occur in pre-war days. Symptoms may resemble those of White Spot ("Ich") so it is very likely that it was confused with *Ichthyophthirius*.

Fishes suffering from Velvet or Rust Disease have a "dusty" appearance on the skin. It looks like a surface which has been dusted with powdered sulphur or with talcum powder of a dark shade. The "dust" is of a pale yellowish colour, and may move over the skin surface.

If some of the "dust" is scraped off and examined under the microscope with a high-power objective, a number of small unicellular parasites can be found, which belong to the Dinoflagellates. These are protozoans, generally characterised by the possession of a scale, consisting of two valves and having a cross-fold or groove.

The causative organism of Velvet Disease is *Oodinium limneticum*. This creature may appear in a free-living, motile stage, conforming to the general appearance of Dinoflagellates. The average length is about 13 microns (1 micron=0.001 mm.) and the shape is more or less ellipsoidal. There are two flagella, a longer one directed backwards and used for locomotion and another which is shorter and concealed in the transverse groove.

When a motile *Oodinium* comes in contact with the skin of a fish, it adheres with its long flagellum, but this is only a temporary stage. Several outgrowths are produced (pseudopodia), resembling those of certain species of Rhizopods (a group of protozoans to which also the well-known *Amæba* belongs). The pseudopodia grow into the skin or the gills of the fish and in this way the parasite gets a firm hold. The flagella and the transverse groove disappear and the shape of the body becomes pear-like.

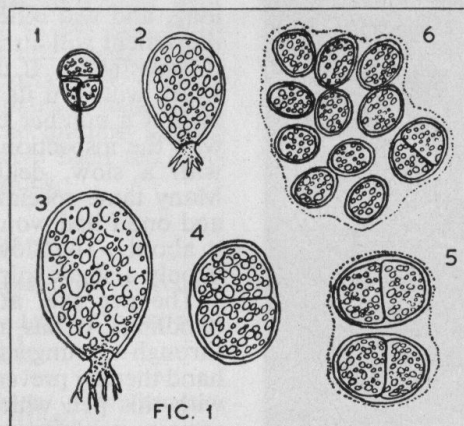
Both the free-swimming and the parasitic forms of the organism con-

tain some chlorophyll, enabling it to obtain food by the process of photosynthesis, as in green plants. This chlorophyll gives the organisms a yellowish colour. However, the parasitic form derives most of its food from the epidermal cells of its host. At the expense of the fish the parasite may grow from five to seven times its original diameter. When reaching maturity, the organism loses its pseudopodia and encysts itself for multiplication. Inside the cyst a series of equal divisions take place, which may give rise to more than 200 young parasites in the course of a few days.

These young parasites develop into the free-swimming flagella-bearing stage and leave the cyst and the fish. They swarm out into the water and, after some time, may settle again on the skin or the gills of a fish. In this way the infection spreads. It is not yet known for how long the motile parasites may survive before finding a suitable host.

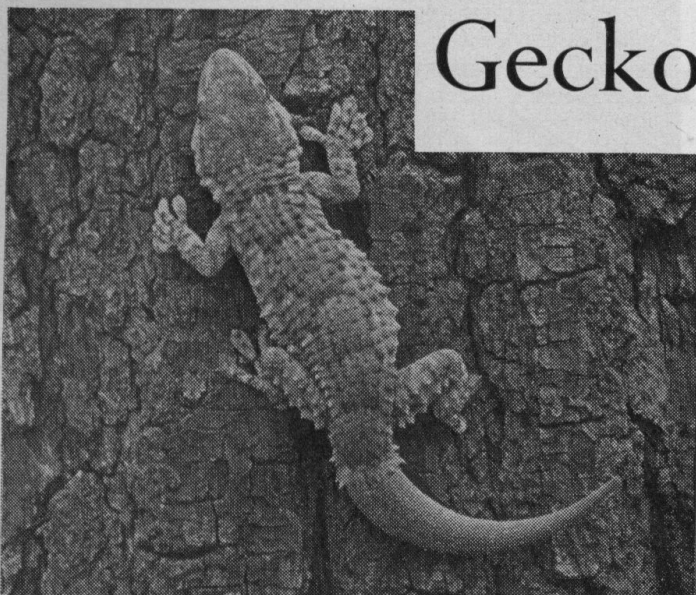
Oodinium limneticum has been found in its parasitic form on White Cloud Mountain Minnows, Barbs, Danios, Labyrinth fish and livebearers. The infection is most dangerous for young fish; adult specimens, having a higher resistance, may carry the parasites for long periods without showing distress. Consequently, most casualties will occur in batches of young fish, unless the victims are treated immediately signs of disease have become apparent.

Fortunately Velvet Disease is not difficult to cure. There are two treatments available, both of which have proved very effective, namely methylene blue and acriflavine or trypaflavine (the latter two are different trade names for the same chemical substance, 3,6 diamino-10-methylacridiniumchloride). For the methylene blue treatment take a one per cent stock of methylene blue (medical quality) in water. At first, 1 cu. cm. per Imperial gallon of water is added, and after one or two days this is repeated. Except for some of the lower plants (*Chara* and *Nitella*) this concentration will not affect the plants.



Oodinium limneticum (after Kozloff) × 270. 1, Free-swimming stage. 2 & 3, Parasitic forms. 4, First division in cyst. 5 & 6, Cysts with parasites.

Selecting Lizards as Pets (5)

Common Gecko (*Tarentola mauritanica*).

THIS article deals with a further selection of tropical lizards suitable for the vivarium. The species I will deal with represent two large, well-defined Families of worldwide occurrence in countries of the tropics. Specimens have recently appeared on the market in this country. Both kinds are fond of dry, warm surroundings, are active in movement, and feed mainly on a variety of insects. Here the similarity ends.

One group, the Geckos, consists of small, lively lizards, which are largely nocturnal and adapted for climbing on walls and trees. The others, called Skinks, are burrowing lizards, with smooth, slender bodies and they live in dry, sandy places. The Skinks come out mostly in daytime and bask for long intervals in the hot sun.

The name Gecko is derived from the call of this type of reptile, which has been likened to the noise made by clock-work machinery. In fact, most local names given to the various species are phonetically based on the call. For example, the Malays use words like Titjak, Gaguh, Goke and Toke, the last being the name for the largest of the 270 or so existing species of the typical Family, *Geckonidae*. This is the Great House Gecko or Tokay (*Gecko gecko*), a handsome foot-long lizard which is coloured a bluish grey and marked with attractive pink lines and spots.

I have kept this species for some months in a heated, wooden cage, containing strips of bark, behind which it could hide. It would come out in the evening to catch the various flies, grasshoppers and other insects which were introduced into its home. During the process of taming it I learnt to respect its bite, which is powerful, indeed painful—although not serious. When annoyed, our Tokay would emit a rattling cry, something like "Tock-aa-aa-aa". My uncle, who spent many years in Java, used to write in his letters to me about the Geckos which lived in his bungalow. Most Europeans in the tropics encourage these useful animals into their homes, as they help to keep down the insect life. The various Geckos in my uncle's house, including the

Geckos and Skinks

By Alfred Leutscher, B.Sc.

(Illustrations by Lionel Day,

F.R.P.S., A.I.B.P., A.P.S.A.)

Tokay, would remain in hiding during the day, each one in its own retreat behind some picture or ornament, emerging at nightfall to hunt the insects which were attracted to the lights. These hiding places were jealously guarded against rivals and fierce fights would often take place between two contenders for the same home. It was a common thing for a pair of struggling combatants, which were fighting overhead on the ceiling or a lamp bracket, suddenly to end up on the table amid the dishes and plates during the evening meal.

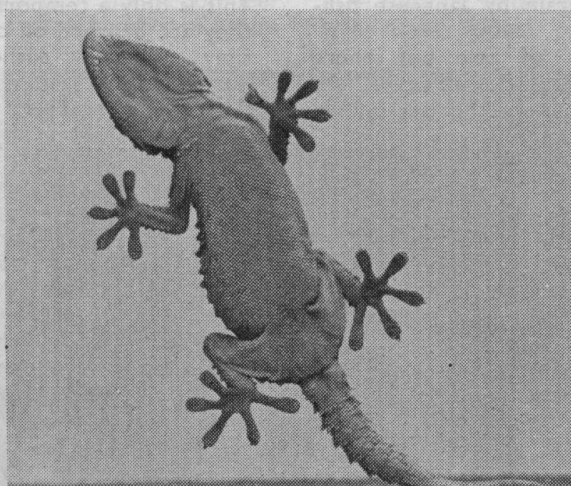
Another specimen I have kept is the much smaller Common or Moorish Gecko (*Tarentola mauritanica*), which inhabits the Mediterranean seaboard and grows to about 4 in. It will come out by day from the cracks in rocks and walls to bask in the sunshine. It can be extremely active at times, as my wife and I once discovered when a specimen escaped from its box late one evening. It was finally captured at 2 a.m. next morning after leading us from room to room and from ceiling to floor, in our endeavours to corner it!

Structure of the Geckos' Feet

Geckos are classified mainly on the structure of their feet, which are their most striking feature. The digits have vacuum qualities owing to the lamellations and hair-like outgrowths on the undersides of the fingers and toes. These leaf-like appendages give the feet their adhesive powers, so that the animal can cling to vertical surfaces, even glass, and will run with ease upside down across a ceiling. The grip of the foot has a velvety touch, and may even give the impression of moistness. This feeling, plus the sharp little claws possessed by Geckos, may have helped to give rise to the belief that these animals were venomous. In some parts they are given the name of Poison-foot.

All Geckos, so far as is known, are oviparous. The small white, spherical eggs are usually laid at intervals in pairs, and may be found in cracks in walls and bark, or on window ledges and behind pictures in dwellings. Geckos have large eyes without movable eyelids, being covered with a transparent shield not unlike a watch-glass. Most are drab in colour, but a certain amount of colour change occurs, enabling them to adjust themselves to their surroundings. In the case of the Bark Geckos (e.g. Genus *Uroplates*) this camouflage property is enhanced by leaf-like outgrowths from the skin and tail, which give them a perfect resemblance to patches of moss and lichen on the trees in which they live.

The very numerous Skinks (Family *Scincidae*) number about 400 species. They occur in all tropical regions, attaining their greatest numbers in the Australian region. Some are lizard-like in shape, but the majority have long, slender bodies with weak, undeveloped limbs. In very attenuated forms the body is



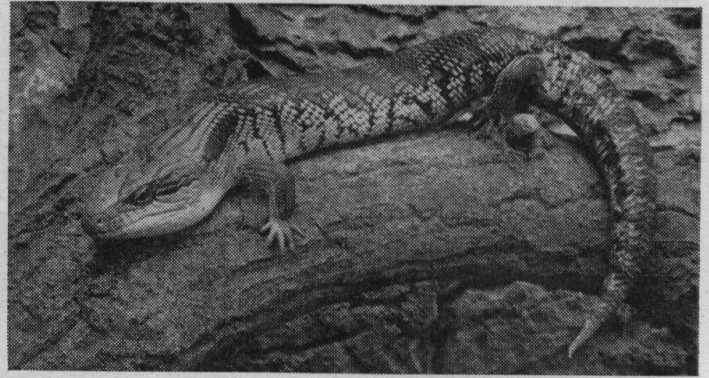
Common Gecko adhering to a sheet of glass. This photograph shows the outline of the fingers and toes.

serpentine and the limbs reduced to a minimum. A range from one extreme to the other can be traced through one genus, *Chalcides*, which includes the pretty little Eyed Skink (*C. ocellatus*). This species grows to about 10 in. and is found in N. Africa and the eastern Mediterranean region. The colour is an attractive yellowish-brown with bluish marking along the flanks.

It was probably this Genus, which has a number of species in the Near East, that became responsible for the name Seps, which has been given a number of Skinks, coupled with a widespread belief that these lizards are highly venomous. "Seps" is from the Greek "to make rotten," and one can discover some surprising statements in the old literature about Skinks, such as the following:—"The Seps, whose bite Consumes the bones, dissolves the body quite" (829 A.D.). "Seps", from which we get the English "septic," is actually used in the scientific name for one species, which is called *Chalcides sepsoides*.

In the Sahara and Red Sea areas is found the Common Skink (*Scincus officinalis*). It has a smaller brownish body marked with darker cross bands and it measures about 8 in. when adult. In contrast to the Seps, this Skink has been renowned since earliest times for its great healing properties, and even today figures in medical prescriptions.

Much larger species, up to a foot and more, sometimes appear for sale on the home market. The Algerian Skink (*Eumeces algeriensis*), and the Desert Skink of Egypt (*Scincus scincus*) are examples from Africa. In Australia is found the Cunningham's Skink (*Egernia cunninghami*) and, one of the largest species, the Greater Skink (*E. major*). Their colours are various shades of dull brown. Of particular



The Northern Blue-Tongued Skink (*Tiliqua scincoides*).

attraction to the Skink collector is the large Golden or Schneider's Skink (*Eumeces schneideri*), a rich golden brown in colour, and the Northern Blue-tongued Skink (*Tiliqua scincoides*). As a novelty some vivarium owners like to keep the harmless and placid Stump-tailed Skink (*Trachysaurus rugosus*), whose body is covered with large plated scales giving the animal the appearance of a large, elongated pine-cone.

Most Skinks have small, tight-fitting scales which give the body a smooth, polished appearance. They can burrow at high speed, and require a heated home containing plenty of loose, dry sand. Skinks produce living young, from 2-4 in number being usual, and feed on a diet of insects and other small animals. Some will also take raw meat, soft vegetation and fruit.

— Know Your Fishes —

No. 23. Medaka or Rice Fish

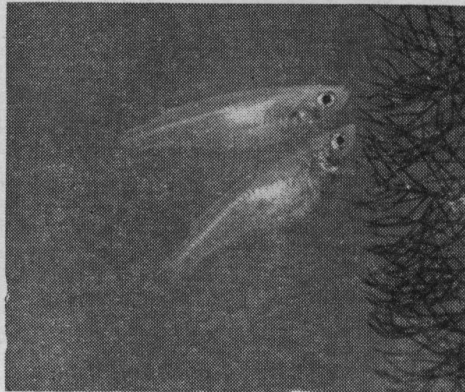
(*Oryzias latipes*)

From the Orient comes a small egg-laying tooth-carp of quiet appeal; it is the Medaka or Rice Fish (*Oryzias latipes*), whose length does not exceed $1\frac{3}{4}$ in. In its wild state the fish is an olive-green above with whitish-yellow underparts. The fins are generally of a greenish hue and there may sometimes be slight orange colouring on the body below the dorsal fin. Medakas of this colour pattern are not so striking as the golden cultivated variety where the upper parts of the fish are golden although the lower regions retain their whitish-yellow colouring. The golden areas are sometimes overlaid with a faint bluish-green tinge. The fins are clear. Evidence seems to suggest that the golden variety was a sport which was bred into a strain by Japanese fish-keepers about 1895.

Colour gives no indication of sex but there are three distinguishing points: 1, all rays are equally spaced in the dorsal fin except the last one in male specimens; here there is a markedly greater distance between the last ray and the one alongside it; 2, the anal fin is larger in the male; 3, the female, in breeding condition, has a fuller body. In addition the male fish is sometimes smaller. The photograph shows a pair, the male being the upper fish.

Fins are not of an unusual shape although the rear edge of the caudal is very nearly perpendicular, with rounded corners. The dorsal is set well back.

Medakas are perfectly peaceful and make excellent community



tank occupants where they help to set off more colourful species. A variety of live foods is necessary to get the fish into top breeding condition but they are omnivorous and will take all types of food. *O. latipes* has a very wide temperature range and on this account it has been called the Coldwater Haplochilus in America. From 45-80 deg. F. will be tolerated provided fluctuations are gradual; 65-70 deg. is a satisfactory range but 72-75 deg. is required when it is hoped to induce a spawning.

The actual spawning procedure is most interesting. Pairs should be separated for a short time prior to breeding—preferably in a single tank with a glass partition. Thickets of fine-leaved plants (e.g. *Myriophyllum*) are required. Within a week the fish should be taking an active interest in each other and during the evening the partition can be removed. The male chases his mate and when the eggs are laid they do not fall from the female but adhere to her vent in a grape-like cluster. This is only a temporary phase and, in about 24 hours, they are brushed off on to the fine-leaved plants where they adhere. Although the adult fish do not normally eat the eggs or fry it is recommended that the parents be removed after the eggs have become detached from the female.

In approximately a fortnight the eggs hatch and Infusoria should be given two days after the young appear. Later on fine prepared food can be offered as well. When the young fish are of a sufficient size, Mikro-worms, chopped White Worms and small *Daphnia* make suitable foods.

O. latipes is native to Japan.
Class: Pisces. Order: Microcyprini. Family: Cyprinodontidae
Sub-family: Fundulinae. Genus: *Oryzias*. Species: *O. latipes*.

tions to "fiddle" should be firmly resisted and the following considerations borne in mind.

Firstly, unless a complicated form of suicide is envisaged, disconnect the electrical system entirely before the apparatus is handled. Secondly, it is unlikely that a very constant temperature will benefit fish to any appreciable extent; indeed, the general opinion seems to be that the converse is true. Thirdly, unless the thermostat is damaged or very badly adjusted, the extent to which the differential can be decreased is limited if efficient operation is to be maintained.

Differential Decreased by Moving Fixed Contact

The differential is decreased by moving the fixed contact towards the bimetal by means of the particular form of adjustment provided. In Fig. 4, this corresponds to a movement of O to the right, which has no effect on the upper curve (the lower point on the differential) but raises the lower curve, i.e. lowers the upper extent of the differential. A decrease of differential, therefore, lowers the average temperature slightly. The graph shows that, at first, as O moves to the right, the differential decreases in a fairly regular manner, but as the flatter part of the curve is approached a greater contact movement must be made for the same decrease in differential. This means that the contact has much less travel in which to accelerate.

The forces regulating the movement of the bimetal are seen to be small, so that the contacts are less securely held together when closed and switching is much more sluggish than when a larger differential is employed. The consequent disadvantages are accentuated by the more frequent opera-

tion of the thermostat, since the heating and cooling periods are shorter. Possible results are worse and more frequent radio interference and deterioration of the contact surfaces by more frequent, heavier sparking.

On the other hand, if O is moved to the left, the increase in differential becomes rapidly greater, so that a small adjustment to O may result in an excessive change in differential, giving highly satisfactory operation but, perhaps, too large a variation for the well-being of the fish. The bimetal assembly must never touch the magnet.

Incidentally, since in Fig. 4 the distances T_1T_2 and CD are equal, if the horizontal scale refers to the position of the fixed contact and not the moving one and the vertical scale to temperature instead of force, the curve DP becomes the graph of differential with fixed contact position; it has no significance to the right of P, where the differential becomes zero. At P there is no snap action at all, the bimetal movement being very large for small variations of temperature and the force controlling it very small. The bimetal in this condition is in a state of delicate balance and may be subject to the influence of small vibrations such as those caused by passing traffic or footsteps in the room—a very undesirable state of affairs.

Readers versed in mechanics may note that the closed curve PDOBP is the work cycle of the thermostat and that its area represents the work supplied in the form of heat energy for each cycle of operations.

The diagrams are drawn to arbitrary scales, but the distance OA in Fig. 1 is usually of the order of a few millimetres.

Selecting Lizards as Pets

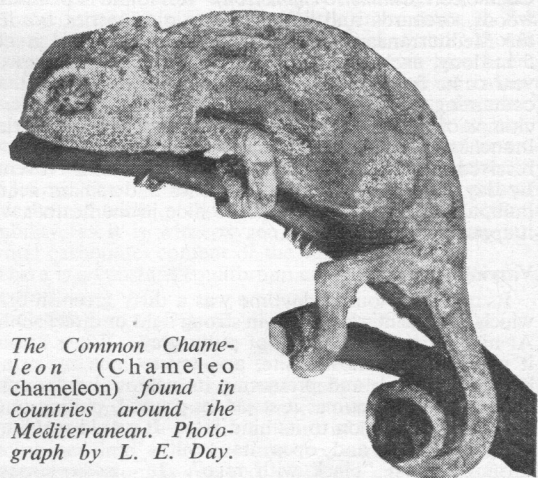
(6) Peculiarities of Chameleons

— By Alfred Leutscher, B.Sc.

THE final article in this series, which is on Chameleons, is appropriate for it serves to show the remarkable variations in shape, size and habits among this group of reptiles. Because chameleons are so different from other lizards, some herpetologists have placed them in a separate division of the *Sauria* (i.e. the name for the Sub-order of Lizards), which they have called the Rhiptoglossa. This means a "thrown tongue", for it is the club-shaped tongue which is the chameleon's most striking peculiarity. It is used, as in the frog or toad, for catching prey and the insect or small animal is secured by the sticky tip. The tongue, when extended, may have a greater length than the body and is shot out with great accuracy. With a telescopic action it is withdrawn by elastic fibres into the capacious pouch of the mouth, the floor of which is supported by the hyoid bone.

Presumably a chameleon cannot hear, for it has no ear-passage or ear-drum. On the other hand its eyesight is good, and the eyes are another striking feature. They are conical in shape, and the eye-balls are enclosed by the circular, fused eyelids so that only the pupils are visible. The eyes have independent movement, and a chameleon can look in two directions at once in a most comical fashion. I have actually seen an animal awake on one side of its body, and asleep on the other! By focusing both eyes on to an object it can judge distance, an important asset to an animal which is slow-moving and has to stalk its prey. To make sure of each meal it must be a "good shot".

Chameleons are climbers, and spend a great part of their



The Common Chameleon (Chameleo chameleon) found in countries around the Mediterranean. Photograph by L. E. Day.

lives in bushes and trees. The hand-like limbs consist of digits which are arranged in two, opposable bunches of three inner digits and two outer ones on the fore-feet and vice versa on the hind feet. By deliberately grasping a branch with each foot in turn the chameleon moves along slowly. The prehensile tail is frequently used as a further support, and is curled up when not in use.

These animals never appear to be in a hurry, and will sometimes stay in the same spot for hours. They are quite harmless and defenceless, and one wonders how they manage to survive. The answer lies in the very efficient powers of concealment. This is by no means confined to changes in colour, for which a chameleon is famous, as these are no more remarkable than those seen in many other lizards. In N. America the name "chameleon" is given to species of the *Anolis* lizards (related to Iguanas), which can change colour equally efficiently.

The chameleon's shape also aids concealment. The body has a resemblance to a leaf, and is covered with small granules, quite unlike the normal scale covering of other

lizards. The arched body is flattened sideways so that, if viewed from the front, the creature appears to be extremely thin, as if in a starved condition. If alarmed it will make itself even thinner, but when handled or annoyed it can take in air and puff itself up to quite a size. This habit has given rise to a ridiculous idea that chameleons live on air; they can certainly live a long while without food, for starvation and finally death is a slow process.

The mechanism and causes of colour change have been the subject of much study. Within the skin are small cavities with branch-like arms, called the pigment cells, which contain a range of coloured pigments. It is the manner in which these pigments are arranged in the cells, and their blending one with another, which produces the range of tones and colours seen in chameleons. It has been found that the colour changes can be effected by the stimulus of light, humidity, heat and by emotions such as excitement, fear and anger.

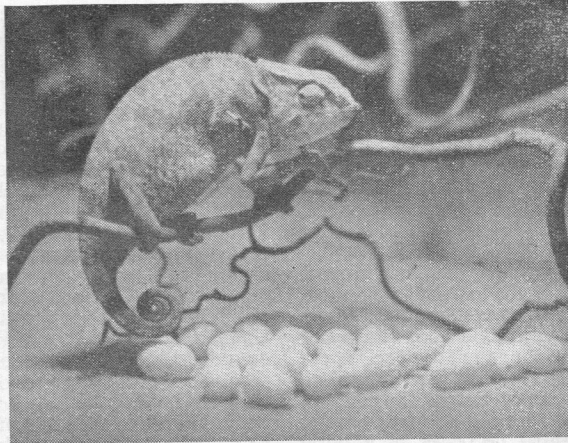
The species with which I am most familiar is the Common Chameleon (*Chameleo chameleo*). It is found in plantations, woods, orchards and olive groves in countries bordering the Mediterranean, from S. Spain to Israel, and is about 5 in. long, excluding the tail. The specimen I kept last year came from Israel. Its home consisted of a 3 ft. tank containing a layer of mixed, dry earth, sand and leaves, with clumps of heather here and there, and a heap of interlaced branches. A 60-watt light bulb hung from the roof. We received the creature in June and it lived until November. By day it would ascend the branches and remain near the bulb, and at night come down to hide in the heather where it appeared to fall asleep.

Varying Colour

Its normal colour in daytime was a dirty greenish-brown, which became much greener in strong light or direct sunlight. At night it paled to a sort of putty grey. When disturbed it would turn almost white, and try to hide by swinging behind a branch and presenting its narrow border toward the viewer. Sometimes it stood its ground, puffing out the body and rearing on to its hind legs. It would make queer chirping noises and open its mouth, turning almost "black with rage". It also did this when another chameleon was introduced, even turning on it and biting. The unfortunate newcomer turned quite "pale with fear", and had to be removed. Chameleons can be very quarrelsome in captivity.

Our pet fed well on a diet of flies, mealworms, grasshoppers and a few moths, which were stalked and caught on the tongue. When moving along a branch, it used to pause now and then and sway backwards and forwards on two feet, with the other two poised in mid-air. In Nature this queer behaviour might well assist in concealment, for the chameleon could easily be mistaken for a leaf swinging in the wind.

One day it descended to the earth and slowly dug a hole. The next day it was back in the branches, and the hole



Photograph]

A Chameleon which laid 28 eggs in a six-inch deep depression.

[Fox Photos

was covered up. I thought at the time it might have been preparing for hibernation, since winter was approaching. Then we discovered in the earth, where it had dug, a clutch of twenty white, oval eggs with soft, leathery shells. These were placed in a tin of damp moss, and stored in the airing cupboard, at a temperature of about 80 deg. F. After nearly three months of careful incubation, no young had appeared, so I dissected two eggs and found well formed embryos inside. Finally, after four months had passed, I concluded that no young would ever appear, so the eggs were preserved in spirit. This was a mistake, for a chameleon expert then

told me that in this species there is a delayed development of the embryo, incubation taking as long as six months.

Death After Eggs Laid

Our disappointment on losing our pet was somewhat eased when this expert told us that the female only lays one clutch of eggs and then nearly always dies. Most chameleons are egglayers but a small species, called the Dwarf Chameleon (*Chameleo pumilus*), produces living young. Largest of the 70 or so species is the two-foot *Chameleo calcaratus* of Madagascar. The group is Old World in distribution, and is found in Africa, Madagascar, Arabia, S. India and Ceylon. Its occurrence on islands is interesting, and one wonders how chameleons got there in the first place. In some species the "helmet" on the head is extended into spiky and horn-like outgrowths; in others these appear on the nose, giving the harmless creatures a fierce, prehistoric look.

The name chameleon comes from two Greek words, meaning "on the ground" i.e., "dwarf-like", and "a lion". These miniature "lions" represent some of the most extraordinary of living creatures and are certainly of great interest as vivarium specimens, and for purposes of study. Yet, unfortunately, they make poor captives, being sensitive creatures, and short-lived. To reproduce the right conditions for their well-being, as well as a properly balanced diet, is not easy and to keep a chameleon for longer than eighteen months is quite an achievement.



Photograph]

A Chameleon, at London Zoo, with its club-shaped tongue partly extended as it catches a cockroach. The tongue is frequently of a greater length than the body and specimens show considerable dexterity when stalking their prey, which is usually an insect.

[Fox Photos

Amphibians and Reptiles of the British Isles

I. Why Our Native Species are Relatively Few in Numbers

By Alfred Leutscher, B.Sc.

(Illustrated by Lionel E. Day, F.R.P.S., A.I.B.P., A.P.S.A.)

AMPHIBIANS and reptiles are creatures which have been greatly abused and persecuted in the past and still enjoy a reputation which is almost second to none where fears and superstitions are concerned. Even naturalists had given them scanty attention until recently. The famous Linnæus had this to say about them, when he was classifying the plant and animal Kingdoms at the middle of the eighteenth century—"Most Amphibia are abhorrent because of their frigid bodies, livid colour, foul skin, cartilaginous skeleton, fierce aspect, scheming eyes, offensive smell, harsh voice, squalid homes, and terrible venom". This was an unfortunate description for the attitude of this famous naturalist must have deterred many students from making this group the subject of their study. The "*Classis III, Amphibia*" of Linnæus was a somewhat mixed collection of true amphibians and what we now call reptiles.

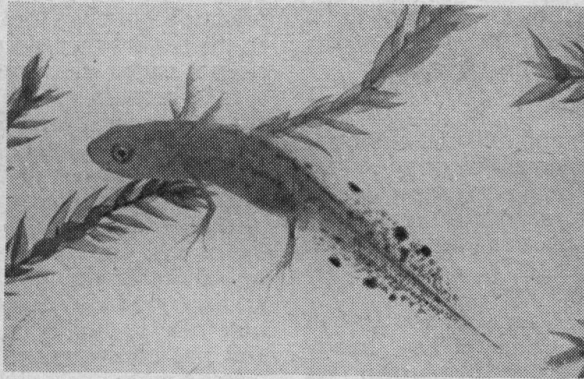
Both amphibians and reptiles today hold the rank of a Class, and their position in classification and evolution lies between the more lowly Class of fishes, and the higher Class of mammals. Briefly their story is as follows.

The *Amphibia*, which are the more primitive, are said to have evolved from a group of fish ancestors during the late Devonian Period, over 250 million years ago.* This process, not yet fully understood, necessitated the development of limbs for walking and lungs so that they might leave the water. These early ancestors of ours, for so we may regard them, were the first backboned animals to colonise the land. They reached their greatest size in the swamps of the "coal" forests which flourished in the Carboniferous Period, over 200 million years ago. From fossil remains have been constructed monsters up to 10 ft. in length.

Developed from Early *Amphibia*

These creatures are now extinct, but from the common stock of the early *Amphibia* have arisen other forms, which we recognise today as frogs, toads, modern salamanders and newts, and the curious cœcilians. The last, which do not occur in Britain, are a small group of worm-like, limbless, burrowing amphibians of the Tropics, and make up a separate Order. Frogs and toads, with short, tailless bodies and powers of jumping, belong to the Order *Salientia* (from the Latin, *salio*—I leap). In Britain we have the native Common Frog (*Rana temporaria*) and the Edible and Marsh Frogs (*R. esculenta* and *R. ridibunda*). Our two toads are the Common Toad (*Bufo bufo*) and the Matterjack (*B. calamita*). The third Order, the *Caudata*, of which we possess three closely related species of newts, Genus *Triturus* (old name *Molge*), have elongated bodies and retain their tails throughout life.

*The extreme importance of the discovery recently of a cœlacanth fish, may be judged from the fact that it is a surviving member of this very group of Devonian fishes, the *Crossopterygii*, which gave rise to the amphibians. For an account of this discovery, please turn to "In and Around the Aquaria World", on page 34.



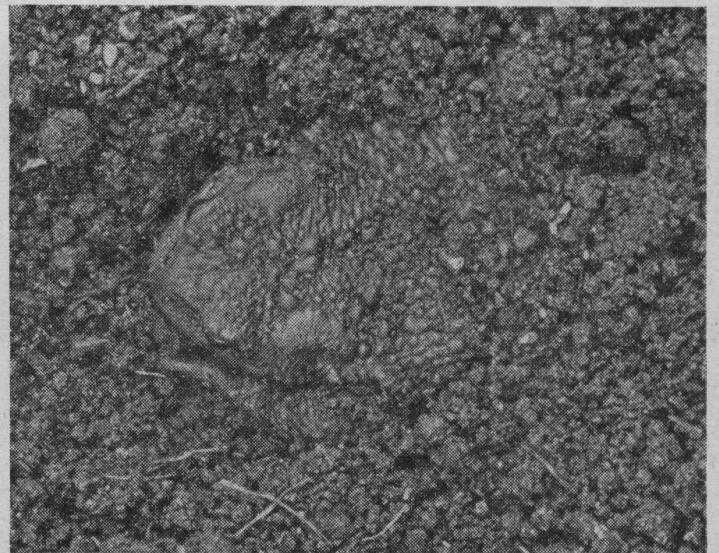
A Newt larva partly through metamorphosis.

These modern *Amphibia* differ from the *Reptilia* most markedly in the method of their development. The majority spend the early part of their lives as aquatic, free-swimming larvæ, called tadpoles, which respire by means of gills. Our ponds are fully stocked with them in spring and early summer. Later on, these youngsters develop lungs and legs, and leave the water to grow up into adults. It is during this change, called a metamorphosis, that the frog and toad tadpoles lose their tails. This curious double existence (i.e. *Amphibia*

—from the Greek, *amphi*—both, and *bios*—life), has often been quoted as an example of how an animal relives the story of its past, as it grows from embryo to adult.

Reptiles today are essentially different. They have no visible tadpole stage. Early in their careers the reptiles produced a tough shell to their eggs, in which the protected embryo could develop unseen. It was supplied with plentiful yolk as food, and also structures for storing waste products and for making respiration possible. Such an egg can be laid on dry land, which would be a dangerous place for the soft, jelly-covered egg of an amphibian.

Originally the reptiles were descendants of the amphibians and, when this shell-egg appeared on the scene late in the Carboniferous Period about 200 million years ago, the time was ripe for a complete land existence. So the reptiles left the water to exploit this novel environment, in which they made wonderful achievements. The fossil skeletons of the giant dinosaurs and pterodactyls, the ichthyosaurs and monster tortoise, are witness to this. There were reptiles



"Toad in the hole." A hibernating toad half covered by soil which camouflages it to a remarkable extent.

everywhere in those days—on the land, in the lakes, rivers and seas, and in the air above. The stories of the “lost world” in which they lived are very popular today with us human-beings, young and old.

Yet, as in the case of the amphibians of old, these reptiles died away and their world came to an end. By comparison the modern *Reptilia* are small and few in number, and represented by four Orders. Three of these—the chelonians (tortoises and turtles), the crocodilians and the unique “living fossil” of New Zealand, the Tuatara (*Rhynchocephalia*), come from a primitive stock and have changed little since the first appearance of the reptiles. The fourth Order, the *Squamata* (from the Latin, *squamus*—a scale), comprises the snakes and lizards. Members of this Order seem to be more recent reptiles, a matter of about 60 million years, and at the same time more progressive and varied.

Similar Numbers of Lizards and Snakes

Snakes and lizards occur in Britain and in equal numbers. The three snakes consist of the venomous but timid Adder (*Vipera berus*), the harmless Grass-snake (*Natrix natrix*) and the rare Smooth Snake (*Coronella austriaca*). The lizards are the widely distributed; Viviparous Lizard (*Lacerta vivipara*), the much localised Sand Lizard (*L. agilis*) and the limbless Slow-worm (*Anguis fragilis*).

The reader is no doubt aware that some of the British reptiles are of the “livebearer” kind. Since it has already been shown that reptiles are egglayers (oviparous), an explanation is necessary. The apparent birth of a reptile is due to the fact that the mother has retained the eggs within her body, so that the time of laying almost coincides with the actual hatching. Her brood appears to emerge from her body. This condition, in which the mother is said to be ovoviviparous, is well known to owners of tropical fish who keep “livebearers”.

Apart from these differences in their life histories, British amphibians and reptiles are easily distinguished by differences in the skin. The amphibian has a naked one; in the reptile it is covered with scales. Consequently the amphibians usually prefer damp, shady situations, and avoid hot sun which might damage and dry up the soft skin, whereas the reptiles can stand more exposure, and frequently bask in the open.

Two Common Characters

There are two important characters which they have in common. One is the smallness of the brain. They do not display the kinds of intelligence associated with mammals, and this may have been a contributory factor towards their decline. In the “struggle for existence”, as Darwin calls it, reptiles and amphibians have taken a back seat in evolution. Even the brain of the mighty *Brontosaurus*, an 80 ft. dinosaur, was not much larger than a chicken's egg. Mother love, which is one of the higher emotions, is almost unknown to them, although their babies seem to get along very well without it.

The other common inheritance is the unstable condition of the blood. We say these creatures are cold-blooded, a misleading term, since the body temperature is actually changing all the time



Care of Your Pets

In a few weeks reptiles and amphibians will once again be available in the shops. Individual species have varying requirements and it is important that these should be known before the creatures are purchased. Specific details for the types most likely to be encountered will be found in two booklets of the WATER LIFE Series, “Hardy Reptiles and Amphibians” and “Land and Water Tortoises.” Both are obtainable from the Publisher, WATER LIFE, Dorset House, Stamford Street, London, S.E.1, the former priced 1/8d. post paid, and the latter 2/2d.

(poikilothermous). Warmth is derived from the surroundings so that, during extremes of hot and cold weather conditions, the creatures become torpid. In Britain they prepare themselves for hibernation at the onset of each winter. In the tropics they sleep during the hot spell. This summer sleep is called aestivation.

It is because of the extremes of cold in the past that Britain can only claim to own twelve native species of reptiles and amphibians today. It is believed that the last Ice Age exterminated what species we possessed, for most of Britain then lay under a cover of snow and ice. With the retreat of the ice sheet a recolonisation began from the Continent, for at that time our islands were linked to Europe. This was about 12 thousand years ago. Water from the melting glaciers gradually filled the seas around us, and these in turn rose to flood the lowlands. Ireland broke away first and, in consequence, received the fewest species. This seems a more likely theory to explain the absence of Ireland's reptiles, than the legend associated with St. Patrick. Today only the Smooth Newt and the Viviparous Lizard are its true native species. On the mainland the distribution is such that all species occur in S. England, far fewer in the north, and least of all in Scotland.

Island Formed

The final severance from the Continent took place when the straits of Dover were formed, and the date given is 5,000 B.C. or thereabouts.

Britain's heritage of these creatures from the “lost world” is a poor one but, nevertheless, worthy of greater respect. It can also be made the subject of some very absorbing study, for there are many problems which have still hardly been touched upon. The fact that most of the fourteen species of amphibians and reptiles found in Britain (of these two are introduced) may be kept for many years in captivity with no apparent decline in health, means that there is an opportunity for most of us to add to the scanty knowledge we as yet possess of their strange ways and habits.

In the articles which follow in this series some account of all the British species will be given, with suggestions for their care in captivity and ideas for useful research work.

Habitats of Reptiles and Amphibians



Left: woodland glade, a haunt of Adders and lizards.
Above: shaded pond, typical breeding place of amphibians.

Magnificent to look at. Cleaning and sand heaving all day". On August 5 the spawning took place. Enormous quantities of large pale eggs were laid on the inside of the flower pot. The female remained inside fanning while the male swam round and round outside guarding his family.

Next morning (August 6) our first horrified thought was that the eggs had been eaten, but all was well, they had changed colour and now looked almost transparent. The guarding went on most diligently until the eggs hatched on August 9 when the fry were carefully detached from the flower pot and put into a pit behind the pot. The excitement was almost too great for the female who seemed to become practically hysterical and turned on her unfortunate husband. Rather than risk them in a battle, he was removed to safety. The family was brought up along the usual Cichlid lines, the young being moved at least once each day by the female, getting their daily bath and massage in the process.

By August 13 the fry, a pale greenish mass, were beginning

to make tiny hops, but it was not until the 17th that they really swam, coming up in a cloud about midday. From then onwards we fed them just about every time we went near the tank on everything suitable we could find—shredded shrimps, shredded worm, Brine Shrimps, Mikro-worms, hard-boiled egg forced through linen and all the finer dried foods. We never gave them Infusoria and these fry seemed well able to deal with the larger food from the start.

The young *Curviceps* proved most satisfactory fry to rear and we had few casualties as they grew. The female fish was left with the young until October 2 when we removed her in order to feed her up before another spawning.

We believe that other aquarists who purchased *Curviceps* from the same consignment had spawnings before we did and their treatment may have followed different lines. This is not a description of how one must treat these fish but only an account of how our *Curviceps* behaved and a tribute to a most handsome and interesting species.

Hatching and Rearing Spur-thighed Tortoises (*Testudo græca*)

By Mrs. A. Noël-Hume, B.A.

THE object of this article is not necessarily to advise others of the method for hatching and rearing Mediterranean Spur-thighed Tortoises but to record in detail such an event. Whilst a high proportion of the eggs laid by tortoises in this country are infertile, it is always worth trying to hatch them, especially when they are laid by newly-imported specimens.

The female in question was purchased on July 1, 1951 and the well-worn condition of her shell suggested that she was fairly advanced in years. A week later she began to wander around the garden in a distracted manner and also made determined efforts to climb through some chestnut pailing into an overgrown and shady plot of land beyond. This continued for nearly a week during which time she ate very little and spurned the company of the other tortoises. Early on the morning of July 13 she dug a large hole in a flower-bed and deposited four eggs in it, with another female immediately beside her. With her hind legs she scraped the earth over the eggs and briskly walked off in search of food.

The eggs were excavated with the greatest care as it is vital that they should not be turned or jolted in any way. A shoe-box containing two inches of silver-sand had been prepared and the eggs were placed on the top of the sand and another inch layer was added to form a covering. The box was stored on the shelf of a cupboard containing the

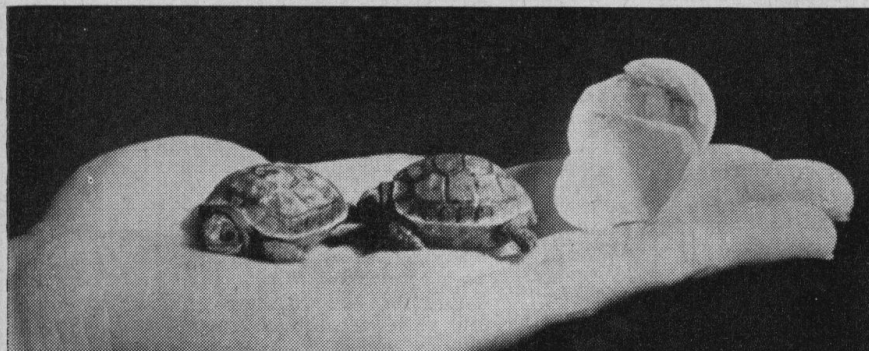
hot water storage cylinder for the house. Here the temperature ranged from 70-90 deg.F. and the box was inspected daily. The sand was not dampened in any way although it is generally thought advisable to do so.

On the evening of October 17, exactly thirteen weeks later, a baby tortoise was seen trying to break the cord which still held it to half of the egg-shell. Once free it crawled away across the sand. The youngster appeared to be extremely lively and took a few drops of water from the end of an eye-dropper. The shell was not hard and the horny scales were not formed on the front legs. Solid food was refused until the following day when it accepted a little lettuce, shredded so finely as to be almost pulp, and a little mashed grape. A small vivarium had been prepared for reception of any creatures which hatched and with the minimum of handling the baby was transferred to this.

Second Egg More Troublesome

Two days later another egg appeared on the surface of the sand and at eight o'clock in the morning a hole was seen in the side. Then a back foot poked through the shell and for the next few hours the baby gyrated inside, using all its limbs and even its head in an effort to widen the hole. At length sand began to filter inside the shell and it was feared that unless some action were taken the baby would be suffocated. The pauses between the efforts to enlarge the hole became longer and exhaustion seemed to be approaching. With the aid of a pair of surgical tweezers small pieces of the shell were picked away until it was possible for the tortoise to give a final heave and free itself. The whole process had taken nearly ten hours and after taking a few drops of water the new arrival joined its fellow.

The vivarium, which was purchased from a shop, has a sloping glass front made to slide in and out, tin sides, a panel of perforated zinc at the back and a tray at the bottom to facilitate cleaning. By cutting a hole in one side and inserting a lamp socket containing a 60-watt pearl electric light bulb a reasonable temperature can be maintained and good illumination provided at the same time.



Photograph]

[Daily Sketch

Mrs. Noël-Hume's young tortoises soon after hatching.

The zinc back can be covered with a piece of cloth to raise the temperature when weather conditions make it necessary. Immediately after hatching the babies were kept at a temperature of 80 deg.F. but later this was lowered.

Water was placed in aluminium milk-bottle tops, with the sharp edges folded over, as the small size of the tortoises makes it hard for them to reach any other container. During the first few weeks both drank at frequent intervals and they also took chopped lettuce, mashed grapes and crushed strawberries. Mashed tomato, peach and stewed apple were refused while grape juice provided a popular alternative to water. There was a tendency to bite both the "water-pots" and some stones used in the arrangement of the vivarium; a baby's plastic teething ring was much used for a few weeks! Gradually the quantity of water drunk decreased as the amount of solid food eaten increased. The eyes of each tortoise often needed bathing with a little warm water and small pieces of uneaten food had to be removed from the mouth.

It was noticed that by the late afternoon the babies became sleepy and in order to simulate natural conditions as far as possible a blue-coloured bulb was substituted. This kept the temperature constant and yet gave almost complete darkness. One side of a small box was removed and when inverted on the vivarium floor it made a "den" into which both tortoises would retire at night. Under this, and in each corner, heaps of lawn mowings provided soft resting places as well as satisfying the creatures' desire to climb.

The problem of a suitable flooring for the vivarium was only solved after several experiments. Sand or soil not only became mixed with the food but in one case was deliberately eaten by a tortoise. A paper or cardboard floor did not give sufficient grip for easy movement. Finally a sheet of thin rubber, which is sold for bathroom mats, was cut to fit the tray and, whilst enabling the babies to move freely, it could be kept spotlessly clean with the aid of a damp cloth. In order to remove the rather unpleasant smell it was soaked for a day in warm water and a strong detergent.

At seven weeks a new phase in their lives began and was characterised by a strong desire to climb which usually resulted in constant falls on to their backs. They appeared to be able to right themselves but only after considerable effort. On one day the elder tortoise was righted ten times in eight hours. In order to prevent too much of this all right-angles at the side of the vivarium were eliminated and a slope substituted. After three weeks the phase passed.

Close Examination of the Youngsters

Although at the time of hatching both babies appeared to be extremely healthy, closer examination showed that the elder had no nostrils making both respiration and eating rather difficult. The other one was normal in all external respects although the shell never fully hardened up and at the age of six months it died. It had eaten on the day of its death and the cause has not been ascertained.

The remaining one has doubled his shell size although at the moment his limbs are small in proportion. At intervals he suffers from acute constipation which is quickly relieved by putting several drops of castor oil on his food. To provide vitamins he is given a twice-weekly dose of a proprietary tonic containing orange juice and halibut oil which he will drink off the end of an eye-dropper. He is fed mainly on chopped lettuce, chopped dandelion leaves or clover with an occasional offering of grated carrot, stewed apple or grape. Bananas are not good food for specimens of under two years as they tend to clog in the mouth. The green foods are mixed with a little powdered cuttlefish to provide calcium for shell and bone growth.

The temperature in the vivarium has been lowered to between 70-75 deg.F. and during the warm summer days the tortoise has been moved to an unheated vivarium on a sunny windowsill. On two occasions, when the outside temperature reached 75 deg.F., it was allowed to walk on the lawn. This was only done when somebody was able to watch it all the time.

Fishkeeping in Austria

By Franz Klausner

SINCE the time Rossmässler established the keeping of aquaria as a popular hobby in Germany, it has also enjoyed popularity in Austria too. The type of fishkeeping in Austria, therefore, is approximately the same as in Germany. As in that country the speciality is the breeding of so-called "problem-fishes". In England I believe the main interests are in line-breeding and the development of new races and varieties of form and colour.

Nearly all kinds of aquarium fishes are kept in Austria, but only in indoor aquaria, because the climate is, in general, too severe (especially in the mountains) to make garden-pond maintenance possible. Therefore the Goldfish and its varieties do not have a large following.

Marine Aquariums Popular

In recent years the keeping of marine aquariums has become increasingly popular due to new methods of aeration and filtration. The sea water is not only filtered through carbon, but also through basalt-splinters, or other materials not containing lime, on which a turf of algæ can grow. This cleans the water biologically too, so that the animals are kept in good condition for lengthy periods.

Before the war aquarists' societies existed only in Vienna and in other towns the hobbyists were not organised into such bodies. During the last few years societies have been formed in other towns. In Vienna there exists a "Society of the Aquarium Fish-breeders in Vienna" which has as its aims the breeding of good and healthy fishes, the furthering of our hobby and the examining of all new aquarium equipment. Members from this organisation have visited other societies.

Nearly all societies have already arranged exhibitions with great success. The only aim of these exhibitions is to publicise the hobby and for this reason the idea is to show as nearly a complete collection of aquarium fish and plants as is possible and even to set up furnished rooms with harmonising aquariums. Some societies also include displays of amphibians and reptiles.

In exhibitions here we prefer to offer the visitor a beautiful picture, as nearly as possible taken from Nature, rather than stage competitive classes. For this reason no show standards exist in Austria. At the last show held in Vienna *Macropodus* fish, Bettas and Guppies were in competitive classes but the fish were judged only according to the personal opinion of the judge.

Aquatic Periodicals

Like all societies in which members speak the German language (Germany, Switzerland etc.) we in Austria read the journal DATZ (Die Aquarien—und Terrarien Zeitschrift), which gives us news of the hobby. Recently an Austrian gardening journal started carrying one page of aquatic articles and local aquatic news.

The Austrian clubs are in keen correspondence with each other and since August 30 of last year they have been formed into the "Austrian Aquarium Federation", with headquarters in Vienna. It has 20 member societies.

Austria had a representative at Amsterdam when the World Union of Aquarists was formed and by such means we hope to extend our beautiful hobby and collaborate with foreign societies to the benefit of aquarists the world over.

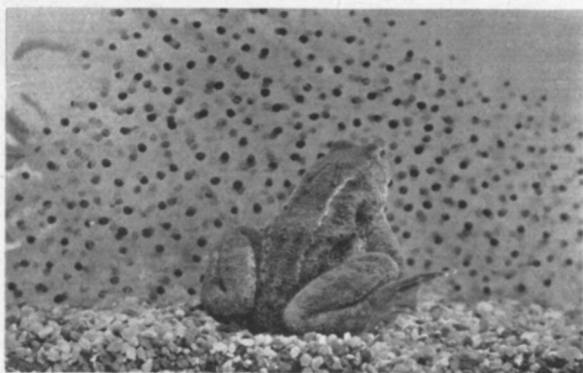
Amphibians and Reptiles of the British Isles

2. The One Native and Two Introduced Species of Frogs

By Alfred Leutscher, B.Sc.

THE frogs of the world number well over a thousand species. There are about 10 species in Europe and only three in Britain. This tiny percentage does not mean to say that nobody ever sees them—in fact they are not easily overlooked. One is common and widespread, and the other two although local, so noisy that once heard they are not soon forgotten.

The Common Frog (*Rana temporaria*) is too well known for description. Even so, it is extremely variable in colour and markings so that it often receives local names. It must be stressed, however, that there is only one species. Colour



Photograph]

[L. E. Day

Female Common Frog (*R. temporaria*) beside a large mass of spawn which she laid in an aquarium the previous day.

ranges from off-white to almost black, and yellows, browns and reds often occur. Not only is there variation in different individuals, but also in the same specimen for camouflage is one of the Common Frog's strong points, and its colour continually changes with the surroundings. The markings, however, are always the same in a particular individual. In some they are large, in others small and numerous, and occasional specimens have hardly any.

Tale of the "Three" Frogs

There is a well-known story, told among herpetologists, of an elderly lady who had three pet frogs in her garden, called Faith, Hope and Charity. Her young nephew, a herpetologist, became suspicious when his aunt told him that they always lived in separate corners of the garden. It turned out, of course, that the trio were one and the same frog, which merely changed colour according to where it happened to be sitting. Had the lady taken careful note of the markings she would have found that these never changed. By this means one can pick out specimens in a pond or vivarium.

Apart from certain Scottish islands and high places, the Common Frog is universal in Britain but in Ireland it probably became an introduced species in 1796. It can be searched for in damp, shady places on waste ground,

Edible Frog
(*R. esculenta*)

Photograph
by L. E. Day.



in ditches or gardens, and along borders of ponds, fields and streams. It is active by day, but usually retires from direct sun and in hot spells. Its camouflage and lively hops are important safeguards against the numerous enemies, of which herons, pike, otters, hedgehogs and grass-snakes are some of the main ones. Man takes a very large toll every year by collecting thousands, for this frog has the doubtful distinction of being the "guinea-pig" of the biologist and teacher. It is the experimental animal of science and the mainstay of the nature classroom.

Common Frogs are usually in their breeding ponds by autumn, for a great number go there to hibernate, buried in the mud and debris at the bottom. At that time they are fully ripe, the males with well developed pads and the females swollen with eggs. It appears, however, that a period of rest and low temperature is required before they will spawn. This is where hibernation comes in, a necessary phase in the reproductive cycle. Frogs which are kept warm and active through the winter do not usually breed.

Spawning Time Depends on Locality

In the pond near my home on the outskirts of London, the frogs are usually out in force during the first sunny spell of early March. In milder Devon there may be spawn a month earlier, and, in Scotland, not until April. A breeding colony is a familiar sight, and one is attracted by the splashing bodies and dull throbbing chorus of the males. The final result is a heap of spawn left in a shallow corner of the pond,



Photograph]

[Mirrorpic

Frogs by a pond in War Memorial Gardens, Amersham, Bucks.



[Photograph]

[L. E. Day

Marsh or Laughing Frog (*R. ridibunda*). Females grow up to 5 in.

then suddenly all activity has ceased and the frogs are gone. This common yearly act is by no means as simple as it appears. A whole sequence of events, which are affected by food, temperature, behaviour, hormones and other chemicals in what is called a "chain reaction", seem to be necessary in the gradual build up which leads to the final spawning act. The British Herpetological Society is now looking seriously into this problem, in an attempt to answer the apparently simple question, "What induces a frog to lay her eggs at a certain time?" A large amount of field data from sources all over the country will be required to help in this work. Any WATER LIFE reader who is in a position to assist is invited to take part in the survey.*

An average spawn mass contains about 4,000 eggs. During the process of development an enormous number of tadpoles are sacrificed as food to the many hungry pond inhabitants, such as fish, newts and insects. Those that survive leave the water as baby frogs, usually some time in June. A shower of rain brings them out—one minute there is none and the next the paths around the particular pond are swarming with the young creatures. This sudden exodus may have given rise to the belief that it has been "raining" frogs.

Most of us have reared tadpoles, from egg to baby frog, by feeding them in a dish of water, on plants, chopped

*Special forms, set out as questionnaires for recording observations on British frogs and toads, may be had on application to the Secretary, British Herpetological Society, c/o Zoological Society of London, Regent's Park, N.W.1.



[Photograph]

[L. E. Day

The dykes of Romney Marshes where Marsh Frogs are now well established.

Earthworm and pieces of raw meat. Yet I wonder how many readers have successfully reared a baby frog to the adult? As tadpoles they browse on their diet of plants but baby frogs, like their parents, catch living prey on their tongues, and the difficulty is to find sufficient food of the right size. A frog has been reared, under controlled conditions, through the tadpole stage up to adult and it lived for twelve years. In the early stages it was given green-fly and tiny Earthworms.

The Edible Frog (*Rana esculenta*) is an introduction, brought over from the Continent during the past 116 years. The earliest record is given as 1837, when some specimens came from Paris and were set free in the fens and meres of Cambridgeshire and Norfolk. They have now largely disappeared from their old haunts, but can be seen nearer London, in places like the gravel pits at Ham, near Teddington, also in ponds in West Kent and on Hampstead Heath. Last year I saw them in a pond near my home at Wanstead, Essex.

The Marsh Frog (*Rana ridibunda*) is much more recent. It was released from Hungary into the Romney Marshes, Kent, in the year 1935, and now covers a very wide expanse of dykes. A much fuller account of this frog has been given in a previous article (WATER LIFE, Vol. 4, No. 2, April, 1949).



[Photograph]

[E. E. Steele

Springtime in the pool. Mature frogs and their spawn.

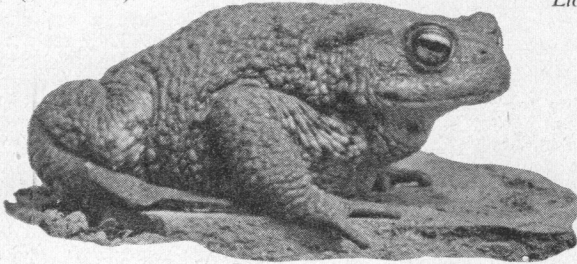
The habits of Edible and Marsh Frogs are very similar, and at one time it was thought that they were merely varieties of the one species. They are known to hybridise where their territories overlap in Central Europe (the Edible Frog is the more westerly species and the Marsh Frog occurs to the east). Both are very aquatic, excellent swimmers, and usually keep together in their respective colonies for most of the year. The males can blow out balloon-like vocal sacs from the angles of the mouth, producing loud croaks which can be almost deafening when a whole colony is in full chorus. Readers may have heard the recordings of Ludwig Koch, played on programmes of the B.B.C. These loud notes, and the bright greens and browns will distinguish both the species from our native frog.

Marsh Frogs can grow to a very large size, and differ from the Edible Frog in that usually the dorsal stripe is missing. Both are late breeders, and spawn does not appear until May or June. On the Continent all three specimens are caught as food, the hind legs being used as table delicacies.

The interest displayed in frogs by the biologist is mainly due to their position on the animal tree. As *Amphibia* they represent a form of life which "sits on the fence", in a manner of speaking, between the true aquatic animals (fish) and the terrestrial reptiles.

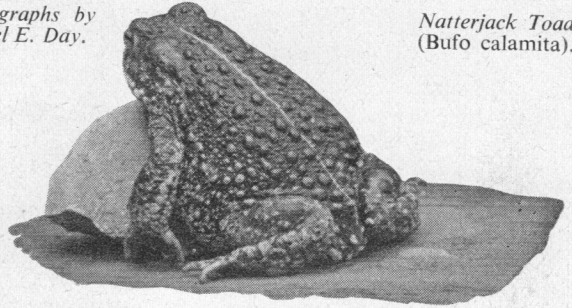
Amphibians and Reptiles of the British Isles

Common Toad
(*Bufo bufo*).



Photographs by
Lionel E. Day.

Natterjack Toad
(*Bufo calamita*).



3. Common and Natterjack Toads

By Alfred Leutscher, B.Sc.

THE difference between a frog and a toad is still a puzzle to some people, who find these little animals hopping in their gardens or down at the pondside. With the British species there need be no difficulty, if the following points are noted. All the three British frog species have moist, smooth skins, longer limbs and stronger webs to their toes. Their heads are more pointed and the colouring is usually brighter. The two British toads, on the other hand, have dry, warty skins, short limbs, a more squat appearance and rounded snouts. The parotid glands behind the head are prominent. The toads are less agile and more nocturnal in their habits.

One of the species, the Common Toad (*Bufo bufo*), is widespread in Britain, occurring on most of the mainland but absent from Ireland. Abroad it spreads through Europe, northern Asia and North Africa. Most Common Toads are of a brownish colour and blend remarkably with their surroundings. Some are yellowish, greyish or an olive shade, and a few are a striking brick-red. The male is smaller rarely exceeding 2½ in., whilst females are about 3 in. long. Sometimes giants occur, measuring as much as 5 in. An Italian specimen I once saw at an aquarist show was so enormous that for a moment I mistook it for the Giant Water Toad of S. America, the largest toad in the world.

These size differences are most marked when the toads are breeding, and occasionally give rise to a remark that a mother toad is giving its child a ride on her back. Needless to say the smaller male is fully mature, and will resist interference when picked up, by protesting loudly with a high-pitched croak and lusty kicks against the intruder's fingers. Because the males are far more numerous in the breeding colonies, there are fights for possession of the females, and large bundles of toads may be seen, where as many as eight or ten little males cling tightly to one hapless female, or each other. She is often killed in the process.*

In the south of England breeding

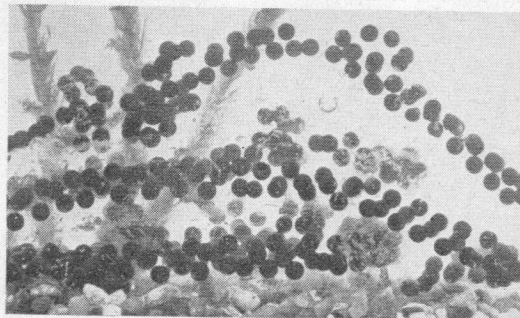
*A warning to fishkeepers. In the absence of a mate, the urge in a mature male or female toad to grip anything is so strong, that it will sometimes grasp and injure, even kill, a torpid fish. All toads and frogs should be removed from a fish pond during spring, and liberated somewhere else. In cases of difficulty or trouble, the author will be pleased to advise.

usually occurs a month after that of the Common Frog, it taking place towards the end of March or in early April. Deeper water is chosen, usually among reeds, which become entwined with the long strings of spawn containing an average of 4,000 eggs. The tadpoles differ from those of the Common Frog by being darker and having a rounded tip to the tail.

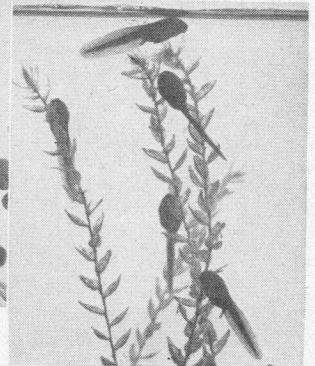
In the breeding cycle of this well-known toad there occurs a yearly migration which is perhaps one of the most astonishing acts of Nature performed in this country. It is most particular in the choice of its spawning sites, much more so than frogs, and every spring the creature makes a regular journey to the same spot. Waking up from hibernation, which may have been spent in the ground or in a drain, cave, cellar or woodpile, each toad makes its slow but sure way to the chosen goal. Ditches and other ponds are ignored on the way, obstacles are climbed and roads are crossed, regardless of danger. Bodies are squashed by cars, sometimes in hundreds, where the migration crosses a highway. Little is seen of these journeys, for movement takes place mostly after dark.

Frog and Toad Survey

Interest in this extraordinary behaviour has lately been revived by the British Herpetological Society, which is investigating the problems in its Frog and Toad Survey (see my article in the last issue). By marking toads for future recognition, and by actually following individuals after dark with a torch, it has been possible to follow and map out their routes. It is hoped to be able to publish some



Toad spawn is laid in long double strings (see photograph above). Right: A number of toad tadpoles.





Toads usually select the deeper areas of ponds where grasses and reeds occur.

information on this migratory instinct in a future number of the Society's journal.

Turning to the second species, the Natterjack (*Bufo calamita*), the difference is soon apparent. It is smaller, the warts on the back flatter, the hind limbs shorter, and the colour quite distinct. It is mainly olive to grey-green, with the warts marked in red, brown or green. Along the back is a distinct, yellow stripe. In some places this little toad is called the Sulphur-back or the Running Toad. Instead of hopping it runs over the ground in a mouse-like fashion. "Natterjack" probably comes from the original *nædre*, meaning nether or low-down, and "jack", meaning something small. "Calamita", from Latin *calamus*, means a reed. Natterjacks are fond of breeding in shallow water,

among reeds. This is a protracted affair. They are in the water by March, and spawn may be laid until August, so that tadpoles of all sizes occur. In Britain, May and June seem to be the common spawning months—at least for the south. The calling of the males is very loud, and more of a distinct nocturnal chorus than that of Common Toads.

Natterjack Toads have a scattered distribution in Britain. They seem to prefer dry, sandy places, often in coastal areas, especially in Dorset, Lancashire and Norfolk. They will tolerate brackish water. In the London area their nearest locality is in the Woking district. A well-known colony can be seen, and heard, in the Little Pond at Frensham, Surrey. The Natterjack is a W. European species. Further east it is replaced by the attractive Green Toad (*Bufo viridis*) which has similar habits.

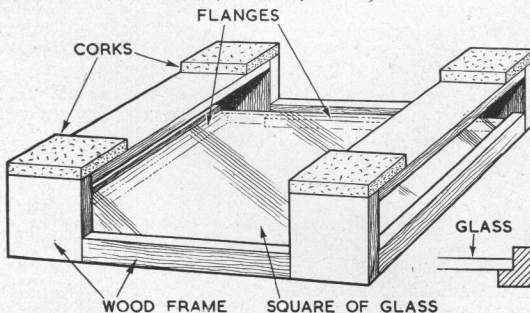
Toads have always been in the unhappy position of being objects of abuse and even fear. Even prominent naturalists, in the past, have had little time for them. One can read in the old manuscripts such phrases as "the most hideously deformed of all creatures" and "objects of disgust and loathing". Toads are only venomous in the sense that their skins secrete a poison under irritation. This is purely protective, so that a slow-moving animal can enjoy a certain degree of immunity from its enemies. In cases where a toad is eaten by other animals the skin is usually removed first. Toad tadpoles are almost always rejected by fish, newts, etc. when given to them as food. The question of a

Readers' Hints and Tips

Floating Frame Feeder

THERE is one stage during the raising of broods of young fish that has caused me considerable concern. It is the time when the fry are feeding at, or near, the water surface. This is, of course, during the first few weeks after they have hatched or, in the case of livebearers, after they have been dropped by the parent fish. Even those fish which must be fed initially on Infusoria will continue to remain close to the surface when they begin to take larger food, e.g., fine dried food and Mikro-worms.

It has been my experience that these types of food quickly drop to the bottom of the tank and remain there ignored by the young fish. Faced with this problem I constructed the floating frame feeder which is illustrated here. The square of glass rests on the wooden flanges as shown. Surface of the water is at the level of the corks.—(G. R. Hill, Herne Hill, London, S.E.24).



(10s. 6d. is paid for all published hints and tips.)



Photograph]

[S. Crook

A pair of toads at the grass edge of their natural pond.

toad's ugliness is largely a matter of opinion. It would be as true to say that "ugliness is only skin deep", and there are many animal lovers with great affection for this quaint friendly little creature. Shakespeare has put on record one of the loveliest objects in Nature, "the jewel in a toad's head", meaning the eye.

Most Intelligent Native Amphibian

Speaking from experience I can unhesitatingly recommend the toad as one of the most engaging of small pets. It is certainly the most intelligent of our amphibians, has many interesting habits, and can live with little care and trouble for many years—up to 40 years has been recorded. In the open it eats enormous quantities of insects, and its value need hardly be stressed. It is indeed the gardener's best friend.

African Clawed Frogs (*Xenopus laevis*)

Strange in Their Ways Yet Easy to Keep

By Viscountess Bury

AMONG the strange creatures that can be kept as pets are the Clawed Frogs of Africa. They belong to the Class *Amphibia* (Order *Salientia*).

For those who like Amphibians, such as frogs, toads, newts and salamanders, they could not find a more interesting species to study, or one which gives so little trouble.

The Order *Salientia* comprises nearly fifteen hundred species of frogs and toads, the Clawed Frog being one of the *Xenopus* Genus, members of which are tongueless.

The Clawed Frogs have five toes in their webbed hind-feet which resemble those of the frogmen of the second World War. The webs have red veins running through them, and the three inner toes are tipped with black horny sheaths, like claws, hence the name. The front feet are quite different in shape. They are formed like a hand with four long tapered fingers and are not webbed.

Colouring of the Creature

The body is olive-green in colour, with specks of mottled black across the back. The underneath part is pale grey, almost verging on white.

Some time ago they were not considered a hardy species, but it is known now that they will thrive in an outside garden pool. They were also supposed to be entirely a water inhabitant, but again they have been known to crawl out of one pool and into another.

They breed very prolifically, laying about a hundred eggs



Photograph [G. J. M. Timmerman]
Underwater picture of *Xenopus laevis* showing the dark dorsal colouring and webbed hind feet with their three black tips.

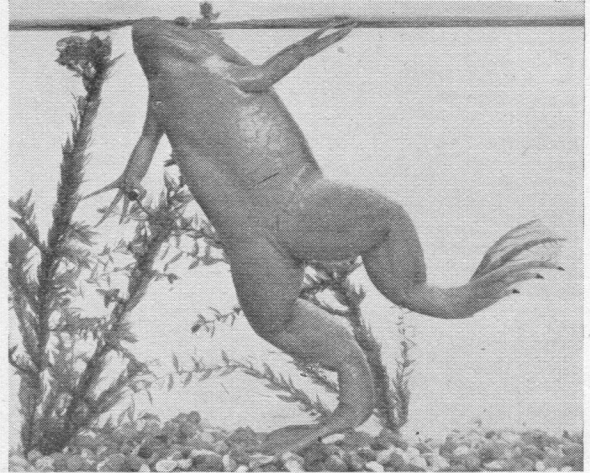
which are attached to aquatic plants. The tadpoles have long feelers at the angles of the mouth and these grow to a length equal to that of the head and body.

The courtship, or mating, of these Batrachians is most interesting. The males, far smaller than the females, seize their mates in a close embrace which lasts for several weeks. Eventually she lays her eggs which are immediately fertilised by the male frog.

In medical laboratories the Clawed Frogs are used extensively for pregnancy tests.

I have a pair of these frogs and they live in an aquarium of orthodox shape, 16×12×12 in. They are very graceful swimmers but, being rather rapid in their movements, they are apt to uproot the plants in the tank.

The proprietary forms of Sea Cypress (page 135, June 1952, WATER LIFE), are ideal for decorating the tank. The base of each bunch has a ring of lead around it which makes it sink to the bottom of the tank so no planting in the shingle is required. Even when the frogs are swimming rapidly they merely push the Cypress out of the way doing no harm, whereas the ordinary aquatic plant would be uprooted.



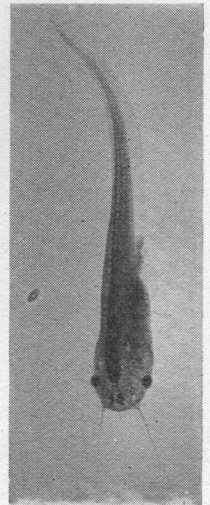
Photograph [L. E. Day]
Clawed Frog with the whitish underparts clearly visible.

In my aquarium there are several rocks which the frogs seem to like, and after a rather large feed they squat behind them. Apart from being necessary for their well being the rocks greatly add to the appearance of the aquarium, especially if they are well grouped and attractively shaped.

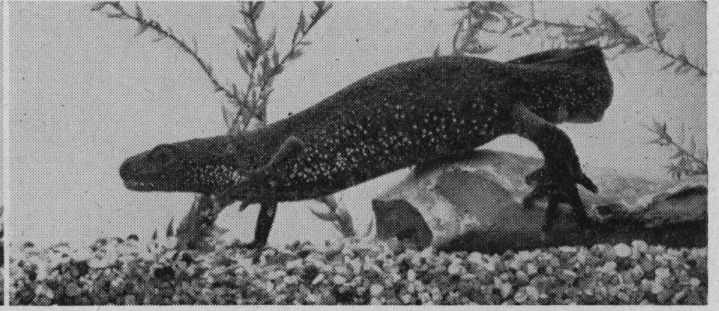
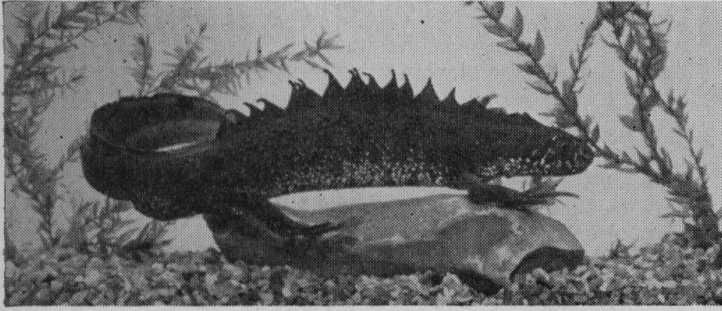
The Clawed Frogs are carnivorous, and their food consists of mealworms, shredded raw meat, Earthworms or pieces of raw fish. They are very ready feeders, and it is most entertaining to watch their strange antics as they cram their mouths full of food. They seize a morsel in their mouth and start ramming it in with their long tapering fingers. They are rather like greedy children who have forgotten their party manners! Very often they blow the food out again and then swoop on it with renewed zeal.

My pair of frogs live in their tank, which is full of water, all the time. It is advisable to change the water once a week in case any uneaten food gets left behind in the shingle and rots. Immediately remove any pieces of meat which have turned white. The frogs come to the surface from time to time and are apt to jump out, but this is a rare occurrence and usually happens if they have been frightened. It has only happened to mine once, and that was because I had them in a very shallow aquarium. A tin lid, bored with holes, can be put over the top of the aquarium for safety and then there can be no danger of this happening.

They are a very interesting species to study, and like all the Family *Pipidae*, to which they belong, they have no eyelids or tympanum. They make fascinating pets and hours can be spent watching their strange and weird performances.



X. laevis tadpole in a quite early stage of metamorphosis.



Crested or Great Warty Newt (Triturus cristatus). Left is a male with high toothed crest and, right, a female.

Amphibians and Reptiles of the British Isles

4. Three British Newt Species as Interesting Vivarium Occupants

By Alfred Leutscher, B.Sc.

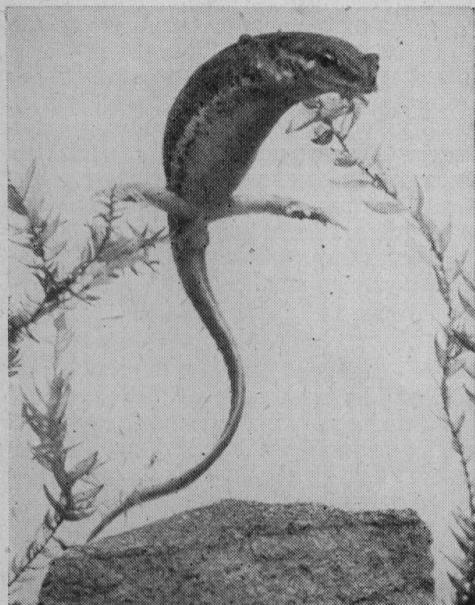
To complete the survey of *Amphibia* which are native to Britain, we have still to include the species which come within the tailed Order, called *Caudata*. This is a comparatively small group confined to the Northern Hemisphere, and universally known as salamanders. Other names are used in different countries, such as the term "newt" which is peculiar to the English language. Its etymology is not clear, but it could be a derivation of the old English "eft" which once embraced both newts and lizards, i.e., water eft and land eft. Indeed, early naturalists often confused the two, yet recognition should not be difficult. A newt, which is an amphibian, has a naked skin—a lizard, being a reptile, has a scaly covering. By saying "an eft" quickly we get the sound of n-eft. In modern spelling the w replaces the f, so finally we get "newt".

When out on land a newt may resemble a lizard, as the skin is often quite dry and dark. We can find it under logs and stones. Not a great deal is known about the newt's land existence, for its movements take place mostly at night. It must travel quite considerably, for water-filled bomb craters and newly-made ponds, which may be some distance from existing water, become mysteriously crowded with newts in a very short time.

Newts breed readily in the most unusual places—in aquariums, small pools, even in water troughs and rain butts. The babies hatch from eggs, and resemble the parents

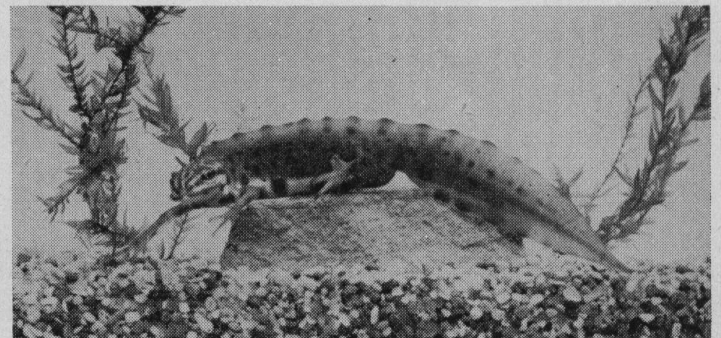
much more closely than do the tadpoles of frogs and toads. By springtime the parents are in the water after their hibernation and are sluggish if the weather is cold and may even be buried in the pond bottom. If debris of leaves, etc., is dragged on to

Female Smooth Newt (T. vulgaris), paler in colour and lacking the crest of the male. Colouring of this species is very variable.



the bank, even as early as February, newts will sometimes crawl out. Some of them actually spend the whole winter there, beneath the water (a habit of frogs). Being amphibians they can all breathe through the skin, taking in what small amount of oxygen they require.

As the temperature rises, activity is resumed. It is then we notice the males pursuing the females, or rising gracefully to the surface to take a fresh supply of air. It is these movements and the bright colouring which make newts such an attractive subject for the aquarium. Breeding commences about April and may go on until July. There is no kind of embrace, or *amplexus*, as in frogs and toads,



Photographs]

[L. E. Day

Male Smooth Newt with wavy crest along back and tail.

but a curious type of courtship behaviour on the part of the male. The male in all three British newt species develops along the back and tail a distinctive crest, and may be recognised by this.

A male recognises a female by sight or scent and proceeds to undergo a lively courtship "dance". During these antics the back is arched and the tail curled round to face forwards. The extreme tip begins to vibrate rapidly. Readers who have kept newts are no doubt familiar with this, yet the purpose of the "tail wiggle" is not clear. It may take the form of sexual excitement on the male's part, as a means of attracting a mate. It has even been suggested that the male exudes a perfume, which is then driven towards the female in a current of water set up by the lashing tail.

The result of all this is that the male will deposit a small, whitish object, called a spermatophore. It is a cluster of many active sperms which comes to rest on the pond bottom. I have managed to observe this in the aquarium. The female then crawls over it and with her hind feet presses it against her cloaca. The sperms then ascend into her body, where from time to time the eggs are fertilised before they are laid. This unusual reproduction seems to be unique

in the Animal Kingdom, and confined to the salamanders in general. Later on the female deposits her eggs here and there among water plants. The British newt normally selects a leaf and cups it with her feet. When the egg is laid it adheres with the jelly-like coating, and the mother usually folds the leaf around it for added protection.

Observing the Breeding Behaviour

All this interesting behaviour has been carefully observed in the aquarium, for it is not difficult to keep and breed these creatures. In some ways they are rather stupid. A male will often "court" another male, or a female from a different species. So far as is known the British newts will not hybridise. I have managed to induce the "tail dance" by using imitation models of female newts held in the tank. To my surprise a newt once "courted" my finger when I held it below the water!

Newts become exceptionally tame, and will soon take meals from the fingers. They will also snap at a moving finger in an attempt to swallow it. One method of catching them is to dangle a garden worm on the end of a piece of cotton in the pond. No hook is required.

The baby newts hatch in a week or so, and retain their gills until metamorphosis which takes place about 2½-3 months later. They then breathe air into their newly-formed lungs, and crawl out of the water. Those larvæ which hatch late in the season may "overwinter", and remain with gills until the following year. At this early age the different species cannot always be identified, and sexing is impossible without dissection. The adults, however, should not give much trouble.

Our largest species is the Crested or Great Warty Newt (*Triturus cristatus*) and it grows to six or seven inches. It is a deep olive brown, almost black, blotched with darker marks, and speckled with white along the flanks. The belly is marked with yellow or pale orange spots. During the breeding season the male carries a high, toothed crest, which gives it the appearance of some prehistoric monster in miniature. It is quite harmless. The female may show a yellow or orange line along the middle of its back although this is not present in all specimens.

There are various Continental races of this species, often for sale in shops under a number of names, such as Triton, Italian Newt and even Salamander. The European Salamander (*Salamandra salamandra*) is glossy black and yellow and is an entirely different amphibian. The distribution of the Crested Newt in Britain is widespread but here and there it is absent, especially from ponds near large towns, where it is a favourite with the school children and has little chance of survival.

Common Newt (*Triturus vulgaris*)

The Smooth or Common Newt (*Triturus vulgaris*) is far better known. It grows to about four inches, and colour varies greatly, from brown to olive, even reddish, marked with deeper spots which are large in the male and small in the female. The underside is whitish to yellow or rose with a median area which is red or orange. On this are black spots which are small and even absent in the female. The throat is also mostly spotted.

This species is widespread but less common towards the

west. The Smooth Newt is the only species found in Ireland, where it is known as the Man-keeper. There is a quaint belief that if one sleeps upon the ground near water, with one's mouth open, a newt is liable to crawl in. When drawing water from a well it is advisable to keep the mouth shut!

The small Palmate Newt (*Triturus helveticus*) grows to about three inches. Whilst breeding the male develops a low, straight crest, and black webs between the toes. The tail ends in a curious fine thread. The female can easily be confused with a small Smooth Newt. The way to recognise it is by the squarish body, and the absence in most specimens of spots on the throat. This area, in both sexes, is a clear, creamy white. The general colouring of Palmate Newts is olive-brown, marbled rather than marked with darker spots which tend to form rows of tiny spots along the tail.

Keeping Newts in an Aquarium

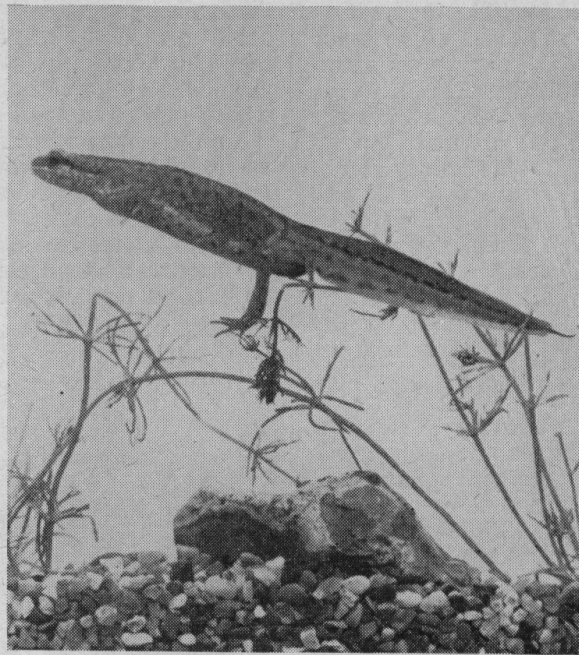
Keeping newts in the aquarium is a fascinating pastime. The usual aquarium set-up, with sand and plants, etc., is quite suitable except that some kind of land space is required so that the little creatures may crawl out from time to time. This is provided in a number of ways—floating cork or wood being the simplest. Another way is to place flat stones or slate on a foundation of rocks, or on an upturned flower-pot. The platform itself is not sufficient, as the newts like something to crawl under. A "roof" can be made with a piece of raised slate or bark.

When entirely terrestrial, after the breeding season, the newts can be transferred to a vivarium, which must provide the humid conditions which they enjoy. A converted aquarium will do, or a fern cage, in which shade- and moisture-loving plants can be grown. Rocks, bark and loose branches arranged here and there will provide the necessary cover. A little ingenuity and careful planning can produce a most attractive home which will be no disgrace to any room. A more satisfactory and permanent arrangement is the so-called aqua-terrarium, in which the aquarium is combined with a miniature garden. The animals can then enter and leave the water as they choose.

To rear newts it is best to remove the plants on which the eggs are laid to a separate receptacle containing shallow, well-matured water. The youngsters will grow up on a graded diet of Infusoria, *Daphnia* and *Tubifex*, as in the case of fish fry, remembering that newts are carnivorous throughout their lives. The adults will take *Daphnia* and *Tubifex* in addition to small garden worms, slugs and insect larvæ. They feed both in and out of water. Larger specimens should be kept away from smaller ones, as one may eat the other.

Feeding on Raw Meat

Many newts will also take raw meat or fish in small pieces, which is about the only kind of non-living food suitable for them. They should be handled as little as possible and then only after wetting the fingers. Occasionally they pick up fungus complaints, which are either due to poor health or dirty surroundings. There is no reason why they should not live many years in captivity when kept under the conditions outlined in this article and some records go up to twenty-five years.



Photograph]

[L. E. Day

Male Palmate Newt (*Triturus helveticus*) showing the unusual "thread" at the termination of its tail.

Amphibians and Reptiles of the British Isles

5. Common and Sand Lizard and the Slow-worm

By Alfred Leutscher, B.Sc.



Gravid female Common Lizard (*Lacerta vivipara*). These lizards are found all over Gt. Britain. Photograph by S. Crook.

SO far in this series of articles we have been considering the eight species of amphibians which are native to Britain. To complete the picture we must now turn to the reptiles—recognisable by their scaly covering—and here the numbers are even less. We can boast only six present-day species.

The days of dinosaurs, crocodiles and tortoises in these islands now belong to the distant past, and to-day we are left with a poor legacy. Three lizards and three snakes are all we can show for a great Class of animals which once dominated the earth. Snakes and lizards, which make up the Order *Squamata* (from the Latin—*squamus*, a scale), are of comparatively recent origin. They evolved somewhere towards the end of the Dinosaur age, during the Cretaceous Period, about 70 million years ago. Were it not for the Ice Age, which swept this country millions of years later, the numbers of native lizards and snakes might have been very much greater, but the intense cold drove them all away. It was only after the last wave of ice had retreated, about ten thousand years ago, that a few species managed to wander back, and this had to take place during the short period of a few thousand years before Britain broke away from the Continent and became an island. Since Ireland separated first, it received the fewest species. To-day it has only one native reptile, the Viviparous Lizard (*Lacerta vivipara*).

This well-known lizard may be found on the mainland almost anywhere from Land's End to John o' Groats, both at sea level and on mountain tops. In Europe it ranges from the Atlantic sea-board, across Europe and well into Asia, and from the southern mountains to some way within the Arctic Circle. In length it measures up to 6 in., provided that the tail is still intact. The colouring is extremely variable, and not easy to describe even in general terms. The ground colour may be some shade of grey, yellow, brown, even reddish or black, and marked with longitudinal rows

of light spots often with a dark, vertebral line. The flanks each have a broad dark band edged with whitish lines above and below. The lower-parts in the male are usually brighter—an orange or vermilion—heavily spotted with black. Some males reflect a beautiful green tint in certain lights. The female below is much paler—a yellow, orange or grey—with fewer spots.

The Common Lizard will often be seen during a walk in the countryside basking with its little body flattened against



Photograph]

[L. E. Day

Sand Lizard (*Lacerta agilis*), an attractive species that, unfortunately is becoming very localised in its distribution.

a log or wall. It is by no means easy to catch but, if one sits quietly near its home, it will soon come out and even crawl on to a hand or clothing. It lives in dry, sunny places, such as in hedgerows, heaths, commons, woodland glades, waste land and gardens. The young are born alive (ovoviviparous) as the name suggests. They are "laid" in a transparent bag from which the youngster struggles out. This usually happens in July or August, when the females can be found swollen with young. It is even possible to predict the numbers of young, by counting the bulges in the mother's body. From seven to nine is an average family, and the babies at birth are almost black in colour. Sometimes eggs containing yolk are laid, and these have actually been found in high places, such as the Pyrenees. It appears that these mountain lizards have retained the primitive, egg-laying habits of their ancestors. I have induced British specimens to lay eggs, by keeping them in cool and damp surroundings.

The Sand Lizard belies its scientific name of *Lacerta agilis*, and is by no means as swift as its smaller relative. The size here can be up to 9-10 in. especially on the Continent. It is mainly a W. European species and recognised by the much blunter head, more thickset body, and, to some extent, by the colouring. Here again this is variable. The male is usually a grey-brown or reddish, with bright green sides and underparts during most of the summer.



Photograph]

[L. E. Perkins

Slow-worm (*Anguis fragilis*). This specimen has lost its tail and shows only a developing stump in its place.



Left: a typical area where Common Lizards might be found. Right: the type of country side inhabited by Slow-worms

Photographs]

[L. E. Day

It can easily be mistaken for the Continental Green Lizard (*L. viridis*), which occurs now and then in this country as an escapee. Specimens liberated here and there, as in S. Devon in 1937, can still be seen. The female Sand Lizard is more uniform in colour, grey or brown, with the flanks sometimes

be in grey, brown or even black, sometimes with dark, longitudinal lines along the body, especially in females. The smaller male has a more noticeable neck region and is sometimes scarred due to bites from its rivals. Specimens are sometimes found with a scale here and there, coloured a deep blue. These very



marked with rows of conspicuous "eye-spots" (dark brown patches with white centres).

Mating of this species takes place in late spring, the mother laying her clutch of eggs in June or July, often in captivity, by digging a nest in the loose soil and then covering them up. The nest is often dug under a log or stone. An average of eight to 10 eggs is laid, the young appearing in August. They look like pale replicas of the parents.

By nature the Sand Lizard is a gregarious reptile and lives in colonies. In this country it seems to prefer sandy and heath-land country, such as sand-dunes and where heather grows. The distribution in Britain is very patchy, and many of the old records are now unreliable. It is a sad fact that our discovery of the seaside for holiday resorts (this goes back little more than a century), has resulted in the extermination of many old haunts. Very little coast-line suited to this lizard is now left undisturbed. Here and there it can still be seen, and the most likely area is its main stronghold in the south, on the dunes and heaths around Poole Harbour in Hampshire and Dorset. Other localities are the Frensham area of Surrey, and parts of the Lancashire coast. The collecting of specimens, either for the vivarium or for sale in pet shops, has not helped in retaining it as a native species, and it is to be hoped that this lizard will be given all the protection it needs, before we lose the species altogether.

Both these lizards should be readily recognised in the field. It is the third species, the Slow-worm or Blind-worm (*Anguis fragilis*), which may lead to confusion. Its serpentine body and absence of visible limbs has probably caused the destruction of many a useful Slow-worm, in mistake for a snake, which is a pity since this creature devours a great number of slugs and other garden pests. A good-sized specimen measures eighteen inches, with tail complete, which is not often the case as a surprising number of Slow-worms seem to lose their tails. A stump-like substitute then grows in its place. The lizard-like characters may be seen on the head, such as the scale pattern, the moveable eyelids, and the fixed jaw bones which can only be moved for opening and shutting the mouth. This limits the size of the prey. In snakes the belly scales, or scutes, are broad in shape, whereas in the Slow-worm, the small, tight-fitting scales are more or less uniform in size all over the body.

Colour is again variable and may

beautiful Blue-spotted Slow-worms are more usually males.

Slow-worms may be found almost anywhere in Britain, except Ireland, in places where they are undisturbed. Damp woods, borders of lanes and fields, waste ground, railway cuttings and country churchyards are some of the most likely places in which to find them. In dull or very hot weather they will retire, and are fond of burrowing into soft soil or crawling into rodent burrows. They can often be found hiding under planks, stones or sacking which may be lying about on farm land. A search in a rubbish dump near a village or wood will often reveal a Slow-worm or two.

The babies are pretty little creatures and easy to identify by their colour. This is a silvery grey above, with a dark spot on the head which extends along the back as a thin, black line. Families of about ten or more appear in August. They are born alive.

The Lizards (Sub-order *Sauria*) are well known to reptile lovers and usually make very satisfactory vivarium pets. For reptiles they show a good deal of intelligence, and display a lively interest in their surroundings. Their hearing is keen and they tame readily. When keeping them as pets their love of sunshine must be borne in mind. A complete lack of this may lead to trouble eventually. This is due to deficiency in vitamins provided by sunlight, and skin complaints can arise in the form of ugly lumps and blemishes. Dry vivariums should be used. A common fault is to keep lizards in damp conditions so that the skin is never quite dry. This encourages fungus infection, and the creatures then have difficulty in sloughing (i.e., shedding their skin).

A vivarium containing dry sand, moss and heather, placed in a sunny spot and provided with a small drinking dish, is quite sufficient. Variety in diet is beneficial. Both Common and Sand Lizards will eat all kinds of insects, Meal-worms, spiders, occasional Earthworms and even sweet fruit.

By contrast the Slow-worm prefers shady and damper surroundings. A good layer of leafmould can be placed in the vivarium, with hiding places of stone, bark, etc., and a drinking dish. It likes to burrow sometimes for day on end, coming out to feed on slugs and Earthworms and even small pieces of raw meat when tame. It usually becomes tame readily, and will entwine one's fingers with a surprising grip, rarely biting, and moves about in a deliberate fashion. It is an ideal children's pet and has lived for 46 years.



Photograph]

[L. E. Perkins

The head of a Slow-worm with the scale pattern, an identifying characteristic, clearly visible.

Amphibians and Reptiles

of the British Isles

6. Harmless Grass and Smooth Snakes and the Shy but Venomous Adder

— By Alfred Leutscher, B.Sc. —



Photograph] [L. E. Day
The frequently-found Grass Snake (*Natrix natrix*).

IN the present series of articles I am attempting to give a general picture of the fourteen species of animals which make up the list of reptiles and amphibians native to Britain. We now come to the snakes. Whenever this subject is raised the immediate reaction seems to be either one of interest, even pleasure, or of revulsion and, in many cases, a distinct fear. There are no half-way measures—one either likes or hates the serpents.

When challenged, the person who dislikes them usually finds it difficult to supply a tangible reason. Some kinds of fear may be psychological and difficult to explain. Fear on religious grounds, because of what we read in the Bible, can be ruled out. In some parts of the world the deadliest snakes are held as sacred, and even worshipped. Certain people fear snakes because some are venomous, and "sting with their tongues". This puts them in the same class as toadstools; because one or two happen to be killers all are treated with suspicion. It even applies to our own timid and inoffensive little Adder, which will only bite in self-defence. The fear of Adders is grossly exaggerated and deaths from their bite in this country are rare. In England and Wales during the last fifty or so years less than a dozen humans have died from its bite.

Fear Through Ignorance or Wrong Instruction

Probably the greatest contribution towards the fear of serpents in Britain, is ignorance and wrong instruction. It is certainly not instinctive, for young children in the care of adults who experience no fear may be taught to love and fondle a snake, as much as they would a kitten or puppy. For such enlightened times as the present it is very surprising what curious beliefs and superstitions still survive, with a result that snakes are so often killed on sight, and generally so persecuted that it is remarkable how they manage to survive. People who understand and have a regard for them are concerned about this annual slaughter, and are quick to defend them. What is needed is a few more champions, like the naturalist Hudson, to uphold the much despised and lowly serpent.

I have written in this vein at some length because as vivarium subjects the snakes have a fascination quite out of the ordinary. Many will tame readily, being quite harmless, and they have a number of strange things to teach us.

One of our harmless native species is the well-known Grass or Ringed Snake (*Natrix natrix*). It also has a wide distribution on the Continent. Many of the Grass Snakes sold in the pet shops come over from S. Europe. The species is recognised by its olive brown colouring, its slender,

tapering body and the yellowish "collar" behind its head. The creature's movements are quick when it is disturbed and it will dart away into the undergrowth or dive into the nearest water, this species being an excellent swimmer. When caught it puts up a fine display of bluff. It will hiss and dart its head, behaving in a most venomous fashion and also void an evil smelling fluid. Sometimes it appears to feign death, going into a curious trance by turning upon its back and opening its mouth. This has often happened with specimens I have caught, but I have never received a bite.

Taming the Grass Snake

Careful and frequent handling will soon tame the Grass Snake into a docile pet which may in time become so tame that it will take food from one's fingers. The main diet in Nature is frogs and toads (some specimens prefer one, some the other), newts, fish and, occasionally, small mammals and nestlings. A pet snake will often take food freshly killed.

In captivity Grass Snakes frequently mate and even lay eggs, which have then been successfully hatched by a number of owners. The time of laying is late June or July and females then seek out damp, warm places in rubbish dumps, haystacks, manure piles and pockets of leaves in ditches and hollows. Incubation lasts about ten weeks and in September the young hatch out as pretty little creatures with bright markings. Whether or not they feed before they hibernate I have never been able to discover, but their starvation until the following March would not appear to harm them. Little is yet known about the natural foods of our baby British snakes. The Grass Snake occurs in Britain



Photograph] [L. E. Day

A species of limited distribution, the Smooth Snake (*Coronella austriaca*). The dark marks on its back are separate and do not form an uninterrupted zig-zag line as in the Adder.



[Photograph]

[S. Crook

The Adder (*Viper berus*), Britain's only poisonous snake.

from the south coast to the Scottish border, becoming scarcer as one goes northwards. It seems to be absent from Scotland as well as Ireland.

Our rarest serpent is the Smooth Snake (*Coronella austriaca*), which is now confined to a few heathland areas in the south of England, especially in Hampshire, Dorset and Surrey. Only an occasional record is given each year. In 1949 I had the good fortune to find a specimen on a Dorset heath which is still in my collection, enjoying good health and feeding regularly. Whereas Grass Snakes frequently grow to three feet or more, the Smooth Snake rarely exceeds two feet in Britain. In habits it is rather sluggish, but quick to bite the hand that holds it. This bite is usually quite harmless, apart from making a scratch, since the teeth are small and non-venomous. This snake gets its name from the silky texture of its skin. The scales are quite smooth and have no keels on them. At first it may be confused with the Adder. The colour is a kind of grey or reddish mahogany with a series of darker, but separate, markings along the back. In the Adder the zig-zag pattern is continuous. There is also a dark strip through each eye. Like the Adder it has living young (ovoviviparous). The Smooth Snake's favourite food is the Common Lizard, and it was once called the Lizard Snake. When swallowing a meal it will often hold its prey in constrictor fashion to stifle its struggles.

Its history is a little puzzling. *Coronella austriaca* was not scientifically recorded in Britain until 1859 and then by Dr. Gray of the Natural History Museum. Dr. Gray's specimen, caught at Bournemouth, is still in the Museum's collection. This publicity soon resulted in many further records, indicating that the species was quite abundant in the south only a century ago. To-day it may be considered rare.

The Adder or Viper (*Viper berus*) is our third and only venomous snake, one of the five species of this Genus found in Europe, and properly called the Northern Viper. It has been discovered within the Arctic Circle, and extends right down to the southern mountain ranges, and from the Atlantic seaboard, across Europe, well into Asia. In Britain it may be said to turn up from Land's End to John o' Groats, and is our most widespread and probably commonest snake. Whereas Grass Snakes prefer ditches, field borders, damper woods, and edges of ponds, lakes and rivers, the Adder is a lover of

more dry situations in woods, on heaths and hill-sides. It is much shorter in length, a two-foot specimen being large, and then it is usually a female. Colour varies a good deal, from the brighter specimens, usually males, to the more brownish females. So-called red and black Adders are also known. The two most reliable recognition features are the thick-set body, and the darker pattern which runs down the back in a wavy or zig-zag line. The fairly characteristic V behind the head is unreliable.

A Lover of Sunny Situations

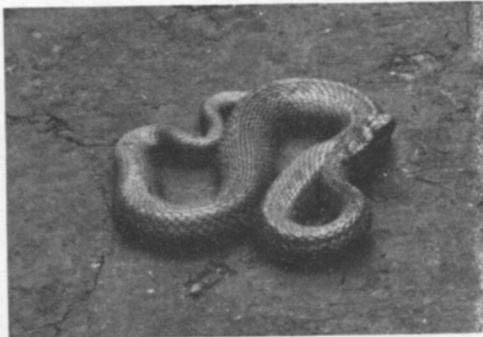
The Adder is by nature a sun lover, and often stays still when accidentally discovered. If teased by the intruder it will coil on the defensive and strike, but will not deliberately attack. People who meddle with Adders and get bitten have only themselves to blame, and there is certainly no need to kill them always, as so often happens. It is, of course, another matter if children, dogs or cattle frequent their localities. Then the Adders ought to be removed. An adult can usually withstand the bite, even without treatment, but a child runs a grave risk, and prompt first-aid is important to save life.

Adders stalk and kill their prey, often after dark, and this includes small mammals, nestlings and lizards including Slow-worms. It is in late summer that the babies are "born", hence the name of Viper (from the Latin *vivus*—living and *pario*—to appear). Adder comes from the old English "nædre", later "nether", meaning low down. From "a nædre" we get "a nadder" or an Adder.

The risk of losing a captive Adder makes it a potential danger as a vivarium specimen. Apart from this it makes a poor subject unless given space in the outdoor reptiliary, as it usually refuses food in the vivarium and, being restless, can soon die of starvation.

When I kept Adders in a garden enclosure I had plenty of opportunity to observe their habits. One of the most impressive sights was the so-called "dance of the Adders", in which individuals reared up and struck at each other in mock combat. At one time this was thought to be a kind of mating dance. It is now known that only males take

part, and that this is really a "fight" for possession of certain territory by rival males.



[Photograph]

[S. Crook

Black Adder, a somewhat rare colour variation.



[Photograph]

[L. E. Day

A typical situation where Grass Snakes might be found.

Supplying the Needs of Vivaria Inmates

By Alfred Leutscher, B.Sc.

1. Indoor Fernery for Amphibians

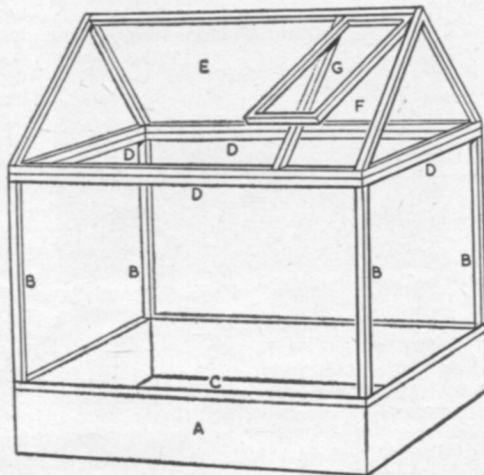
ANY lover of animals who wishes to keep pets will realise that under conditions of domestication they become entirely dependent on the owner. He must therefore provide them with the best living conditions in captivity, artificial as these may be. A healthy animal, they say, is a contented one, and this will depend largely upon two things—the proper environment and the correct diet. It is, therefore, a wise hobbyist who decides beforehand whether he can adequately provide such conditions for his pets.

In previous articles appearing in *WATER LIFE* I have had something to say about various reptiles and amphibians, the animals of the vivarium hobby. This new series deals with their homes in captivity. A vivarium keeper starts with one advantage in that his animals require comparatively little space in which to live, so that a vivarium can be installed in the smallest space, even a flat. The kinds of vivaria which are used will depend largely upon the creatures we choose, and since these can vary enormously in their habits—from purely aquatic to entirely terrestrial—the design and construction of vivaria lends added interest to the hobby. The finished products will depend upon what we can afford to spend on material, on our own ingenuity and workmanship, and on time and labour we can provide.

Let us start with a community vivarium for amphibians. This can be made for the cost of some wood, screws, window glass, zinc sheeting and paint. I am in the habit of giving names to my vivariums, each conveying a different idea of style and use. This kind is named the Fernery, a very popular ornament in Victorian days when it was used for housing a collection of ferns and other moisture-loving plants. It also makes an ideal home for amphibians.

Sketch 1 will give some idea of its shape. The bottom, A, is a shallow, wooden tray of tongue-and-groove boarding, which is lined with some zinc sheeting on the inside. The framework which holds the glass above this is made of one inch hardwood strips. Firstly, prepare the four uprights, B. These should have grooves cut in them with a tenon saw, down the two adjacent inner sides into which the glass can be fitted. Now prepare the base of the frame, C, so that it will sit on top of the tray, and groove lengthwise as before. Next, cut the window glass carefully so that each piece will slide down the upright grooves when the uprights are screwed in place. Each piece of glass must be so cut that it is slightly above the uprights, because it will have to fit into the grooves of the top part of the frame, D. If the uprights are pulled into position with the glass in its place before the top is screwed down, the frame should be rigid.

The sloping glass roof, E, is made in a similar way, and will require a little more precision because of the angles. The triangular ends are made first, then screwed on to the cross pieces. This roof merely rests on top of the main cage. Ventilation is provided by a strip of perforated zinc, F, fixed on the inner side of the frame towards one end. Over this is fixed on hinges a wooden flap, G, which can be adjusted to admit



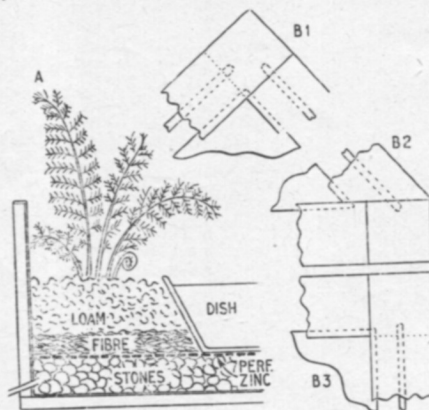
or exclude the air from outside. Finer details of the frame hinges and grooves are shown in Sketch 2.

A Fernery must be well drained. The tray bottom is covered with loose stones, bricks or cinders, to a depth of about three inches. On this is placed a sheet of perforated zinc which is then covered with moss or peat fibre. Finally comes a good layer of soil for the plants to grow in. A loamy soil will suit ferns best, such as a mixture of leaf-mould, sand and some good garden soil. Somewhere in the tray a shallow dish of water is sunk to the rim. There should also be a small drainage pipe fitted into one corner.

The plants which will occupy the Fernery should not be too crowded. They may either be purchased at a florist's or collected from the countryside. Places to search are along shady banks and ditches, hedgerows, old walls and undergrowth in woods. Ferns, mosses and other shade dwellers should grow well with little attention. Here and there a broken flower pot, a branch or two or some bark strips will provide shelter for the amphibians. In a community like this one can assemble together a collection of small frogs, toads and salamanders. Newts can also be added during the times they are out on the land. Small specimens of each species are advised.

Food such as maggots, worms, slugs and meal-worms are best, served by hand or in a feeding dish. If flies are given they can be dropped in alive. A regular supply is possible, by placing in the cage a small pot with a hole in the lid, which contains maggots. These will pupate and hatch. The flies finally crawl out into the cage. I have known toads to wait around such a pot for the next meal.

The size of a Fernery will depend upon space and contents. Mine works out roughly 3 ft. long by 1 ft. 6 in. wide and about 2 ft. high. The woodwork has been given an annual coating of oak stain, but the inside is untreated. The dish is always filled with clean water, and a small pot stands under the drain pipe. The animals are fed about twice a week, and are hibernated in a cold garage for the winter.



Sketch 1 (upper illustration on this page) shows the structure of the wooden framework of the Fernery. The lettering is referred to in the text.

Sketch 2. A, is a section of one end of the tray. B1 is an end view of the frame at the top of the roof. B2 shows the base of the roof and B3, the top of the main cage. Dotted lines are grooves for the glass.

Germans have a theory that large tanks and aeration promote stronger, fitter fish by giving adequate muscular exercise.

Holland is the only country outside Britain that has an organised Guppy breeding club; it is the three-year-old Nederlandsche Guppen Kring; a club of about thirty members that relies mainly on correspondence and its own bulletin to keep members advised of what is going on. Starting from scratch (for which they are to be admired), the Dutchmen were just getting to the stage of breeding a rather stubby Doublesword when the F.G.B.S. gave a helping hand by sending over Scarftails and Veiltails, at the time of the recent International Conference. Later, Doubleswords, Bottomswords and Lyretails were sent across. As a result of these contacts, an exchange of ideas will shortly begin.

The interest that the average overseas member has for the activities of the home-based G.B. societies, is remarkable. Club reports are eagerly scanned, and the recent inter-society matches were followed to the extent of a number of enquiries for photographs of members whose names appeared regularly in the bulletin reports. With support and enthusiasm such as this, one can rest assured that the British Guppy will travel further yet. It is the ambition of the F.G.B.S. to make its own standards the yardstick by which all are compared, and it will be those overseas members, the Cleveland Professor, the Portuguese trader, the Rhodesian businessman, the Tyrolean gentleman and the pastor from Pennsylvania, together with all of the other overseas members, who will help to make it so.



"Alf," posing for his photograph, taken by the author.

IF you are a town dweller, with little room to spare for the building of pools, you may be interested to hear of my successful attempt to rear a limited number of frogs from the spawn stage, in a dish measuring 10 in. by 8 in. Year after year my son literally filled my pool with frog spawn, and consequently I was unable to rely on the pool for a supply of *Daphnia*. Last year I suggested that half-a-dozen tadpoles would be quite as interesting as a thousand, especially if kept in a vessel where observation would be easy. Fortunately he fell in with the idea, so an enamelled pie dish was obtained from the kitchen.

Positioning the Container

A shallow depression was dug at a spot where the sun shines most of the day, the pie dish was sunk level with the soil, a few turves of rough grass were patted down around the edge, and the "pond" was ready. The dish was filled with pool water, a few pieces of filmy algae were dropped in, and we set out for the spot across the fields which had never yet failed to serve us with spawn. It needed about three visits before we were lucky, but eventually we found a newly-spawned mass. A very small slippery "lump" was broken off and deposited in the dish, which some members of the family derisively christened "the lake".

We found that the water quickly warmed up when the dish was covered with a piece of glass, so this was left on

Rearing Frogs in a Miniature Enclosure

By V. H. Lacey

most of the time. The small black wrigglers were rather inconspicuous at first but, when fed with waste matter siphoned from my aquariums, little bits of scalded bread, and other oddments, they came on at quite a rate. One thing which never seemed to fail as a food was a small quantity of "Bemax"—they seemed to have a great liking for it.

As they got bigger we found the most popular food, as well as the one inducing fastest growth, was a piece of rabbit liver which had been pulped and dropped in raw. I think they adhered to this night and day for about a week until the last vestige disappeared. It may strike some readers that by this time the water was becoming somewhat foul; but there is little to worry about with tadpoles—they are not "mature-water" faddists. The dish was flushed over daily with a jugful of fresh water, and remained quite inoffensive.

Exceptional Development

By the time the first pair of legs of the tadpoles appeared, I was beginning to feel that they were making extraordinary progress, and the place where the spawn was found was revisited. Our tadpoles certainly were completely outstripping their wild brethren—I really believe they were at least 3 weeks ahead of the naturally-grown specimens which we found in the swamp from where we collected the spawn.

By early Summer we had five young frogs, with stumpy tails, leaving their miniature home to hide upon the rough grass during the warmer part of the day, returning occasionally to get their skins wet if the day was very dry.

It was found that if one or two grass stalks were smeared with treacle the frogs took quite an interest in the flies which were attracted; so we kept this simple bait spread on the same grass stems continuously.

Eventually, during a damp spell, our frog family broke up; four went out into the world to fend for themselves, leaving us with Alf, pictured here, like a faithful dog, intently watching his favourite grass stem. And when I decided it was time to obtain a portrait of Alf, this was how I found him; all the fuss and clatter of setting up the camera, and taking it down again afterwards, failed to disturb him in the least; his mind was on higher things as he posed for me.

I recommend this experiment to any reader interested in our hobby, and can assure him of a whole Summer of interest at no expense whatsoever.

Supplying the Needs of Vivaria Inmates

2. Creating the Right Conditions for the Several Newt Species

By Alfred Leutscher, B.Sc.

SPRING is a time of renewed activity when many a "happy event" may be expected in the animal world. The vivarium keeper in this country will be on the look-out for amphibians in his local pond, where the frogs, toads and newts foregather to lay their eggs. In some mysterious way they may even turn up in his own garden pool.

Now is a good time to observe the breeding habits of our newts. Unlike frogs and toads, the breeding period is a protracted affair, lasting well into the Summer. An aquarium makes an ideal home for keeping these attractive little creatures under observation. It should be set up on the same lines as a coldwater tank for fish, i.e., a well matured aquarium with a selection of pond plants anchored in sand or gravel.

Certain modifications are required, however. Firstly, the choice of plants. Female newts lay their eggs on these, and seem to prefer the leafy kinds, such as *Elodea*, *Fontinalis* (Willow Moss) and *Callitriche* (Starwort). All three are commonly found in ponds. The more luxuriant *Egeria* (*Elodea densa* sold by dealers is also excellent spawning material. The female newt lays an egg on a leaf, then wraps it over the egg automatically, as a means of protection. *Vallisneria* could be used but in time it would become unsightly because of the leaf-folding habit.

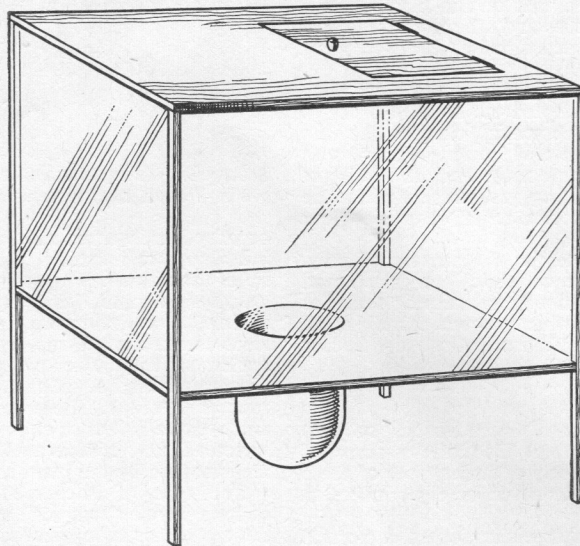
Secondly, some sort of landing platform must be

provided. At the end of the breeding spell newts begin to leave the water. To assist them in this, a flat stone, tile or slate should be laid on top of some rockwork in the aquarium, so that it rests just above the surface. On the platform is placed a raised "roof" or tiling, or bark, under which the newts may hide. They prefer to get under cover when out on land, especially in the daytime. The use of an inverted flower-pot as a foundation is a good idea, since it is light and economical on space—if pieces are chipped out then the newts can use it as an underwater hiding place. In ponds the

creatures will often hide in old tins and rubbish. Newts may be caught with a net as they rise to the surface for air, or on a worm tied to some cotton. Another way is to lower a piece of piping or wide-necked bottle, tied with string, on to the pond floor, and leave it for some hours. If it is then carefully hauled in it may well contain a newt or two.

A 2 ft.-long tank is suitable for two or three pairs of newts. If the species are mixed they should be of equal size, or the larger one may attack the smaller. Males in most available species are recognised by the crest along the back, which is used in display during courtship.

A selection can be made from the three British species—the large Crested Newt (*Triturus cristatus*), the Common or Smooth Newt (*T. vulgaris*) and the little



The "Bell-jar" House, which makes an ideal permanent home for newts. Sides are of glass and top and bottom, wood.

Moisture-loving Insectivorous Plants

(Continued from previous page.)

to overfeed the plant as it will soon sicken, and indeed show all the herbivorous symptoms of indigestion!

Another British carnivore, which is often found growing in mountainous regions, is the Butterwort (*Pinguicula*). The yellowish-green leaves, clustering in a squat rosette, are pointed and from 1½-2 in. in length. In early Summer tall thin stalks bear violet-shaped blue flowers. A white form is occasionally found in certain isolated districts.

The upper sides of the leaves are sticky and any insect which alights on them is firmly held. The victim soon dies and digestive juices secreted by the plant dissolve its body and the juices are then re-absorbed.

An interesting characteristic of this plant is that its leaves contain a substance with the same properties as rennet, which coagulates milk. I well remember my grandfather telling me years ago how he had seen Laplanders gathering the leaves of *Pinguicula* for butter making. These were laid over sieves standing on pails, through which the Lapps would pour their milk—still warm from the reindeer cow. As it cooled it coagulated and became coarse butter. This would appear to be the origin of the name Butterwort. In the Alps

it is claimed that this plant has a medicinal effect in curing sores on cattle.

The Venus' Fly Trap grows in the damp, swampy wastes of N. America. The leaves are doubled so that they appear hinged at the centre and their edges are bordered with a row of spiky bristles, whilst three hairs—known as Trigger Hairs—appear on each leaf section. These hairs are not viscous in any way, and the plant relies on speed to trap its prey. Immediately a fly touches the triggers, the leaf begins to close, so that the victim is completely imprisoned in 20-30 seconds. An individual leaf may take as long as a fortnight over a meal but, again, if too large an insect is taken, the plant appears to suffer from such "over-eating" and the leaf dies.

In Portugal there is a plant with long, narrow leaves covered with numerous red glands. These have the power of catching insects so that the natives often hang the plant in their windows. Thus it affords a natural and effective means of killing flies. Its name is *Drosophyllum*.

Many of these unusual insectivorous plants can be grown in a moist, shaded greenhouse. They should be fed regularly on small pieces of shredded meat, and afford a fascinating study for those interested in observing the limits to which plants adapt themselves to live and flourish under adverse conditions.

Palmate Newt (*T. helveticus*). The first is often sold by dealers as a Continental sub-species. The second is too well known for description, and the third can be distinguished by the dark webs on the toes. The male has a curious thread-like extension to its tail.

Further species are the Alpine Newt (*T. alpestris*), about the size of our Smooth Newt, dark in colour and with an orange belly. Perhaps the most handsome species is the Marbled Newt. Some specimens are beautifully marked in dark and pale green. The largest species, from Spain, is the Pleurodele Newt. It can grow to eight inches or over, is particularly aquatic, and has no crest. Unlike the *Triturus* newts there is not much display on the part of the male—instead he pushes under the female's body and grips her forearms with his in a curious embrace.

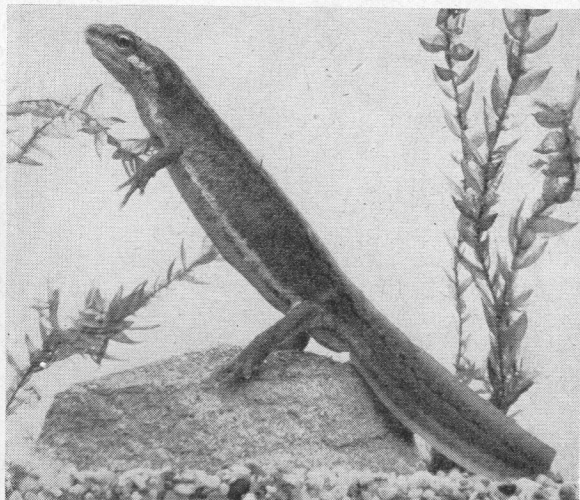
Interesting Pets

A newt aquarium is always an object of interest and beauty. The inmates have graceful movements as they swim about or rise to the surface for air. The courtship antics of the males can be observed at close hand, and females will be seen to clamber among the plants to lay their eggs. Food consists of various aquatic animals, such as *Daphnia*, *Tubifex* and gnat larvæ. Tadpoles are relished, but the toad tadpole should be avoided as it has poisonous qualities. Small Earthworms, White Worms and raw meat in tiny shreds are also eaten.

Eggs of newts should be removed to a separate dish of shallow, mature water, as they may otherwise be eaten by the parents. The baby newts are reared on animal life, given according to size, along similar lines to the "diet sheet" of fish fry, that is, Infusoria and Mikro-worms, White Worms, *Tubifex* and *Daphnia*, and finally insect larvæ and small Earthworms. The babies should transform in 2½-3 months from hatching, and will then probably leave the water.

When keeping newts in an aquarium it is most important to use well-established water. I have often found that specimens collected from a pond may look big and healthy at the time of capture, with well-developed tails and crests, yet after only a few days of aquarium life in tap water, their beauty has gone and the crests almost disappeared. It is believed that natural water contains certain growth-promoting substances—missing in tap water—which are absorbed through the skin of newts and which keep them in their fine condition. Indeed, newts seem to thrive in the dirtiest situations, in water which has a high organic content.

Apart from the normal vivarium for their land existence, newts may be kept in a sort of double home, such as the one illustrated. We call this the "Bell-jar" House. The cage has a false bottom into which is fitted an inverted bell jar or similar glass container. The newts breed in this and spend the rest of the year in the little garden which is grown on the shelf. Ferns, mosses and other shade-loving plants do best



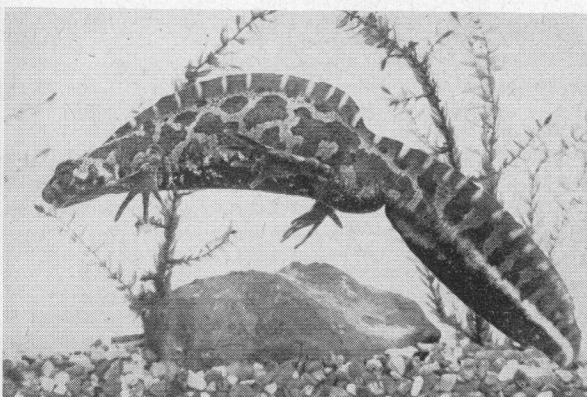
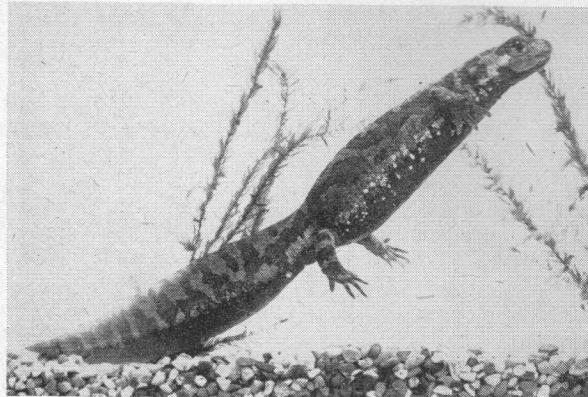
Underwater picture of a female Common or Smooth Newt (*Triturus vulgaris*). The male is distinguished by a crest along its back. Colour varies considerably in this species.

planted in some loamy soil. Ventilation is avoided in order to give the house a humid atmosphere, but a door can be fitted to the roof.

Newts make interesting pets and can be long lived. There is a record of a Crested Newt having lived for 28 years. Readers wishing to breed from these animals can either catch new stock each Spring and release it after the breeding period, or keep the same animals year by year. In the latter case it is important to remember that they should pass each Winter in hibernation, especially if they are to breed. Newts which are kept warm and active throughout the winter will come to no harm, provided they are fed regularly. The following Spring, however, it will probably be found that they show no desire to enter water or lay eggs. Lack of hibernation seems to have something to do with this.

How to Induce Hibernation

The method for hibernation in captivity is to remove the whole cage to a cool place in a shed, greenhouse or conservatory, away from draughts and frost. As an alternative the newts may be put into a perforated tin, packed with damp moss, and left the whole Winter in a similar draught- and frost-free situation. An occasional inspection and further damping of the moss is all that is necessary. This treatment will bring them into breeding condition for the next Season.



[Photographs]

The striking European Marbled Newt (*Triturus marmoratus*). Female is to the left and crested male to the right.

[L. E. Day

light whilst Moors will produce greater intensity of black if transferred to water outdoors.

It has been suggested on several occasions that greater intensity of colour can be produced in Nacreous or Calico fish if they are obtained by crossing the Metallic type with Matt or Transparent, some people adding the proviso that both types must have come from good coloured Nacreous stock. Now in practice, this appears to work providing the Metallics are of a type which fail to colour (i.e. lose their black pigment). If they are of a quick-colouring type then the propensity for xanthochroism may be passed to the Nacreous

offspring which, though highly coloured when young, might lose all pigment by the time they have reached 18 months.

So it would appear that, whilst good quick-colouring Metallics might be produced in any of the varieties of Goldfish, it would probably be advisable to keep them separate from Nacreous stock. This is, of course, entirely my own view and is not, so far as I am aware, accepted by other aquarists. In support of this argument there is the fact that, where highly-coloured Nacreous fish have been produced by specialised breeding, the bronze offspring rarely colour.

Brazilian Giant Tortoise (*Testudo denticulata*)

By Mrs. A. Noël-Hume, B.A.

WHILE suppliers' lists generally include very few species of land tortoises, the attractive and intelligent Brazilian Giant Tortoise (*Testudo denticulata*) is often featured in them. Adults of this species are usually priced between £5-£8 but younger specimens may be purchased for as little as 30/- or £2. At the moment most *T. denticulata* reaching this country are being collected in the Guianas but the tortoise is common in the tropical forest areas of Brazil, Venezuela, Colombia and the north-east of Peru. In all these regions its flesh is considered a great delicacy by the native population and for this purpose they sometimes keep specimens in semi-captivity. This article is based on my experience with an adult male and a very young female of the species.

The Brazilian Giant Tortoise has two main identifying features, the first being the elongated shape of the shell and the second, the brilliant orange or red scales on the head and legs. I have also noticed another characteristic present in specimens of all ages. This is the method of moving the back legs when the tortoise is walking, for each in turn is lifted high into the air as if the reptile is stepping over some unpleasant object in its path. The leg is actually withdrawn inside the shell before being placed on the ground again. Experiments show that the nature of the ground has no effect on this behaviour and it is equally pronounced on flower-bed or carpet.

To return to the more easily observed of these features, the shape of the shell. The carapace is usually twice as long as it is broad and this effect is heightened by the rear marginal shields being almost vertical. Specimens with a carapace length of 30 in. have been recorded but the average length of those to be procured in this country is between

16 and 20 in., due, no doubt, to the high freight charges on the heavier specimens. The characteristic oblong shape develops only with age, young specimens being more circular in appearance. The shields of adult specimens are dark brown in colour with a deep yellow areola and the growth rings become almost obliterated. In young tortoises of this species the shields' centres tend to be a dull brown instead of yellow and there is a distinct concavity corresponding to the area not covered by the rings.

The brilliantly-coloured scales which make the adult *Testudo denticulata* such an attractive tortoise are not present in young specimens. In the latter the scales are a pale yellow in colour and would seem to darken very gradually, especially those on the forelegs. No young specimens possessing red coloration could be located by me but it seems likely that a similar deepening of the colouring occurs.

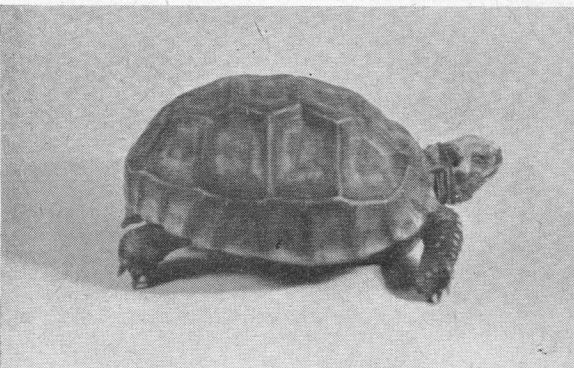
The head of *Testudo denticulata* is not sharply pointed but the serrated jaws are extremely powerful. The eyes are large and dark brown in colour except for a pale yellow outline. While the eyesight of this species is extremely good, its reaction to colour is below average for the land tortoises. There is a tendency for the eyes to water rather excessively at times but this appears to bear little relation to temperature, light or the health of the creature.

Differentiating the Sexes

As in most land tortoises, difference in sex is marked by a concavity in the plastron of the male (that of the female being flat) and by the former's larger tail. There is a marked increase in sexual activity during the months of October and November and the male, if not prevented, will make frequent attacks upon the young female I possess regardless of the difference in their sizes (carapace lengths of 18 and 4 in., respectively). He is able to pick her out at once from among a large group of tortoises of a similar size and coloration and will not attack any young specimens of other species. He will, however, assault one other tortoise in the collection, a fully grown *Cinixys erosa* with whom he had been for a year before coming in to his present home. During the period of sexual activity he refuses any food except bananas but would appear to drink more water.

The accommodation of this species presents few problems during the Summer. Whenever the temperature exceeds 65 deg.F. the tortoise can be given the freedom of the garden and, although some damage may be caused to tender blooms by its large feet, the owner may rest assured that they will not be eaten. However it is not wise to leave trusses of reddening tomatoes within range and small specimens may attack young lettuce when hungry.

Coming as it does from areas of dense forest, *Testudo denticulata* is not fond of sitting in the sun and should be allowed access to plenty of deep shade. It likes to hide

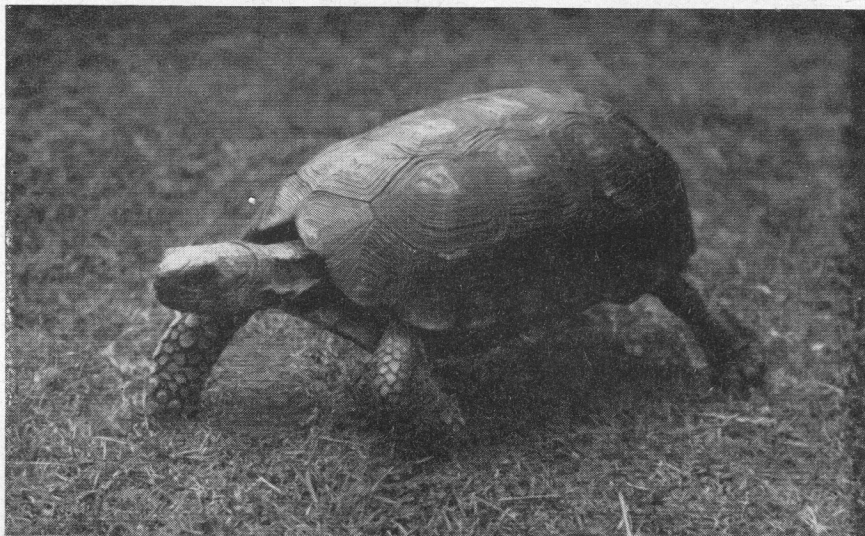


Photographs]

[Mrs. A. Noel-Hume

Mrs. Noël-Hume's young female Brazilian Giant Tortoise (*Testudo denticulata*). Carapace length of this specimen is 4 in.

under low bushes and hedges and, if there is a greenhouse or shed in the garden, the door should, wherever possible, be left open for it to go inside. My adult specimen prefers to spend the hottest part of the day in a room opening on to the garden. When placed on the lawn in the early morning it will immediately come to the doors of the room. Should these not be open it will march up and down outside several times before walking round the house to the kitchen doorstep to gain admittance there. Only when the heat of the day has passed does it emerge and spend a couple of hours walking on the lawn and climbing on the rockeries and a flight of steps. The young female prefers to spend most of the day beneath a large catmint but emerges earlier in the day than the adult.



The author's large male Brazilian Giant Tortoise with carapace length of 18 in.

This species will drink water at very frequent intervals during the Summer and, if possible, the drinking vessel should be large enough to allow the tortoise to sit in it at the same time. A rectangular baking tin, of the type used for roasting poultry, set into a flower bed and with the surrounding area covered with cement or paving would serve admirably for this purpose. Care should be taken to see that the tin is kept full and that the water is always clean.

Summer nights in this country are frequently both cold and damp and for this reason it is extremely unwise to let *Testudo denticulata*, and for that matter any other tortoise from a tropical climate, sleep in the open. However, there is no reason why—during a heat-wave when the weather appears to be settled—this tortoise may not spend the night in a greenhouse or shed, provided that these have a well-fitting door. From the point of view of the owner's peace of mind and the tortoise's comfort, it is more satisfactory to have these delicate tortoises within the house at night or within a conservatory attached to the house. A suitable "bed" for a tortoise can be made from a wooden box which should be enclosed on three sides to minimise draughts and with a roof to give the tortoise a feeling of being hidden from possible enemies. The floor may be covered with layers of newspaper which can be removed when soiled.

Feeding Arrangements

In the Summer, I feed the tortoises twice a day, at 7 o'clock in the morning and at a similar time at night. Although the times are chosen to suit the author's domestic arrangements it also seems to be most satisfactory for the reptiles who both refuse to eat during the heat of the day. The food is given indoors as there are less distractions and, as a result, more is eaten. The adult specimen insists on eating from an enamel plate which is placed on a large plastic sheet to prevent the food being spread all over the floor. The young one feeds directly off the sheet as it is not yet large enough to reach on to a plate. Green vegetables are given every meal but are varied as much as possible. The most popular seem to be cabbage, lettuce and spinach. To these are added any two of the following fruits, according to which are available at the time, orange, tangerine, tomato, banana, water melon, fresh or tinned pineapple, any soft fruit, raw or cooked apple, grapes and pears. Both the adult and the young specimens are given the same diet but powdered cuttlefish or halibut oil is added to the latter's food at alternate meals.

By the middle of September the amount of time when the temperature exceeds 65 deg.F. decreases rapidly and

arrangements must be made to accommodate the species throughout the long Winter. A minimum day and night temperature of 70 deg.F. is needed but this in itself is not sufficient. The accommodation must be free from draughts and even in a well-heated house this is not always easy to arrange. The greatest possible amount of natural light must be provided for the tortoise which must also have adequate room for exercise. Very young specimens can, of course, be housed in a large vivarium and allowed to exercise in a warm room, whenever possible. With adult specimens the solution is not so easy but the best answer, and the only one for the tortoise enthusiast, is a room set aside for the reptiles. There are many ways of heating such accommodation but, whenever possible, the heating should be regulated by a thermostat. I manage to combine a large cupboard containing the hot water storage cylinder with another small room and this gives sufficient room for both *Testudo denticulata* and *Testudo pardalis* to exercise quite freely. Tortoises should never have access to a room with an open fire unless the latter is protected by a stout fire guard firmly attached to the floor and the fireplace.

During the cold weather there is usually a change in the feeding habits of these tortoises. At first it is only in the quantity eaten, which is less than half that accepted in the Summer, but then, as already mentioned, comes the period of great sexual activity when almost all food is refused. After this it becomes impossible to feed at regular times and the tortoises have to be coaxed with such things as bananas and pineapple. While on such a diet the tortoise sometimes feels the need for roughage which is satisfied by offering the tough outer leaves of cabbage and by keeping a plate of puppy meal within easy reach.

The amount of water drunk increases rapidly and this is generally given tepid, rather than cold as in the Summer. My younger specimen continues with the same diet but eats less and takes longer over it. The weight gained during a typical Winter was only 1½ ounces as against nearly 2½ ounces during the following Summer.

In common with all the other reptiles in this collection, these tortoises have been given a daily few minutes under an ultra-violet lamp, great care being taken that their eyes remained covered during the treatment. As the winter progresses there is a tendency for the skin to become dry and cracked but this can soon be cured by the application of a little olive oil to the affected areas at frequent intervals.

While *Testudo denticulata* is somewhat expensive to keep I believe it is the most interesting of the land tortoises.

Supplying the Needs of Vivaria Inmates

3. "Treetops" Vivarium as a Home for the Climbing Reptiles and Amphibians

By Alfred Leutscher, B.Sc.



Vivarium for climbing creatures.

MOST vivariums are designed to allow as much floor space as possible in order to give the inmates plenty of freedom of movement. In this article I propose to deal with a different kind of vivarium, in which floor space is sacrificed for height. This is what I like to call a "Treetops" vivarium, which gives a clue to the habits of the occupants. A certain number of reptiles and amphibians, such as Tree-frogs, Geckos, Chameleons and certain climbing lizards, spend a good deal of their lives well above ground level, such as in bushes and trees, and on walls and rocks. It is the needs of these tree-top dwellers which we will now consider.

Tree-frogs are too well known to require description. By means of sucker-like fingers and toes they can cling to leaves and branches, even bark and vertical glass. Those frequently kept by hobbyists are the members of the Family *Hylidae* (which are actually toads), and usually come over from N. America or Australia, which are two of their strongholds. The best-known vivarium Tree-frog, however, is the European Green Tree-frog (*Hyla arborea*), which is generally on sale by late Spring. Most specimens seem to come from France and Italy.

Dimensions of the Glass Cage

A suitable-sized home for a small colony of these attractively coloured amphibians is a glass cage, about 18 in. square, by 2½-3 ft. high. The base consists of a wooden tray which is about the same depth as an average-sized flower pot. The reason for this will become clear later. On this tray is erected the main glass cage, made of a frame of strong wood (about 1 in. × 1 in.) which is slotted to take panes of glass. This glass should fill in three sides. Directions for making such a frame and fitting the glass were given in the first article of this series (see *WATER LIFE*, February-March, 1954, issue). The fourth side of the frame is fitted with a separate square of glass in its own frame, which is hinged into position to act as a door. The general result will appear similar to the sketch above.

The top of the cage is covered with perforated zinc to allow for ventilation. From it is suspended an electric light bulb, about 40- or 60-watt strength, which will provide the lighting and heating if and when required. The wood-work of the vivarium can be stained on the outside to match

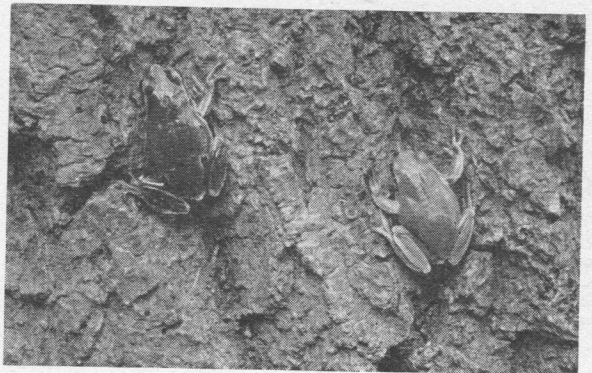
the furniture of the room in which it is to stand. The inside is best left untreated, to avoid any risk of harming the inmates.

Some plants may be introduced and these can grow in their own pots. The base of the vivarium (i.e. the tray) is filled with large stones, and the flower pots sunk among these up to their rims. The stones will serve a double use. They hide the pots and at the same time provide hiding places for the inmates, should they wish to leave the branches and leaves. If desired the stones may be covered with a layer of loose moss, to retain moisture. It might also be a good idea to first line the tray with metal sheeting, to keep it water-tight.

There are plenty of plants from which to choose. They should be the sturdy indoor kind, preferably broad-leaved and evergreen, so that there is ample surface for the Tree-frogs to grip. Many florists now cater for the indoor plant hobby, and can provide just the right kind. Some examples are the various *Hederas* (Ivy), *Tradescantia*, and small specimens of Fig, Castor Oil and *Aspidistra*. A climber called *Phyllocladon* is ideal. All these plants will require sticks for support as they grow taller. The actual climbers can be supported with loops of twine tied to eye hooks which are screwed into the framework at convenient places. Virginia creeper and the variegated *Coleus* add a pleasing splash of colour to the "Treetops" vivarium.

The purpose of the light is merely for inspection. European Tree-frogs live fairly well in our climate, and do not require much extra heat. The bulb which I use is coloured green and is intended for decorative effect. When switched on it produces a beautiful, diffused greenish glow throughout the cage, enhancing the natural green colouring of the frogs and plants.

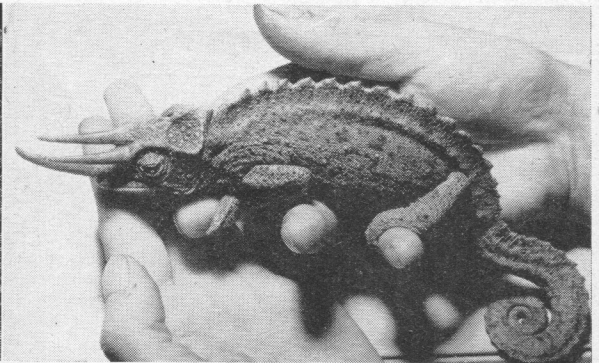
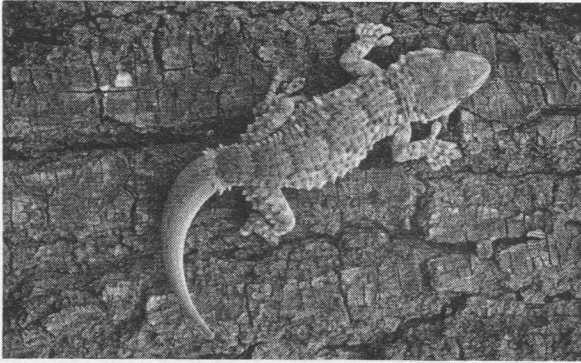
Elsewhere I have stressed the importance of keeping amphibians in humid surroundings. Tree-frogs are rather the exception and can stand a good deal of dryness. All that is necessary in hot weather, is to spray the plants and frogs with fresh water every morning. Both will keep happy



Photograph]

[L. E. Day

European Tree-frogs do well in the vivarium described in this article and can tolerate a reasonably dry atmosphere.



Photographs]

[L. E. Day and Sport & General

Left, a Common Gecko (*Tarentola mauritanica*) and, right, a Jackson Chameleon (*Chameleo jacksoni*).

for the rest of the day. Occasional watering of the pots will also be needed.

Tree-frogs should be fed on a variety of insects. Flies are the main stand-by, and these are quickly caught by the creatures, even by leaping into the air. A steady supply can be ensured by placing some fly pupæ into a small pot with a perforated lid and standing this in the cage. As the flies hatch they leave the pot and escape into the cage.

A similar home to the above will serve for Geckos, but a modification is necessary. These active little lizards are usually nocturnal, and spend the day in hiding. If one side of the glass case is lined with a sheet of plywood, then some strips of bark can be fixed to it. The Geckos will hide in the cracks and behind the bark. I have such a piece of bark-covered plywood which can be placed in position inside the cage, against one side of glass. By removing it later, the Gecko cage of one year can then be converted into a Tree-frog cage for the following. In other words, the same vivarium is in use for different inmates. With the Geckos a light is helpful, to provide the adequate temperature. This may be controlled by fixing a sliding shutter on to the roof above the perforated zinc.

Chameleons can also live in such a "Treetops" house. One specimen is best, as they are rather quarrelsome creatures. For climbing purposes it is advisable to include some stiff branches. Some of the perches should be placed so that the Chameleons can hide itself among the foliage. Personally, I am not too keen on keeping Chameleons in my collection. Feeding is one difficulty, and on top of this the normal expectation of life seems to be very short.

Apart from a cork background, we can try to erect a wall of brickwork or rock, making a setting for such lizards as the Wall species. Because of limited space this will require some care. By breaking up house bricks and shaping them, one can build up a miniature wall at the back of the vivarium on which it is even possible to grow rock plants. Succulents, such as the stoncropps and other drought-resisting plants, are the best. Such an arrangement as this makes a really beautiful background for a small colony of active lizards which like to climb, such as Wall Lizards and small Green and Eyed specimens. As they dart about and finally settle on top of the wall (to get nearer the light bulb) one gets a far better view of them than if they remained on the ground level. As the brickwork warms under the bulb, they will lie out in a flattened "sunning" position, remaining like this for long periods.

The above are just a few ideas on how to build and design a novel type of vivarium, and the main purpose of this "Treetops" villa is to give the inhabitants plenty of scope to exercise their climbing abilities. Finally, a useful tip. It is sometimes possible to obtain a ready-made tall-shaped "vivarium" at an auction sale or a shop. What I have in mind is a display or show-case, used for advertising purposes in many shop windows and on counters.

Water — the Basis of Fishkeeping

First Article in an Important New
Series by the WATER LIFE Analyst

IN Nature water occurs as a condensate in the upper atmosphere in the form of rain droplets and, as such, is probably the purest form of water occurring naturally. However, purity is merely a relative term, for even at the moment of condensation water dissolves atmospheric gases and small amounts of mineral matter. As the rain droplets descend earthwards, greater amounts of these impurities may be gathered, depending upon the nature of the area over which rain falls. Thus, in the Highlands of Scotland where the atmosphere is reasonably free from impurities, rain water will reach ground level in almost its pristine purity, whereas rain falling over industrial areas will meet with dense atmospheric pollution in the form of solid and gaseous products of combustion, and considerable contamination will result. However the final character of these surface waters is dependent almost entirely on the nature of the ground upon which they collect.

Water collecting upon the hard and impervious rocks of the Highlands retains the characteristic softness of the original rain, whilst water seeping through the comparatively soft chalk comprising the Downs of southern England dissolves some of the mineral constituents and in so doing becomes extremely hard in character.

These differences of the mineral content in water are revealed by chemical analysis and, to allow comparison, the table on page 129 exemplifies the difference of mineral content for water taken from lakes fed by inflowing streams of surface water from almost barren rock, and water taken from chalky areas. The Ennerdale and Katrine Lake waters are classified as extremely soft, whilst the chalk waters are extremely hard in character, the causative agents of hardness being the content of calcium and magnesium salts held in solution. Waters containing less than a total combined amount of 50 parts per million of calcium and magnesium salts may be classified as soft in character. A water containing 100 to 150 parts per million of hardness is slightly hard, over 200 and under 300 parts per million, hard; and over 300 parts per million, extremely hard.

Hardness of water is referable to the degree of soap destroying power of water containing calcium and magnesium

believed that not all these eggs would be fertile as the female sometimes released eggs without the male being near her.

The collected eggs lay in about a $\frac{1}{4}$ in. of water, to which a little methylene blue was added as a Fungus deterrent. The fertile eggs hatched out on the second day after spawning and approximately a third of the total eggs hatched and developed into free-swimming fry.

The chief behaviour points of this pair of fish again concerns the male's lack of spawning instinct but it may well be, in this case, that the drive was missing owing to the male's defective field of vision. It is both a well-known and accepted opinion that "sighting the female" plays an important part in arousing the spawning instinct. As to this second female, she was only too co-operative in her desire to be spawned, but obviously she was not influenced in her action by any driving procreative instinct but rather from a gourmet's urge for caviare, a common enough failing in the female *Betta*!

Unaided Release of Eggs

A final point is that the female released eggs without the male being near her. Mr. Wolfsheimer particularly emphasised in his own report that this is a matter which is still being argued about, though he personally knows of similar cases. I can verify his contention, for I, too, had the experience of observing a female *Betta* voluntarily releasing eggs whilst still divided from the male by a glass partition. In this case the egg-shedding may have been motivated by the sight of the male frantically displaying on the opposite side of the glass.

Sometimes, after spawning a couple of fish of a "hard-to-sex" species, aquarists will experience the eventual disappointment of a complete failure in that the eggs fail to hatch. When seeking a reason for what went wrong, the possibility of a "two-female" spawning should not be overlooked. Mr. L. A. White, secretary of the National Aquarists' Society, has related to me a perfect example of such a

spawning. At one time he owned two fine specimens of *Corydoras aeneus*, which shared a tank with a number of Guppies. During one evening it was observed that the two *C. aeneus* had commenced the typical procedure of a *Corydoras* courtship, one fish excitedly swimming over and around the other. Naturally interest was aroused by this promising activity, though nothing further happened that evening. On inspection early next morning, it was found that a spawning had taken place.

The delighted aquarist now found himself in a quandary, for he realised that the Guppies should come out of the tank and he had to rush away to business. A plea was made to the lady of the house to get out the Guppies whatever happened and an agitated aquarist rushed away to more mundane matters. On returning in the evening he found the eggs still apparently in good condition but unfortunately there is a sad end to the narrative, for none of the eggs hatched out. On thinking the matter over, Mr. White came to the conclusion that this particular spawning had, in fact, been a "two-female" event. These suspicions were later confirmed when an authority on the *Corydoras* examined both fish and gave his opinion that both were females.

I can tell of a similar experience. Until fairly recently I possessed an apparently well-mated pair of Angel Fish. The assumption that they were a true pair was based on their behaviour over a considerable length of time and especially when they started a period of mouth-locking and leaf-cleaning activities, which finally culminated in an actual spawning. This event I had the experience of observing in full. Having chosen the upper surface of a large *Nuphar* leaf, the female swam slowly across it, depositing a few eggs on her way, whilst close behind came her partner who, instead of following her and fertilising the ova, chose instead to dine on the new-laid eggs. This performance continued with intervals for quite a while, neither fish interfering with the other's activities. Some weeks later the non-egg-laying fish died and examination proved it a female.

Supplying the Needs of Vivaria Inmates

4. A Suitable Enclosure for the Easily-tamed Toads

THE herpetologist has many kinds of reptiles and amphibians from which to choose, each with a different set of requirements according to its behaviour and food habits.

For a number of reasons I have always looked upon toads as my first favourites. These gentle and benign little creatures fit perfectly into the role of vivarium pets and, provided their simple wants are catered for, will live in captivity for many years. Ten years or more in the vivarium is not uncommon.

By nature a toad is usually a nocturnal creature, hiding by day, and hunting its prey after dark. It will spend long intervals in the same spot under a log, a wall or even inside a flower pot, wandering off at night in search of food, and



The Spadefoot or Digging Toad (*Pelobates fuscus*), found in Europe. Photograph by L. E. Day.

By Alfred Leutscher, B.Sc.

returning to the hiding place on the following morning.

During the breeding season it is in the water, where jelly-covered strings of spawn may be found entwined among water plants. Our native Common Toad (*Bufo bufo*) will travel a considerable distance to reach its favourite pond. This mysterious migration has been known to naturalists for many years, and some recent field work done on toad movements in Spring by members and friends of the British Herpetological Society will be of considerable interest to nature lovers. It is hoped to publish an account of this in the Society's journal.

Distinguishing the Common Toad

The Common Toad may be distinguished from its relative, the Common Frog (*Rana temporaria*), by a more solid-looking body, shorter legs, blunter snout, and a dry, warty skin. The frog is usually more sleek, with longer legs and more pointed snout. Its skin is inclined to be smooth and moist. It should be pointed out that these differences are only superficial, and that other so-called frogs and toads are incorrectly named. The basic difference between the two is found in the skeleton. In a true frog, the shoulder

girdle is firmly united across the chest; in the toad it is separated and overlaps. This would mean that amphibians such as the Tree Frog (*Hyla*) and the Painted Frog (*Discoglossus*), are really toads!

In captivity, a toad will settle down well, either in a garden enclosure, or a vivarium. In the former, a wall of bricks, wood or tin sheeting should have an inside ledge along the top, about 2-3 feet above the ground, to prevent the creatures escaping. Toads are notorious climbers. Inside the vivarium, on a base of loose loamy soil, various plants may be grown. Hiding places are provided by laying out stone caves, small logs, flower pots and strips of bark. A shallow pond made of cement, or from a shallow tin or bowl sunk into the ground, must also be included, as toads like to use it for an occasional bath and may even breed there. Incidentally, amphibians "drink" water by soaking it up through their skin.

If the garden is escape proof so much the better. A few toads will act as valuable allies for the keen gardener, since they catch so many injurious insects and other garden pests.



Photograph]

[H. Bastin

Toads soon become very tame, says the author. Here a specimen rests on its owner's hand.

bark strips, rock-work, flower pots, etc., provide the hiding places for the toad colony. Each hiding place should have an entrance, small enough to keep out the light, but large enough, of course, for the toads to crawl through. It will be found that, once inside, they always sit facing the doorway. A shallow dish of water will provide a bathing place.

Plants in this "Toad Hall" are a matter of choice. I now avoid them, because I find that during their digging operations, the toads are likely to disturb them, or may crush them with their rather heavy little bodies. Sometimes during hot weather, a toad will dig itself right into the soil, and may retire for many days.

Toads do not usually enter water as frequently as frogs, and I have noticed that when they do this, it is a sign that they are about to slough. This is an amusing sight to watch. The moist skin splits along the back and, by a series of wriggles, the toad slowly peels off the outer skin by using its fingers and toes. The skin rolls up over the back, peeling off the legs and arms right down to the tips, then over the head, finishing as a tight ball just above the mouth. It is finally swallowed.

Interesting Feeding Habits

Even more amusing to watch is a toad eating a worm. Normally any smaller prey, such as an insect, is swallowed in one gulp, disappearing with a flash of the tongue. A worm has to be swallowed in stages, and during the process a kind of boxing match takes place. The little creature heaves and struggles with the wriggling prey, pushing and prodding at it with its fore-feet. This is actually a process known as the "cleaning action", in which the fingers are scraped along the worm's body in order to remove the dirt. Frequently the eyes are closed and, as the eyes bulge inside the sockets, they are pressed against the worm, helping to push it down the gullet!

Toads become so tame that they feed and perform even when handled. I had one specimen which would allow itself to be lifted on one's hand, so that it could catch flies crawling up the wall or window. Another well-loved pet, called Sally, would be taken out of her box every evening, and allowed to wander about my study table, but eventually she came to a sad end. During the night she took her usual fortnightly bath, and the next morning we found her there, drowned, after four years as a favourite among the family pets.



Photograph]

[L. E. Day

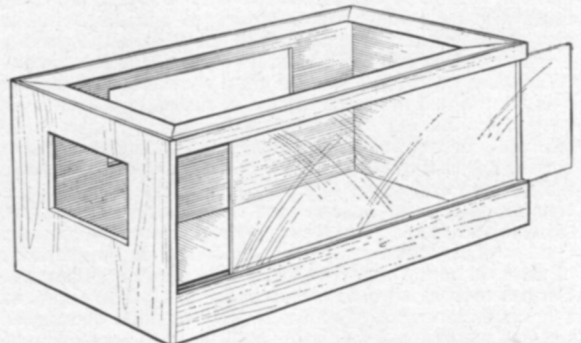
The Midwife or Bell Toad (*Alytes obstetricans*), a native of Western Europe, which has been introduced to England.

A toad in the greenhouse or conservatory will act as a useful controller of insects. It should be provided with some sort of cover, such as a small box of earth, and a shallow dish of water.

Here is a useful tip for the housewife who has trouble with ants in the kitchen or pantry. Simply introduce a toad for a few days! Ants figure highly on the toad's menu, and I have known them to disappear very rapidly when a toad was allowed to sit on the pantry floor.

The vivarium which I have now been using for many years (needless to say I call it "Toad Hall"), is a rectangular wooden house, measuring about 3 ft. in length, 1 ft. tall and 18 in. deep. The top is open, but has strips of glass fitted along the top inner edges, to form a jutting ledge. The back and sides have windows of perforated zinc, and the front is of glass which fits into slots. It can be slid in and out from one side. The bottom edge of this glass rests on a strip of 3 inch wood, as shown in the sketch. This strip acts as a barrier to the vivarium contents, which might otherwise fall out if the glass ran along at floor level.

The vivarium floor is covered with about three inches of loose soil (leaf mould, earth and sand mixed together), kept permanently moist. To protect the woodwork the vivarium floor has been lined with tin sheeting. Periodically this soil is stirred up to freshen and sweeten it. The usual

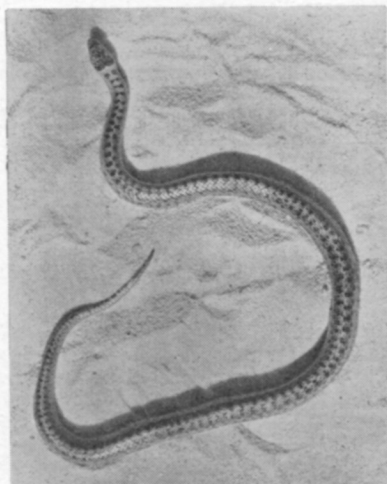


Rectangular toad vivarium which has windows at the sides covered with perforated zinc and a front panel of glass.

Supplying the Needs of Vivaria Inmates

5. Large and Small Snakes Make Fascinating Pets

By Alfred Leutscher, B.Sc.



Photograph] [L. E. Day
The docile Smooth Snake (*Coronella austriaca*) which makes a good pet.

THIS article will deal with a controversial branch of the vivarium hobby — keeping snakes. As pets these reptiles are not everybody's idea of a hobby even among animal lovers. It is generally found, however, that those who do keep snakes are sufficiently sensible to weather the good-humoured ridicule of their friends and of their neighbours.

They become devoted to a fascinating pastime which teaches them a great deal, for snakes are undoubtedly among the most wonderful and, at the same time, most unorthodox of creatures. Without limbs, they can crawl, burrow, swim, climb and even "fly". They swallow whole meals which put a healthy human appetite to shame, yet can starve for over a year. They may carry the deadliest of venoms, yet are rendered helpless with a light blow. They slough their skins in one piece, can "smell" with their tongues and sleep with their eyes open. So one could go on listing the remarkable feats of the serpent.

No wonder a snake devotee becomes attached to his pets, and is quick to correct the numerous stupid notions which are still written and believed in by so many otherwise intelligent people.

Signs of Good Condition

With the exception of venomous species, which are fortunately in the vast minority and never fully to be trusted, most snakes sold in the pet trade become readily tame with proper care and handling. Snakes in poor condition should be avoided. The body should be plump and firm to the touch. Thin and weak specimens are usually so because of sickness or starvation. The skin should be clear of blemishes (apart from clean, healed wounds), and free from fungus as this interferes with sloughing, an important and regular act in a snake's life. A good sign is the purplish "bloom" which can be seen reflecting from the skin. Any mites which are present should be removed, as these may carry a blood disease which often proves fatal. The tongue should be constantly in action, especially when the snake is anticipating a meal or senses danger. This sensitive organ, incidentally, is quite harmless, and is used to test the air for scent. If it is seldom exposed one should suspect trouble in the mouth, which may be gummed up with bacterial growth.

In selecting a specimen for one's collection, it is sometimes better to choose an aggressive rather than a docile snake unless, in the latter case, it is already tamed and is coming from a reliable source. Unless the creature is already tamed one will

at least know that an aggressive specimen is fit and healthy.

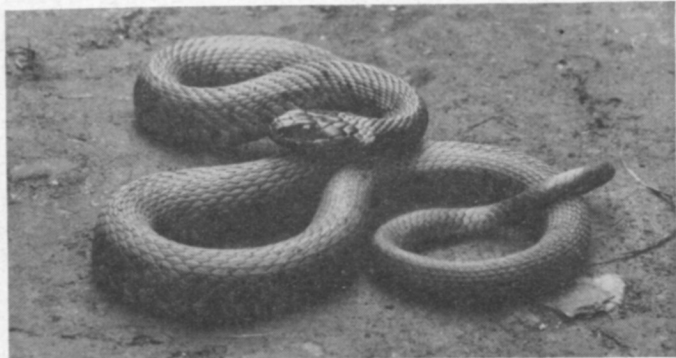
What type should we select as our future pet? This will depend upon a preference for small or large snakes, space requirements, and the cost. The question of food must also be considered, as it is no good keeping a snake which cannot be given the proper diet.

We may divide pet snakes into three categories, depending upon size. The following selection gives some idea of the range now to be had in Great Britain. Firstly, there are the small species which grow to about a foot or so. The North American Garter Snakes come into this group. Of these the Common Garter Snake (*Thamnophis sirtalis*) and the Ribbon Snake (*T. ordinatus*) frequently come over to this country. They are readily tamed, and soon feed on a diet of Earthworms, small fish and amphibians. They are "livebearers," and produce quite large families of up to seventy or more young.

Rare British Species

The Smooth Snake (*Coronella austriaca*) makes a delightful pet, and is one of my favourites because of its docility, good feeding and ready acceptance of captivity. Its main diet is lizards, with occasional baby mice. In Britain this little serpent is now rare, and requires protection.

The Continental specimens can more readily be had through dealers. Young Grass Snakes (*Natrix natrix*) either British or imported, the Dice or Tesselated Snake (*N. tessellata*) and the Viperine Snake (*N. maura*) make hardy little captives. All have rather similar habits, and feed on small frogs, toads, newts and fish. The two latter prefer fish, and are fond of entering water. At earlier ages these snakes are more attractively marked than the adults. The



Photograph] [S. Crook
The hardy and completely harmless Grass Snake (*Natrix natrix*).

adults will grow up to three or four feet, and in this second group we have a fine selection from which to choose, especially among the North American species. The Water Snake (*Natrix sipedon*) is a cousin of our Grass Snake, with a similar diet and a particular fondness for water. Like Garter Snakes it is viviparous. The most handsome American snakes are undoubtedly the many useful rodent hunters which prey on rats and mice. Small birds, lizards and eggs are also eaten.

By general consent among snake keepers, the King Snake (*Lampropeltis getulus*) in its many forms is looked upon as the prize of any collection. It is handsomely marked in

shiny black with wavy white markings and makes a docile pet, usually feeding well. Another favourite is the Milk Snake (*L. triangulum*) which is brownish in colour with darker blotches of brown along the back.

The Corn Snake (*Elaphe guttata*) and Pilot Black Snake (*E. obsoleta*) can also be recommended. The former is tan coloured, marked with reddish blotches, the latter a shiny black. South Europe possesses three species of the same Genus. One is called the Æsculapian Snake (*E. longissima*) known as the "Healing Serpent" from Greek mythology, and discussed in WATER LIFE, February-March, 1950, issue. The second is a real beauty, called the Leopard Snake (*E. situla*). Its name will give some idea of the colour pattern. The third, the Four-lined Snake (*E. quatuor-lineata*), has a grey-brown body, banded with elongated pale stripes. Another Genus, *Coluber*, includes the European Dark Green or Angry Snake (*Coluber viridi-flavus*), and an American relative, the Black Racer (*C. constrictor*). It is reputed to be one of the swiftest snakes, but is badly named. These two do not constrict their prey in true fashion, but hold it down in the coils to assist in swallowing. All the others (*Lampropeltis* and *Elaphe*) kill their victims in their coils first.

I have found all the above species make good captives, which may cause surprise to some readers. This is partly because some specimens are inclined to be aggressive, and do not readily feed, as in the case of *Coluber viridi-flavus*, which has not been called the Angry Snake for nothing. This is partly the "luck of the game," as snakes are very individualistic.

Popular Large Pythons

Some people enjoy keeping the large snakes, which make up our third group. These are the various constrictors, which will all require some form of permanent heating to their cages. Many species are now imported, either as babies about three to four feet long, or adults up to ten or more feet. The most popular species seems to be the Indian Rock Python (*Python molurus*), especially the pale form. It has a good name for being docile and being ready to feed at most times. It is this species which usually appears in the circus act or music-hall turn. Snake charmers will keep one handy in order to impress an audience. Other large snakes include the West African Rock Python (*Python sebae*) and the handsome Royal Python (*P. regius*), also from Africa. The various Boas are usually from S. America, and the Diamond or Carpet Snake is Australian.

One species which is inclined to be aggressive at times, is the Malay or Reticulated Python (*P. reticulatus*), which rivals in size the S. American Anaconda (*Eunectes*). These two are among the world's largest snakes, and are said to reach 30 feet. Such pet snakes feed mainly on rabbits, rats, mice and birds.

Lively at Higher Temperatures

Some people are terrified at the sight of a constrictor coiled around the body of its owner, and are ready to expect the worst. In almost every case the powerful pressure one feels from the coils, is merely the Python's way of holding on, as it would do on a tree branch, and not an attempt to crush an enemy. Such tame pets can usually be trusted not to crush or bite, and a wise owner will always cool his specimen before allowing strangers, especially children, to hold it. Snakes are more lively at the higher temperatures.

The homes for most snake pets follow a similar pattern, depending upon size, and may range from a small vivarium

to a large, wooden cage. There is no point here in going into great detail as to their construction, but a few general hints may come in useful. Firstly, this sort of home *must* be escape proof. Snakes will nose and lever themselves through the smallest cracks and holes, and can cause considerable alarm if found roaming about at liberty. Secondly, there should be ample lighting and access to sunshine, especially in those snakes which like to bask. Constrictors, incidentally, usually avoid direct sunlight. Thirdly, ventilation. This should be carefully arranged, in order to exclude draughts. Top ventilation is perhaps best (perforated zinc or fine wire netting, firmly secured to the roof). If a separate fitted roof is made, it can be placed on the top of this, and adjusted to control the heat inside.

Furnishing Their Quarters

Perhaps the most important consideration is the vivarium contents. It is very tempting to set out an attractive "garden" of plants in soil, as suggested for amphibians in previous articles, but there is a danger in this. The plants have to be watered from time to time, and snakes kept in close surroundings where this is done, are inclined to get wet skins. This may soon lead to skin troubles, because the animal would never get a chance to become dry. My advice, and this is quite personal, is to keep the snake's home *perfectly dry*. Snakes will live quite happily on dry earth or sand and even on bare wood. Some dry vegetation is useful for cover, and will assist in the sloughing process. Moss, dry bracken or heather, branches and rockwork all help in this. Old sacking is often put down for the large snakes. They seem to like to coil inside this. A dish of clean drinking water must always be present. Most snakes appreciate an occasional luke-warm bath and they can always be taken out for this treat.

Heating, where necessary, can be provided by an element or tubular heater, or a suitable light-bulb, depending upon the amount of heat or temperature required. Thermostatic control is also useful. Heat sources must always be out of the reach of snakes, since they will do stupid things, such as curling up in direct contact with the heater or bulb, and may receive burns.

Snakes behave in different ways; some tame readily, whereas others are ever ready to hiss and bite. Since none of the above are venomous the bite need cause no alarm. In biting, the sharp teeth may draw blood or lacerate the skin, but such an injury is no worse than a graze or scratch from a nail or thorn. The wound is merely cleansed and treated with an antiseptic then covered with a light bandage.

Hints on Handling

Actually snakes rarely seem to bite certain people who know them. There is a certain amount of "green finger" treatment about this, and I may be one of the more fortunate snake owners who is seldom bitten. It is as well to know certain points. Never make a sudden movement near a snake. When holding it do not actually grip or squeeze the body, but let it glide easily through one's fingers, from one hand to the other, or over one's shoulder and neck. The last takes considerable courage with people who have mistaken ideas about serpents. My experience is that they usually show surprise that the "evil, slimy creature" is actually dry, smooth and silky to the touch, and quite tame and gentle after all.

A particularly important point is that the head should not



Photograph] [Fox
Marion Rix of Sutton and Semra Alioglu,
who comes from Turkey, both aged 12,
examine the markings of a constrictor
owned by Mr. G. J. Boyce of Streatham.

Current Research

Salmon Migration and Environment

By Alastair N. Worden, M.A., B.Sc.,
M.R.C.V.S., F.R.I.C., M.I.Biol.

IN the June issue of *WATER LIFE* (p. 124) we discussed the work of Dr. William S. Hoar, of the University of British Columbia, on the physiology of migration. In a contribution to *Nature* (1954, Vol. 174, pp. 215-217) Prof. A. G. Huntsman, of the Fisheries Research Board of Canada and the University of Toronto, summarises his views on original observations on salmon migration carried out over the past 20 years.

"What fish do of themselves is simple enough," writes Prof. Huntsman, "but where they go is complicated by environment and weather". The Margaree River of Cape Breton Island is particularly suitable for studying the migration of local salmon, even for the sea portion when they are, for the most part, deep in the water and out of sight. When small salmon or parr that live for several years in the river are swept down towards the sea by heavy floods, they reach the Margaree estuary. Where the water is not so saline as to be lethal, these parr survive and ascend small streams that are tributary to the estuary.

Movements of Adults

When adult Margaree salmon are marked and liberated in the estuary after spawning they may or may not, depending on the floods, ascend the river and be found in it as late as the middle of the following summer. Eventually they are found only in the sea and, until they have again become fat and vigorous, only along the outflow of the river for some 10-20 miles to the N.E. of the coast.

Fat salmon that have ceased feeding and are wandering vigorously have been marked after capture in traps on the Margaree coast and released. The individuals appear to travel in every direction and recaptures take place at all points where there is gear to take them. As a whole, however, they are shifted by the water movements. They may be concentrated near the shore by near-surface currents from onshore winds, or concentrated near the mouth of the estuary by the return subsurface current that replaces the sea water entrained in the outflow. They are shifted not only offshore and onshore, but also to and fro along the coast by wind currents.

The wide dispersal through this bandying about by the weather, as well as through wandering, was shown by recaptures from a batch of more than 30,000 fish that had been marked by fin-clipping when they were descending as smolts in 1938. Some of these were recaptured as fat three-sea-year fish in 1941 from various nets along the coast.

Behaviour of Smolts in Tidal Waters

The young Margaree salmon become smolts in the spring and descend to the sea after 2 years in the lower, warmer parts of the river system and after 3 years in the upper, cooler parts. They descend when it becomes warm enough for them to be active, and when light and low water do not keep them so close to the bottom that they are stimulated to head and swim upstream. Their behaviour in tidal waters where there is plenty of room may be observed when they are in the broad and shallow estuary before they are carried out in the strong currents and deep water of the spring tides.

They may be seen dispersed over the bottom, each one occupying a station and feeding on passing plankton. It is presumed that they do this where they are carried by the estuarial outflow to deep water, where they descend out of sight.

Limited Dispersal of Two-year-old Fish

It only becomes profitable to fish for the salmon when they cease feeding, and on wandering, become concentrated near shore or in the outflow. Few salmon do this as grilse after the first year, but most of them do it after 2 years and a considerable number after 3 years. During the first part of the 1940 fishing season the two-year-old salmon that had been marked as smolts in 1938 were found only in the outflow and along the coast at distances of up to 20 miles from the mouth of the estuary. They were more abundant near the inner part of this zone, which was where they had evidently settled as smolts. In the following year the three-year-old salmon that had been marked in 1938 appeared later in the season than the two-year-olds had done in 1940, and along a greater part of the outflow.

Stimulated by Fresh Water

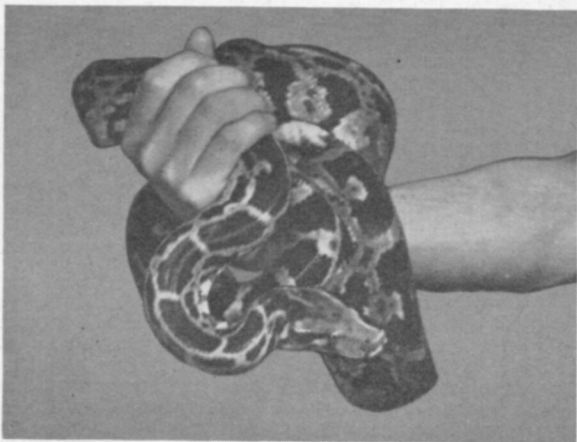
In both seasons the distribution of fish later became less and less distinct due to the wandering of individuals, but the inference was that the three-sea-year fish settle farther offshore in deeper and cooler water, where they mature more slowly and are exposed later in the season to vernal warming. Where they settle determines their remaining a longer time in the sea and attaining a greater size.

In the course of these studies it has been found that while individual fish may quickly reach and enter the river—one has been found to return from Newfoundland—the entrance of adult salmon into the estuary depends in the main on the carrying of the fish into the estuary or close to its mouth. Actual ascent of the river from the estuary depends upon freshets (i.e. streams of fresh water) which stimulate the fish to greater activity.

Supply the Needs of Vivaria Inmates

(continued from page 225)

be tampered with as a snake is most sensitive there. After being handled a while it will probably settle down over one's shoulder in one's hands, and actually seem to enjoy the warmth and proximity of its new-found human friend. Yes, there is a lot to be said in favour of serpents.



Photograph]

[Lotus Ph. Service

A specimen of the Indian Rock Python (*Python molurus*) photographed in Bombay where it was kept as a pet.

yellow band while the remainder of the fin is greenish with darker markings. The small ventrals are similar in colour and the pectorals are yellowish. There is much variation in colour, not only in a particular fish but also between different individuals, and while the best males are very pretty one does find some whose colour is dull. The female is much more subdued in colour than the male although she does show the body markings of the male to a lesser extent, and her fins are often suffused with a reddish-brown shade.

The male attains a length of 2 in., the female less. Care and breeding needs are the same as for *A. australe*.

Aphyosemion roloffii was imported into Germany from the neighbourhood of Freetown (Sierra Leone) in 1950 by E. Roloff, whose name it bears but fish of apparently this same species were imported into this country shortly before the war. The stock of the last importation was lost and no fresh importations from Africa appear to have taken place since then.

The male is one of the most colourful of this beautiful Genus. Its back is olive but most of the body is a bright blue-green which in some specimens appears, emerald green. The sides are adorned with a series of short horizontal red streaks which give place to a number of forwardly inclined, downward slanting, red bars behind the dorsal. The upper and lower edges of the rounded caudal are orange,

bordered on the inside with dark red-brown, while the central area is green-blue with bold red markings. The dorsal is blue-green with red markings and carries a light blue edge below which there is a dark reddish brown band. The anal fin is similarly patterned, but with an orange edge. The yellowish ventrals are bordered with blue.

The female is of the usual drab olive coloration but has a vestige of vertical bars in its posterior region and shows a dark spot on the upper caudal base. It is some time since I saw this species (in 1939) but, if my memory is correct, the spot is darker and more distinct than in the females of *A. calabaricus*.

The requirements of this species are similar to those of *A. australe* but I have no personal knowledge of its breeding habits. They are reported to resemble those of *A. australe*, the eggs being deposited near the bottom of the aquariums and hatching in about 14 days. The statement that they spawn near the bottom causes one to suspect that they may spawn, like their near-relative *A. calabaricus*, not near, but on, the bottom of the tank. The male reaches a length of 2½ in. with the female slightly smaller.

In the next contribution I shall cover one other species in the Sub-genus *Aphyosemion* of Myers—*A. schoutedeni*. I shall then go on to discuss fish in the remaining Sub-genera.

Supplying the Needs of Vivaria Inmates

6. Aquatic Reptiles — Terrapins, Crocodiles and Alligators

By Alfred Leutscher, B.Sc.

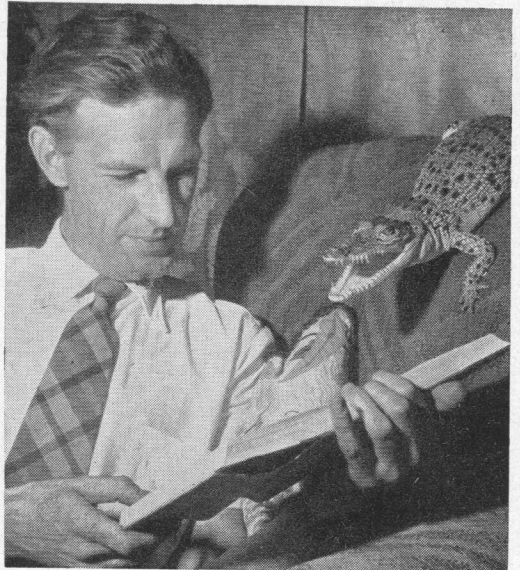
IN this concluding article on homes for vivarium animals, we shall cater for the aquatic reptiles, such as terrapins, crocodiles and alligators. Previously it has been stated that, as a rule, the amphibians prefer wet surroundings whereas reptiles enjoy the drier conditions. The above reptiles seek a compromise, and are equally at home in water and on land. They like to lie out for long intervals in the warm sunshine, but are frequently in the water, which to them is the source of their food as well as a retreat from danger.

The homes for all these pets follow the same pattern, that is, some sort of enclosure containing shallow water, and having a raised bank or shelf on which they can lie and bask. For indoor purposes an aquarium may be used. The size should fit the occupants—a 2 ft. tank will house two or three 4 in. terrapins, or a baby alligator. Such a container is filled to about a 4-6 in. depth of clean water. At one end a shelving bank of sand of flat stones is erected, wide enough for the inmates to lie comfortably out of water. A weighted glass cover will prevent any escapes, and also help to conserve the heat inside. Artificial heat will depend upon the species one keeps, its age and the time of year. Tropical kinds require heat, of course, and it is advisable to keep all baby specimens warm, whether terrapins or crocodilians. The older creatures from temperate lands can endure the normal indoor temperatures. In fact, some will come to no harm if allowed to hibernate in normal fashion, that is, with a drop in temperature. I have known cases of

Mr. A. Leutscher with a friend's Salt-water Crocodile. This reptile is not always easy to tame.

Photograph]

[Keystone



the European and Spanish Terrapins, even the Mississippi Alligator, sleeping the Winter under the ice in an outdoor pond.

Heating may be supplied with a controlled aquarium heater, which must be carefully insulated against direct contact. Another method is to use a heat source (a gas jet or spirit lamp) which is played on to the aquarium floor from below. The flame must not play directly on the aquarium bottom but on to a metal baffle plate placed a few inches below the tank. Another alternative is top heating and lighting supplied by a suspended light bulb which hangs inside the tank just above the basking platform. A thermometer is useful in each case, to check and regulate the temperature.

An alternative vivarium design is now given. A wood and glass cage is built to fit to some convenient water receptacle, such as a sink, a zinc bath, or a large bowl. If the cage is made a little wider than the sink, the gap between can be filled in with wood boarding, so that it rests on the rim of the sink. This will provide a sunning platform.

The question of setting plants is debatable as the

creatures are heavy and clumsy and liable to do damage to vegetation in confined spaces. I once arranged a row of potted plants behind a glass partition in a crocodile enclosure which worked quite well but took up valuable space.

Our choice of pets is fairly wide these days, as a number of species are now regularly imported. Among terrapins the European Pond Tortoise (*Emys orbicularis*) is a hardy favourite, and will stand up well to our climate. The same applies to the Spanish Terrapin (*Clemmys leprosa*) and the lesser known Caspian Terrapin (*C. caspica*). From the U.S.A. we get the Painted Terrapin (*Chrysemis picta*), with its black shell and bright red markings, and an occasional adult Elegant Terrapin (*Pseudemys scripta*). Another species from S.E. Asia is Reeve's Terrapin (*Chinemys reevesi*) a brownish species with three ridges down the carapace. All these are sold between 4-6 in. long, which is the adult size.

There are also in popular demand a number of baby terrapins, especially the attractive green ones from the U.S.A., which are mostly the Elegant. Appealing as these may look, I am reluctant to recommend them as pets. It is now generally agreed among experienced terrapin keepers that they are by no means easy to rear, and require careful and special treatment as well as diet. Permanent heating, plenty of sunshine and a regular but carefully selected diet are essentials. Some further details on terrapins may be found in WATER LIFE pp. 119-120, June, 1951.

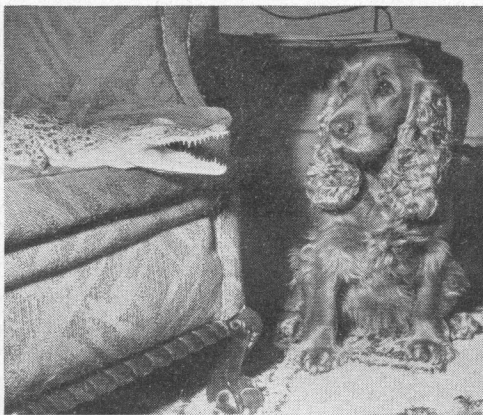
Among the crocodylians, the Mississippi Alligator is by popular consent a general favourite. Once settled in its new home it becomes very tame and will rarely bite. It can be handled with ease if this is done regularly. It has an amusing way of closing the eyes and throwing back its head in evident enjoyment when stroked on the chin. This is a North American species. S. America is the home of its cousins, the caymans. The two usually seen are the Black Cayman (*Caiman niger*) and the Spectacled Cayman (*C. sclerops*). Both appear to be amenable pets.

With the true crocodiles, however, temperaments are a bit uncertain. One may pick on a docile pet, or one which will not behave. The most pugnacious species is undoubtedly the Saltwater Crocodile (*Crocodylus porosus*). It is found along the sea-board of S.E. Asia and Northern Australia, and has a reputation as a killer. Specimens are said to reach a length of 30 feet.

I once had a three-foot baby Saltwater Crocodile to look after for a friend. It was in splendid condition, plump and full of life. After nine months of careful handling there were still no signs of tameness. As one passed its aquarium home it would hurl itself at an intruder with a heavy thud against the glass. After having received the full impact of its needle-like teeth in my hand on three occasions, I decided to change the feeding tactics. After that all food was offered on the end of a piece of cotton! It was a relief to have it, literally, off my hands.

Other species of crocodiles are the Nile Crocodile (*C. niloticus*) and the Mugger of India (*C. palustris*). They are usually well behaved as youngsters. Probably the most friendly species are the curious gharials, which have long, narrow snouts. Even the adults are not greatly feared in their native homes. This may be because they are almost exclusively fish eaters, and usually avoid man.

In handling these creatures it should be understood that they do not necessarily bite because of aggressiveness as in the case of my friend, the Saltwater Crocodile. This may



Photograph]

[Keystone

The author's spaniel looks questioningly at a rather defiant Saltwater Crocodile (*Crocodylus porosus*).

well be due to nervousness, so that proper handling will help much towards overcoming the biting habit. Leather gloves may be worn to start with, but it is possible to remove a small crocodile from the water, by gently dragging it out by the tail. It is then firmly grasped in one hand near the base of the tail, where all the strength lies, and with the other holding it around the arm-pits. As soon as any struggles die down it should be stroked gently along the head and back, and finally underneath. In no time it will lie passive along the arm. All these movements should be unhurried.

Ailments and ill-health are rare among these aquatic reptiles, provided that proper attention is given to the diet, and that the

risk of chills is avoided. The basic foods are pieces of raw [meat and fish, given daily or when the pets show signs of hunger. Vitamin shortages can be made up with supplies of oily foods, such as liver and raw herring. It is a good idea to wrap an occasional liver-oil capsule (as given to humans) inside a piece of meat, and feed this once a week. A natural meal will help in digestion, such as a dead mouse or bird, a frog or some other small animal. Bone building foods, where calcium is required, can be supplied with fish containing the bone, grated cuttlefish bone spread on a meal and a number of small creatures with shells or hard bodies, such as snails, mealworms and crustaceans. These latter are more suitable for terrapins.

Sunlight, incidentally, is an excellent vitamin restorer. This is where the aquarium home is so useful, since it is easily moved, and should be placed outdoors on every warm and sunny occasion. Scrupulous attention must be paid to the water. Since these reptiles tear up their food, stray pieces are easily overlooked and will quickly pollute the tank. This may lead to bacterial or fungus trouble which can affect the eyes.

Summing all this up, we cannot do better than carry out the three golden rules of a vivarium keeper—plenty of sunlight and warmth, constant clean water, and a regular but varied diet.

The purpose of these articles has been to suggest to the reader ways and means of keeping vivarium creatures in his home. This is the only way for many people, such as flat dwellers, or educationists and students who keep a classroom or laboratory zoo. Usually such homes are quite satisfactory, but it cannot be stressed too often that, wherever Nature can play her role, the outdoor vivarium is best.



Photograph]

[R. L. Gardner

Nile Crocodile (*C. niloticus*) in an aquarium adapted as a useful vivarium at this year's Wandsworth Borough Show.

through a fine mesh net and the net is dipped into the rearing aquarium which has been prepared with soft water and a peat filter. Under no circumstances must the young fish be pressed and damaged in this operation.

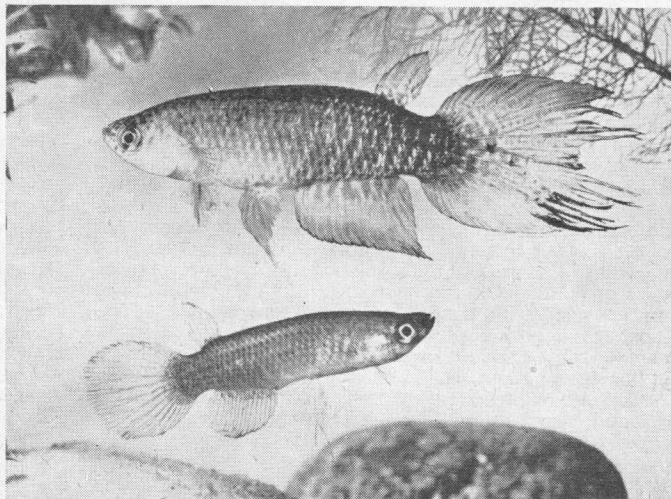
It is advisable to pour soft water once more over the peat in the larger vessel in order to produce any stragglers which quite often hatch after one or two days. After this the peat rarely contains eggs which would develop within a short period. Actually, if one had the patience and let the peat stay in the water for a few weeks longer (four to five weeks), then more young fish would hatch out, but, generally, one is content with those first born which constitute by far the greatest percentage.

Rearing is not difficult. First of all one gives Brine Shrimps (*Artemia*) or *Cyclops* nauplii with the smallest threadworms (Mikro). Later small *Daphnia* and Dwarf White Worms and finally *Tubifex* and *Daphnia* can be offered. A peat filter is advisable. The water temperature should be about 68-73.5 deg. F. There are only a few species of tropical fish which must be kept at a higher temperature, about 82.5 deg. F., and these are chiefly the Labyrinths and the surface fish. In the case of the Characins and the layers of adhesive eggs, the temperature should generally be between 68 and 73.5 deg. F. The temperature for the bottom layers, to which group *Pterolebias longipinnis* belongs, is within 64.5 and 68 deg. F. Should these creatures be kept at a higher temperature there comes about that characteristic change of colour from blue to rust-brown or gold which I have already mentioned. I believe that the precise observation of the rearing temperature is of the greatest importance for the development and the sound state of health of our fish. Even to-day this is a point to which most aquarists rarely pay attention.

I think it is by a successful breeding of fish that the aquarist first confirms that his fish rearing has been correctly executed. It is the case that rearing and breeding can never be separated from one another. In every instance we should

persevere with the breeding of a fish species until fertile eggs finally result. From this we gain the certainty that we have recognised the relationship of the particular fish species to its environment (to which it is connected in a singular manner) and that we have also succeeded in bringing this cycle of life to our aquariums. This should be the direction of our highest ambitions, namely to maintain living creatures extensively in similar conditions to those occurring naturally.

Mutation breeding, so beloved by some hobbyists, is, I believe, no art, because it neglects the collective organisation of the essential nature of life and limits itself to the fixing of single notable forms. There are many difficulties in maintaining the natural essence of the living organism and, as aquarists, I feel we should strive at all times to comply with the natural conditions of our fish.



[Photograph]

[Günter Senfft]

Veiltail Top-minnows (*Pterolebias longipinnis*). Male is the upper fish.

Breeding Albino Axolotls

Saving the Eggs — Feeding the Young —
Growth Rate — Restricting Numbers for Rearing

By "Natrix"

THE Axolotl is one of the easiest of creatures to keep; so easy and interesting that it should be the means of introducing many people to the hobby of herpetology. Unfortunately this is not so. The name is such a tongue-twister that it puts some off; others just take one look and say "Ugh—what awful things!" and pass on quickly to the tropical fish. At first glance these creatures are not very prepossessing but that in itself can be an attraction. I have offered sixpence to each visitor who would put his fingers in and let the Axolotls have a bite. Assurances that they have soft mouths and are perfectly harmless are of no avail. They resemble crocodiles to the layman and that outweighs any assurances. I have only had to pay out once.

They really are perfectly harmless, live in cold water, require little attention and can be left for a fortnight at a time without food with no ill-effects. They cannot be taught tricks like a dog, but mine stand up on their hind legs against the side of the aquarium when footsteps are heard approaching the tank and this can be mistaken for begging.

I have a pair of Albino Axolotls in a tank 18 × 10 × 12 in.

kept half full of water. There is an inch of gravel on the bottom, but no plants. It is useless having plants in the aquarium, as they are walked over, pulled up and generally not appreciated. Axolotls are liable to get skin diseases, so the water should be changed regularly, not less than once a month and preferably more frequently, as otherwise their skin may be affected. For food they are given a three-inch worm twice a week.

History Previously Detailed

The history of the Axolotl, which is very interesting, has been dealt with in an article by Mr. Alfred Leutscher, B.Sc. which appeared in *WATER LIFE*, October-November, 1950, issue.

It is not difficult to sex them. The mature male has a noticeably swollen cloaca, while that of the female is quite small. This is easily discernible. The head of my male is larger than the female's, which, according to all the reference books, is unusual and quite the reverse of normal. However the best method of sexing Axolotls applies also to any other

tailed amphibian. The tail/body ratio of the male is greater than that of the female. With Axolotls the male tail/body ratio is about 5:4, while with the female the ratio is about 1:1. The female also fills out with spawn and it is then much fatter than its mate.

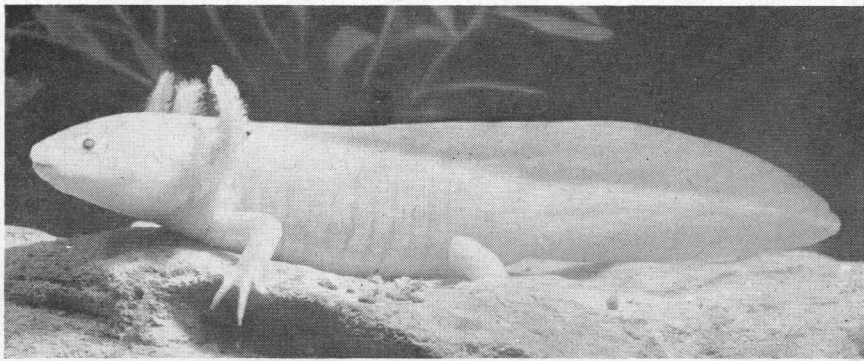
Axolotls are brought into breeding condition in a most improbable way—by depriving them of food for a short period and a drop in temperature. Give them no food for a fortnight at a time and pour in cold water from a jam-jar. This worked like magic with my pair; several times I arrived home from the office to find pieces of jelly floating round the tank; the parents having apparently laid eggs and eaten them. I have never seen their courtship but by all accounts it is similar to that of newts.

As the eggs are adhesive, I thought that they would stick to the glass and gravel and so could be removed, but the parents were too quick for me. The solution is to get bunches of *Elodea* from the pond and put them into the tank, making it hard for the Axolotls to move about. In this way many of the eggs should be saved. Two days after I did this the plants were covered with eggs. They were about the size of the individual eggs of frog spawn, although there was a transparent yolk to them. They appeared to be laid singly or in bunches of about six. More eggs were laid the next day. As they are really adhesive the plants with eggs can be lifted out and placed in another container. In all, my pair laid eggs six times in six weeks.

Hatching Period

As will be seen from the résumé in the next paragraph, the eggs took 23 days to hatch, which is average. When the young hatch out they are about 1 cm. long. To me, they appeared too big to eat Infusoria, so they were given newly-hatched Brine Shrimps. These were sieved through silk, and then rinsed in fresh water before being placed in the tank. For three days, although the Brine Shrimps disappeared, I could not see the young Axolotls eating. However, after that, they could be seen doing the usual "Axolotl jump" which is always made when grabbing food—a spring forward and upward. Sometimes they landed on their snouts and balanced there for up to five seconds.

After three weeks they were started on chopped White Worms and were soon growing well. As they grew bigger, whole White Worms were given, and then they were offered small Earthworms. One problem that the beginner finds hard to solve is—are the young progressing satisfactorily? So I have listed below my impression day by day, starting the day the eggs were laid. I have written it down exactly



[Photograph]

[Sport and General

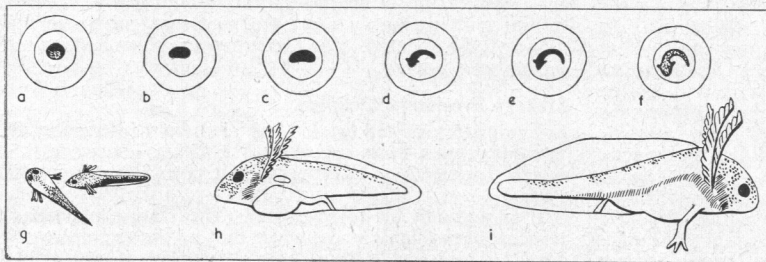
The Albino Axolotl—an unusual and fascinating creature, harmless and easy to keep.

as it appears in my diary. The first day was April 22 and the 110th day, August 10. 1st day, eggs laid. 2nd day, more laid. 5th day, the young in the egg changing shape. 10th day, young shaped like young frog tadpoles. 15th day, growing bigger. 20th day, seem to be getting lighter in colour. 24th day, 10 hatched, 1 cm. long. 27th day, all hatched but cannot see them eating. 30th day, 1½ cm. 35th day, 1½ cm., red spot visible on left side. 41st day, 1½ cm., spot on left side becoming elongated. Body growing. 46th day, 2 cm. maximum, 1.7 cm. average. 53rd day, 2.4 cm. largest, 2 cm. average. 56th day, 2.5 cm. maximum. Eating whole White Worms. 57th day, limbs beginning to grow. 60th day, front limbs well grown, but not used. Appear to have only three fingers on each. 62nd day, definitely standing on their front limbs. 3.3 cm. largest, 2.7 cm. average. 63rd day, fourth fingers developing now. 68th day, 3.8 cm. largest, 3.3 cm. average. 74th day, 4.2 cm. largest, 3.4 cm. average. Back legs starting to grow on most of them. Getting more like the adults. 75th day, saw one crawling for the first time. The red spot has now turned purple in colour, is larger and oval in shape. 81st day, fingers on the front limbs growing longer and developing black tips. 87th day, 5.3 cm. largest, 4.5 cm. average. 97th day, 7.5 cm. maximum. 110th day, 9.5 cm. largest.

Importance of Consistent Temperature

Care is necessary when changing the water. Make sure that the temperatures are the same. Later on in life Axolotls love a change of water and within reason are indifferent to temperature change. Once the young Axolotls have grown all four limbs they should be given plenty of space. The rate of growth varies greatly and the largest are very liable to eat their smaller brothers and sisters. This is perfectly natural—the cannibal thriving, growing bigger and fatter. When they grow up they often grab and pull at each other's legs and no harm is done, but when young the legs are soft and liable to come away. Let me add that the victims do not appear to be inconvenienced. I have kept a few footless ones and the feet appear to be regrowing. Young Axolotls eat a tremendous quantity of food, and it is far better to rear a few good ones than to try vainly to rear many. I reared thirty, and this is as many as I could manage to feed satisfactorily.

The young have really beautiful colouring. The purple on the body and the pink of the gills contrast with the mainly white body. As a postscript I should like to add that I am finding little difficulty in disposing of them, and have had a number of enquiries for the stock which I successfully reared from this spawning.



Development of the Axolotl from the day eggs are laid:— a, 1st day; b, 6th day; c, 8th day; d, 11th day; e, 15th day; f, 22nd day; g, 25th day; h, 53rd day; i, 62nd day. The first batch hatched after 24 days and all had hatched in 27.

Timothy—the Pet Alligator

WHEN walking down a garden path in this country, one hardly expects to stumble over an alligator which, moreover, is so tame that it refuses to move aside. It would be even more surprising to find it curled up in the drawing room hearth like any fireside pet.

Yet this is the contented lot of Timothy, a Mississippi Alligator, which now lives at the home of Mr. Lionel E. Day, F.R.P.S., A.I.B.P., A.P.S.A., the well-known photographer.

Actually Timmy belongs to Mrs. Day, who first had him nearly four years ago. His story really begins in the far-off Mississippi valley, where he was caught as a year-old baby about 20 in. long. Because of the dollar restrictions he came to England in a roundabout way. From his home in the swamps he travelled north to New York, was then flown across to Vienna, and so across Europe to England, where he finally landed at Heston Airport, close to London.

This was four years ago. Timmy is now four feet long and growing steadily. He conforms to the average rate of growth in young alligators, which is about a foot every year. His life at Westcliff, Essex, has settled into a well-defined routine. All Summer he spends in the garden, free to roam and do as he pleases. Actually he rarely strays, and spends most of the time sprawled out on the warm flagstones which border the garden pond. This latter measures 12 ft. x 6 ft. and is 3 ft. deep. It now belongs exclusively to Timmy whereas at one time it was the home of Goldfish.

Livefood is given regularly to the alligator in this pond where, strange to say, there are some of the original Goldfish,

recognised by Mrs. Day, which are never touched.

As evening approaches Timmy slides noiselessly into the water and settles down for the night. Next morning he is back again as soon as the early sun reaches the flagstones, having crawled out by means of a series of bricks arranged as steps. Humans can approach him quite closely and he does not move but as soon as Spot, a lively terrier, comes near, Timmy is gone in a flash. Mrs. Day informs me that in spite of his sleepy appearance, Timmy always has a weather eye open, and invariably faces the pond when at rest, ready to dart in when danger threatens.

Demise of a Sparrow

One day Timmy caught a sparrow! These garden birds are so used to him that they hop around quite unconcerned, but one morning a certain sparrow came too near. There was a lightning flash of teeth and that was that. Mrs. Day was so surprised that she was too late to save it. One can well understand how easy it is for a large "killer" crocodile to catch an animal or human unawares at the river bank, and then drag the victim into the water. Timmy always takes his meals into the water before swallowing them.

During the cold months he spends his days in a large, heated tank in the conservatory. He is then fed on horse-meat and raw fish. Sometimes he spends an hour or two indoors, in a box of straw by the fire.

Timothy has an uncanny "feel" for the weather. From his Winter quarters, in a steady temperature of about 75 deg. F., he can sense whether it is a warm, sunny day outside, and becomes restless. As Spring approaches he makes repeated attempts to crawl out of his tank, and



Photograph]

[L. E. Day

Mrs. L. E. Day with Timothy, a five-year-old Mississippi Alligator now four feet long.

sometimes falls to the conservatory floor with a squelchy flop, doing himself no harm. He then tries to clamber over the wire-netting gate of the door, in order to reach his pond.

By now he is well-known in the neighbourhood, and often visited by the children. He, in turn, has been to their schools and has appeared at local shows and television. Timothy is now a fat and lazy, but contented, alligator, and there is no reason why one day he should not reach the size of famous George, the London Zoo alligator, who died recently at the ripe old age of some 100 years.—Alfred Leutscher, B.Sc.

Aquatic Press Topics

By L. W. Ashdown

Ensuring You Have a Pair of Fish

POOLS enthusiasts—not garden but football—will no doubt be *au fait* already with their chances of achieving affluence during this season and may even have applied similar mathematics to their fishkeeping, but for others an article in THE AQUARIUM (U.S.) should be of interest. An earlier contribution had said that "the mathematicians tell us that six is the smallest number from which there is a reasonable assurance of obtaining both sexes (of fish)." Naturally, one can never be 100 per cent certain of obtaining a pair from six fish of one species which are either too young to sex or cannot be visually identified as male or female. Nevertheless, James W. Beach, who is in the mathematics department of a N. Illinois College, says that many mathematicians would agree that there is reasonable assurance of getting both sexes when the probability is 95 per cent or more. With a sextet of fish the chances are approximately 97 per cent, with a quintet they are below 94 per cent. The more sets of six fish one has the greater the possibility of approximating to these figures.

The moral seems to be that if you like to buy young fish and grow them on yourself, or if you see a tank containing an unusual species and want to try your hand at breeding them, then a purchase of six fish will give you a reasonable possibility of obtaining both sexes. You may be one

of the unlucky ones, but there is a 97 per cent chance that you will not be. Good luck!

REFER to the article on page 24 dealing with Pompador Fish and you will reason that one American aquarist had a heart beating quite a bit faster than normal one evening. Thinking it unnaturally warm when feeding his fish he found the water in one tank had shot up to 102 deg. F. Among the fish were three prize Pompadors. Heater unplugged immediately and tray of ice cubes floated in the water resulted in the temperature coming down to 85 deg. in four hours. At the peak the fish had been lying horizontally on the bottom. Gradually they recovered and by 1 a.m. they took shreds of steak, seemingly none the worse for their excursion nearly half-way to boiling point. The story is told by Estelle Mason, associate editor, in an issue of THE TROPICAL FISH MAGAZINE, produced by Pioneer Valley A.S. (Massachusetts).

"CONSIDER the lowly snail," says Mr. F. E. Lowell, in the November issue of THE AQUARIUM JOURNAL (U.S.). He develops quite a case against keeping these molluscs in community aquaria, not because of their mutilating effect on the plants, but because the snails themselves

are being asked to exist in a hostile environment where fish are often all too ready to give them unwelcome attention. This is an opposite viewpoint from the one we usually hear when snails are vilified as damaging denizens of our tanks although they do contribute to the spring-cleaning a little by eating old plant leaves and unwanted algæ.

Mr. Lowell, quite rightly, I feel, says that snails are worthy of a tank to themselves. They are not everyone's choice, obviously, just as appreciation of their edible brethren's succulent qualities is, for the most part, restricted to just a section of Continental gourmards. The author says that "snails, particularly Red Ramshorns, grow much bigger, acquire a clear, red colour, and move boldly about, waving their long graceful tentacles and exhibiting many other charming attributes" when kept by themselves. For maximum development they should have ample space and food. Cereals, tinned salmon and spinach, are excellent alternatives for tender plants and dead matter eaten in the wild. Young Red Ramshorns are best nurtured on algæ. Here Mr. Lowell suggests a novel method of encouraging algæ development by mixing a small quantity of a plant nutrient with two teaspoonfuls of plaster of Paris. The mixture is poured into a jar and allowed to dry, after which aquarium water is added. A growth of algæ soon covers the plaster base and young snails thrive on it.

Small types recommended are Red Ramshorns, Paper Shells and Australian Red Snails.

harden the canada balsam. During this time any small air bubbles that may have become entrapped will usually disappear.

The mount just described will consist of diatom frustules scattered over the area of the drop in no particular order. The selected mount, on the other hand, although requiring greater skill in preparation, is far more satisfying in that it consists of a number of selected frustules laid out in a pattern determined by the mounter. In this the same accessories are required, a clean slide and cover glass, some thin canada balsam and, in addition, a "lifter" for picking up the frustules. I use a lifter made by gluing a cat's whisker (genuine) to a pen holder, the free end being gently tapped with a steel spatula to flatten it slightly. It will be found that a whisker prepared in this fashion will enable the user to pick up frustules quite easily with a little practice.

The centre of the cleaned slide is smeared with a small amount of a watery solution of gum arabic (supplied by any chemist) over an area the size of a cover glass, and this is then allowed to dry. Some of the treated frustules, which have been cleaned as described, are transferred to a shallow dish and focused under the 2/3 in. microscope objective. A frustule is selected and picked up with the lifter, the dish is removed and its place is taken by the prepared slide, the frustule is now transferred to the gummed part of the slide, and a slight breath on the slide will render the gum tacky enough to hold the frustule in place. Further frustules may now be transferred to the slide and arranged in a pattern to suit the mounter's taste.

Once the desired number of frustules has been mounted, the slide can be treated in one of two ways. The gum may be allowed to harden, covered with a cover glass and this sealed down with a waterproof sealing agent (I prefer black "Japlac" lacquer).

If, however, it is intended to examine the mount under a 1/12 in. oil immersion lens, the slide must be treated as

follows. The film of gum should be thoroughly dried, in a warm dry place, for several days, it should then be covered with a little thin canada balsam and a cover glass added. The mount should be allowed to dry for a few more days and then sealed as above with a waterproof sealing agent. This operation of sealing, by the way, is known technically as "ringing" and although it may be performed freehand,

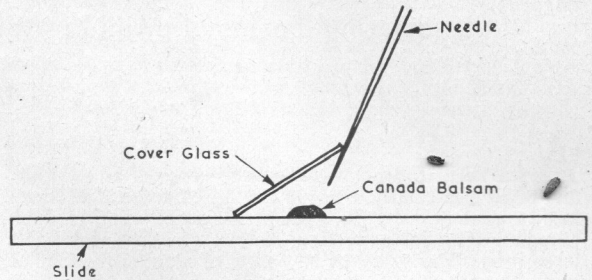


Diagram to show the lowering of a cover glass on to a slide containing dried suspension and drop of canada balsam.

there are on the market a variety of "ringing tables" that enable the job to be done quickly, efficiently and neatly.

These methods enable any interesting frustules that may be encountered to be preserved for future reference. One point that should always be remembered is that slides should be labelled with details of the type of frustule, if known, where found, how mounted and the date. Thus one can obtain an interesting and orderly collection of these fascinating little skeletons and, at the same time, acquire a useful knowledge of microscopical technique, which may be adapted to examination of other minute forms.

Care of Leopard Tortoises (*Testudo pardalis*)

Supplying the Correct Conditions and an Adequate Diet

By Audrey Noël-Hume, B.A.

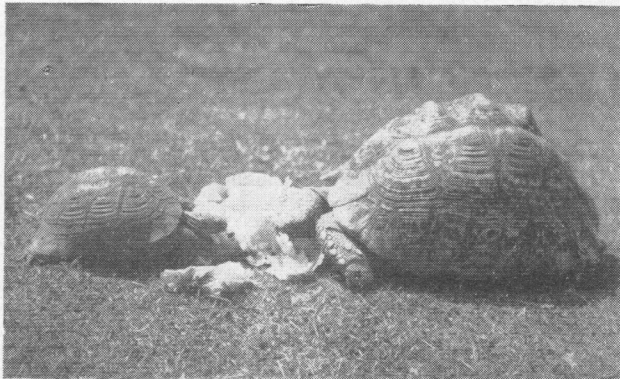
DESPITE the unsettled political conditions which exist in its native country, Kenya, the Leopard Tortoise is frequently obtainable in this country. Its relative hardiness (in comparison with *Testudo denticulata* and *Cinixys*), its love of a simple diet and its lack of shyness, make it an attractive reptile for the herpetologist who has the room its large size demands. Prices for adult specimens with carapace lengths of 12-20 in. may be as high as £20, the

result of freight charges, but smaller examples may be obtained for about half this sum.

The name "Leopard Tortoise" is derived from the blackish markings which are present in large numbers on the dull yellow ground of the carapace (shell protecting the back) and which offer a certain degree of resemblance to the skin of a leopard. A few similar markings appear on the plastron (shell protecting underparts) of some specimens, but these are usually confined to the fore-section, the rest being an unrelieved yellow ochre. The carapace is highly domed, making the tortoise appear larger than it really is, an effect which is heightened by each vertebral (dorsal shield) and costal (shields either side of vertebrals) being individually rounded in section.

Character of the Skin

The skin is a uniform dull brown, but this is relieved by the presence on the powerful front legs of some horn-coloured scales. The hind legs are equipped with



Mediterranean Spur-thighed Tortoise and a Leopard Tortoise eating lettuce. The Leopard Tortoise is a female with carapace length of 13 in. It came from Kenya but the species is found from Abyssinia to South Africa. Photographs taken by the author.

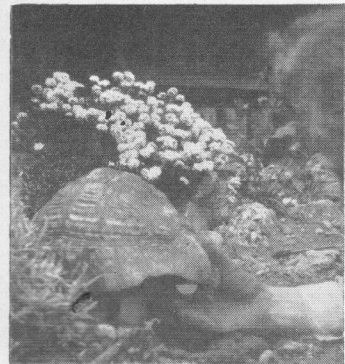
stout nails while, on female specimens, the series of horny scales at the back of the foot are especially well-developed to assist in the excavation of the nest. On the thighs are two or three large tubercles surrounded by a number of horny scales. The head of the Leopard Tortoise is similar in shape to the Mediterranean Spur-thighed Tortoise but is, of course, very much larger in adult specimens. The jaws are extremely powerful and capable of inflicting a nasty bite when the tortoise is being hand-fed.

Mention has already been made of its simple taste in food but it must be remembered that this is a large tortoise and needs relatively larger amounts of food than most other species. Although it is found in large numbers in Kenya, the Leopard Tortoise is also present in other scrub-land areas of the eastern part of Africa, from Abyssinia in the north, to the Transvaal in the south, where it feeds off the coarse grasses and low bushes common in such regions. For this reason, in captivity the Leopard Tortoise prefers green foods to fruit, with the exception of tomatoes.

My adult female will eat three medium sized lettuces and half a pound of tomatoes early in the morning, then crop the grass for a few hours before having another meal of two lettuces and more tomatoes. So it can be seen that this is not a cheap tortoise to keep unless adequate supplies of lettuce can be found at a reasonable price, but the diet can, and should, be varied with spinach, cabbage, pea pods and runner beans.

In the Winter the appetite of this tortoise naturally declines, but a minimum temperature of 70 deg. F. should keep it feeding the whole time. A lettuce a day will be needed then to ensure good health, but this, when they are a shilling each at most green-grocers, can be expensive. Like most tortoises from hot areas, the Leopard Tortoise drinks water at frequent intervals.

Whenever the air temperature exceeds 65 deg. F., *Testudo pardalis* should be put outdoors unless it is raining. I have found that these tortoises dislike rain intensely



Leopard Tortoise laying an egg which subsequently proved fertile.

and will try to find shelter from all but the mildest drizzle. It is a reptile which needs a great deal of exercise and should not be kept in a small or secluded garden for it loves to spend hours basking in the sun. This does not mean that it will not need access to shade and it must also be protected from cold winds. Summer nights may be passed in a greenhouse, but many herpetologists prefer to sleep their tortoises indoors where there is complete protection from damp, cold and rodents.

Because of its large size, Winter accommodation for the Leopard Tortoise can be rather a problem if no separate room or building is available. It will need a minimum



Female Leopard Tortoise excavating the nest prior to her laying nine eggs.

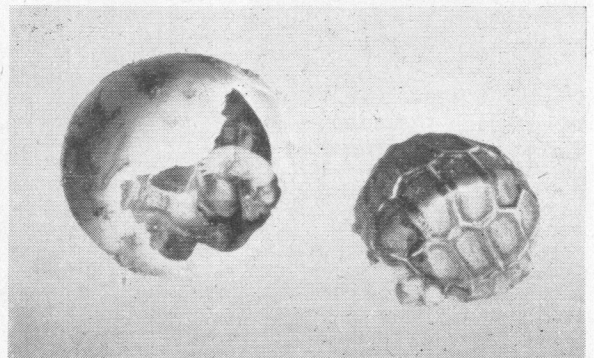
temperature of 70 deg. F. to keep it feeding, but there must also be adequate room for exercise. My adult Leopard Tortoise solves the problem for me by sleeping in a wooden box beside the permanently-burning coke boiler for five days on end, waking only to turn round or stretch. Then on the fifth evening she wakes up and comes out to eat several lettuces and tomatoes before taking herself on to the hearth in front of the lounge coal fire where she spends the rest of the evening. Then she is put back into her box and sleeps away another five days. The fact that there is a considerable amount of noise in her "bedroom" does not seem to worry her in the slightest. This has been her routine for the two Winters that she has spent in this country and not until the warm days of March does she begin to wake up more frequently. With the exception of her bed, she is perfectly house-trained and has never been known to forget her manners.

I received her in December, less than a fortnight after she had been caught in Kenya. However, within a week of my first meeting with her, I could feed her by hand and she has never shown any fear of human-beings.

In the May following her arrival, she laid a clutch of nine eggs, six of

which were fertile, but unfortunately my attempt to hatch them failed. It was, however, possible, because of her complete lack of fear, to obtain a series of photographs of the whole process of making the nest as well as the actual laying. The nest was excavated with her hind legs and during its construction the ground was constantly soaked with urine. This enabled her to lift out the soil in the form of mud which could be raised on the hind legs, a process which would have been impossible if the earth had remained dry and powdery. The depth of the nest was about 10 in. and, although its neck was narrow, it opened out into a circular chamber below. Owing to the urine, its sides were smooth and firm and the diameter did not exceed nine inches. The nine eggs were laid in the space of half an hour and with surprisingly little effort on the tortoise's part.

While the Leopard Tortoise is expensive to buy and to keep, it is one of the hardiest of the unusual land tortoises and does not seem to need as much supervision as the more exotic species from jungle areas.



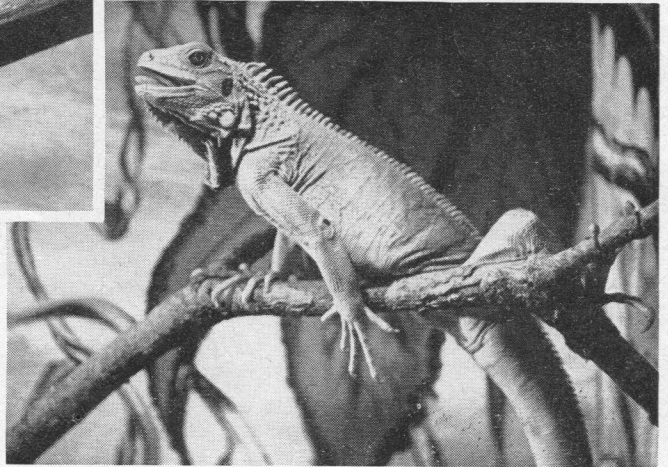
Left: Partially-formed Leopard Tortoise in its egg. Right: Dead tortoise after it had been removed from the egg.



Care of the Common Iguana

By Mary E. White

The author's Common Iguanas, "Iggy" and "Anna." In the upper photograph they pose for their picture and camera-conscious "Iggy" drops his dewlap. The right-hand photograph shows "Iggy" enjoying his daily spell under the infra-red lamp. Whilst in the author's possession these creatures have been quite tame, and have made no attempt to bite. Their spacious vivarium is in the dining room. Photograph by G. S. C. White.



THE Common Iguana (*Iguana iguana*) from tropical America is not for the novice herpetologist, but if one is more experienced, and has plenty of space and time to devote to these lizards, they are very attractive and interesting. It would be best to obtain the very young specimens that are sometimes available, as this Iguana can grow up to six feet in length. Obviously, in time, if all goes well, they will grow too large for the average herpetologist to cater for, but reared from babies one can provide for them for a considerable time.

The cost of maintaining them is somewhat high, especially in the Winter months when fruit and greenfood, which is their main diet, are scarce and expensive. However, the smaller they are the less they require. Heating is also a problem as they need a large vivarium, but no doubt there are various methods of heat saving to be tried. An infra-red light bulb I believe to be a necessity, but this need not be on all the time. Switched on for an hour or so daily it is very beneficial to these lizards. When using this light a strict watch must be kept on the temperature, as it rises very rapidly and they must be able to move away from the direct heat if they wish. At other times an ordinary light bulb can be used for illumination.

In the following paragraphs I have set down my own experience which may be useful to others interested.

In November, 1953, I purchased two young specimens measuring about six inches from nose to vent. Having previously seen only the large Iguanas in the London Zoo, these babies were rather disappointing on first acquaintance. Their colour was a brilliant green, but, not having the spiky adornments of their elders, they looked rather like puny chameleons.

I first housed them in a vivarium measuring 36 x 18 x 30 in. furnished with suitable branches for climbing, and (mistakenly) sprays of rhododendron leaves for decoration. The temperature was kept between 75-80 deg. F., and an infra-red light bulb was switched on for several hours daily. At first an ultra-violet lamp was also used twice a week.

This I discontinued after a while, as there was no means of protecting their eyes from the powerful light. Being very inquisitive lizards they would stare at it and make their eyes sore.

Hoping they were a pair (being too young to sex) I named them "Iggy" and "Anna." "Iggy" was without much doubt a male. Nodding and bobbing his head, which is a characteristic of the males, he would drive "Anna" from his favourite branch. Most of this aggressiveness was only bluff. When she stood her ground he was at a loss to know what to do.

They fed well from the start, favouring such items as lettuce, watercress, and banana. Soon they began to grow. The dewlaps and leathery spines started developing, and their faces became bluish in colour. So fast were they growing that it soon became obvious that they needed a larger home.

Cause of Illness

It was during April, 1954, that "Iggy" became ill. He was dull in colour, eating nothing, and staying on the floor of the vivarium. The latter seems to be a bad sign in the arboreal lizards, and as his excreta were bloodstained I knew that there was something fundamentally wrong. On looking round I noticed that large bites had been taken from the rhododendron leaves, and a horrible suspicion crossed my mind that the leaves were poisonous. After searching through a veterinary encyclopædia, I found that that was indeed the case. In common with most other evergreens, the rhododendron is poisonous to herbivorous animals. The remedy given for this type of poisoning was purging with a vegetable oil. Putting on a pair of leather gloves (to avoid being clawed) I proceeded to catch the patient. Sick as he was, this was no easy task. Scratching and lashing wildly with his whip-like tail, he tried to elude capture. My husband was standing ready with the olive oil, anticipating trouble, but to our amazement "Iggy" took his medicine like a lamb—a desertspoonful of it!

The next day he nibbled a lettuce leaf and climbed groggily up to his favourite perch. Within three days he was back to his normal arrogant self. Needless to say, the offending

leaves were never again used for decorative purposes. For about a week after his treatment he would lash the air wildly with his tail whenever I opened the feeding door. However, he soon forgot the indignity of the medicine and calmed down again.

By the end of May their new house was ready. This was far more spacious, being 4 ft. x 2 ft. x 5 ft. in height, which gave them plenty of room for climbing.

We managed to transfer the Iguanas without much difficulty, but, as soon as they were in the new vivarium, an amazing scene took place. Both creatures inflated and arched their bodies, which became brilliant in colour and blotched with black. The dark tail bands were very pronounced, and the pupils of their eyes contracted to mere pin points. This gave them a vicious appearance as they advanced on one another to do battle. With lashing tails and open jaws they jostled for position, each trying to bite the other about the body. Pushing and leaning like two wrestlers, each was unable to get a grip on the hard inflated body of its opponent. This continued for almost half-an-hour, and was a most impressive sight. Finally, they parted, each selecting a branch to lie on. Gradually their appearance returned to normal, and from then on they were the best of friends.

Stroking Appreciated

Both Iguanas like to be stroked as long as the tail is not touched. "Anna" especially enjoys it, closing her eyes in obvious delight. "Iggy" is rather more condescending, holding himself erect in a slightly lofty manner. When sloughing they like the loose skin pulled off, as the ragged pieces seem to irritate them.

The vivarium they are in stands in my dining room, and they take a lively interest in everything that goes on. They are very clean in their habits, having a special corner for excretory purposes. I use leaf mould for the floor covering, as I find it hygienic and absorbent.

So far they have remained mostly herbivorous, eating clover, lettuce, watercress and fruit. Tender young dandelion leaves are also liked. They seem to prefer green leaves to fruit. Mealworms are relished, small pieces of raw meat and smooth caterpillars, but vegetation remains their favourite food. I have rarely seen them drink, although water is available. They appear to get sufficient moisture from the green leaves. The infra-red light, which is now fixed in the vivarium, is switched on for several hours daily. This seems necessary to their well-being, toning up the circulation and inducing them to feed well.

These lizards have never at any time attempted to bite, but I have great respect for their large claws and powerful tails. "Anna" is the more docile of the two, and as she never nods or swaggers she is almost certainly a female. Although they are extremely fast moving when so inclined, they spend most of the day lazily sprawled on a branch, with legs dangling in a ludicrous manner.

Eye Movement When Annoyed

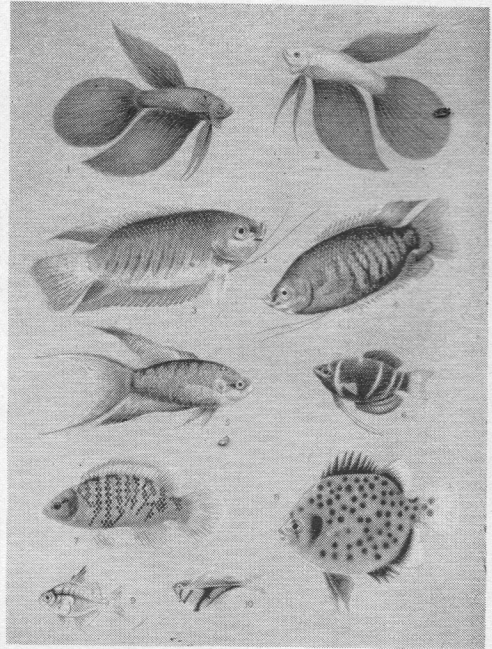
When annoyed the eyes contract and dilate like those of an angry parrot. The male extends his dewlap and inflates his throat as well. So far they have retained their bright green colouring on the body, but their heads are now blue grey. "Iggy" has a beautiful mottled appearance about the neck and throat.

They seem very intelligent creatures, recognising people, and showing alarm when strangers look at them. My own dog they take no notice of, but should any other dog come into the house they flatten their bodies and try to hide behind the branches. I have noticed this same habit in chameleons. At the time of writing they have been in my possession for a year, and are now over 30 in. in overall length. If they grow too large I shall, of course, have to dispose of them to a Zoo, but I should be very reluctant to part with them.

GUIDE TO TROPICAL FISHKEEPING

Photographs in Natural Colour

Six Identification Plates



THE above picture is a reduced black and white reproduction of one of the six 7 x 5½ ins. identification plates in full colour appearing in the new comprehensive work of reference for aquarists, "Guide to Tropical Fishkeeping." These plates give at a glance nearly 70 species and varieties. The book also contains 24 photographs of fishes in natural colour. Black and white illustrations total 269 (fish 200, plants 30 and general subjects 39). There are line drawings and classification charts.

The book, in the preparation of which the author has had the full co-operation of WATER LIFE editorial staff and a panel of experts, deals with nearly 400 species and varieties of tropical fishes. No keen tropical fish breeder can afford to be without a copy of this new work, which contains descriptions of individual species and varieties with sections on feeding, breeding and identification. That devoted to classification will do much to avoid future confusion over nomenclature. The book is printed on high-class paper, has a stiff linen-bound board cover, with an attractive dust cover, and, as end-papers, maps showing the areas from which the fish come. The large number printed, which will be needed to meet the demand, has enabled the publishers to keep the price down to a very low figure and yet give a wealth of illustrations, the high standard of which, plus the reliability of the text, make it a book which should be in your possession.

"Guide to Tropical Fishkeeping," by J. H. P. Brymer. Price 35/- (36/- by post from the Publishers, WATER LIFE, Dorset House, Stamford Street, London, S.E.1.).

Starting a Vivarium (I)

Amphibians and Reptiles Are Not Difficult to Keep in Good Health, Says Alfred Leutsch, B.Sc., and He Gives Their Basic Requirements

ANYBODY who keeps an animal collection must be only too familiar with the passing remarks of a friend who wants to know how it is possible to keep animals, which are naturally wild, in healthy and apparently happy conditions. Having duly admired the fish, reptiles or birds, he then asks, "How do you find the time to do it? What about feeding and expense? Does it take up much space, and are knowledge and experience necessary?"

This article is an attempt to give an answer as far as the vivarium hobby is concerned, and is written for young as well as adult readers of *WATER LIFE* who are either newcomers to the hobby, or who may already be experienced aquarists, but have not yet taken up the vivarium hobby. First of all, let it be said that every pet lover, no matter what he keeps, should ask himself the above questions before taking on this responsibility. Pets are at the complete mercy of their owners, and it is therefore our duty to see that they receive the best care and attention we can give them.

Availability of Food

The question of time, space and expense is a matter for every reader to decide personally. Food should next be considered. Is it easy to obtain and available at all times? Thirdly, there is the question of understanding one's pet. What surroundings does it live in best? Are there any ailments or enemies from which it must be protected?

A lot of this understanding comes from experience and book learning, or from advice given by knowledgeable friends, but in the long run a great deal of it boils down to plain common sense. In this article we shall deal with the amphibian side of the vivarium hobby. These creatures belong to the animal Class, called the *Amphibia* (frogs and toads, newts and salamanders) which range in size from frogs and toads less than an inch long, to the five-foot Giant Salamander of Japan and China.

With some exceptions all amphibians agree in certain basic characteristics. They are back-boned animals with a variable body temperature (called "cold-blooded"); their skins are naked, and the young pass through an aquatic tadpole stage bearing gills. Most amphibians are carnivorous, and feed on living insects and other small creatures such as worms, slugs, crustaceans and millipedes. We visualise a small, somewhat shy creature which hides away in undergrowth, in ditches, under stones and logs, avoiding the hot sun and dry, exposed air because of its soft, delicate skin. Somewhere in the neighbourhood is a pool or pond to which it must travel in the breeding season, in order to produce a family.

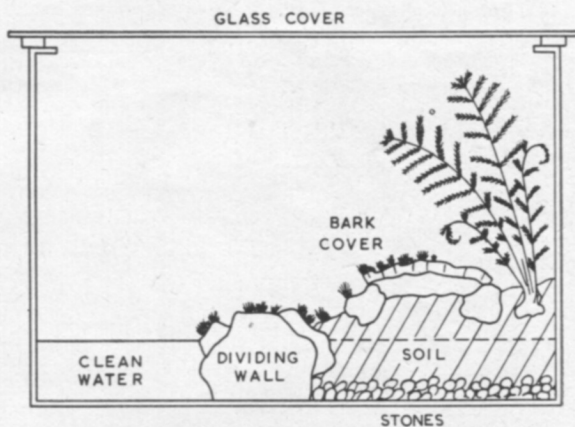
Disposition of Amphibians

Being cold-blooded it will conserve its energy, and will remain quietly in one spot for long intervals in contrast to the more restless, warm-blooded mammals and birds. It hides by day from the sun and enemies and comes out after dark to hunt its food. In countries which have a cold Winter it hibernates.

How can we satisfy all these conditions in captivity? From long experience I find that for most people the ordinary aquarium is the best. This gives good viewing, is compact and easy to handle, and is watertight. If a sheet of glass is placed on top, it will cut down ventilation and produce a humid atmosphere inside, which is one of the requirements

of amphibians. It also prevents the creatures escaping. I raise my glass covers on corner supports of sponge rubber. This cushions the glass and lessens the risk of breakage. The space between the glass and frame is less than half an inch, and allows a certain amount of ventilation.

To convert the aquarium into a vivarium for amphibians, I usually go about it in the following way. A low barrier of rockwork or large stones is laid across or along the middle of the aquarium, depending on what area of water space is needed. The height of the wall is about four to six inches. Alternatively, a piece of tree branch is cut to the required length and placed in position. One side of the aquarium is now filled in with loose soil (a mixture of leaf-mould and sand) to the height of the wall. It is laid on a foundation of loose stones. In the soil is planted a selection of small shade and moisture-loving plants, such as ferns and mosses. In odd corners hiding places are made from broken flower pots and pieces of curved bark, raised up on stone pillars. Bark taken from old, fallen trees is especially suitable, as



A simple yet adequate home for amphibians. The container is an aquarium set up with ferns, bark cover and rocks.

it is often covered with moss. This will keep in a fresh, growing condition for many months.

The other partition is filled with water until a level is maintained just below the top of the wall. It should be about three inches deep. Much of the water will soak through the wall into the soil. This is all to the good since the plants benefit from damp earth. In Nature that is what happens alongside a pond or river, and near a wet ditch. Plants in these places like to have their toes wet.

The type of vivarium I have described is sometimes spoken of as a "wet" vivarium, as opposed to a dry one which is more suited to reptiles, like snakes and lizards. The "wet" vivarium should be placed in a cool, slightly shaded spot away from direct sunlight. Close to a north or east window would do very well.

As inmates I have chosen two hardy favourites which never seem to give me any trouble. One is our native Common Toad (*Bufo bufo*) and the other, the European Salamander (*Salamandra salamandra*), a widespread species in Continental countries. Two or three specimens should live comfortably in an 18 in. converted aquarium. The

two species will even live together, but should all be about the same size, since cannibalism is not unknown. The small specimens mysteriously disappear, and the larger ones look even fatter and more self-satisfied.

Common Toads are to be found in the countryside, especially when breeding in their ponds in Spring, or in woods and lanes during Summer evenings. The European Salamander is usually to be had from our dealers at a reasonable price. At first these pets may show a little shyness, remaining in hiding and refusing to feed. In time they will become bolder, and should be feeding before the week is out. They tend to come out during the evening. I have found that their tameness is so marked that they will take meals from one's fingers, even attempting to "catch" a finger which is waved in front of them.

My salamanders can now sense my presence as soon as I enter the room, and will come out of hiding in anticipation of a meal. A favourite pet toad will allow me to hold it up on the palm of my hand, close to a wall or window where a fly is crawling, and immediately catch it with its tongue.

Food for these amphibians can consist of a variety of insects, worms and slugs. Beetles are favourites with toads, and small slugs with salamanders. The food is simply placed loose in the vivarium, or in a shallow feeding dish. Fly maggots and mealworms, bought from dealers, make a useful standby. To see that each gets a fair share, I usually take my specimens out, and feed them separately on a wooden "dining" tray which I keep for this purpose. Incidentally, amphibians should be handled gently, and preferably with fingers wetted first.

It is doubtful whether toads will breed in confined space,

but it commonly occurs in garden ponds and outdoor vivariums. With salamanders breeding is commonplace and I have known it to occur in captivity at all times of the year. The female enters the shallow water to produce her family (she is a livebearer), and these babies take about three months to develop. I remove them to a separate dish of shallow water, and feed on *Daphnia* and chopped *Tubifex*. Tiny worms and pieces of raw meat are added as they grow in size. At metamorphosis they take on the bright colours of the adults, and leave the water.

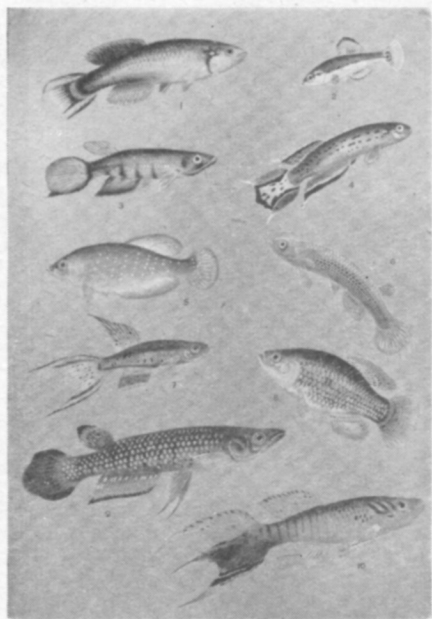
No Truth in the Legend

No doubt readers are aware that this species is the notorious Fire Salamander of the European legend in which it is said that it can exist in fire and is highly venomous. Both ideas are nonsense, and it is quite harmless to humans. The colours are merely Nature's way of warning off enemies. The skin of the salamander, also that of the toad, contains a highly distasteful secretion which acts as a protection should an enemy try to bite or eat these rather helpless creatures. With the exception of snakes, few animals molest them.

Disease Rarely Encountered

Illness and disease are rare with these two amphibians. Fungus is the most common, and then only occurs through dirty water, overcrowding and poor health due to bad treatment and wrong feeding. There is no reason why these two engaging and interesting pets should not be kept for 20 years, as has been done already by vivarium keepers.

The next article will deal with the care of some common and hardy reptiles for the beginner.



Among the 18 pages in full colour included in "Guide to Tropical Fishkeeping" are six identification plates by R. A. Vowles. A much reduced reproduction of the one illustrating Egg-laying Tooth Carps is shown here on the left.

"Guide to Tropical Fishkeeping"

Swedish Journal's Complimentary Review

in the main by means of photographs and this is a very suitable choice . . . we are particularly impressed by the many beautiful photographs which were taken by the Dutch master photographer Timmerman.

"There can be little doubt that Brymer's book will turn out to be the companion book for those whose hobby is aquaria for a long time to come, and this will not be least because the author had done such a lot of work in making sure that he has the correct nomenclature.

"There are a lot of nice things we could say about 'Guide to Tropical Fishkeeping,' which is a book one can seriously recommend to any person who is interested in aquaria and who is able to read English, and it certainly should not be lacking from any club library . . . it is the most beautiful book of its kind."

The views expressed in the journal catering for Swedish aquarists are similar to those made by knowledgeable aquarists of all countries who have seen it. Nearly 200 pages are devoted to details of all the well-known species and varieties of tropical fishes, there are 269 black and white photographs, 24 coloured photographs and 6 identification plates showing 68 fishes. A copy of this book on your bookshelf means that you will have by you an authoritative and up-to-date work giving the latest information about available tropical fishes, supported in many cases with reliable photographs which make identification easy. Order your copy now from any bookseller or newsagent or send your remittance direct to the publishers.

"Guide to Tropical Fishkeeping." Price 35/- (36/- by post). 352 pp. plus 18 colour insets. Over 300 black and white photographs, drawings and charts. Published by WATER LIFE, Dorset House, Stamford Street, London, S.E.1.

THE new standard book for fishkeepers, J. H. P. Brymer's "Guide to Tropical Fishkeeping" has been acclaimed as filling a long-felt want and copies of the first edition are selling quickly.

Our contemporary Swedish journal "Akvariet" has published a lengthy and appreciative review in which it states:—"There has for a long time been a need for a large and comprehensive book on aquaria in the English language . . . WATER LIFE has been aware of the need for a really thorough aquarium manual . . . they have chosen to illustrate the fishes

Australian Frogs as Colourful Pets

Difficult-to-find Members of the Genus *Pseudophryne*

By C. W. Emmens, D.Sc., Ph.D.

(Professor of Veterinary Physiology, University of Sydney)

AUSTRALIA boasts a very rich fauna of frogs, many of which have received almost no scientific attention. Harrison's paper (1922) on the breeding habits of some species still remains the best source of information on that topic.

Many Australian frogs are of a burrowing habit, being rarely seen although often heard, while some can stand a remarkable degree of dryness, almost amounting to desiccation. Of these cryptozoic frogs, the Genus *Pseudophryne* is outstanding. Three species will be described here, all of them small, burrowing frogs with colourful markings. Their size, hardiness, bright colours and general temperament make them first-class pets.

Markings of One Species

Pseudophryne australis (Gray) is about an inch in length at the most, with brown body, slate-grey sides and legs, a T-shaped orange or red mark on the head, various other small red dots or splotches on the body, white spots on the arm and thigh, and white tips to toes and fingers. The belly has black and white markings. It lives in sandstone areas under rocks, fallen trees, or in actual burrows in the soil, usually in the roots of plants. About 20 large eggs are laid, again in a burrow, and are guarded by the female. It breeds at any time of year after a fall of rain. The egg develops out of water, but hatching depends on the egg reaching water either by being pushed in by the mother or being washed in by a further fall of rain. The positions in which some batches of eggs have been found makes it almost certain that the mother frog must push them into water. The tadpole can remain, ready to hatch, for several months, at which stage it already has hind-limb buds.

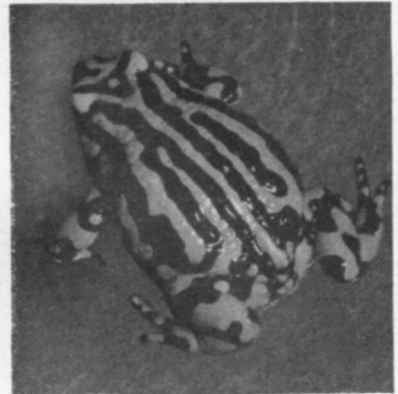
Pseudophryne bibroni (Günther) is very like *P. australis*; indeed, there has been some discussion about its separate identity. It now seems to be agreed that it is a distinct species and not merely a variety. *P. bibroni* is not found on sandstone, it has yellow markings instead of orange or

red ones, and these have a rather different distribution over the body. No white markings are present. About 100 eggs are laid and left unattended. Breeding is seasonal and takes place in the Autumn. The tadpole takes five to six months to metamorphose instead of the four weeks of *P. australis*. This longer hatching period seems to be associated with the fact that *P. bibroni* lays its eggs near to more permanent water than does *P. australis*, which is liable to deposit its spawn near very temporary water-holes or creeks. The two species are practically never found together.

These frogs are both very attractive, easy to handle, and easy to feed. They eat any small insects and thrive on *Drosophila* (the fruit fly) or small ants. I trap ants by leaving a pot with meat or fruit near to their nest and place it in the frogs' quarters when several hundred ants have accumulated. This, several times a day, feeds 50 to 100 frogs. They do not like being in water and actively avoid it; it is only the tadpole that needs it. Their home should therefore be damp but not wet, with a little pool for any breeding they may care to do. Both species are probably quite plentiful in the wild, although not often seen and not easily caught because of their burrowing habits. In captivity they soon become very tame and do not hide away once they learn that a pot of ants is awaiting their attention above deck. On the contrary, its presence is heralded by a communal croaking and prompt emergence of frogs from various hiding places in the vivarium.

Bright Corroborees

Pseudophryne corroboree (Moore) provides quite another story. It is possibly the most spectacular frog known and also, to date, about the rarest. It was identified by Professor J. A. Moore of Columbia University, New York, on a visit to Australia in 1953. It was known from a single, rather faded, specimen, so far unnamed, in the Australian Museum.



Photographs]

[C. W. Emmens

Pseudophryne corroboree (Moore), said to be "possibly the most spectacular frog known and also, to date, about the rarest."

Professor Moore recognised that it must be a new species of outstanding appearance and, as a result of his efforts, a few others were discovered. Even so, until very recently, only nine had ever been captured. It is another small, cryptozoic frog, rather larger than *P. australis*, about 1½ in. long. Its dorsal surface is striped a vivid yellow-to-orange and black, with white or blue on fingertips and toe-tips. The ventral surface is splotched with black, white, yellow and blue. Some specimens nearly or completely lack the blue markings and are just black, yellow and white on the belly.

Aborigine Connection?

The colouring so resembles an Australian aborigine decked up for a corroboree (ceremonial dance) that one wonders if the tribesmen—who would undoubtedly find the frog much more readily than we do—derived their inspiration from it.

Even more than its fellow members of the Genus, *P. corroboree* does not act like a frog. It rarely hops, but crawls on all fours more like a toad, sometimes right up on its fingertips. It succeeds in looking more like a little striped teddy bear than anything else and, with such attractive habits added to the outstanding colours it possesses, it represents a very desirable pet. Unfortunately, few can hope ever to possess it unless it is found in unexpected abundance in some new locality.

Several Dozen Found

However, a short time ago several dozen *P. corroboree* were found by a friend, who was looking out for them when on holiday because he had seen one or two in the neighbourhood before. They were located in a high mountainous region where he usually takes his vacation and with them were also found two batches of eggs. All the circumstances of this and previous discoveries suggest that the life cycle resembles that of *P. australis*, but the frog is confined to colder areas. Although the adults live quite happily in typical hot Sydney weather, it seems likely that they may need cooler conditions for successful breeding. At present, I have some *P. australis* and *P. corroboree* together in a

(Continued next page.)



Colony of *Pseudophryne australis* and *P. corroboree* frogs, both of which are native to Australia. *P. corroboree* (the striped specimens) generally crawl like toads and rarely hop.

Current Research

Colour Change in the Minnow

By Alastair N. Worden, M.A., B.Sc., M.R.C.V.S., F.R.I.C., M.I.Biol.

THE subject of colour change, and the mechanisms by which it is brought about, are of great interest. As long ago as 1876, Pouchet investigated the colour change of certain Teleost fish, including the turbot and some flat fish, and found that it was under the control of the nervous system. This was confirmed for the Minnow in 1911 by the famous comparative physiologist, Prof. Karl von Frisch, whose contributions to the study of animal behaviour, including the "dances" of the honey bee, are still being made.

Von Frisch showed, as a result of experimental interference, that the nerve fibres responsible for colour change were in tracts which, coming from the brain, pass along the spinal cord the level of, approximately, the 15th vertebra. There they pass into the sympathetic chain and run backwards and forwards, finally reaching the black pigment cells, or melanophores, of the skin through the medium of the spinal nerves (or, in the head region, the trigeminal or 5th cranial nerve). When the path of these nerve fibres was cut at any point, the part of the body thus separated rapidly darkened, and no longer responded to changes of background. Von Frisch noticed, however, that if the Minnow survived the operation,

and was kept on a white background, the dark region resulting from a severance through the side of the body (into the sympathetic chain) gradually became pale. This paling was quite distinct from that which may be caused by interruption of the blood supply. These pale areas, due to the nerve operation, would gradually darken again if the fish was then kept for some time against a black background.

Many other workers have followed up these observations, using not only the Minnow but other species. It was shown in 1918 that adrenalin could cause the pigment cells in *Ameiurus* to aggregate, and later it became clear that in the case of amphibians the colour changes could be controlled by hormones. In 1932, Giesberg carried out experiments which seemed to indicate that the coloured chromatophores in the Minnow did not have any nervous supply but were entirely under the control of hormones secreted by the pituitary gland. Other studies confirmed the findings of von Frisch, but indicated that these slow colour changes in parts of the skin from which the nerve supply had been cut, occurred only if the blood supply was intact. This suggested that the slow changes were brought about by the presence of hormones carried in the blood stream.

The problem has lately been re-investigated by Dr. E. G. Healey, of the University College of Wales, Aberystwyth, whose papers have appeared in the *Bulletin of Animal Behaviour*, the *Journal of Experimental Biology* and elsewhere. His careful work has involved separate operations on different Minnows, with sections of the spinal cord at different levels from the 4th to the 15th vertebra. Records were then made of the times required to reach equilibrium against different (black or white) backgrounds. It was shown that, wherever the level at which the operation had been performed, the times taken for the colour cells to attain equilibrium were very much the same. Without going further into the somewhat complex experimental details, it may be stated that the quite definite colour changes in these operated fish were unrelated to local nervous tissue, and the conclusion is that they must be due entirely to the effects of hormones.

The work was, of course, controlled by observations on normal Minnows not subjected to surgical interference, and interesting variations were observed. The Minnow, like many other animals showing colour change, reacts not only to the tint of the background, but also to the intensity of the light. In some observations that were made on blind fish, this response to light intensity was evident within a few seconds of transference from darkness to light. The Minnow also changes its colour very rapidly on being handled.

The main conclusion is that the rapid changes in colour that occur in such circumstances are due principally to nervous control, although they may be reinforced by the action of hormones. The slow colour change in darkness, such as is seen in the operated fish, but which also occurs naturally, is believed to be due solely to the action of hormones.

For Your Bookshelf

Dual Language Volume
on Tropical Fish*

MANY aquarists like their reading matter laced with vivid descriptions. For a few moments they like to conjure up the torrid conditions of the Upper Amazon where their favourite Neons originate or they try to visualise dangers which collectors undergo in tropical jungle to bring new colourful fish to aquarium keepers. For these hobbyists Dr. W. Ladiges' book "Tropical Fishes" will have an immediate appeal. Throughout the notes on individual fishes, albeit comparatively brief, come glimpses of Dr. Ladiges' experience in fish collecting.

The book itself is unusually presented, being in German with an unabridged English translation. Misprints do occur in the English text and the publishers apologise for them.

The volume is fully illustrated. Stage-by-stage photographs show the setting up of an aquarium. Others are of plants, which supplement a brief text, and live-foods, diseased fish and fish collecting. All illustrations of fish are drawings, many in black and white and a large number in colour. We must express a preference for photographic studies of fish, resorting to artists' impressions only for special purposes. Whilst many of the illustrations are well executed, others seem hardly to capture the character of the fish portrayed.

Renowned Author

Dr. Ladiges is internationally known in the fishkeeping world and his writings in *WATER LIFE* have been appreciatively received. Differences in classification occur in this volume but they are no more than we would expect in a book from another land. The *Barbus* Genus, particularly, has some discrepancies compared with that used in this country.

A modest fifteen pages at the end is given over to a chapter on breeding fishes of different groups, contributed by Dr. Rolf Geisler. The general instructions contained in it are most useful.

Division of the text so that chapters deal with the fish of a continent rather than a particular group of fishes, gives variety. Species native to Asia, Africa, South America and Australia are treated in this fashion and, in addition, there are sections dealing with Cave Fish, Glass Fish, Dwarf Fish, Luminescent Fish, Leaf Fish and "Living Electric Power Plants"—actually Electric Eels and Catfish. Some of the types covered are in the connoisseur category in this country.

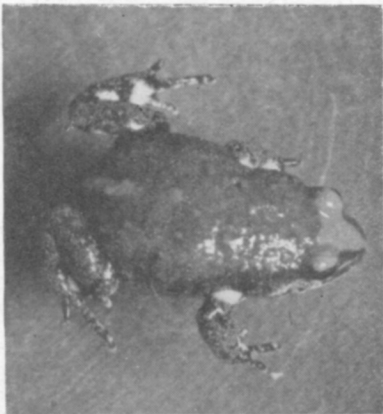
Dr. Ladiges says, in an epilogue, that he has presented the colourful glittering world of aquarium fishes. That his book covers but a cross-section he readily admits, and goes on to point out that larger handbooks are available for those who wish to delve deeper. Viewed from this angle his book will form a useful additional compendium for the aquarists' bookshelf. It has individuality in its approach and format and will no doubt present its readers with a new facet to their knowledge of the fishes they keep.

*"Tropical Fishes" by Dr. Werner Ladiges with appendix by Dr. R. Geisler. 215 pages plus 28 pages in colour. Published by Gustav Wenzel and Son, Braunschweig, Germany. DM.19.80.

Australian Frogs as
Colourful Pets

(Continued from previous page.)

large vivarium and frequently see *P. australis* males clasping *P. corroboree* females, although never the reverse. The



Pseudophryne australis (Gray).

consequence of any possible hybridization almost defies imagination, since their colours and patternings are so different.

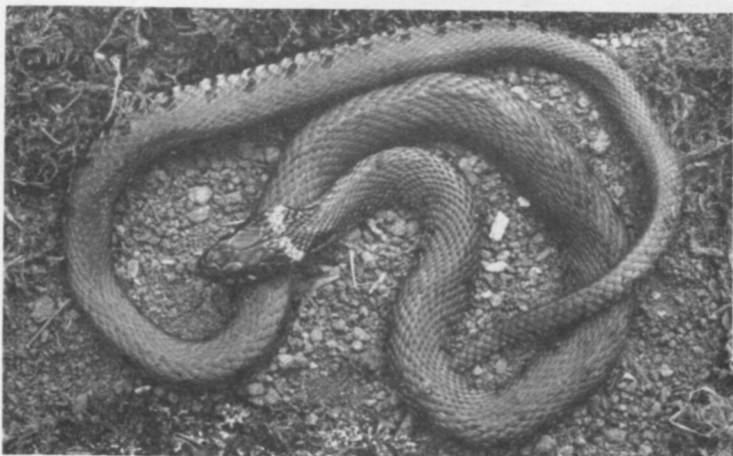
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Moore, J. A. (1953). "A new species of *Pseudophryne* from Victoria." *Proc. Linn. Soc., N.S.W.*, 78, 179.

Starting a Vivarium (2)

Grass Snakes and Wall Lizards

By Alfred Leutscher, B.Sc.



Photographs [L. E. Day & S. Crook
Left: Our native Grass Snake, ideally suited to vivarium life. Above: The Adder, Great Britain's only poisonous snake.

FROM amphibians, which were dealt with in the last article, we will now turn to reptiles, as these form part of the vivarium hobby. True reptiles differ from amphibians in a number of ways, one obvious difference being the nature of the skin. In the former this is covered by an outer layer of scales or horny plates, giving the reptiles a certain protection from injury, disease, and from drying up due to exposure. Generally, a reptile is fonder of sunbathing than an amphibian, and will lie out for long periods in places where an amphibian might soon die. Some reptiles can exist in extreme conditions of dryness, such as deserts.

Another important difference is that a reptile has no visible tadpole or larval stage. From the word go, as soon as it hatches or is produced alive by the mother, the baby has a pair of well developed lungs and looks like its parents. Even such particularly aquatic reptiles as crocodiles and turtles must surface for air and they invariably come ashore to lay their eggs. Sea snakes appear to be the only exception and, as "livebearers," are said to have their young at sea, in the shallower coastal waters.

Easily-kept Reptiles

As examples of common reptiles well known to the vivarium keeper, I have selected the Grass Snake and Wall Lizard. Both are fairly easy to obtain in the proper season, are hardy, and give very little trouble if their few respective needs are satisfied.

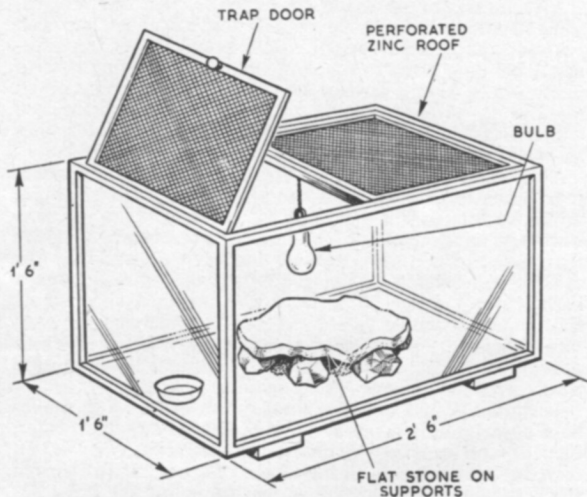
The Grass Snake is a great favourite with many persons, and a specimen may be caught wild in the countryside (first making sure that it is not our other native species, the venomous Adder), or purchased from a dealer. The shop specimens are usually imported from South Europe, and called Italian Grass Snakes.

The kind of vivarium which I prefer for such a pet is a roomy glass cage with a wooden framework. The illustration will give some idea of its shape and size. It will suit one or two Grass Snakes. The vivarium floor is made of tongue-

and-groove boarding raised on cross pieces which hold them together. The frame is of one-inch jointed hardwood. The glass (ordinary window glass will do) is fitted to the frame with shaped beading after the fashion of a picture-frame construction. The roof is covered with perforated zinc, and is in two halves. One half is a permanent fixture, and the other is built as a separate, hinged frame which acts as a trap-door in the roof.

If desired, the side of the vivarium facing the wall against which it will stand may be boarded in. The point to aim at is letting the maximum light enter the cage, wherever it may stand. It is finished off with a coat of wood stain on the framework. The floor is left untouched.

(Continued next page)



The design of the vivarium described by Mr. Leutscher.

"Guide to Tropical Fishkeeping" Receives Wide Acclaim

WRITTEN by J. H. P. Brymer, in collaboration with the Editorial Staff of WATER LIFE, "Guide to Tropical Fishkeeping" is a lavishly produced volume of 374 pages including 269 black and white photographs, 24 photographs of fish in natural colour, and six full colour identification plates showing 68 species and varieties.

The work has been received enthusiastically in many countries. Random comments are :-

- "Undoubtedly one of the most outstanding works of its kind."—The Fish Culturist (United States).
- "All that one needs to know about this fascinating hobby."—The Field.
- "A first class reference book."—The Times of Malta.
- "In its field it is outstanding."—Aquatic Life (United States).
- "Likely to remain a standard reference book for some time to come."—Yorkshire Observer.

You should not be without this authoritative book. Order a copy from your bookseller to-day, price 35/-, or send a remittance for 36/- to WATER LIFE, Dorset House, Stamford Street, London, S.E.1, when a copy will be sent to you direct.

Starting a Vivarium (2)

(Continued from previous page)

Showcases seen in shop windows or museums make excellent snake vivariums, and can sometimes be picked up cheaply at second-hand shops, or at auction sales.

It will be noticed that ventilation is via the roof. This ensures that the snake will not suffer from draughts as might well happen with any side ventilation. The only door, in the roof, will minimise escapes; even the best of vivarium keepers sometimes leave doors open!

Vivariums can be made to many shapes and designs, some in wood, others in metal. The above example has been purposely chosen for ease of construction as well as cheapness. We now come to the contents. It is tempting here to plant out a small garden with a miniature pool, in an attempt to produce the natural surroundings associated with a Grass Snake, for in Nature it is a serpent which likes to bask in the sunshine and has a fondness for water.

After many years of keeping Grass Snakes, I have decided, regretfully, to dispense with live plants in a small vivarium, attractive though this may look. It never works in practice. For a few days the plants look fine, then one begins to notice that they are getting disturbed and even flattened by the snake's movements. Also, each time the animal takes a bath it drags water out of its dish, and in a surprisingly short time the whole vivarium becomes a marshland. As a result the creature can have a permanently wet skin which never gets a chance to dry off. This may lead to skin trouble due to difficulty in sloughing.

It should always be remembered that, in the wild, snakes have clean and dry skins, and that even after a spell in water, they dry off quickly. Plants which need watering should therefore be used only in the larger vivarium, or the garden reptiliary, in which there is ample room for the creatures to move about. In the cage described above, the wooden

floor is covered with a loose layer of dry earth and sand, mixed with dead leaves, and covered with clumps of dried moss, bracken and heather. Here and there flat pieces of bark, stone or tiling are supported on upright stones to form miniature caves, under which the snake can hide. A shallow dish of water, replenished daily, is the only liquid in the cage, and is for drinking. From time to time my snakes are removed from their cages and given a bath in a separate bowl.

Food for the Grass Snake should not be difficult to supply. Grass Snakes feed in the main on frogs, newts and small fish—some will eat toads. They readily tame and submit to gentle handling, even taking food from the fingers—and food which is freshly killed at that. This is a useful habit, as some owners object to giving live food to snakes.

Supplying Light and Heat

Lighting and heating are desirable, especially during dull or cold weather. An electric light bulb suspended in the cage out of harm's way will provide both. A flat stone or some bark placed beneath it will encourage the snake to curl up in the warmth. This, however, is only a stand-by, and full advantage should always be taken of any available sunlight by placing the vivarium near a sunny window, or even outside, but first making sure that either the heat will not become excessive or that the vivarium will not be soaked by rain.

What has so far been said applies equally to the keeping of the Wall Lizard. Of the many available lizard species this is one of the commonest on the market, as well as one of the hardiest. It comes from South Europe. A small collection of about half-a-dozen specimens will provide much pleasure and entertainment, since these active little creatures are always doing something. They readily tame, feed from one's fingers, and can even be taught little tricks.

Wall Lizards live up to their name, and like to bask and hide in ruins, old walls and among rocks. As a modification to the vivarium, a miniature "wall" made from broken house bricks could be built up along the back, and the holes and cracks loosely packed with moss. Here again, dryness is the best in the long run, as it lessens the risk of illness and fungus troubles.

Lizards are sometimes affected by vitamin deficiency, often due to lack of sunlight, and warts appear on their bodies. Here, even more so than with snakes, sunlight is very beneficial, and the lizards should be given the opportunity of a sunbath from time to time. Wall Lizards will eat almost any small animal, such as insects, worms, spiders or crustaceans. They also relish soft fruit and sweetened liquids.



Photograph]

[W. S. Pitt

Wall Lizards, an agile species for the indoor vivarium.

Perfect Veiltails (Twintails) as Visualised by the Hobby of To-day



be mild in my criticism. The fact is that by the time the breeder has rejected all those fish with joined tails and single anals, he finds himself with a limited choice from which to select for body shape, fins and colour. Add to this the relative paucity of knowledge on colour inheritance and the mating of pairs becomes a matter of intelligent guesswork. My observations on the subject are that the deeply pigmented fishes are those which have the odd shiny scale visible, suggesting that whilst they are Nacreous, they are getting rather near to Metallic.

It is not only in the colour factor that the Veiltail has failed to respond to hard work on many breeders' part, but in every other characteristic, except the finnage. Why, for example, are spawning percentages less than 50 per cent for the divided tail and double anal? My own experience on a line of seven generations, using only perfect fishes in this respect, is that results are no better now than they were, say, after the third generation.

Body shape is more heartening as this improves with every generation. Whilst on this topic I would mention that there is room in Veiltail breeding for improvement in body width. There are too many strains with a thin flattened body. The ideal fish is wide across the "beam" which can only be achieved with a well set up bone structure on which the flesh and muscle can build to give that true spherical effect.

To appreciate the Veiltail and to get the best out of it, the approach must be right. The Shubunkin technique, which can produce large numbers of above-average fishes will not do for Veiltails. They cannot be herded together, but require plenty of space and water with ample dissolved oxygen in it. Shubunkins can survive with as low a concentration as 30 per cent saturation, but Veiltails require at least 50 per cent. See the difference in fishes in well oxygenated water: the fins are bright and clear, the colours are vivid and the fish moves about the whole time instead of lying on the bottom. The best way to achieve this state of affairs is by means of a good biological filter and a reduction in the numbers. A four-ounce fish demands at least 12 gallons of water so that three adults can only be comfortably housed in a tank at least 36×18×18 in., kept sweet and clean by a filter passing the whole of the water through at least four times in 24 hours.

Because the Veiltail is also a dainty feeder it likes to have the opportunity to inspect its food before swallowing it. This is not possible where numbers of fish fight for the available food and, inevitably, the grosser fish thrive at the expense of the more desirable types.

After long experience with this variety, I am now of the opinion that high-class fish will only be developed when this segregation is carried out at the earliest opportunity and I welcome the time when it will be possible to take the potential champions away at four weeks, place them in trios in 12-gallon tanks, and give them the individual treatment that such conditions would make possible. Each trio would be studied individually at monthly intervals and

those not making the grade would be discarded to allow those that did to grow on under the best possible conditions.

Remember, the aim is not for the survival of the fittest but the survival of the fittest fish which also conform to an aesthetic standard. With the ruthless technique of eradicating the unworthy at the earliest opportunity, it is possible to save time, concentrate one's efforts and put available food and water space to the maximum use. My figure for those fish to be eradicated as time and space wasters is 95 per cent, so there is no need to fear being too drastic when you face 1,000 fry in a 30-gallon tank. Hesitate or be chicken hearted and the 50 potential winners which you have will not even materialise.

Carolina Box Tortoises

By Audrey Noël-Hume, B.A.

ONE of the greatest problems which confronts any tortoise-keeper is how to maintain a garden of reasonable beauty and at the same time allow his animals a fair degree of freedom. All seedlings and juicy plants are subjected to continuous attack by the Mediterranean species (*Testudo graeca*, *Testudo hermanni*, etc.) and only the provision and maintenance of good wire barriers, or the penning up of the tortoise, can prevent damage. Larger species, like *Testudo pardalis* and *Testudo denticulata*, refrain from taking their meals off the herbaceous border but will certainly use their greater weight to flatten any plant which is unwise enough to grow in their chosen path.

Gardener's Friend

There is, however, one species of tortoise which can be rightly described as the gardener's friend for neither of the aforementioned sins can be laid to its charge and, in addition, the diet of adult specimens may be composed of a number of garden pests like slugs and wireworms, which the tortoises will catch for themselves.

The American Box Tortoises, to which I am referring, have recently become more generally available in this country, after a long absence occasioned by war and currency problems. Of the four main members of this Genus the Carolina Box Tortoise, *Terrapene carolina*, known in its native country as the Common Box Turtle, is most frequently kept in England and Europe. It is widely distributed over the eastern half of the United States from central Maine in the north, to the top of the Florida peninsula in the south, and westwards to the Mississippi river.

The Carolina Box Tortoise is a small reptile, whose shell rarely exceeds 5½ in. in length. The carapace is highly domed, resembling, in silhouette, a German tin helmet of the last war. In adult specimens the growth rings may be completely smoothed out, giving the shell a polished appearance. The coloration of the carapace is usually a dull chocolate brown adorned with deep yellow streaks and blotches in an irregular pattern. The marginals, which flare only slightly, generally bear a number of wide bars of yellow.

The ability to "box" all their soft body parts, which these tortoises possess, is occasioned by a bi-lobed plastron; this rises when the weight of the head, legs and tail is removed by their withdrawal into the shell. The plastron may bear a similar pattern to the carapace or, in many specimens, it may be a uniform yellow.

Shape of the Head Region

The head of the Carolina Box Tortoise is rather small and pointed with a heavily hooked upper jaw. The hind legs show the close relationship of this Genus to the terrapins of the *Clemmys* and *Emys* Genera rather than to the true land tortoises of the world. The toes are slightly webbed on the hind feet. Sexual differences in the species are denoted by red eyes in male specimens and yellow eyes in females, a concavity in the rear lobe of the male plastron, and the vent of the female being relatively nearer the plastron.

Some three years ago I purchased a female Carolina Box Tortoise which, judging from the worn condition of the shell, was well advanced in years. During last Winter she was joined by two males, one larger and the other slightly smaller than my original "Boxie." The improvement in the latter since the arrival of her companions, and her rapid increase in weight, confirmed my long-held belief that it is fairer to owner and to pets to keep at least a true pair of tortoises. From being an erratic and faddy feeder, Boxie has become the demanding member of the trio. Prior to their arrival she was accustomed to make a loud clicking noise when eating but her manners have now improved and, apart from occasional lapses, she is a silent eater!

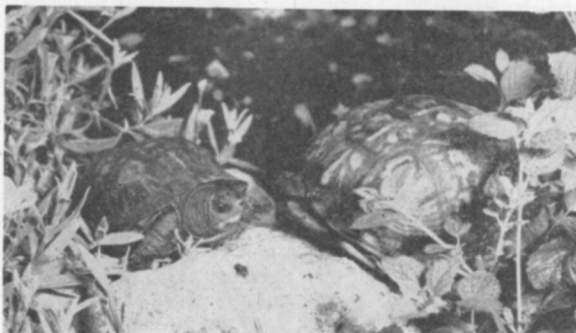
Careful Watch Kept

During the Summer months Boxie and her friends, Sid and Snuffkin, have the freedom of the garden only when I am at home to keep an eye on them. This is because of their small size, their great climbing ability and their passionate desire to excavate near fences. For this reason, in my absence, they are placed in the enclosure and pond used by the larger terrapins and the pond tortoises.

Although the pond is nearly 3 ft. deep in places the trio are able to keep afloat and I have no fear that they will drown even if they are pushed in by a larger companion. Their slightly webbed feet do not allow them to be either

efficient or attractive swimmers but each one takes a daily bath during which they probably swim the length of the pond, which is over 3 ft. In addition, all take three or four long drinks from the pond and I have found that when they are indoors during the Winter the amount of water consumed is even greater.

The rest of the day is spent in the shade of some tall plant, generally without food, for although I offer my Box Tortoises fruit and greenstuff, they are exclusively carnivorous and insectivorous. When dusk comes I put them on to the



The two male Carolina Box Tortoises owned by the author. The right-hand specimen has withdrawn its head and fore-legs and the plastron has risen to close the aperture.

largest flower bed and, with great excitement, three little tortoises go in search of their supper. They will kill and eat slugs, snails, wireworms, stag beetles and earthworms and find great pleasure in sorting through the compost heap. In this respect they are of great assistance to the gardener and, at the same time, must derive great psychological benefit from finding at least some of their food. Obviously such an insect diet needs supplementing, and I give minced steak or liver to the trio when they have been brought into the house for the night. Drinking water is always at hand for them and, after a last drink, they hurry off to their favourite sleeping place under the heated towel rail in the bathroom.

Although many owners allow their Carolina Box Tortoises to hibernate in the Winter, I have never done so, as I believe this to be rather a risky operation, for the reason I will mention later. My trio have the run of a room where the temperature is always between 65-70 deg.F. and the freedom of the lounge hearth in the evenings. Their small size means that they need comparatively little space for exercise. Their food consists mainly of minced meat or liver augmented with the few insects which I risk pneumonia to catch for them. They also have a daily session under a sun-ray lamp and, should their skin tend to become dry, I rub a little olive oil into those parts which look powdery.

Hibernation Not Encouraged

For some hitherto unexplained reason, Carolina Box Tortoises are subject to abscesses in the region of the ears. These develop quite rapidly and it is because of this that I prefer not to hibernate Boxie and her friends. All of them have at one time or another suffered from one or more of these unpleasant things. Thanks to expert lancing and the use of modern antibiotics they have suffered no permanent harm.

I would heartily commend the Carolina Box Tortoise to all herpetologists who are anxious to progress from the Mediterranean types. Its small size, the relatively low prices charged by most dealers (about 30s. to £2) and its onslaughts on garden pests make it a most commendable reptile. It is friendly and attractive and, apart from the one complaint discussed above, is hardy and fares well in our rather changeable climate.



Photograph]

[Ivor Noel-Hume

A Carolina Box Tortoise showing the extreme doming of the carapace, likened to the shape of a wartime tin helmet.