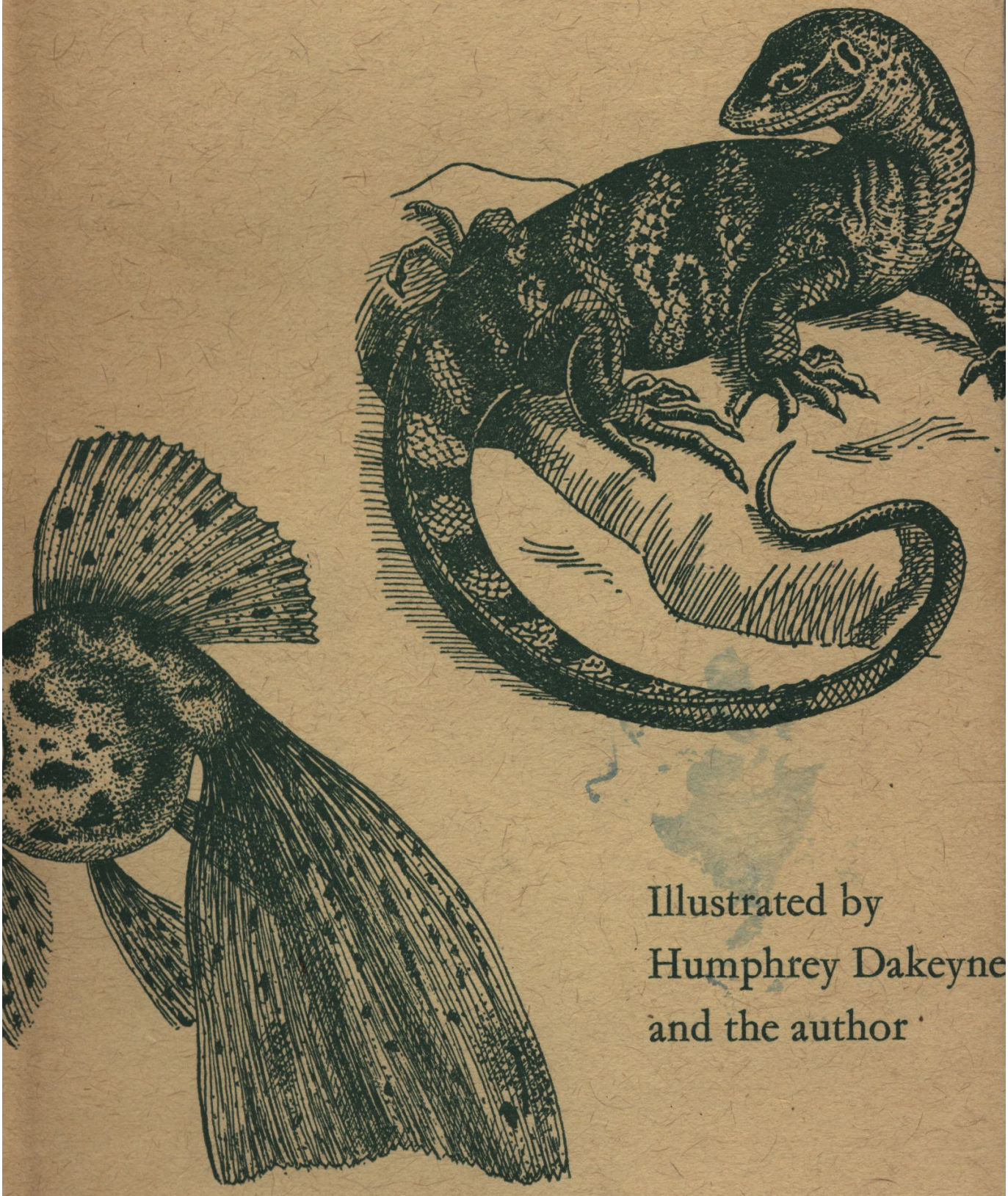
Vivarium Life

A Manual on Amphibians, Reptiles and Cold-water Fish by

Alfred Leutscher



Illustrated by
Humphrey Dakeyne
and the author

There are notable improvements in this enlarged Second Edition of Mr Leutscher's handbook, which describes all the animals —amphibians, reptiles and some cold-water fishes—likely to be kept in a vivarium, and also certain appropriate aquatic plants.

He has redrawn a large proportion of the illustrations, and in response to requests has included a section on setting up a vivarium, with drawings.

In addition to names, distribution, characteristics, food, breeding habits, etc. he includes suggestions on the type of living quarters, thus greatly increasing the practical value of this standard guide.

The author is extremely well-known as a guide-lecturer, and is a former Secretary of the British Herpetological Society.

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A MANUAL ON

AMPHIBIANS, REPTILES &

COLD-WATER FISH

BY

ALFRED LEUTSCHER

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Founder-Secretary of the British
Herpetological Society

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Humphrey Dakeyne
and the author

Second Edition

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SECOND EDITION

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Preface

Amphibians, reptiles and fish are creatures which readily adapt themselves to close confinement. Concise information on their characteristics, habits, food, life-histories and distribution is not readily available, and this book is intended to supply it briefly and readably, to the increasing number of people, amateur and professional, who keep living animals of this kind in aquaria or vivaria in home, classroom, museum, research establishment or zoo.

The information is confined to the main essentials, a page opening with its appropriate illustration being, as far as possible, devoted to each species. The drawings are intended to show the main features for recognition, and have been made from actual specimens, either living or preserved. The number of species dealt with is not exhaustive but includes most which are usually met with in the aquarium or vivarium. Average sizes and durations of metamorphosis and life are given as they can be most variable. Tropical fish are not included in the book, but there are sections on Live Foods and Cold-water Plants which are an important factor in the biological balance of aquarium and vivarium life.

A note upon the origins of the words aquarium and vivarium is perhaps not out of place. The word aquarium comes from the Latin, meaning 'a watering place for cattle,' and was first applied in a utilitarian sense, as 'a place where living animals and fish are maintained or preserved for food.' Today the word is normally restricted to the familiar tanks, usually with glass sides, in which water animals and plants, especially fish, are kept alive for observation and study. The word vivarium (from the Latin, *vivus*—living) once had a wide application, and referred to such different things as an enclosure for living game, a warren, even a fish-pond. It is now restricted to an artificial domi-

cile, e.g. a cage or tank, containing a selection of plants, which provides a home for animals known as amphibians and reptiles. The pond and reptiliary provide the respective and alternative accommodation for them in the open air.

An animal confined in captivity, either for pleasure, instruction, or scientific research, is at the mercy of its owner. It is his responsibility to see that his charge is given proper treatment for its well-being. Often such animals suffer through mistaken kindness or because of ignorance, or even wrong instruction. It is hoped that not only the amateur aquarist or herpetologist, but biologists, teachers, and curators will find here some useful guidance on a singularly interesting group of animals.

PREFACE TO SECOND EDITION

This edition meets, it is hoped, the principal wish expressed by many users of the original version: that it should not only describe the individual creatures likely to inhabit a vivarium, but should give some general information on how to set one up. The author has provided an introductory section on this subject, with a number of drawings of suitable constructions; and to the accounts of each species are added references to the type of living quarters appropriate.

Most of the drawings of amphibians and reptiles are new and made by the author for this edition; the rest are the original ones by Mr Dakeyne. A number of revisions and additions have been made throughout the book.

The quick-reference arrangement of information has been preserved, so as to make the book a handy guide to the habits, biology, feeding and maintenance of reptiles, amphibians and certain fresh-water fish. Nearly all the species included are readily available either through the trade or from the British or European countryside.

ALFRED LEUTSCHER

London, Summer 1961

Contents

The Vivarium - its Construction and Maintenance

The vivarium, considered here as 'a place for keeping reptiles or amphibians,' may take on many forms or sizes, depending on the pocket, workmanship, space required, and the number and type of specimens to be housed. This chapter contains a selection of vivaria which the author has used over the past thirty years, and which have shown satisfaction both in use and economy.

A vivarium can either be purchased ready made, or self-built. No specified shape or size can be laid down, since this artificial home will become an environment to suit the individual requirements of each species by imitating as closely as possible the conditions found in nature. This is only fair to the animals. Since keeping animals is a common desire among most children and many adults it is as well to appreciate that, for all the pleasure and instruction they can give during captivity, these exiles deserve at least a healthy life and proper care. Keeping reptiles and amphibians has certain advantages over keeping other animals. Firstly they can be long-lived. The record for old age among animals is found in reptiles, of which the Giant Tortoise is known to live for more than 150 years. Secondly, they readily adapt themselves to close confinement. Even in nature long intervals are spent in one spot, even in the same position. Thirdly, they can fast for long periods, an advantage during times like holidays when they may have to be left unattended.

Since reptiles and amphibians are found in a wide range of habitats, from purely aquatic environments to dry deserts, and from the hot tropics to lands with cold winters, a number of vivaria to suit each condition have been selected so as to provide one or other of the four basic needs—wet or dry, and cool or

warm. It follows that this will also apply to the selection of plants which are chosen to grow in the vivarium. Some knowledge of plants and their requirements would therefore help in planning these miniature homes in which the animals will spend their days.

INDOOR VIVARIA

1. The Glass Vivarium

Probably the simplest and most readily available indoor vivarium is a converted aquarium, accumulator tank or large glass bowl. These have the advantage over a constructed vivarium in

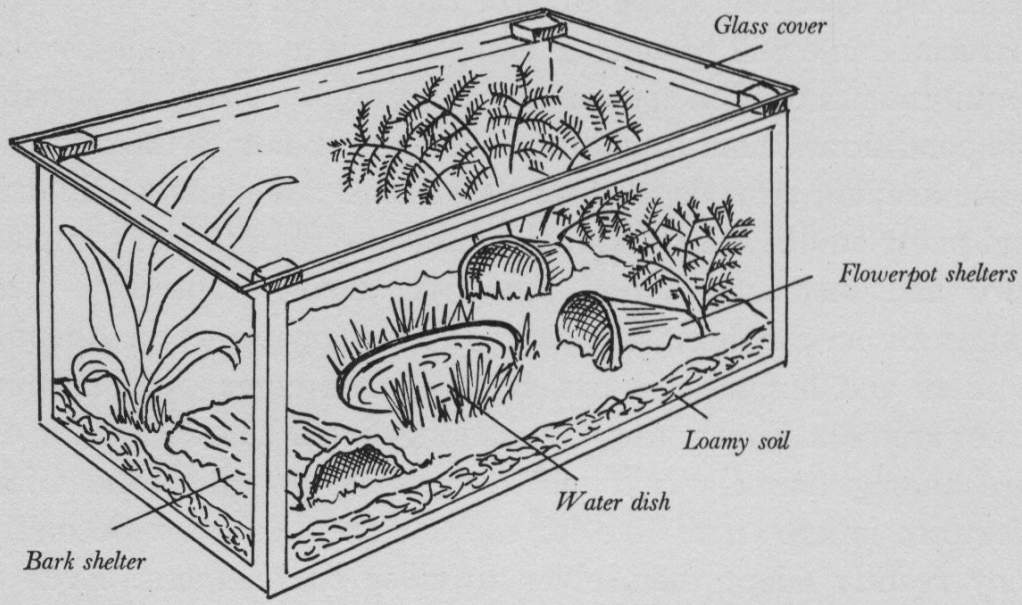


Fig. 1 Glass vivarium set up for amphibians

that they are made watertight. There is also an unrestricted view of the occupants. A cover may not be necessary, provided that the sides are steep enough to prevent any escape, but it will be needed for tree-frogs, geckos, and small amphibians whose feet can cling to glass. If a cover is required it should be a tight fit. Perforated zinc or fine-mesh wire netting fitted to a frame would serve, allowing ample ventilation at the same time. The

use of a sheet of glass laid on narrow corner supports of rubber or cork has two advantages. It helps to retain moisture inside and provide the humid atmosphere required by some amphibians, and at the same time retains warmth should this be necessary. A disadvantage is that viewing is restricted where there is any condensation. This can be avoided by making the cover half glass and half perforated zinc. A hole in the zinc with a cork stopper would serve as a feeding aperture.

This very simple home having a floor space of, say, one square foot, would be suitable for a pair of land salamanders, a frog and toad, a small snake, or two or three of the smaller lizards. It is economical of space and can be easily moved about when required.

The contents will vary according to the inmates, and the following may serve as a general guide.

A AMPHIBIANS Most of these when on land prefer moist, shady surroundings. Cover the floor space with a good depth of loamy soil and sand (some amphibians like to burrow). Sink a shallow water dish in a convenient spot and keep permanently filled with clean water. Here and there provide hiding places by using suitably sized flower-pots, split in half and laid on their sides. Alternatively, use pieces of curved bark, or make small grottos out of rockwork. Small shade- and moisture-loving plants should be added, either planted in the soil or left in their flower-pots (if there is room). Mosses and small ferns together with certain house plants from the florist can be selected, provided that they take to the damp and shady atmosphere. An occasional spray of water will help to keep them fresh. The water dish may need topping up as evaporation takes place, in itself helpful in maintaining humidity.

B REPTILES These usually do best in drier surroundings, unless aquatic. This is especially so with many snakes and lizards. There is a danger that their skins may become constantly wetted in the surroundings recommended for amphibians. This could

interfere with sloughing, and may be damaging to health. It is safer to provide dry conditions. Cover the floor with a mixture of dry peat and sand, or earth. Sink the usual drinking bowl in a corner, and use the same shelters as given above. To provide the light and sunshine usually enjoyed by snakes and lizards (there are exceptions) stand the vivarium near a window, making sure that the exposure to the sun is not so strong as to overheat the contents. Plants which can stand dryness (cacti, succulents, etc.) may be included, or more simply some handfuls of dried moss, bracken or heather can be inserted. Snakes and lizards should always be given something to crawl through in order to assist them during sloughing.

Where necessary light may be supplied from a suspended light-bulb hanging from the roof. The warmth from this will also be enjoyed if a 'sunning' platform of stone or bark is placed directly below.

2. The Wooden Vivarium

A vivarium of wood has unlimited scope in design and finish, and, apart from its main purpose to house the animals, can be made aesthetically pleasing to the eye and give much satisfaction in its construction. Indeed, it can be made a very attractive addition to the furniture of a room or hall if the woodwork and finish are made to match. The example here chosen was made and used by the author, and stood in the entrance hall of a flat for many years, housing a succession of salamanders, frogs, toads and lizards.

The dimensions are three feet long by eighteen inches deep by one foot tall. The base, supported on two cross-bars, consists of a shallow tray of three-eighths planking into which a zinc tray, three inches deep, is fitted. The sides and back, made of similar planking of planed dealwood, rise from this base and are joined at the corners by three-quarter-inch square uprights. From the sides and back squares are cut out and covered with

perforated zinc to provide ventilation. To give a finished look these are framed with wooden beading. The front consists of a single sheet of clear glass slotted into grooved uprights so that it can be removed when required. This is also framed with beading to give a picture effect to the contents. The top is kept

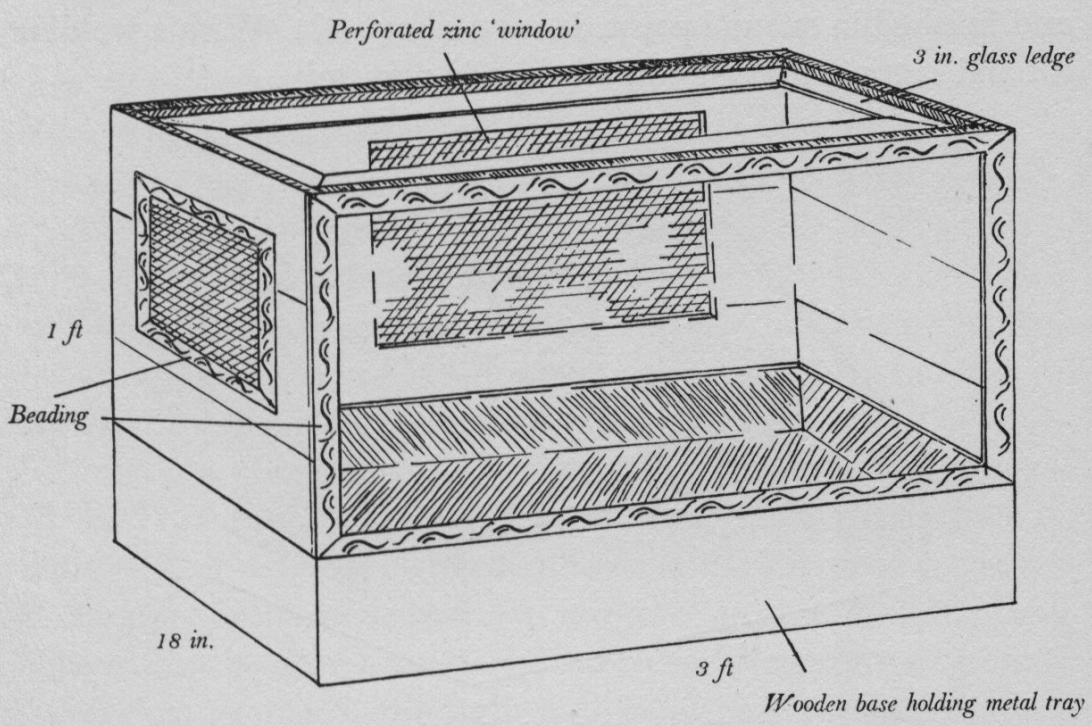


Fig. 2 Wooden vivarium

open, and to prevent escapes has a ledge running around the inner edge, consisting of strips of three-inch glass. The zinc tray, which prevents leakage and retains moisture, holds a mixture of loamy soil mixed with sand and peat. The usual hiding places and plants, as described for the Glass Vivarium above, are used, and a shallow dish of water sunk into the soil serves as a miniature 'pond.'

The inside of this wooden home is finished in waterproof enamel, coloured a creamy white to show up the plants, etc. and the outside stained in dark oak to match the furniture. The time and labour spent in construction, and the cost of material

(thirty shillings—1950) have been well spent for the many years of interest and pleasure derived from this venture.

3. The Metal Vivarium

This type of vivarium, occasionally supplied by the trade, is usually made of tin or zinc sheeting fixed to an iron framework, and finished in enamel paint. It costs about £1. With a welding kit and cutting tools it could be made privately.

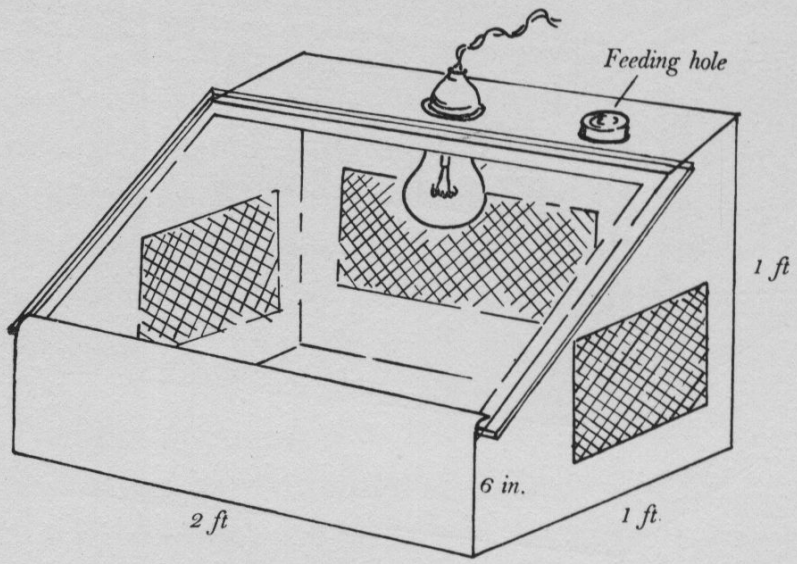


Fig. 3 Metal vivarium

The dimensions are approximately two feet long by one foot deep by a foot tall at the back, sloping down to about six inches tall in the front. A framework of angle-iron is made to these dimensions, and the back, sides and front covered in with sheeting which is sweated on to the frame. For ventilation a square is cut out of the back and sides and perforated zinc soldered on. The sloping top has a narrow flat roof at the back, into which a hole is cut to take a wooden plug or cork. This can be used for introducing food. Another hole may be used to take a light socket, should lighting be required. Against the sloping part of the roof is placed a sheet of glass resting against a stay-bar fitted along the front edge, and secured at the top with swivel

catches. This arrangement is apparent from fig. 3. Coloured waterproof enamel paint will finish the job. White or cream on the inside and green on the outside make an attractive contrast.

The advantages of metal over wood are its strength and durability; the objections are the possibility of rust setting in or paint flaking off (usually due to neglect). Some authorities also feel that contact with metal may affect the animals. This has not been so in the experience of the author, provided that the vivarium is properly maintained.

4. The Tropical Vivarium

One may wish to keep a number of exotic amphibians or reptiles from warmer countries, such as tropical fish, in Britain. Skinks, geckos, and chameleons require heating, as well as a number of frogs and toads, snakes and terrapins, to name a few. The simplest method of heating is the electric-light bulb, already mentioned. This has the dual purpose of supplying light as well as heat, should the latter be needed because the surrounding room temperature is insufficient, i.e. at night, or in an unheated place. Where light is not essential, as in the case of nocturnal animals like geckos or toads, the light-bulb may be screened. A thermometer for checking temperature, and a thermostat control, will ensure a steady supply of heat at the level required. For tropical animals 75°–80° F is normal. As an alternative one could use an element heater of suitable power. This must be properly insulated and screened to prevent any accidents caused by electric shock or fire, either to the vivarium owner or to the inmates. Another excellent heat source can be provided by placing a light-bulb inside a tin. The socket is fitted into the lid and a few holes let into the tin. This will give off a surprising amount of heat.

Heated water may also be used to supply warmth to the vivarium. The following idea has been taken from the Rev. Bateman's book *The Vivarium*. The usual wooden cage with

glass front has a false bottom of perforated zinc resting on cross supports. This forms the actual floor of the cage. Underneath, a metal boiler is fitted. It consists of a closed cylinder of a suitable size, resting on its side. At one end is a short tube acting as an escape valve, through which fresh water may be

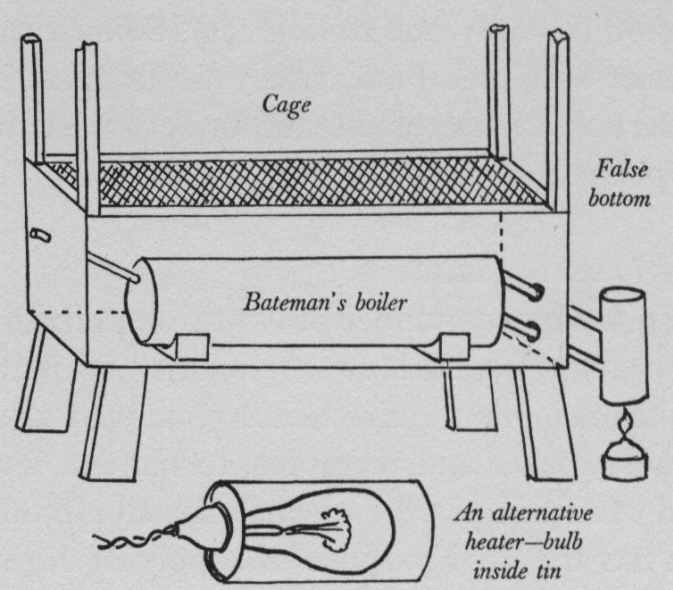


Fig. 4 Tropical vivarium

added when filling the boiler. At the other end, as shown in fig. 4, a smaller, upright tin is connected to the boiler in the position shown, so that the two connecting tubes are slanting. This tin must be at a lower level than the boiler. Heat applied to the tin will warm the water and produce a steady circulation by convection. The warmed air then rises into the cage through the perforated zinc floor. The temperature can be regulated by using a sliding wooden roof. The false bottom may be packed with insulating material placed around the boiler, such as paper or wood shavings.

5. The Aquarium

Apart from its use as a fish container, an aquarium may also be used for aquatic amphibians or reptiles, or for breeding purposes where reproduction takes place in water, e.g. amphibians.

The tank is first inspected for leakages, then thoroughly washed in soapy water to which a disinfectant may be added to kill impurities. Next, some planting medium such as gravel or the recommended aquarium sand from dealers is required. This is also thoroughly washed and treated for impurities. Fine materials such as sea-sand are not advised as this tends to pack too tightly underwater, and is not so easy to keep free from pollution.

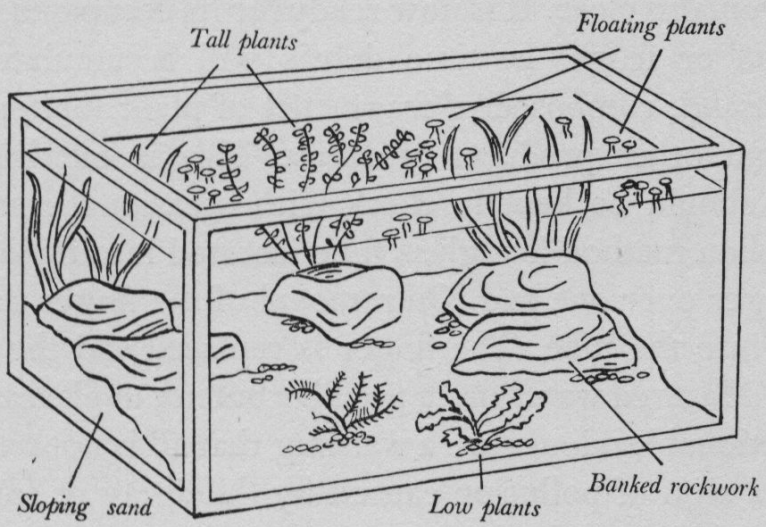


Fig. 5 The aquarium

Before any water is added, the aquatic plants selected should be placed in position. Their use will be three-fold—to supply oxygen, to act as a cover or screen, and to provide a spawning medium for those animals which lay their eggs on plants. They will also add colour and attraction to the aquarium. Plants with roots should be carefully pressed into the sand, and may be anchored with small stones. Tall-growing plants look best along the back and sides, with more bushy ones in the centre, and small kinds at the front. One should aim at a rising landscape from front to rear. This effect can be magnified by building up rock-work in tiers towards the back, or by allowing the sand to slope forwards, as shown in fig 5. Floating aquatics may be used as a top screen.

Water is now added, poured from a jug or siphoned into a saucer placed on the bottom, so as to avoid disturbance. If tap-water is used, then a cup or two of strained pond-water should be added, so as to introduce some microscopic life. Under the stimulus of daylight the microscopic plants will multiply, and may even turn the water green. Microscopic animals will, in turn, feed on this until the water turns clear. In a matured condition, water takes on an undefinable 'bloom' which reflects the light yet remains clear. It is now ready for its occupants, whether fish, newts or frogs. In time debris will accumulate on the aquarium sand, composed of fragments of plant matter, animal excreta and other products of decay. This is excellent plant food, but should be kept in check with occasional removal. A simple siphon method is a glass tube inserted into the aquarium with a finger over one end. On removal of the finger the debris is sucked into the tube. The finger is replaced and the contents lifted out. Matured water has a peculiar but not unpleasant smell. Any objectionable odours are a warning that all is not well. They are often a sign of pollution caused by the decay of some dead animal which is overlooked, or due to the decomposition of uneaten food. The cause should immediately be removed and a quantity of water exchanged for some fresh. This may remedy the defect, but if things have gone too far, the survivors should be taken out, and the aquarium set up anew.

In maintaining an aquarium trouble may arise from three main causes.

(*a*) Lighting. This is essential to proper plant growth but should be controlled. Too much will cause excessive growth, and too little will result in unhealthy-looking plants. The position and screening of the aquarium will help to control this. If added light is necessary then special aquarium covers which take a light-bulb or strip light can be supplied by dealers for the purpose. In any case some adequate covering to the aquarium, such as a sheet of glass raised on corner supports, is recommended. This

helps to cut down evaporation, keeps out dust and prevents escapes.

(*b*) Pollution. As already mentioned this is a matter of vigilance, to ensure that no decaying matter or dead inmates are overlooked. The unpleasant odour is an obvious warning.

(*c*) Overcrowding. This may lead to oxygen starvation. A very rough guide to avoid it is not more than one inch of fish to each gallon of water. Since oxygen is readily absorbed at the surface, the more surface area to the volume of water, the better. This explains the conventional, rectangular shape of most aquaria, designed to absorb a maximum intake of oxygen. Plants will help to supplement this, and will also remove carbon dioxide.

It is generally thought that an air-pump will also help in supplying extra oxygen. Actually, this is not the case. Its main value is in disturbing the water as the air bubbles rise to the surface, causing a circulation which helps to bring unwanted gases such as carbon dioxide to the top. In this way they are more readily discharged into the air.

NOTE Amphibians which come to the surface for air are not so dependent upon dissolved oxygen as fish. Their larvae, however, breathe with gills, and are best reared in shallow water of not more than about four inches in depth.

6. THE AQUA-TERRARIUM

Most amphibians spend part of their lives on land, and part in water, and it may become necessary to transfer them from one home to another. For example, newts during their land existence may be kept in the glass or wooden vivaria described in 1 and 2, but for breeding purposes would have to be transferred to the aquarium (5). To obviate this an aqua-terrarium will provide both habitats. It could be used as a permanent home. Two methods are suggested here. The first consists of an aquarium with a 'house' built on top. Around the top edge of the

back and sides of the aquarium a shelf of planking is fitted and supported by uprights as shown in fig. 6. The spaces underneath can be boarded in or fitted with curtains, and used as store spaces for aquarium accessories, food, etc. Above the aquarium and taking in the shelf space is erected a cage of glass with a roof of perforated zinc. The front glass is fitted into a frame so

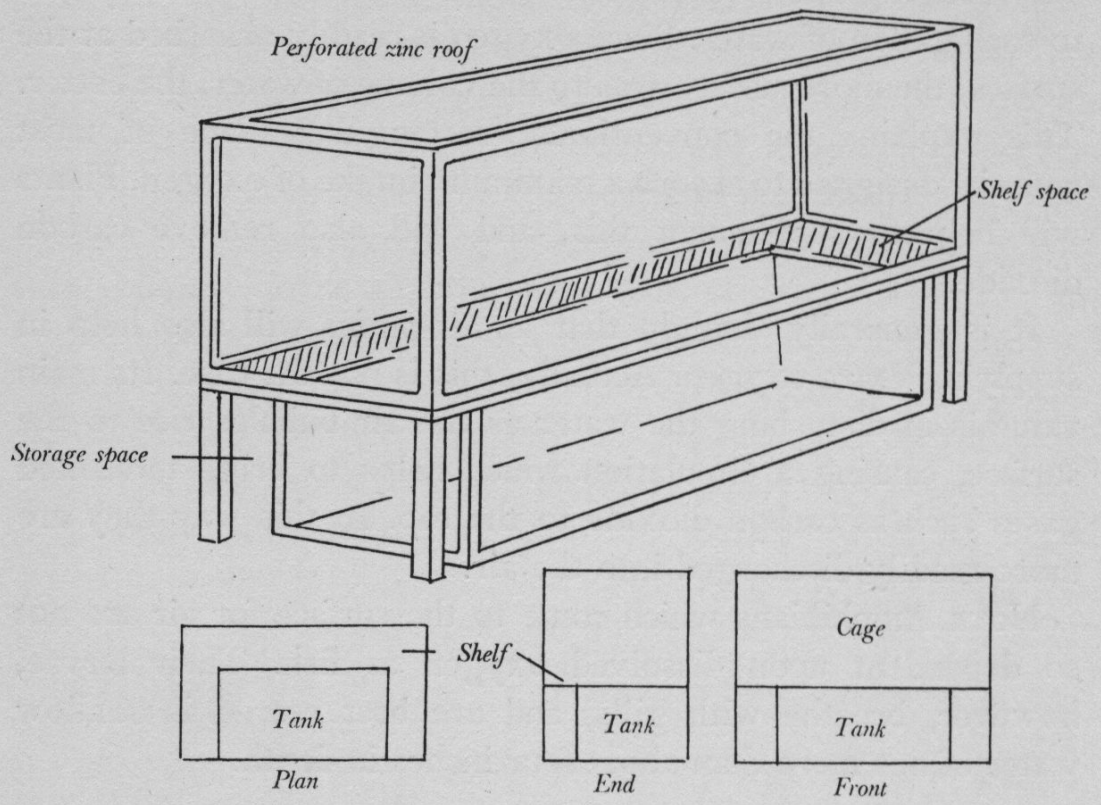


Fig. 6 The aqua-terrarium

that it can be fixed with hinges, to be opened and shut after the fashion of a skylight window, that is, opened upwards. When open it can be fixed in position with a light chain or bar.

The aqua-terrarium once used by the author included a miniature rock-garden. On the shelving a thin layer of waterproof material was laid down (actually a good-quality cement was used, and on this a generous layer of good enriched soil was spread out). Suitable rockwork was next carefully built up and a number of the smaller rock plants and alpines encouraged to

grow in the soil. A carefully channelled course was made in the cement to take a miniature stream of water which originated from a hidden water supply, and meandered through the garden to drop into the aquarium over a jutting rock as a tiny waterfall. The effect was most pleasing. Circulation was maintained by a small pump. Apart from the garden plants a number of creepers such as *Philodendron*, *Tradescantia* and *Hedera* were trained up the sides of the cage, and hanging plants suspended from the roof in their pots. The aquarium used was made to special measurements, and had a sloping end by which the animals could enter and leave at will. For some years this ambitious enclosure provided a considerable source of pleasure and instruction, and housed a succession of frogs, toads, tree-frogs and salamanders. Newts lived there permanently and bred each season.

No measurements have been given here, as this will depend upon the space available. In the author's case the aqua-terrarium was built along the wall of a conservatory, on a firm wooden bench giving eye-level viewing. The aquarium was three feet long, eighteen inches wide and a foot deep. The shelving jutted out nine inches and the cage was three feet tall.

A BATEMAN'S AQUA-TERRARIUM A much simpler aqua-terrarium was suggested by the Rev. Bateman in his book. For this a large bell-jar or similar glass container is used—if still obtainable. The inverted bell-jar rests on a padded cushion with the open end fitting into a hole cut into boarding. This

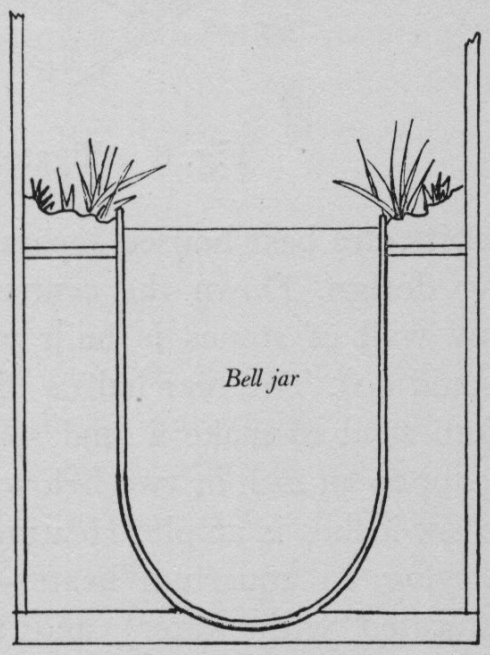


Fig. 7 Bateman's aqua-terrarium

becomes the floor of the cage which can be made of wooden uprights, glass and perforated zinc in the manner already described. As the author says, this makes an excellent breeding house for newts.

7. The Alligator or Terrapin Vivarium

Reptiles such as those which are carnivorous by nature, and require plenty of water space because of their amphibious

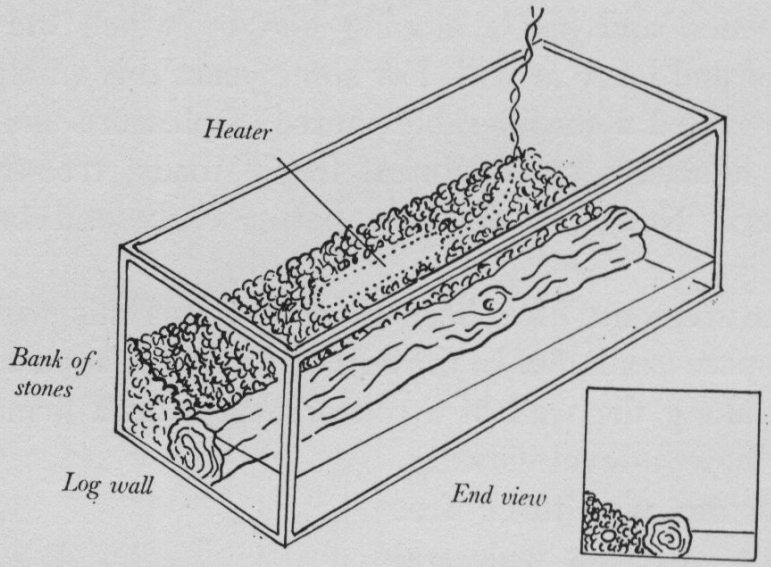


Fig. 8 Alligator or terrapin vivarium

habits, are best housed separately in a vivarium of the following design. Down the centre of an aquarium, lengthwise, a low wall of stones is built up (a thick branch cut to length would do). The rear half is filled up with small stones or aquarium sand to make a land space. The front half is filled with water to an inch or two below the land surface. A depth of four to six inches is ample. Heating, if required, can be supplied by burying an aquarium heater-element into the sand (already saturated with water) and the warmth will spread in all directions. Using a suspended light-bulb would only tend to heat the air and not the water. If the aquarium rests on a metal base

then heat could also be supplied from a spirit lamp placed underneath.

8. Other Indoor Enclosures

Apart from the above, excellent use can be made of such structures as garden sheds, greenhouses and conservatories in housing certain reptiles and amphibians. Provided that there is access to water, and suitable shelter from excess warmth or cold, species such as toads and frogs, tree-frogs, tortoises, lizards and terrapins can live and move about in ample space, even assisting a gardener to protect his plants from invading insects. It is necessary, of course, to block all escape holes. One way of doing this is to substitute a window or door by a wire-netting frame. In this way ventilation is not interrupted during summer weather. A fairly large, shallow trough of water should be made available, and the animals provided with suitable places in which to hibernate. The author has successfully bred from frogs, toads and newts in this manner, and lizards have been known to lay eggs in the sand-trays provided. The fresh air and direct sunshine through the wire frames help to keep the inmates in better health than may be expected from indoor conditions. By using permanent heating even tropical species may be kept in this manner.

OUTDOOR VIVARIA

There can be little doubt that the outdoor vivarium, whether small or large, is to be preferred to an indoor one wherever possible. Lack of a garden or the tropical nature of the animals may prevent this. A point to remember when keeping animals for study is that they behave more naturally in the open, receive the benefits of fresh air and sunshine, and hibernate in the normal way. There is also more chance of picking up natural food. Breeding is also more likely to occur. There is some evidence

that the breeding cycle may be interrupted or suppressed under indoor conditions, especially if proper hibernation does not take place.

9. The Reptiliary

This is basically a piece of land enclosed by a suitable barrier. Most zoos now possess an outdoor reptiliary for displaying snakes and lizards which are diurnal. A private reptiliary could

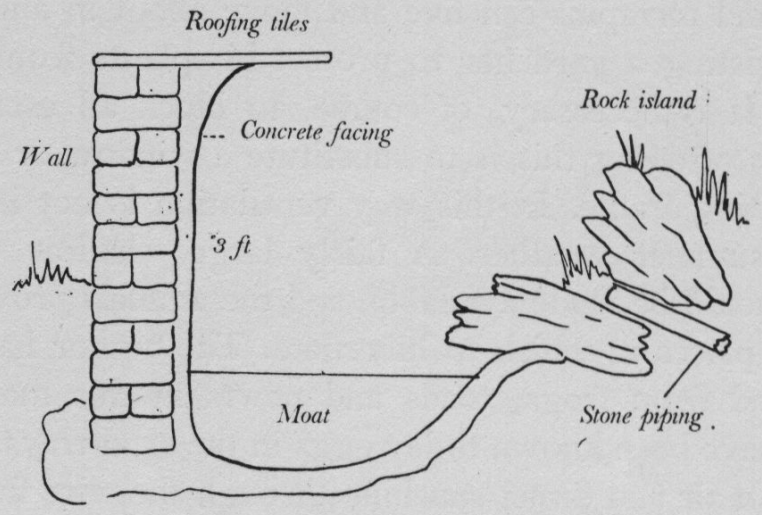


Fig. 9 Garden reptiliary

also be used for amphibians, although these would normally be in evidence only at the end of the day and through the night.

Layout and construction will depend on a number of things —cost, labour and space being three important considerations. Even so, the finished result will be an attraction in any garden, as well as a source of constant pleasure and education whether in a garden, school field, or museum ground.

The barrier or wall should be not less than three feet tall, and preferably made of weather-resistant material such as bricks, cement blocks or metal sheets. To prevent the animals from climbing out an inner overhang is necessary. For this, roofing slate may be used, or the inner face of the wall shaped

into a curve with a strong layer of reinforced concrete, as shown in fig. 9. This can be continued inwards from the wall base to form a circular moat. The earth removed from it can be heaped up in the middle of the reptiliary to form an island, which could well be made into a small rock-garden. Before inserting the rocks it is an excellent plan to bury one or two large pieces of clay piping into which the animals can retire or even hibernate. Alternatively, a small cave could be made, lined with bricks and covered with earth except for a narrow entrance.

In preparing these hiding places care should be taken to protect them from waterlogging in times of heavy rain, and to ensure that they can be cleaned out from time to time, and fresh bedding inserted. Such a winter den should be safe from frost. Using £10 worth or less of bricks and cement it should be possible to build a reptiliary about ten feet square.

10. Toad Hall

A name like this speaks for itself—a house for amphibians, from which there is no escape, such as may occur in the walled

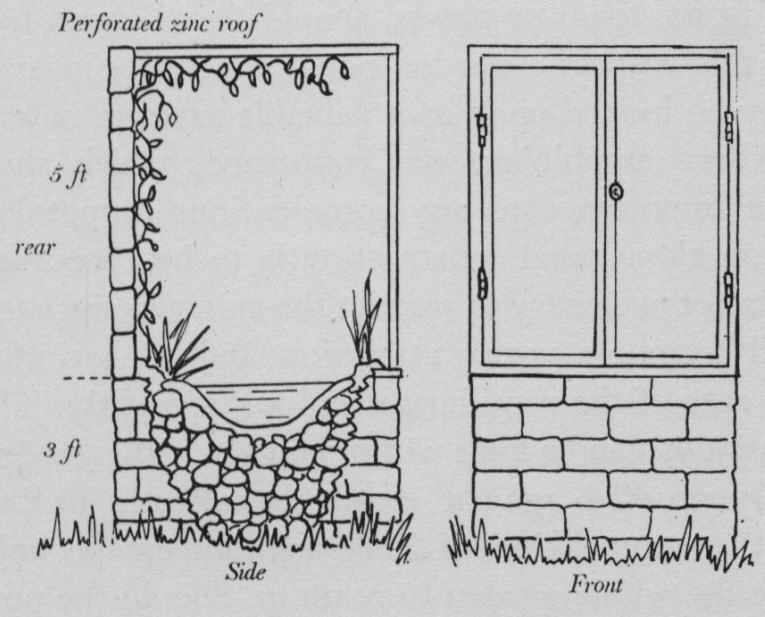


Fig. 10 L. G. Payne's toad hall

reptiliary. Such a house was made and used for many years by the British herpetologist, Mr L. G. Payne, and proved an excellent community centre for a variety of frogs and toads, tree frogs and salamanders. On a square of brick walling, about three feet tall, was erected a glass cage to a total height of about eight feet. The viewing side had sliding glass windows. The roof of perforated zinc allowed a certain amount of rain to penetrate. The walled base was filled up with loose rubble and covered with a good layer of soil. In the centre was a hollow lined with cement to form a miniature 'pond.' Various plants grew in the soil, and the cage was well covered with climbing plants such as ivies and creepers.

The animals behaved normally in retiring by day and coming out in the cooler evening time to feed. The success of this experiment may be judged from the regular calling of the animals, and the yearly spawning which took place.

11. The Garden Pond

Although a garden pond is usually maintained for the exclusive use of fish and aquatic plants, it often attracts a local wild population of frogs, toads or newts, should they happen to be in the area. In this respect a garden pond, especially in any built-up area, may be looked upon as a valuable asset to nature conservation where amphibians are concerned, which should be a matter of importance to any conscientious herpetologist. For this reason alone pond construction is to be encouraged. Normally it is not necessary to restrict the animals, since the pond in itself will become a yearly attraction. Indeed, a confining wall as in the case of the reptiliary may look unsightly. The amphibian population can be kept within bounds if the garden itself is adequately proofed against escape by already having a wall around it, or some kind of fence without escape holes. They then have the whole garden to roam in. Should the pond owner also wish to construct a rock garden around the pond, in itself

an added attraction and a foil to the water, then there is an unobtrusive way of confining the amphibians to the pond side. It is, simply, to construct a wall along the base of the encircling

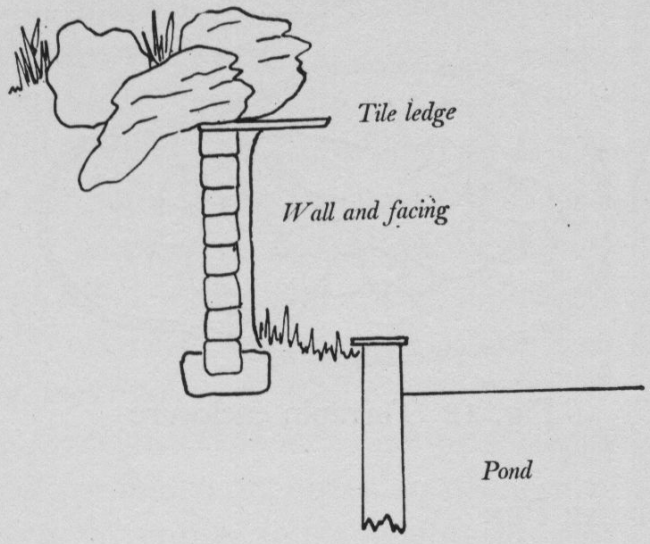


Fig. 11 Enclosed garden pond

rock-garden so that it becomes half hidden by the overhanging plants. At a suitable level a row of roofing tiles is inserted between the bricks to form the overhang. Figure 11 will make this clear.

12. The Terrapin Enclosure

A number of species of terrapins do well out of doors in the summer months, and benefit from the sunshine in which they lie and bask for hours out of water. The reptiliary above (9) will suit their purpose very well. The island shelter is not so essential in their case, since terrapins usually retire to the water in dull weather and at night, even hibernating there in some cases. The bare essentials are the low retaining wall with ledge (about two feet tall is sufficient) and a shallow pond inside the enclosure. By all means add rock-work and plants as an attraction to the layout, and a submerged log on which to bask.

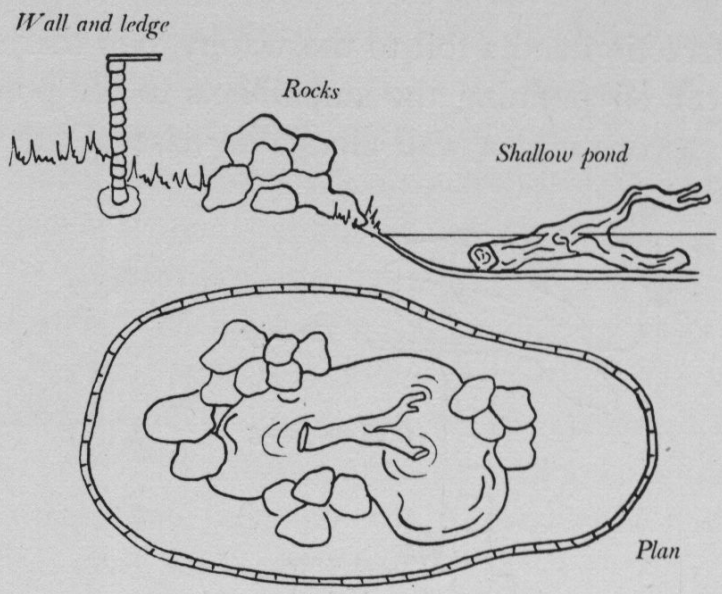


Fig. 12 Terrapin enclosure

13. The Tortoise Pen

Most tortoises which are kept as pets in Britain will live quite well outdoors during the warmer months, and will derive benefit from the sunlight and warmth. They should, however, be

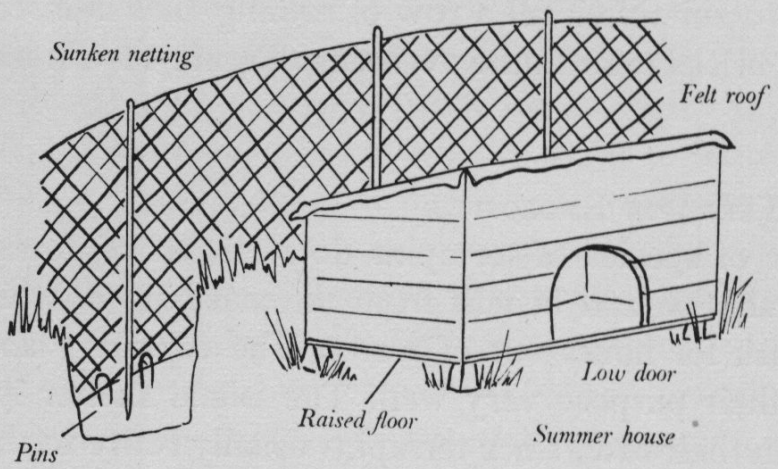


Fig. 13 Tortoise pen

sheltered from winds and rain, and in any case given a place for retirement at night since tortoises are diurnal. The simplest enclosure consists of a fence of wire netting, pegged down just

below ground level, and supported at intervals by strong iron or wooden stakes. Some form of shelter should be included. This will serve as a summer-house (not a place for hibernation) and can be made from a stout wooden box. In making this there are three requirements—a roof properly waterproofed against rain (using roofing felt or lino), a low doorway through which the animals can pass, and a slightly raised floor to avoid any damp from the ground. This is placed in a sheltered corner of the pen with the door facing towards the south-east so that the early sun is an attraction. A shallow container sunk into the earth and kept filled with clean water will serve as a drinking place, and somewhere to take a bath, which tortoises occasionally do in hot weather.

NOTE The terrapin enclosure and tortoise pen (11 and 12) can always be combined in order to economize on space and labour, since these reptiles live amicably together. The smaller specimens of crocodile and alligator can also be included.

14. THE OUTDOOR LIZARD CAGE

There is no doubt that lizards, more than any other kind of reptile, suffer from vitamin deficiency if kept permanently in artificial light and away from direct sunshine. The fortunate ones may be given artificial treatment from a sunray lamp, but direct sunlight is nature's best medicine.

In the summer months, or all the year round where the lizards can stand the climate, a reptiliary is the best home, but not essential in the way described above (9). A much simpler and cheaper enclosure is a box-frame of durable wooden bars, about two inches square, over which small meshed netting is secured but with one side left open. This is simply placed with open end downwards in a sunny position. It is not unattractive to place this frame, suitably painted, over some of the plants in the herbaceous border. Since it is easy to move it can be shifted around from time to time.

This enclosure will be exposed to the weather at all times, so that shelter for the lizards is required. A few built-up rocks, a broken flower-pot or two, or some curved pieces of bark can be laid down on the ground. The drinking bowl should not be overlooked. This home is almost self-supporting, even to the supply of food, since insects, etc. can easily enter from outside.

Frogs

Frogs belong to the group of tailless amphibians called the *Anura*, and come within the division known as the Firmisterna, in which the coracoid bones of the shoulder-girdle are firmly united across the chest.

Most frogs possess smooth and, usually, moist skins, which are highly vascular and supplement respiration through the lungs. The latter function is a pumping action which is seen as a pulsation of the throat as it forces air into the lungs. Hind-limbs are long and powerful, strongly webbed and used in hopping and swimming.

In temperate lands frogs emerge from hibernation in spring to congregate in shallow water for breeding. Males grasp the females from behind, in an embrace called amplexus. This grasp may be around the chest or around the groins. Packets of eggs (sometimes many thousands in number) are laid by the female in the water in a protective coating of albuminous jelly. Fertilization is external by the active spermatozoa ejected into the water by the male.

The eggs hatch into gilled larvae, the tadpoles, which at first browse on such plants as algae, later turning into scavengers as their legs appear. At metamorphosis, in 3–4 months, they leave the water having developed lungs and limbs. The tail is absorbed into the body. On land they behave like their parents, reaching maturity in the third or fourth year. A variety of living food, mainly insects, is caught on the sticky tongue. Food is detected by sight when it moves.

Frogs vary in size from midgets a centimetre or two in length to monsters like the Goliath Frog of tropical Africa (*Conrana goliath*) which may grow to nine inches in body length and can catch small mammals. The family *Ranidae* are the most typical of the frogs and include the three British species.

Some frogs are more aquatic than others and rarely stray far from water. The skin is of little protection against dry air and direct sunlight, and must be kept moist. Frogs normally live in a humid atmosphere under stones, logs, and in low vegetation or in water. They enjoy a degree of protection from enemies as many can tone well with their surroundings by changing colour.

Frogs are eaten as food in many parts of the world and have proved valuable to education in experimental research and in man's fight against destructive insects.

Frogs and Toads, i.e. the *Anura*, number about 2,000 species.

Their home in captivity may consist of an outdoor enclosure surrounded by a 3-ft wall with overhanging ledge, and containing plants, especially ferns, rocks and stones for hiding places, and a pool of water. The latter can be made from a sunken bath or as a moat inside the wall, enclosing the central land part as an island. Aquatic species can be kept in a garden pond, in which case enclosure may be necessary to prevent straying.

Frog colonies in these surroundings will be self-supporting. They will breed and hibernate in their season and natural food will appear from outside. Flies may be encouraged within range by leaving out pieces of raw meat. Worms and other small garden animals can be thrown down occasionally.

For indoor purposes an aquarium, glass accumulator tank or glass-sided box may be used, or a vivarium constructed to individual design or requirement. In this is placed a layer of mixed earth and sand or leaf-mould in which can be grown shade- and moisture-loving plants, such as ferns and mosses. Some ventilation is necessary and a door or lid for introducing food. This is given about twice weekly. A dish of clean water should be provided.

Another method is to use an aquarium containing about 3 in. of water, in which are erected small islands of rock-work, or pieces of slate resting just above water-level on stone supports. Alternatively a sloping bank of sand is built along one side of

the aquarium. These conditions are better suited to the more aquatic frogs which require a greater water area.

Cover all such homes with sheet glass resting on narrow cork or wooden wedges so as to reduce evaporation to a minimum and also to prevent escapes. One should aim at producing humid conditions within the tank or vivarium. Tropical species are best kept indoors.

Spawn may sometimes be laid in captivity, especially in out-door ponds, and the tadpoles will usually develop without attention. If reared indoors they will require plant food in the early stages, such as algae, lightly boiled leaves of lettuce, nettle or spinach, to which should be added a meat diet when the legs appear. Chopped earthworms, small dead animals and pieces of raw meat and fish are acceptable. Such food may pollute the water which will then have to be changed.

Fungus parasites sometimes attack frogs, and are due to dirty water or wounds through which they can penetrate.

Frogs kept out-of-doors should be given protection against their enemies, such as cats, hedgehogs, snakes and herons. A covering of wire-netting may be necessary.

COMMON OR GRASS FROG

Scientific Name *Rana temporaria temporaria* Linnaeus, 1758. Three sub-species.

Distribution Widespread. From Britain to Japan and from 70° N latitude to the southern mountain ranges of Eurasia. In Britain, most of the mainland counties except some Scottish islands and parts of Wales. In Ireland mainly in coastal areas (probably introduced in 1796).

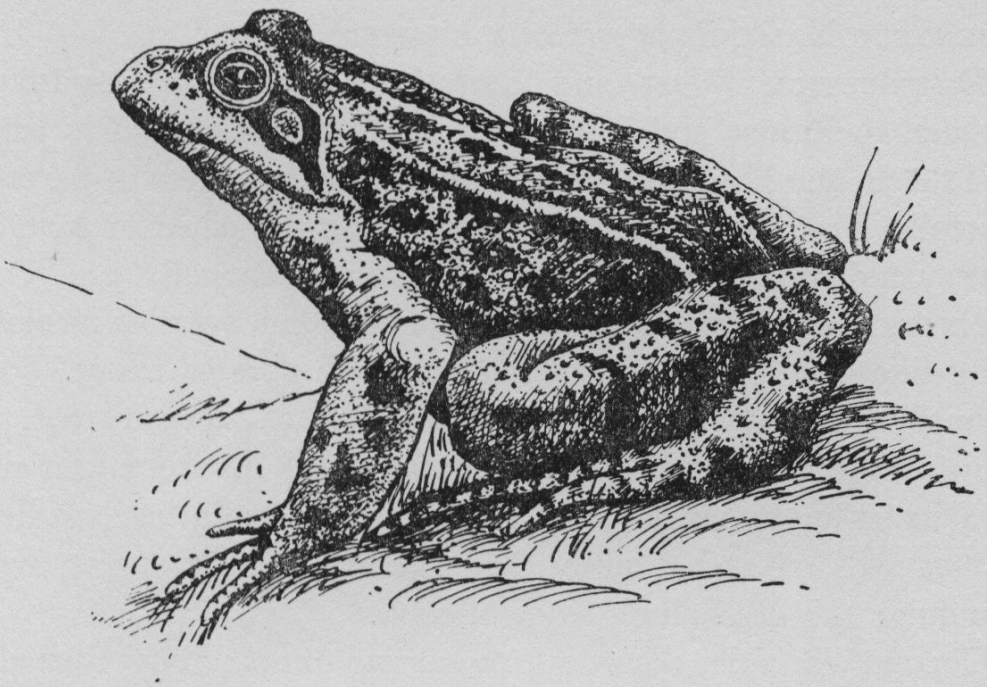
External Features Grows to about 9 cm, sexes about equal. Head broader than long, snout rounded and eardrum distinct. Toes strongly webbed. Male has two internal vocal-sacs and stronger fore-limbs. At breeding time small black tubercles appear on the palms of the hand and a swollen black pad on each thumb in the male. The male's throat may turn bluish. Skin smooth and moist.

Colour Most variable, depending upon surroundings. Above: whitish, greyish, reddish, brown or yellow, marked and striped with brown or black. The markings are large or small and numerous, or sometimes absent. The sides are mainly spotted and the limbs striped. A temporal patch occurs between each eye and the angle of the mouth, with a clear patch beneath. Below: whitish or usually yellowish or orange, marked with brown, red or orange, or with grey spots.

Habits Lives mostly in shady, damp situations, especially in waste undergrowth, field borders, gardens, ditches and edges of ponds and streams. Active by day but avoids hot sun, retiring in drier spells. The male gives a dull croak mainly when breeding. This species sometimes screams when attacked by snakes. It swims well and is a good jumper.

Hibernation In damp vegetation or earth, in ditches and hollows or in mud below water in ponds, from October to March in southern England, longer in the north and at high altitudes.

Food Small, live animals such as insects, worms, crustaceans and particularly molluscs. Hunts by sight, catching food



on the tongue, and uses a scraping action of the forefeet to clean its prey, such as worms.

BREEDING Appears in colonies in shallow water in early spring, the males a little before the females. The male grips the female from behind around the chest in an embrace which may last from a few days to about a fortnight. The female lays a spawn-mass of about 4,000 eggs, 2–3 mm in diameter, black above and whitish below. The deep brown tadpoles, with a pointed tail-tip, metamorphose in about 3 months. Baby frogs emerge from the water, usually in June or July, measuring 1·5 cm. They are mature in the fourth year. A specimen has been kept for 12 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 10, 11.

EDIBLE FROG

SCIENTIFIC NAME *Rana esculenta* Linnaeus, 1758.

DISTRIBUTION West and central Europe, from southern Sweden to France and Italy. Introduced into England as early as 1837 in the Foulmire Fen, Cambridgeshire, later in parts of Norfolk. Now largely extinct there, but established in parts of Surrey and west Kent, probably other places as well.

EXTERNAL FEATURES Grows to about 9 cm, smaller in male. Frog-like, head as broad as long and with pointed snout. Toes strongly webbed. Male has a pair of vocal-sacs situated, as skin-folds, in the angles of the mouth, which inflate to the size of a hazel-nut when in use. The breeding male has swollen, brown pads on each thumb. Skin smooth, usually moist, with glandular skin-fold along sides of back.

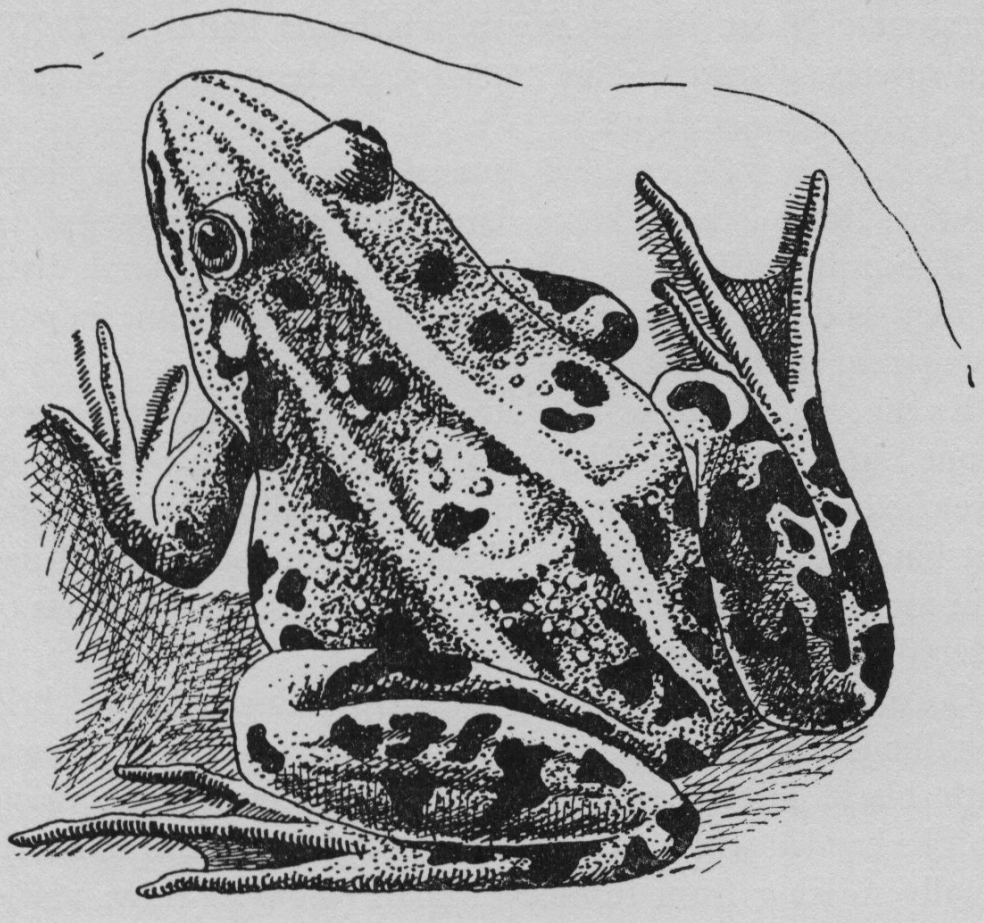
COLOUR Variable, according to surroundings. Above: usually bright emerald green, brown or greyish, marked and striped with black and brown. Thighs banded with black and yellow. There is usually a pale dorsal stripe. Below: a uniform white, sometimes speckled with black. Vocal-sacs in male whitish.

HABITS Very aquatic. Occurs in colonies in ponds, canals, dykes and lake borders. Basks at water's edge or on the surface. Enters water or submerges when disturbed. A very active and strong swimmer. The hind-legs are served as a Continental dish. The male gives a loud, penetrating song, during late spring and summer, especially in the evenings and at night, or after rain.

HIBERNATION From October to April, in mud under water or at the water's edge.

FOOD Similar to the Grass Frog. In addition, various small aquatic animals, caught at the surface or below water. Will catch newts and small fish.

BREEDING In Britain, in May or June. Mating similar to Grass Frog. The female lays spawn, usually in small clumps of up to 6,000 eggs, 1·5 mm in diameter, and brownish-yellow in colour. The brownish tadpoles metamorphose in 3–4 months,



the young frogs measuring about 2 cm. Tadpoles commonly overwinter on the Continent. A specimen has been kept for 6 years in captivity.

VIVARIUM 1, 6, 7, 11.

MARSH OR LAUGHING FROG

SCIENTIFIC NAME *Rana ridibunda ridibunda* Pallas, 1771. Two sub-species. (Described in 1897 by Boulenger as the eastern variety of *Rana esculenta.*)

DISTRIBUTION Central and eastern Europe, from Germany to western Russia, the Balkans, Urals and parts of western Asia. In Britain it has been established in the Romney Marsh district of Kent and Sussex since 1935, probably from some imported Hungarian specimens.

EXTERNAL FEATURES The largest frog in Europe. Grows to about 5 in. (13 cm), smaller in male. Total length with legs outstretched nearly one foot. Similar to the Edible Frog in shape, but hind-legs proportionately longer, snout blunter and moist skin more warty. Is closely related to the Edible Frog but considered a distinct species.

COLOUR Variable, according to surroundings. Above: bright metallic green or bronze, sometimes putty-coloured, marked with black. Hind parts more brownish, even faint orange. Thighs banded with white, green or black. A pale dorsal stripe, usually missing from Romney Marsh colony. Below: uniform white, sometimes speckled. Vocal-sacs in male blackish.

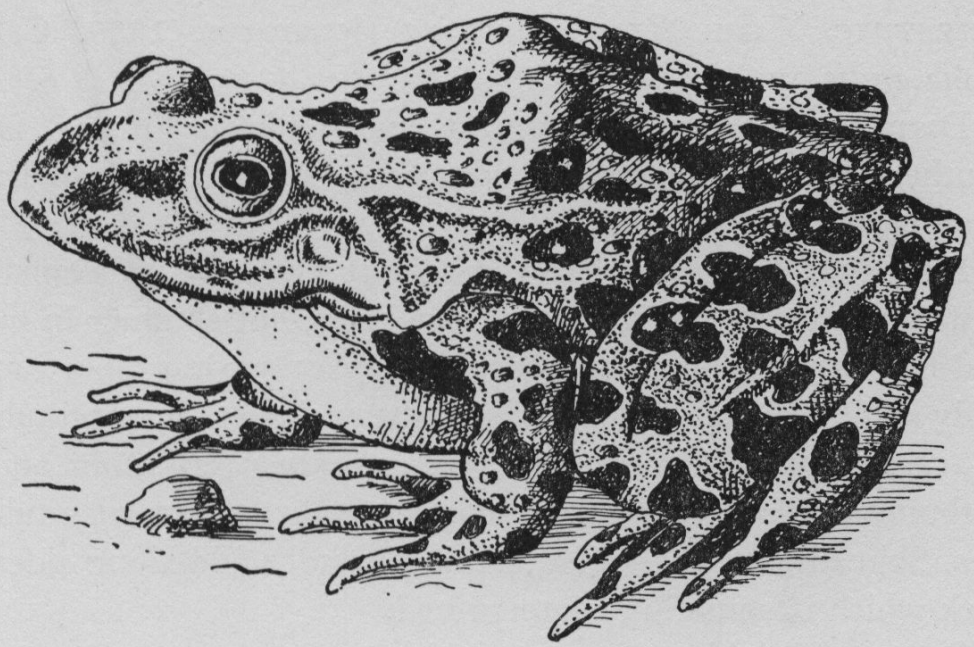
HABITS Similar to Edible Frog, but stronger and more aggressive. Can leap a distance of 5 ft. Mating chorus very loud. Lives in larger, more open waters. Has been used for experimental work and is caught for food.

HIBERNATION Similar to Edible Frog. Usually burrows into mud and debris below water.

FOOD Similar to Edible Frog. Can catch and swallow small fish, young frogs, newts and large garden worms, even small mammals and nestlings.

BREEDING Similar to Edible Frog. Male grips female from behind in an embrace around chest. The clumps of yellowish spawn are laid in clusters among plant stems in shallow water. The brownish tadpoles grow to 6–7 cm (3 in.) and may not metamorphose till following spring. In Britain it appears to

MARSH OR LAUGHING FROG



breed a little later, about June–July, and will hybridize with the Edible Frog in captivity. So far it is not known whether the hybrid offspring are fertile. A specimen has been kept for 4 years in captivity.

VIVARIUM 1, 6, 7, 11. Keep apart from smaller animals.

AGILE OR NIMBLE FROG

Scientific Name *Rana dalmatina* Bonaparte, 1839. Called *Rana agilis* by Schreiber in 1912.

Distribution Local in central and southern Europe, from southern Sweden to France and across Europe to the Balkans. Also parts of western Asia.

External Features Grows to about 9 cm, the male smaller. Sometimes confused with the Grass Frog, but slimmer in build and has a more pointed snout with legs longer in proportion to body and toes large and shiny. Ear-drum close to eye and tubercles occur under fingers. Male has stronger fore-limbs and is without vocal-sacs. Breeding male has pads with greyish tubercles. Skin smooth and moist, and a glandular fold along sides of back which is sometimes interrupted.

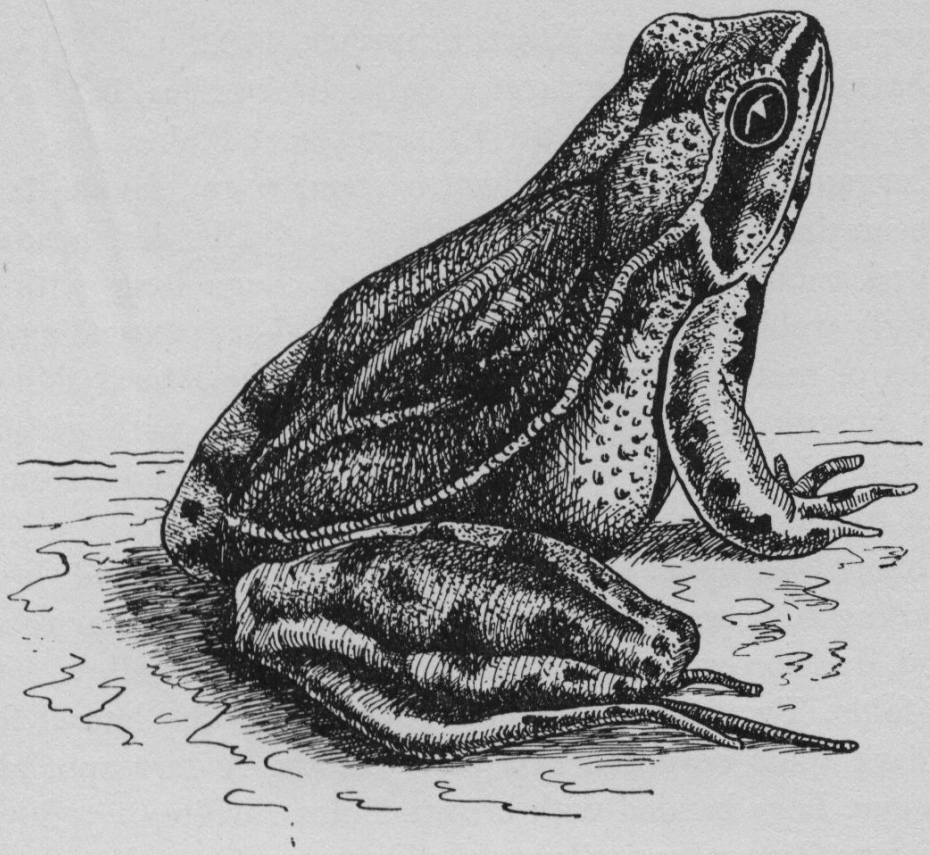
Colour Variable. Above: whitish, yellow, grey, brown or reddish, with marks and stripes in brown or black. A black, open V mark commonly occurs between shoulders and there is a distinct temporal patch. Sides usually clear of markings. Below: immaculate white or cream, tinted with rose on throat and feet.

Habits Similar to Grass Frog, inhabiting dry or damp situations. More active and usually avoids water except to breed. Occurs in ditches, undergrowth, woods and waste ground, often far from water. Call of male a feeble croak. Can make a leap of 6 ft. Usually remains hidden in daytime.

Hibernation Similar to Grass Frog. The male may hibernate below water but the female usually remains on land buried in leaf-mould.

Food A variety of insects and other small animals, hunted by sight and caught on the tongue. Very quick at catching insects, leaping high into the air to secure flies and gnats.

Breeding Similar to Grass Frog. Male grips female around chest from behind. Breeds a little later, in March or April, and mating is of short duration. Fewer eggs, up to 1,000, are laid in deep water. The yellow-brown tadpoles metamorphose in 2–3 months. The baby frogs emerge in July or August and measure



about 1·5 cm. They mature in the fourth year. Has been kept for 5 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 10, 11.

COMMON LEOPARD FROG

SCIENTIFIC NAME *Rana pipiens* Schreiber, 1782.

DISTRIBUTION Western states of North America, between the Sierra Nevada range and the Eastern Great Plains.

EXTERNAL FEATURES Grows to about 9 cm, female larger. Shape rather similar to Edible Frog, body slender, head with pointed snout and rounded ear-drums. Legs long with toes strongly webbed. Male with internal vocal-sacs extending from angles of mouth across each shoulder to the lateral skin-fold. Skin smooth and slightly tubercular, moist, with glandular skin-fold along sides of back and prominent ridges from the snout to each eye.

COLOUR Variable. Above: bright green-grey and brown, according to surroundings, marked with two irregular rows of round, dark-brown spots along back between the yellow, lateral skin-folds. Two more irregular rows below the lateral folds, the dark spots bordered in a paler colour. A dark spot above each eye. Legs banded with brown. Below: white or yellowish.

HABITS Generally similar to the European Grass Frog, occurring in meadows, ditches, open glades in woodlands, and borders of ponds, streams and lakes. Male gives a soft guttural croak, sometimes heard in female. One of the commonest North American frogs in the areas where it occurs. The young are used as anglers' bait, adults for food and biological study.

HIBERNATION From October to March or later, according to locality. Burrows in vegetation or beneath logs, stones and tree-roots, sometimes in mud below water.

Food A variety of insects and other small animals, hunted by sight and caught on tongue. Large specimens will sometimes devour sizeable prey such as small snakes.

BREEDING Similar to Grass Frog. Male grips female under armpits from behind. Appears in colonies in shallow waters of lakes, ponds and marshes in March or April. Female lays a spawn mass of 5,000–6,000 black eggs, about 1·5 mm in diameter. Tadpoles metamorphose in about 3–4 months, measur-

COMMON LEOPARD FROG

ing about 1·5 cm. A specimen has been kept for 6 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 10, 11.

NOTE This species is a North American representative of the large genus *Rana* (about 200 species) in the typical frog family *Ranidae*. Nine species occur in Europe.

COMMON BULL FROG

SCIENTIFIC NAME *Rana catesbiana* Shaw, 1802.

DISTRIBUTION North American states, east of the Rocky Mountains.

EXTERNAL FEATURES The largest American frog. Grows to about 7 or 8 in. (18–20 cm), the female even larger. Body stout and flat, head broad and flat, with rounded ear-drums which are about the size of the eyes in female, larger in male. Legs powerful and strongly webbed. Male with internal vocal-sacs extending over each shoulder. Skin faintly granulated and moist above, smooth below, without lateral skin-fold. This occurs instead from behind each eye, extending to the shoulder and curving around the ear-drum.

COLOUR Variable. Above: green or green-brown in light or dark shades according to surroundings, sometimes with darker spots. Limbs with darker spots and bands. Throat of male sometimes yellow. Below: white, sometimes mottled with darker spots.

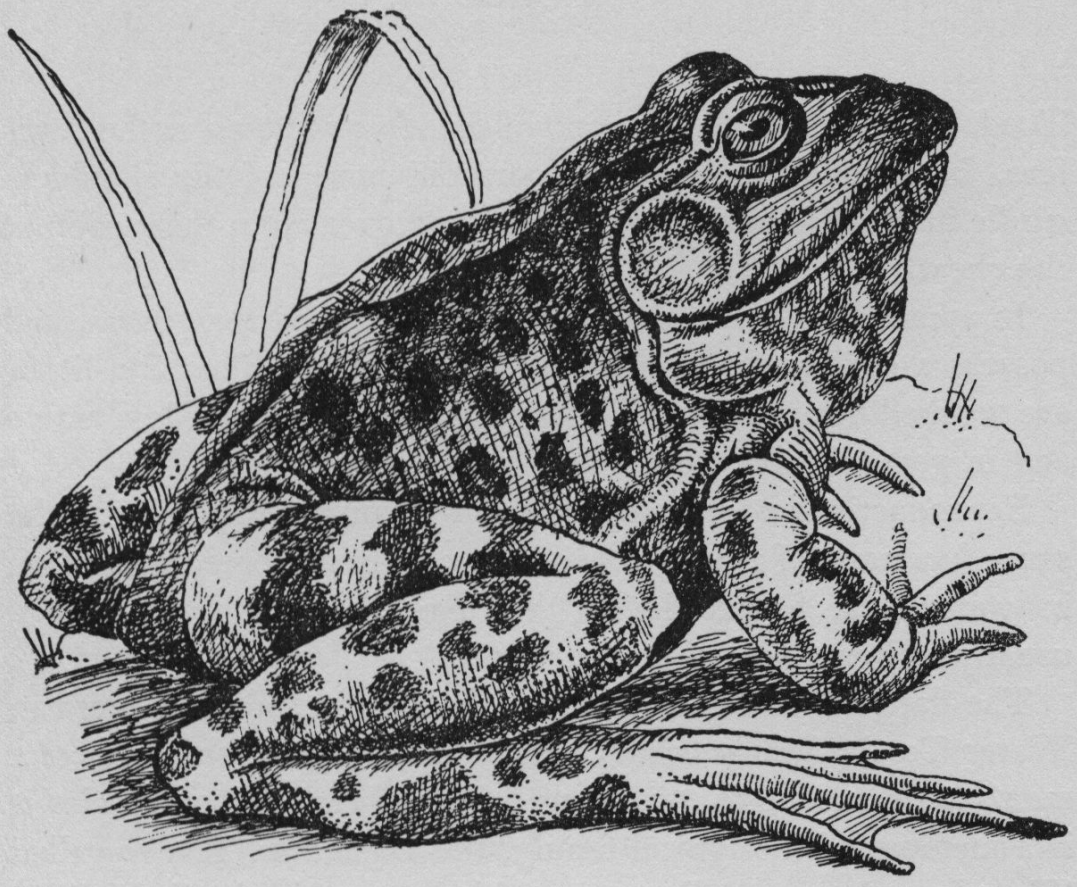
HABITS Very aquatic. Occurs in lakes, ponds and swamps, among water-plants, often basking at water's edge. Rather solitary except when breeding. Male gives a very loud penetrating croak likened to a bull's roar, called in America the 'Jug o' rum' call. Will also scream when in distress. Widely collected as food and for experimental purposes. Bred on farms.

HIBERNATION Buries in mud, usually under water, from October to April–May.

FOOD Various small animals, including insects, molluscs and crustaceans, caught both under and out of water. Will catch and eat crayfish, small mammals and nestlings, also fish.

BREEDING In June and July, congregating in numbers in shallow water. The female lays clumps of spawn, containing about 2,000 eggs, 2–3 mm in diameter. The tadpoles, speckled brown above, white below, may reach a length of 7 in. (18 cm) and usually metamorphose in the second, even third year. A specimen has been kept for 16 years in captivity.

COMMON BULL FROG



VIVARIUM 1, 6, 7, 11. Keep apart from smaller animals.

Toads

Toads come within the division of the *Anura* known as the Arcifera. In contrast to frogs the coracoid bones of the shoulder-girdle in these animals are separate and overlap in the region of the chest.

In appearance toads are more squat in shape than frogs, and possess a dry, warty skin in the typical forms. The hind-limbs are webbed but shorter and less powerful. Toads are less active and in general more nocturnal.

Reproduction and development of the young are similar to the same functions of frogs. The adults pair in the breeding season in water, the female laying her eggs among water-plants, usually in long, albuminous strings.

The largest living toad is probably the South American Water Toad (*Bufo marinus*), which is as large as the palm of a man's hand and up to 6 in. long. Like the two British species it is a member of the typical family, the *Bufonidae*. The so-called 'Tree-frogs' are actually toads and belong to the family *Hylidae*, and are mainly arboreal. They have sucker-like pads on the fingers and toes used for clinging to the leaves and bark of bushes and trees.

The *Pelobatidae* or Spadefoot toads are a family of digging toads (having a spur-like extension on their heels). The Surinam Toad and African Clawed Toad both belong to a specialized group of the *Anura*, called the Aglossa. They are entirely aquatic and have no tongue. The African Clawed Toad is used in experimental work. The little Yellow-bellied Toad is fairly aquatic, and with its relatives, the Fire-bellied and Midwife Toads and Painted Frog, belongs to the *Discoglossidae*. Their tongues are rounded and non-protrusible.

Toads, like frogs, will shed their skins at intervals. This is pushed with the legs off the body towards the snout, rolled into a ball and swallowed. Food is caught on the tongue or in the mouth and consists of numerous small living animals such

as insects and their larvae, molluscs, crustaceans and worms. They are, therefore, of value to the farmer and gardener and for this reason alone, if for no other, these animals deserve our protection.

Some toads possess a strong homing instinct, and will return to the same spot, such as under a flower-pot or log, every morning after their nocturnal search for food. A strong migratory behaviour is also displayed, shown by the fact that in the springtime toads make for certain ponds in which to breed.

Although generally similar in habits to frogs, toads can usually withstand less humid conditions and are sometimes found in dry surroundings. With certain exceptions they are less inclined to enter water except when breeding.

In captivity toads may be kept in the type of garden enclosure described for frogs. Being less active and more inclined to stay in one spot they may even be given the freedom of the garden provided that all escape holes are covered in the fence or wall. Cats and dogs are less inclined to molest them because of a secretion from the skin which is highly distasteful.

Indoor conditions, as described for frogs, are also suitable. The Common Toad will often take up residence in a cellar, garden shed or conservatory. In this event it should be provided with a bowl of water. If the vivarium is used this should be sprayed occasionally. Flies, maggots, caterpillars, beetles, 'meal-worms' and slugs can be given as food.

The tadpoles, as in the case of frog-tadpoles, may be reared in dishes of shallow water. In their vegetarian stage they feed on algae and the leaves of lettuce, spinach or nettle. When legs appear, chopped garden worms and raw meat should be added. At metamorphosis a landing space is necessary for them to leave the water. The babies will feed on green-fly, fruit-fly and small insect larvae or worms.

Toads show considerable intelligence and a certain attachment to their owner. They will respond to a call and feed from the fingers.

COMMON TOAD

Scientific Name *Bufo bufo bufo* Linnaeus, 1758. Originally named *Rana bufo*. Three sub-species.

Distribution Widespread in Europe, north of the Alps. Spreads into Asia. In Britain, most counties on the mainland; not present in some Scottish islands, parts of Wales and Ireland.

External Features Female grows to about 10 cm. Male 7 cm. Head broader than long with short rounded snout. No teeth. Ear-drum small and parotid glands large and prominent. Body squat and limbs short with toes half-webbed. Skin dry and rough, above warty, below granulated. Male without vocal-sacs. The breeding male has black pads along three inner digits of each hand. Gigantism in female occurs, especially in central Europe.

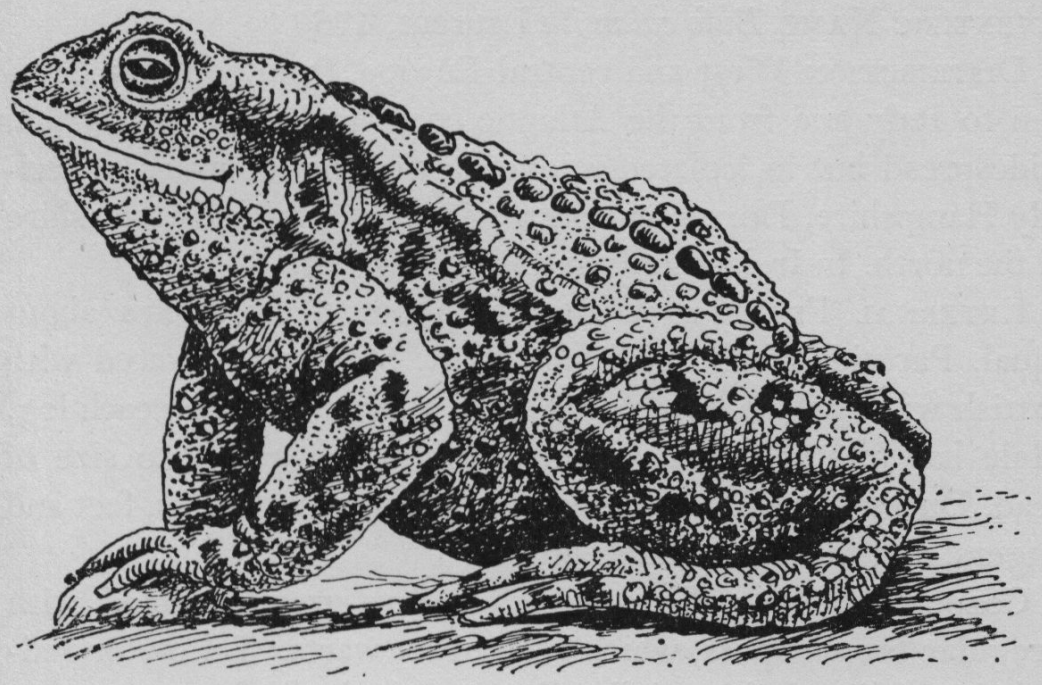
Colour Variable, depending partly on surroundings. Above: olive-brown or grey, with or without reddish or dark patches. Below: whitish, grey or bluish, spotted with black.

Habits Lives in woods, ditches, gardens, among stones and in rubbish heaps. Prefers to hide by day and emerge in the evening. Slow in movement, progressing in short hops. Passive and easily tamed. Skin poisonous but is otherwise harmless. Male gives a high persistent croak at breeding time.

Hibernation October to late March in southern England, in damp or dry places in the soil, under vegetation, logs and stones. Frequently enters cellars and outhouses.

Food Similar to Grass Frog. Tends to sit and wait for its prey. Devours a great number of nocturnal insects, especially beetles and ants.

Breeding Enters water in colonies in spring, the males preceding the females or riding on their backs. Mating similar to Grass Frog but about a month later, usually early April in southern England. Much smaller male grips female in armpits. Female lays twin strings of spawn of up to 7,000 eggs, 1·5–2 mm in diameter and black in colour. Very dark tadpoles with



tail-tip rounded metamorphose in about 3 months and leave the water as baby toads about 1 cm long. Individuals of this species have a strong 'homing' instinct, tending to visit the same pond every year to breed. A specimen has been kept for 12 years (*36* years in a garden).

VIVARIUM 1*A*, 2, 3, 8, 10, 11. Provide a good depth of loose soil.

NATTERJACK OR RUNNING TOAD

SCIENTIFIC NAME *Bufo calamita* Laurent, 1768

DISTRIBUTION West and central Europe, from southern Sweden to Italy and from the Atlantic coast to Poland. In Britain widespread but in isolated colones in the drier counties, especially Hampshire, Dorset and Surrey in the south, and Lancashire in the north. In Ireland only in the south-west.

EXTERNAL FEATURES Grows to about 6 cm, sexes about equal. Parotids small and limbs short. Skin soft, covered with flattish warts which have pores, with a large gland on each leg. Male has internal vocal-sac in throat which swells to size of head. During breeding male has black warts on thumbs, feet and fingers, and the throat turns bluish.

COLOUR Above: yellow-green or olive-grey, marbled with irregular brown spots, which are red on warts. Yellow or reddish dorsal line. Below: dull yellow, marked with brown.

HABITS Prefers sandy localities and light soil, in dunes, commons and woodlands where it lives in colonies. Moves in short runs and does not hop. Largely nocturnal. Will often dig into soil. Call of male a persistent and high-pitched croak. A poor swimmer and usually avoids water. Tolerant of brackish water. Climbs well.

HIBERNATION Similar to Common Toad, from October to late April in southern England. Usually burrows into the earth.

FOOD Catches by sight on the tongue a variety of small animals, including insects, slugs and worms.

BREEDING Appears in colonies in shallow water in April, and breeding is intermittent throughout the summer until September. Mating similar to Common Toad. Male grips female in armpits in an embrace lasting about a fortnight. Female lays up to 4,000 eggs, 1–1·5 mm in diameter, which lie alternately in the strings of spawn, this being usually caught up in waterplants in shallow corner of pond. The deep, reddish-brown tadpoles metamorphose in about 3 months, the baby toads

measuring about 1·5 cm when they leave the water. A specimen has been kept for 16 years in captivity.

VIVARIUM 1*A*, 2, 3, 8, 10. Provide a good depth of loose soil.

GREEN OR CHANGEABLE TOAD

SCIENTIFIC NAME *Bufo viridis viridis* Laurent, 1768. Number of sub-species uncertain.

DISTRIBUTION Western, central and southern Europe, from southern Sweden to Italy, also North Africa and across western Asia to Tibet. Is mainly a species of the Asian steppes.

EXTERNAL FEATURES Grows to about 7 cm, larger in the female. Shape toad-like, snout short and rounded. Body squat and limbs shortish. Distinct ear-drums and parotids. Skin dry with flattened warts, similar to Natterjack. Male has a small internal vocal-sac.

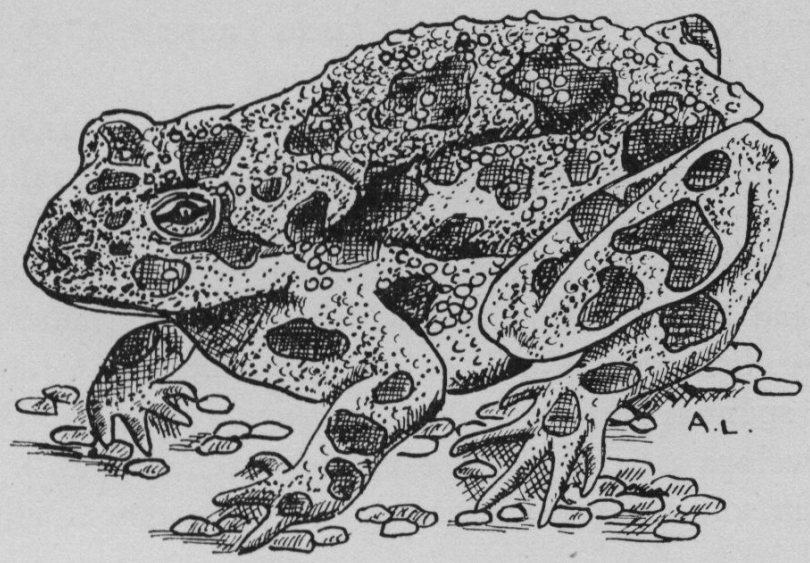
COLOUR Above: olive, grey or green, marked with patches of deeper green or olive, set in black. Below: uniform grey-white, sometimes spotted in black. Some specimens are heavily marked and others a more uniform green. The colour intensifies or darkens in different surroundings.

HABITS Very similar to Common Toad. May occur at high altitudes and favours open country. Can tolerate dry surroundings but a little more aquatic than the common Toad. Fairly active, can run or hop and is a good climber. Call of male softer than Common Toad and more trill-like. Often burrows.

HIBERNATION Similar to Natterjack, October to March, but varies with locality. Frequently burrows in ground.

FOOD A variety of insects and small animals, such as beetles, worms, flies, slugs and moths.

BREEDING Similar to Common Toad, from April to July, and of longer duration. Male grips female from behind in armpits. Female lays a large number of eggs, up to 20,000, 1–1·5 cm in diameter, in numerous rows to each string. These hatch in a few days and the large tadpoles, 4 cm long, metamorphose in about 2–3 months. They are brownish or olive grey above, blue-grey below. The baby toads measure about 1·5 cm and mature in the fourth year. A specimen has been kept for 9 years in captivity.



VIVARIUM 1*A*, 2, 3, 8, 10, 11. Provide a good depth of loose soil.

NOTE This toad, the Common Toad and the Natterjack are the only three European species of the large and typical family *Bufonidae*. There are no teeth in the upper jaw.

SPADE-FOOT OR DIGGING TOAD

SCIENTIFIC NAME *Pelobates fuscus fuscus* Laurent, 1768. Originally named *Bufo fuscus*. Two sub-species.

DISTRIBUTION Europe, from Sweden to the Alps countries and the northern Balkans. From France eastwards to the Urals.

EXTERNAL FEATURES Grows to about 7 cm, male a little smaller. Body squat and dumpy, often with skin-fold across back. Head broader than long with very short, rounded snout and large, brilliant eyes. Toes strongly webbed. A metatarsal digging spur on each heel. Male without vocal-sacs. Breeding male develops a large, oval gland on each fore-arm, but no pads. Skin soft and smooth, rough on head where it adheres to the skull.

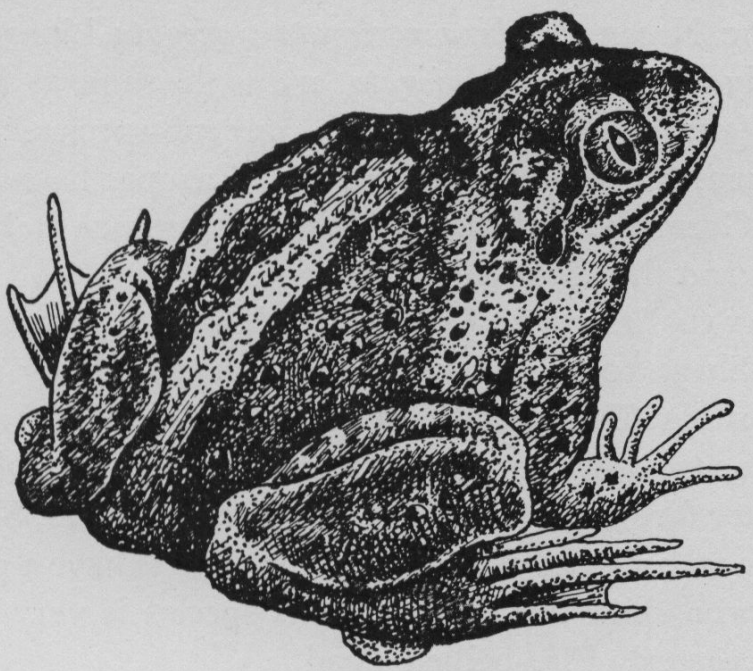
COLOUR Variable. Above: grey or shades of yellow or brown, marked or marbled with red-brown sometimes in a band along each side of back. Below: a dull white, sometimes spotted with brown.

HABITS Terrestrial, spending much of the day buried in mud and soft ground, into which it digs with shuffling motions of the hind-feet, using the spurs as digging organs. Emerges at evening. A good swimmer. Produces a peculiar, garlic odour when disturbed. The male gives a slow harsh croak.

HIBERNATION Buries deeply into soft earth, from October to March.

FOOD Similar to Common Toad, especially worms, slugs and beetles.

BREEDING Enters water in April, the male gripping female in the groins from behind. Mating lasts about a week. Female lays a single, short and thick spawn-string, about 80 cm long and 1·5 cm across, containing about 2,000 eggs, 2 mm in diameter. These are laid attached to plants in still water. The deep brown tadpoles, the largest in Europe, grow to 17 cm and may overwinter. At metamorphosis, in about 4–5 months, the baby toads measure about 3 cm, and are mature in the third year. A specimen has been kept for 9 years in captivity.



VIVARIUM 1*A*, 2, 3, 8, 10, 11. Provide a good depth of loose soil.

NOTE This species belongs to the small family *Pelobatidae* (four species occur in Europe) which possess teeth in the upper jaw. The spiracle in the tadpole is on the left.

YELLOW-BELLIED TOAD

SCIENTIFIC NAME *Bombina variegata variegata* Linnaeus, 1758. Originally named *Rana variegata*, and is the same as *Bombinator pachypus* (part) of Schreiber, 1912. Four sub-species.

DISTRIBUTION Western and central Europe, from France to western Germany, and from Holland to northern Italy, parts of Bohemia and the Carpathians.

EXTERNAL FEATURES Grows to about 5 cm, male a little smaller. Shape toad-like with squat, flattened body and short, rounded snout. Toes strongly webbed and soles of feet swollen. Male has stronger fore-limbs. Breeding male has black warts along inner fore-arms and under three inner fingers. Skin warty, especially on back and outside of limbs. Warts have a pore in the female and a spine in the male. This species is very similar to the more easterly Fire-bellied Toad.

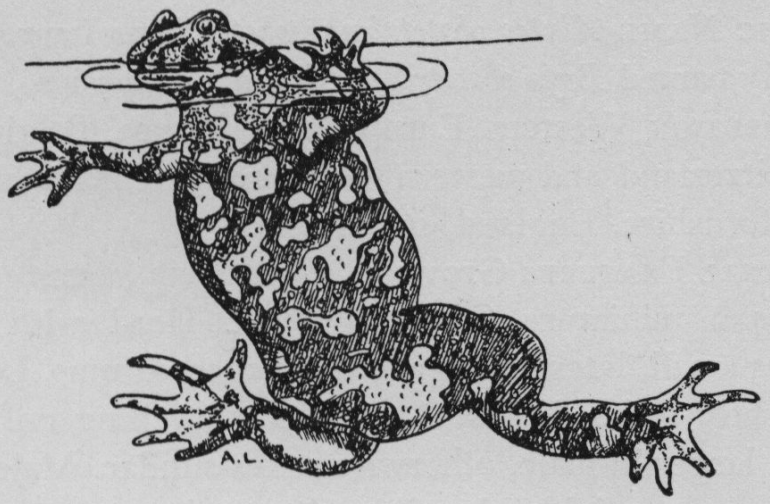
COLOUR Above: an earthy-brown, green or olive, even blackish, marked in black. Below, and under limbs: yellow or orange, marked or spotted with blue-black, more blue-grey in belly region. Base of fingers and toes yellow. Colours in young more intense and more yellow below.

HABITS Frequents shallow water, in stagnant pools, ditches, even puddles, and is fond of water where it gathers in small colonies. Usually appears at dusk, hiding by day under logs, stones and vegetation. Easily tamed. When alarmed will resort to a defensive attitude, exposing the bright underparts by raising its limbs and arching the back. Lively in movement and a good swimmer. The male gives a soft, plaintive croak.

HIBERNATION From October to March in mud, soft earth, under stones or logs.

FOOD Similar to Common Toad, Prey smaller.

BREEDING Appears in colonies in shallow water in March, and breeds intermittently until September. Male grips female from behind in the groins. Female lays small clumps of spawn of about 100 eggs, about 2 cm in diameter. Tadpoles metamorphose rapidly in about one month, the baby toads measuring



about 4 cm. A specimen has been kept for 7 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 10. N.B. Fairly aquatic.

MIDWIFE OR BELL TOAD

SCIENTIFIC NAME *Alytes obstetricans obstetricans* Laurent, 1768. Originally named *Bufo obstetricans*. Two sub-species.

DISTRIBUTION Western Europe, viz. France, Belgium, Holland, Switzerland and western Germany. A colony introduced into Bedfordshire, England, still exists.

EXTERNAL FEATURES Grows to about 5 cm, sexes equal, and resembles a miniature Common Toad. Head with rounded snout, has small, lateral eyes and distinct ear-drums. Legs short with slightly webbed toes. A glandular swelling on forearms and legs, larger in male, otherwise sexes similar. Male without vocal-sac or nuptial pads. Skin dry and warty, granulated below.

COLOUR Above: dull yellow, olive-grey or brown, marked with black or green, sometimes with red spots. A clear patch between shoulders. Below: greyish with glands marked in black, more flesh-coloured on limbs.

HABITS Very terrestrial. Lives in small colonies in woods, ditches, ravines and among rocks. Active at night, hiding by day. Male has an attractive, bell-like call, hence the alternative name, Bell Toad.

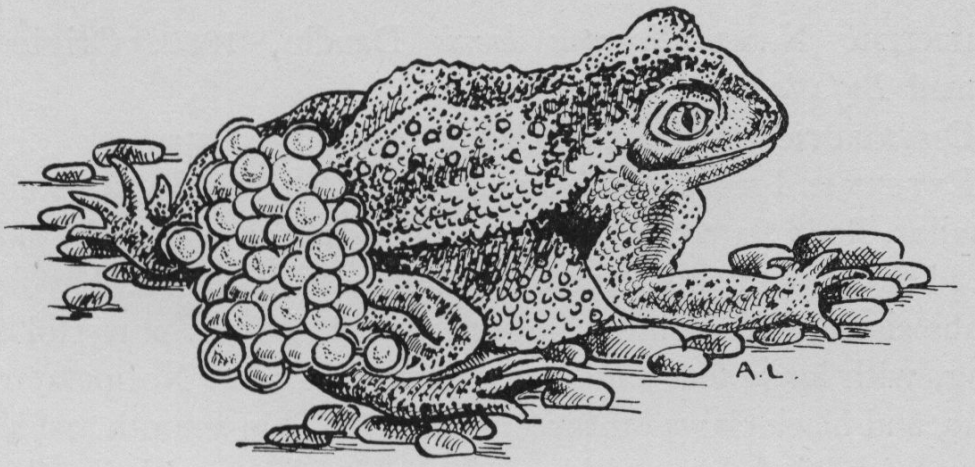
HIBERNATION In holes in the ground, under stones, logs, among tree-roots and in vegetation, from October to March.

FOOD Similar to the Common Toad, but smaller prey.

BREEDING Throughout the season from March to September. Pairing occurs at night on land. Male rubs female with his hind-legs to encourage egg-laying. Female lays, three or four times a year, strings of about 100 eggs, 3 mm in diameter, each attached to the next by a gelatinous cord. Male wraps string, about 7 cm long, around heel-joints, sometimes collecting more than one string from different mates. Eggs are moistened at intervals, male finally entering water as tadpoles hatch out, measuring about 1·5 cm. These grow to about 4 cm and metamorphose in about 4 months. A specimen has been kept for 20 years in captivity

VIVARIUM 1*A*, 2, 3, 6, 10, 11. N.B. Largely terrestrial.

MIDWIFE OR BELL TOAD



NOTE This species and the Yellow-bellied Toad belong to the family *Discoglossidae*, in which the tongue is more or less circular, and the spiracle in the tadpole median.

AFRICAN CLAWED TOAD OR PLATANNA

SCIENTIFIC NAME *Xenopus laevis* Daudin, 1802. Originally named *Bufo laevis*.

DISTRIBUTION Africa, from Abyssinia to the Cape.

EXTERNAL FEATURES Grows to about 10 cm, the male much smaller. Body flattened, with a swollen appearance on the sides. Head small with small eyes, no tongue or ear-drum. The fore-limbs short, with pointed fingers, the hind-limbs powerful and long, with large feet and strongly webbed toes. No metatarsal spur, and black claws on three inner toes. Skin smooth and slippery, with stitch-like markings along hind-legs and belly. Sexes similar but female more swollen and with three folds of skin in the cloacal region.

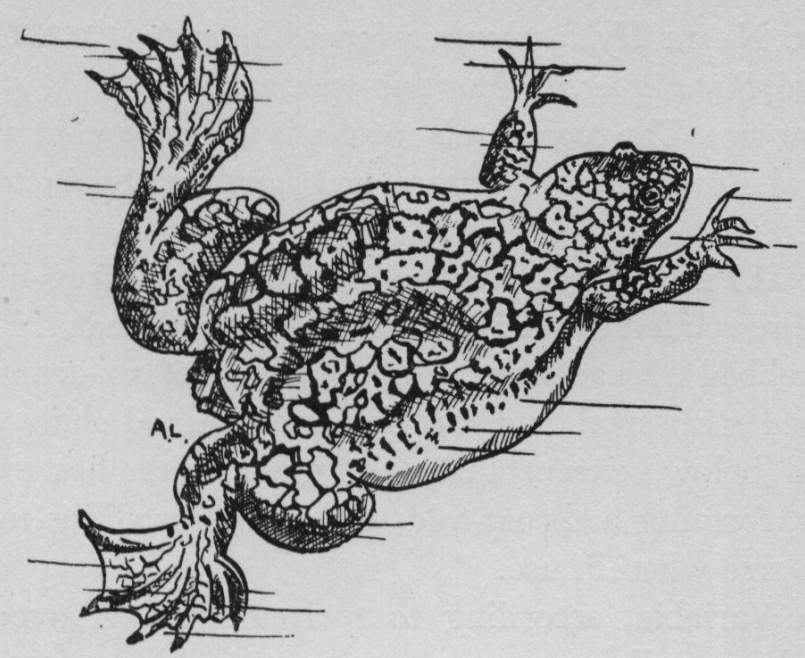
COLOUR Above: usually a mottled brown or greyish, pale or dark according to surroundings. Fingers and fore-limbs darker in male. Below: whitish, chequered with a darker pattern.

HABITS Very aquatic. Lives in water-ditches, pools, tanks and 'vleis' of its native home. Occasionally leaves water but very clumsy on land. Extremely active and a strong swimmer. Surfaces rapidly for air. Can produce a peculiar, faint call like the winding of a watch.

HIBERNATION Doubtful, although it can do so in mud of outdoor pools in Britain. In Africa will burrow into mud during the dry season.

FOOD Various aquatic animals, sought after in mud with the sensitive fingers and crammed into the mouth. Also creatures which occur at, or fall into, the water-surface. Very voracious.

BREEDING At the onset of the rainy season in Africa, varying with the district. July to September is given for the Cape area. Will sometimes breed naturally in Europe, but more usually after hormone treatment. Male grips female in the groins from behind. He twitches his body to stimulate egg-laying. Female, in a few hours, lays numerous pale eggs in jelly, about 2 mm in diameter, singly among water-plants, often in rows on stalks of reeds. Tadpole at first is very transparent and hangs near the



surface in a downward position, flicking its tail. It has two long antennae-like feelers and is at first a filter-feeder, subsisting on microscopic water-life. Metamorphosis occurs in about 2 months, the baby toads measuring about 1·5–2 cm, behaving like parents and catching live food. A specimen has been kept for 15 years in the aquarium.

VIVARIUM 5, 6, 11 (in summer). N.B. Entirely aquatic.

NOTE *Xenopus* is used in medical research and reacts to the human 'pregnancy test' when injected with the female hormone.

EUROPEAN OR GREEN TREE-FROG

SCIENTIFIC NAME *Hyla arborea arborea* Linnaeus, 1758. Originally named *Rana arborea*. Four sub-species.

DISTRIBUTION The typical sub-species is widespread in western and central Europe, from France and northern Spain to Germany.

EXTERNAL FEATURES Grows to about 5 cm. Shape frog-like, but species more related to toads. Snout short and rounded. Fingers slightly webbed with adhesive discs about size of ear-drum. Toes half-webbed with smaller discs. Skin smooth and shiny above, granulated below, except throat in male. Male has external vocal-sacs, forming a throat-fold at rest and swelling to more than head size when in use.

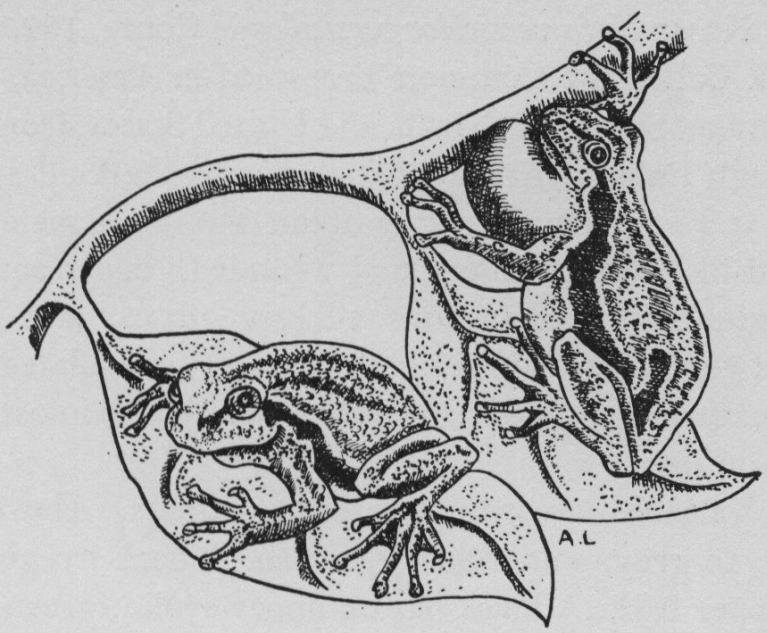
COLOUR Variable, according to surroundings. Above: from uniform glossy yellow to grey, green, even black, sometimes with darker patches. Below: white, the digits yellowish or rose. Throat of female whitish, male yellow or greenish. In the typical sub-species a lateral band, black or grey and bordered in white, passes from each eye to the groin. It has a curve in the lumbar region which bends upwards and forwards. Camouflages very well.

HABITS After breeding lives throughout the summer in colonies in bushes, low trees, often in parks and gardens, clinging to the bark or leaves with the pads and matching the surroundings closely. Mainly active by night and avoids bright light. A hardy and lively species and active leaper, clinging to each new perch after it leaps through the air. Male gives a very loud high-pitched croak.

HIBERNATION In soil, under stones, roots and logs, from October to March.

FOOD Mainly small animals, such as insects, which may be caught in mid-air.

BREEDING Adults enter water in early spring. Mating, in pairs, is of short duration, sometimes only a few hours. Female lays small clumps of spawn of about 1,000 yellowish eggs, 1·5



cm in diameter. In about 3 months the baby tree-frogs, about 1·5 cm long, leave the water to live above ground like the parents. A specimen has been kept for 14 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 8, 10. Climbing perches required.

NOTE The species *Hyla arborea* is very widespread and stretches from the Atlantic seaboard to Japan and southwards to the Mediterranean and Canary Islands. The very large family of tree-frogs (*Hylidae*) is almost world-wide and most numerous in America and Australia.

AMERICAN TREE-FROG

SCIENTIFIC NAME *Hyla versicolor versicolor* le Conte, 1825. Three sub-species. Called the Common Tree-toad in America.

DISTRIBUTION Southern Canada and United States, from Manitoba, through Dakota, Kansas, Oklahoma to the Gulf states.

EXTERNAL FEATURES Grows to about 4–5 cm, female larger. Shape toad-like. Snout short and rounded, body squat and plump, digits with conspicuous adhesive discs, and slightly webbed between toes. Skin rough and warty, granulated below. Male has external vocal-sac, which swells up to almost size of head when in use.

COLOUR Variable, according to surroundings. Above: from pale brown to grey, sometimes greenish. A dark irregular star mark on upper back. A black bar on upper eyelid, greenish bars on legs and pale patch below eyes. Below: whitish to yellowish, orange under hind-limbs and thighs. Throat of male yellowish.

HABITS Similar to European Tree-frog. After breeding ascends into trees, bushes and walls, especially where moss and lichen occur. Call of male a loud, resonant trill, repeated at intervals for about half a minute.

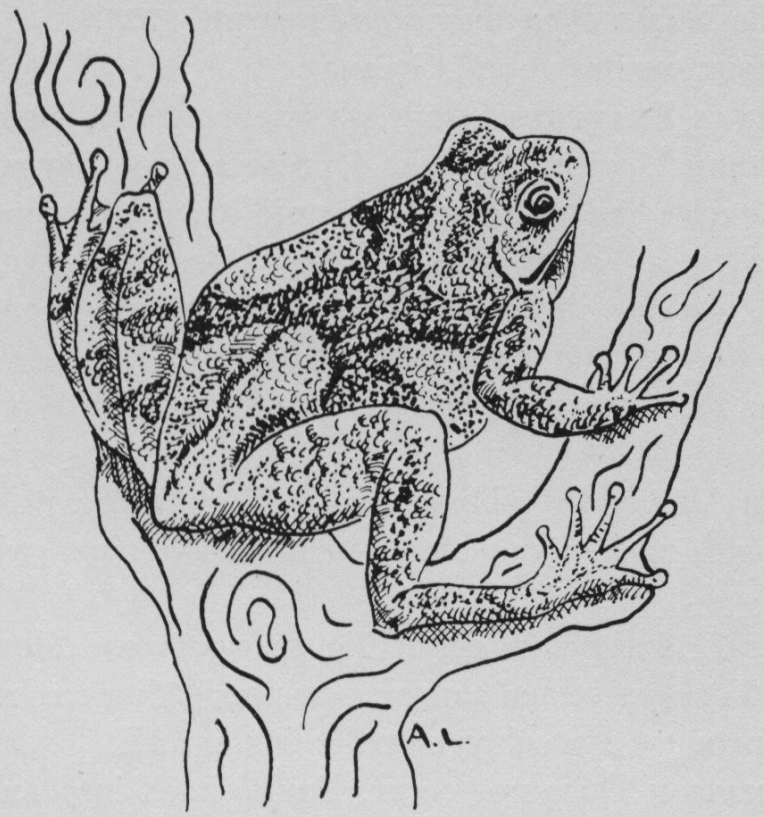
HIBERNATION Similar to European Tree-frog, but variable with latitude. Retires under stones and among tree-roots.

FOOD Similar to European Tree-frog. Various insects which occur in trees and bushes.

BREEDING Adults enter shallow water in spring and breed from April to August. Female lays small clumps of up to 30 or so yellowish eggs, about 1 mm in diameter, usually attached near surface to water-plants or grass. Tadpoles, with long crimson-bordered tail, metamorphose in about 3 months, the baby tree-frogs measuring about 1·5 cm. A specimen has been kept for 7 years in captivity.

VIVARIUM 1*A*, 2, 3, 6, 8, 10. Climbing perches required.

NOTE Twenty species have been listed for North America, varying in length from less than 1 in. to nearly 2½ in. *Hyla versicolor* is one of the best-known species in this family (*Hylidae*).



Its voice is often heard as a background to jungle scenes in American films.

SURINAM TOAD

Scientific Name *Pipa americana* Laurent, 1768.

Distribution Brazil and Guianas.

External Features Grows to about 10 cm, male smaller. Body flattened, with smallish, depressed and triangular head. Short tentacles and skin flaps on angle of mouth, upper lip and corner of eyes. Latter minute. Short fore-limbs with fingers flattened, ending in star-shaped appendages. Toes strongly webbed. No teeth or tongue. Skin slippery, covered with small tubercles. Related to *Xenopus* in the group Aglossa (without tongue).

Colour Above: olive-brown to blackish. Below: paler brown, spotted with white or whitish with dark-brown stripe along belly.

Habits Entirely aquatic, living in pools and slow-moving streams. Very active and a strong swimmer. Surfaces rapidly for air. Can produce a peculiar metallic ticking call.

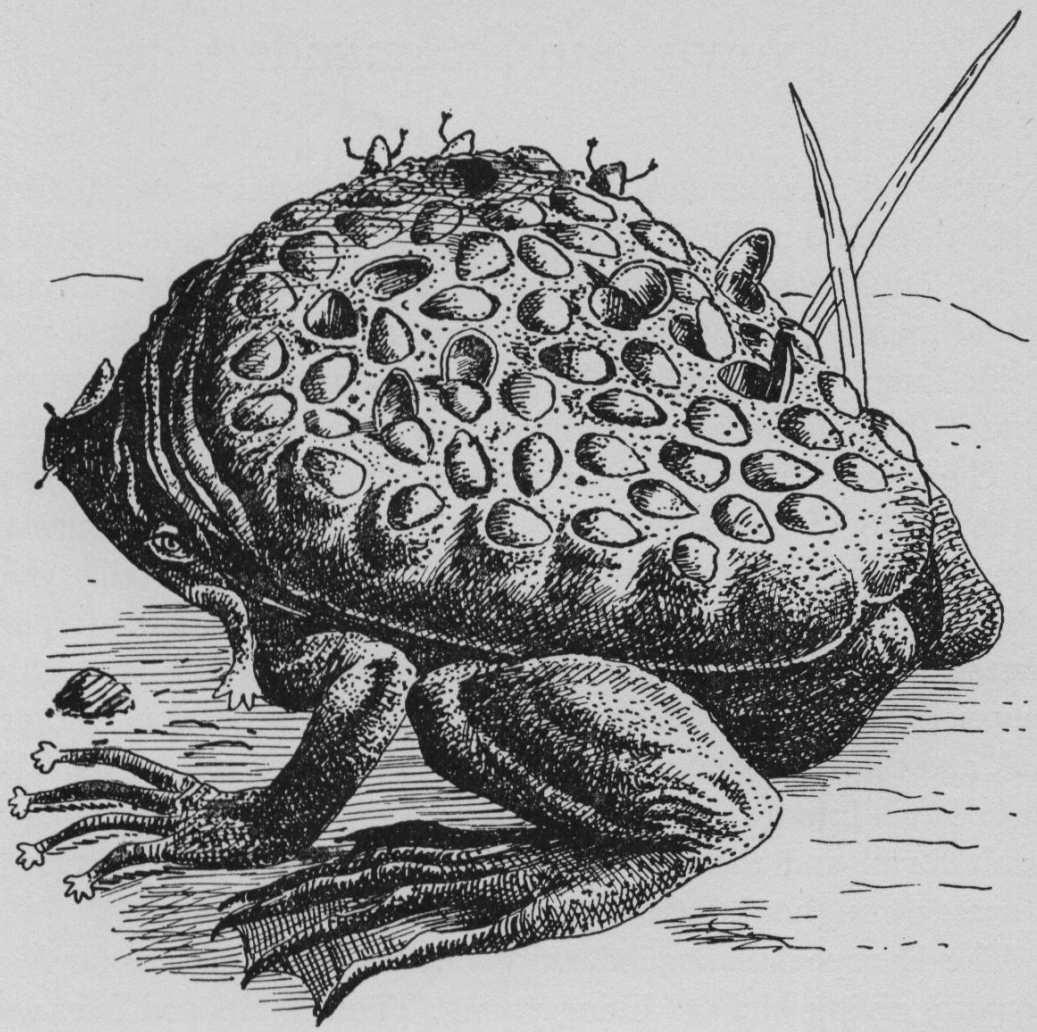
Hibernation Does not occur. Buries itself into mud, sometimes in large numbers, in the diminishing pools and swamps during the dry spell.

Food Various aquatic animals, sought after with the sensitive finger-tips and pushed into the mouth with the hands.

Breeding After the first rains the male grips a mate in the groins. The oviduct of the female protrudes about 3 cm, becoming retroverted on to her back. The male then presses this to squeeze the eggs on to back of female, where they sink into the spongy skin. A cavity or pouch forms around each egg with a lid on top. When male leaves female her oviduct reduces to normal and disappears into body. The eggs hatch into larvae which remain in the pouches until metamorphosis. This lasts for about 3–4 months. Has occasionally been bred in Britain, such as at the Zoological Gardens in London.

Vivarium 5, 6. n.b. Entirely aquatic.

Note The three genera *Xenopus*, *Pipa* and *Hymenochirus* represent a primitive group of the *Anura*, called the Aglossa (with-



out tongue). This is connected with their aquatic habits, in which no tongue is required by animals which seize their prey under water.

Newts and Salamanders

Newts and Salamanders, in contrast to the *Anura*, retain their tails throughout life, and are placed among the tailed amphibians, or *Caudata*. This is a small group of about 200 species, found mainly in the Northern Hemisphere. Most are less than 6 in. long. The largest, the Giant Salamander of China and Japan (*Megalobatrachus maximus*), can grow to 5 ft.

The three British newts belong to the genus *Triturus*. These enter water of ponds and ditches in spring to breed. A curious courtship, in which the male displays his crest and tail, takes place; the male then lays a spermatophore (a cluster of spermatozoa) which is picked up by the female. She lays her jelly-covered eggs singly among water-plants. Fertilization is internal, and there is usually no embrace, as in frogs and toads. The eggs hatch into gilled larvae which later metamorphose into the adult form, and then leave the water. Newt-larvae are carnivorous throughout, feeding on small aquatic animals.

The European salamanders (genus *Salamandra*) are far less aquatic, giving birth to living young. Their habits and lives are similar to the North American Blunt-mouthed Salamanders (family *Ambystomidae*), some of which, however, lay eggs. The Axolotl is a permanent larval form of salamander within this second family. Other gilled salamanders occur in the families *Amphiumidae*, e.g. the Giant Salamander; the *Proteidae*, which includes the curious 'Olm' (*Proteus anguineus*) of underground waters in the eastern Alps; and the *Sirenidae*, to which belongs the Mud-eel of the south-western U.S.A. (*Siren lacertina*). Some North American salamanders are lungless (family *Plethodontidae*) and although they live on land in damp undergrowth, can respire by means of the skin. Cases of *neotony*, in which the animal grows up as a larval form, as well as albinism, are not uncommon.

Kept in natural surroundings within a confining wall (as described for frogs), newts and salamanders live quite well out-of-doors and will probably breed every year if given access to water. They are often found in garden ponds, having arrived there naturally. For closer observation and to reveal their beauty and grace of movement, newts may be kept in the aquarium. This is set up as for a fish-tank, containing a layer of washed sand, a selection of plants, and, in addition, a landing space. Rocks can be built up in one corner, but for lightness an upturned flower-pot is best, on which is placed a flat stone just clear of the water-surface. The newts can then enter or leave the water, which is best left to mature before use. The tanks, placed in medium light, should contain about 6 in. of water. It must be covered to prevent escapes. Most newts will breed in these surroundings, provided that their hibernation is not interrupted. The eggs should be removed to a shallow dish of well-aerated water, since they are gill-breathers, and where they are safe from attacks of the adults. These larvae will feed on infusoria and *Daphnia*. In terrestrial forms the floor of the aquarium is planted with moss, ferns and other moisture-loving plants in a layer of loose soil. Bark and stones for cover and a shallow dish of water are placed among these and the tank covered with glass to retain humidity.

Food should consist of aquatic insect-larvae of the harmless kind. The adults will take, in addition, garden worms of suitable size, small slugs, wood-lice and fly larvae. They feed under water as well as on land.

The Axolotl requires an aquarium as it is entirely aquatic. (Its young are reared like newt-larvae.)

Occasional disease from which newts and salamanders suffer is caused by fungus parasites and is usually the result of dirty surroundings or overcrowding.

GREAT CRESTED OR WARTY NEWT

SCIENTIFIC NAME *Triturus cristatus cristatus* Laurent, 1768. Originally named *Triton cristatus*. Four sub-species.

DISTRIBUTION Europe, north of the Alps to the 60° N latitude, and eastwards to central Russia. In Britain, all counties except some parts of Scotland and Wales. Not known in Ireland.

EXTERNAL FEATURES A large newt, growing to 17 cm, the female usually larger. Head as broad as long with rounded snout. Breeding male has a high serrated, dorsal crest (dorsal groove in the female), which dips sharply at the tail-base. The tail in both sexes develops a border crest. Digits free of webs and flattened. A throat-fold and warty skin.

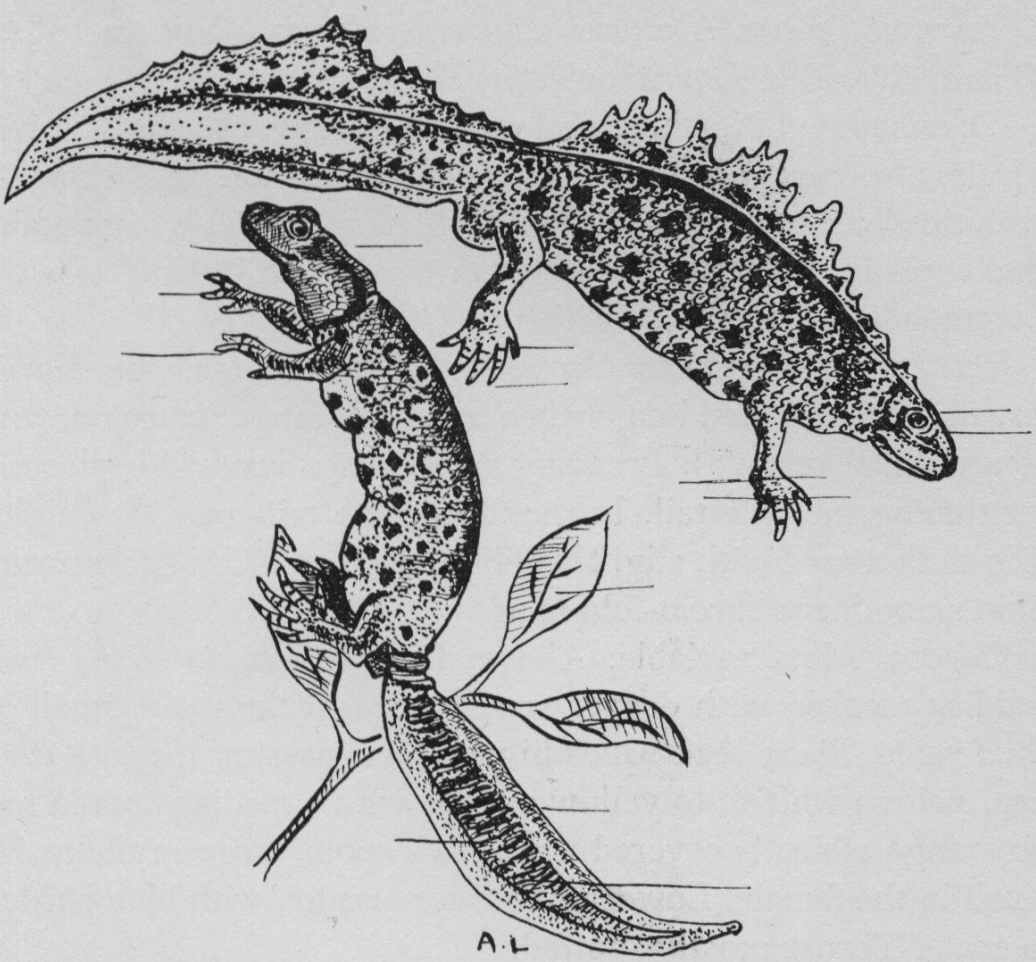
COLOUR Above: deep olive-brown, sometimes paler, with black spots. Flanks stippled in white. Below: yellow or orange with black spots. Digits yellow, ringed with black. Tail in male with silvery band along each side. In female, lower edge is orange. Female and young may have a yellow dorsal line. Larvae heavily spotted.

HABITS Spends life in water or on land. Enters static water of ponds, ditches, etc., in early spring to breed. Swims with lateral undulations of the flattened tail, or crawls over bottom or among plants. Surfaces at intervals for air. Emerges on land about midsummer, spending daytime in hiding in damp vegetation, in ditches, under stones, logs, etc., but may remain in water throughout year.

HIBERNATION October to March, under stones, logs, etc., also in mud and vegetation at pond bottom.

FOOD Small, living animals of suitable size, including insects, worms, molluscs, and crustaceans, also small newts and fish. Food caught with snap of the mouth, on land or under water.

BREEDING From spring to midsummer, in water. Male courts female by contorting body and curving tail into an arc. The tip is vibrated. A spermatophore is laid on the floor and taken up into the cloaca by the female. The spermatozoa pass into her oviduct. She lays eggs, about 2 mm in diameter, in a jelly



coating, here and there among water-plants (occasionally on stones), using the feet to wrap a leaf over each egg. Gilled larvae hatch out, feeding on tiny aquatic animals. They metamorphose in about 4 months, leaving the water about 6 cm long. Late larvae may overwinter. Newts are mature in their fourth year. A sub-species has been kept in captivity for 28 years.

VIVARIUM 1*A*, 2, 3 (when on land), 5 (for breeding), 6, 6*A*, 10, 11 (permanent).

COMMON OR SMOOTH NEWT

SCIENTIFIC NAME *Triturus vulgaris vulgaris* Linnaeus, 1758. Originally called *Lacerta vulgaris*. Four sub-species.

DISTRIBUTION Northern and central Europe, eastwards to the Urals, also parts of the Balkans and Asia Minor. In Britain, all counties except parts of the Scottish and Welsh mountains and areas in the west. The only newt native to Ireland. It is the commonest of the three British species.

EXTERNAL FEATURES Grows to about 11 cm, the female usually longer. Head longer than broad, and snout rounded, with longitudinal grooves. Breeding male has a wavy dorsal crest continuing into the tail. In the female the tail-crest is straight. Digits flattened with slight webbing on toes of breeding male. Skin smooth and throat-fold faint.

COLOUR Most variable. Above: from brown to olive, even reddish marked with deeper spots, large in the male, small in the female. Black head-bands in male, one passing through each eye. Below: whitish to yellow or rose with a median area in red or orange which is covered with black spots, large in the male, small in the female. Lower tail border orange, with blue border in male. Throat mostly spotted.

HABITS Similar to Crested Newt but far less aquatic. Usually emerges on land early in summer and may travel far from water. Often appears early in newly made areas of water, e.g. ditches, garden ponds, gravel pits and water troughs. Will tolerate dirty, even foul, surroundings.

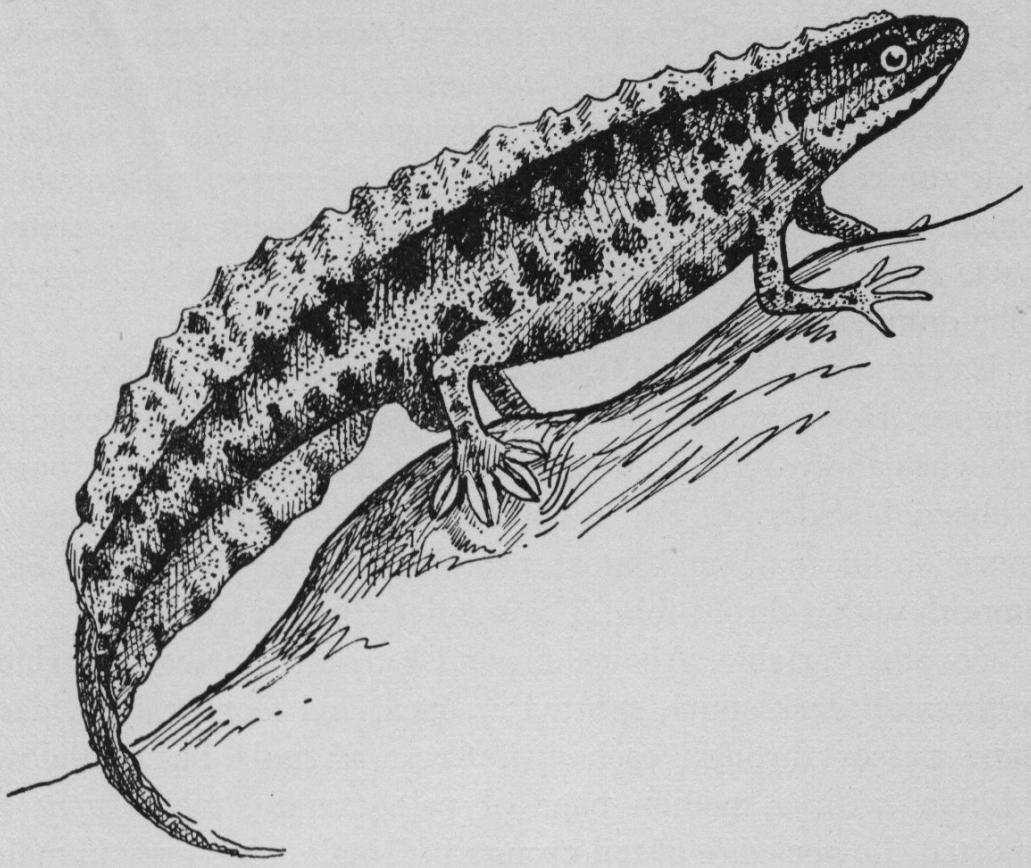
HIBERNATION Similar to Crested Newt. Is often found under stones and logs, and mistaken for a lizard.

FOOD Similar to Crested Newt. Prey smaller, such as small worms, insects, molluscs, waterfleas and tadpoles.

BREEDING Similar to the Crested Newt. The male is active during courtship, vibrating its tail rapidly. Larval development a little shorter than that of Crested Newt. Young about 3–4 cm at metamorphosis. Has lived for 18 years in captivity.

VIVARIUM See Crested Newt.

COMMON OR SMOOTH NEWT



PALMATED NEWT

SCIENTIFIC NAME *Triturus helveticus helveticus* Razoumowsky, 1789. Originally called *Lacerta helvetica*. Two sub-species.

DISTRIBUTION The western European countries of Holland, Belgium, France, Switzerland, western Germany and northern Spain. In Britain, widespread but local. Absent from eastern parts of England and southern Scotland. Not found in Ireland. The dominant species along the west side of Britain.

EXTERNAL FEATURES Grows to about 10 cm, male usually smaller. Head longer than broad with rounded snout. Breeding male has a low, straight dorsal crest, squarish body and strongly webbed black toes. Tail in both sexes ends in a fine thread, more so in male and most prominent when breeding. Skin smooth with a throat-fold. The smallest British species.

COLOUR Variable. Above: brownish to olive-brown, marbled with small dark spots, spotted on head and along tail. A dark band passes through each eye. Crest of male black. Below: whitish, with a median band of pale orange, which may be spotted. Lower edge of tail orange in female, blue-grey in male. Throat pale cream, never with spots. Larva greyish. The young newt is pale brown above, orange below.

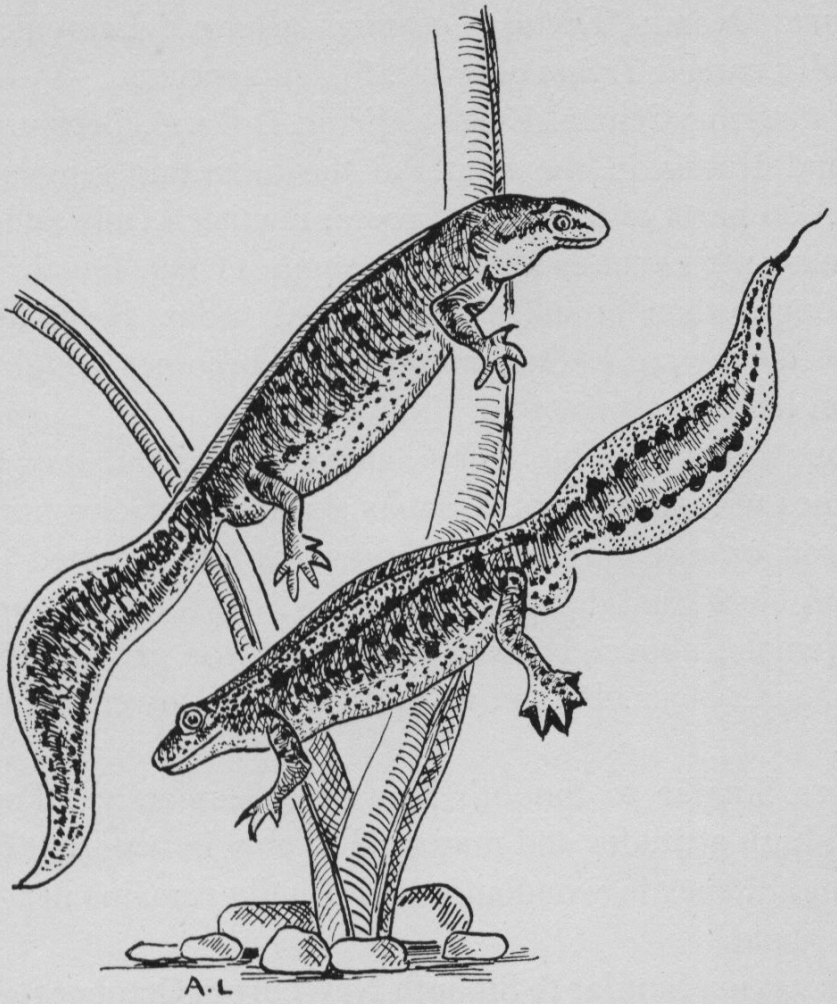
HABITS Similar to Smooth Newt. Often occurs in small areas of water, such as ditches and small pools. Prefers acid soils (e.g. in woods and heaths) and in such places is often the only species.

HIBERNATION Similar to Smooth Newt, on land or in water.

FOOD Similar to Smooth Newt. Prey smaller.

BREEDING From spring to midsummer, in water. Male courts female after fashion of Smooth Newt, curving tail and vibrating tip. Female lays eggs, about 1·5 mm in diameter, on water-plants, after the fashion of Smooth Newt. Young about 3 cm at metamorphosis, emerge on land after 3–4 months, and are similar in appearance to Smooth Newt tadpoles. They mature in about 3 years. Has been kept for 18 years in captivity.

VIVARIUM See Crested Newt.



NOTE Occasional specimens of British newts occur as albinos, in which metamorphosis is delayed, gills are retained, and the larva grows to adult size (see Axolotl).

ALPINE NEWT

SCIENTIFIC NAME *Triturus alpestris alpestris* Laurent, 1768. Originally named *Triton alpestris*. Six sub-species.

DISTRIBUTION Central Europe. From Holland, Belgium, Germany and Russia in the north to the mountain ranges in the south. Also parts of northern Greece, northern Italy and Spain.

EXTERNAL FEATURES Grows to about 11 cm, female larger. Head longer than broad, with rounded snout. Breeding male has low dorsal crest. Skin smooth but becomes rough above when on land. A throat-fold.

COLOUR Most variable. Male, above: grey, bluish or purple, sometimes with black spots. Flanks sky-blue, grading into clear yellow or orange on belly. Throat may be spotted. Digits ringed in black, and dorsal crest yellowish with a zig-zag black band. Female, above: brown, olive-brown or grey, sometimes marbled with black. Below: as in male, with lower edge of tail orange.

HABITS Similar to Smooth Newt but less active. Found at low and high altitudes and may tend to stay in water. It favours ponds and ditches in woodlands and usually remains near water when on land.

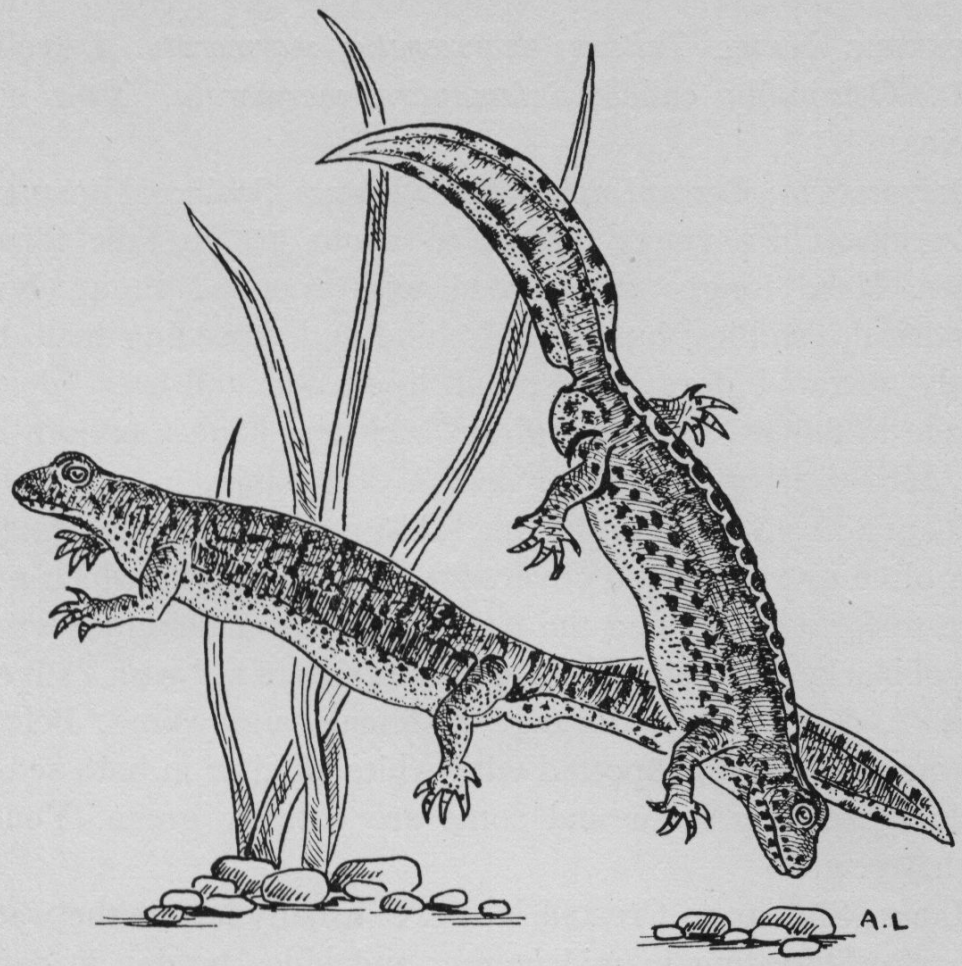
HIBERNATION Similar to Smooth Newt, from October to March in water or on land. NOTE Hibernation in newts of the genus *Triturus* varies with localities. The normal habit is to leave the water in midsummer, remain on land until spring, and hibernate during the cold months under stones, logs or buried in vegetation. Some colonies are more aquatic than others. Experience with captive newts shows that they remain more aquatic in deeper and colder water, also when semi-starved.

FOOD Similar to Smooth Newt. Small water animals, such as insect-larvae, crustaceans and tadpoles.

BREEDING Similar to Smooth Newt. The larvae metamorphose in about 3 months and can measure 6 cm. Has been kept in captivity for 15 years.

VIVARIUM See Crested Newt.

ALPINE NEWT



MARBLED NEWT

SCIENTIFIC NAME *Triturus marmoratus marmoratus* Latreille, 1800. Originally called *Salamandra marmorata*. Two subspecies.

DISTRIBUTION Central and southern France, Spain and Portugal.

EXTERNAL FEATURES Grows to about 16 cm, the female larger. Head longer than broad with rounded snout. Body cylindrical, swelling out towards hind end. Breeding male has faintly serrated dorsal crest which dips at tail-base (dorsal groove in female). Skin rough on back and flanks, smooth below. Lips overhanging lower jaw. A throat-fold.

COLOUR Above: a bright emerald-green, sometimes tinged with olive or yellow and covered with black marks which may unite to form lines along the flanks. Crest of male with vertical bars of black, green and white, and each side of tail with a silvery band. A dorsal line of orange in female and young. Below: brown, grey or rose, spotted with white, similar in both sexes. Dark forms may occur and some are entirely green. Young bright green.

HABITS Similar to Crested Newt. It usually leaves the water soon after breeding in midsummer and hides by day in damp places in undergrowth.

HIBERNATION Similar to Crested Newt, either in water or on land.

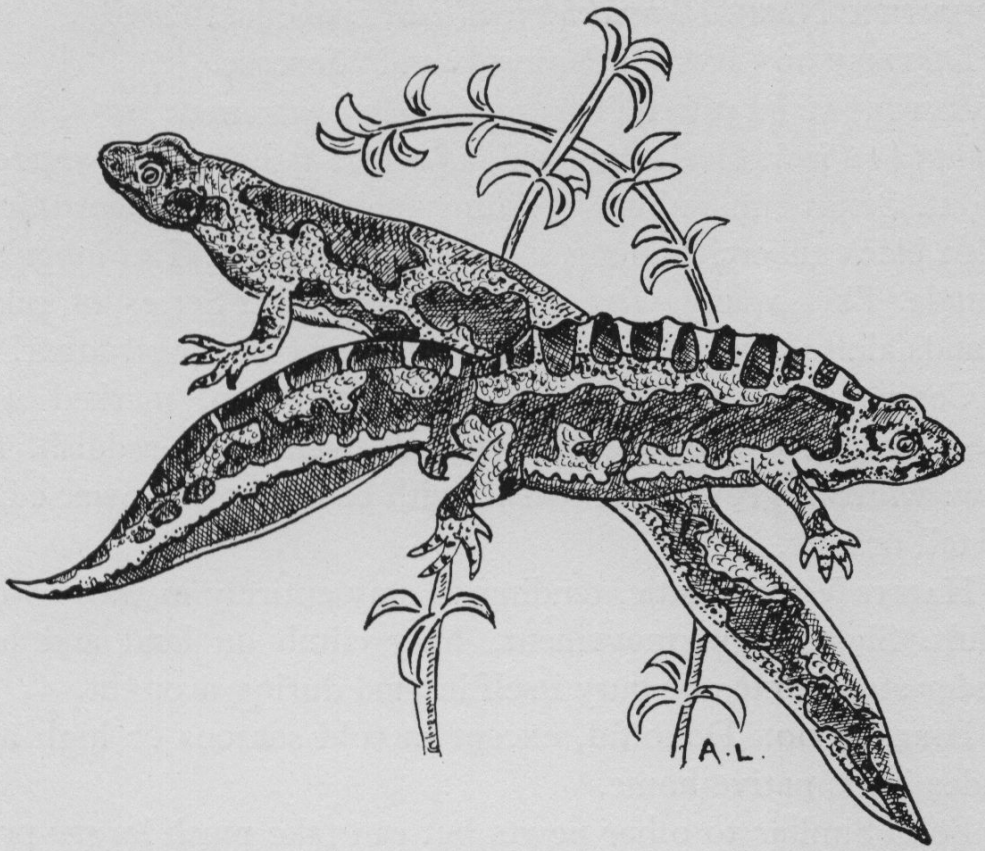
FOOD Similar to Crested Newt. Will devour small fish and smaller species of newts.

BREEDING Similar to Crested Newt. Eggs pale green. Young about 7 cm at metamorphosis. Leave the water after 3 months. Larvae a reddish-brown. May hybridize with the Crested Newt.

VIVARIUM See Crested Newt.

NOTE The genus *Triturus* has 8 species in Europe. They have two characteristics in common—the male produces a nuptial crest in the breeding season and there is a courtship display. Furthermore there is no form of embrace in these European species, as in some other European newts.

MARBLED NEWT



IBERIAN, SPANISH OR RIBBED NEWT

SCIENTIFIC NAME *Pleurodeles waltli* Michahelles, 1830.

DISTRIBUTION Iberian Peninsula and Morocco.

EXTERNAL FEATURES The largest European newt, growing to 30 cm (12 in.). Head flattened, as broad as long, with rounded snout. Sexes similar, but breeding male has stouter fore-limbs with black tubercles along inner side. No crest. Tail longer in female. Skin warty with strong throat-fold. Series of raised glands along flanks, sometimes with tips of ribs protruding.

COLOUR Above: olive-grey or bottle-green, marked with black, rounded spots. Lateral glands, yellow or reddish. Below: whitish, grey or yellowish, with black spots. Lower edges of tail orange.

HABITS Very aquatic, tending to stay entirely in water when adult. Sluggish in movement. May climb on land and hide under stones, etc., or bury itself in mud during drought.

HIBERNATION Doubtful, except in cold seasons or high altitudes in its native home.

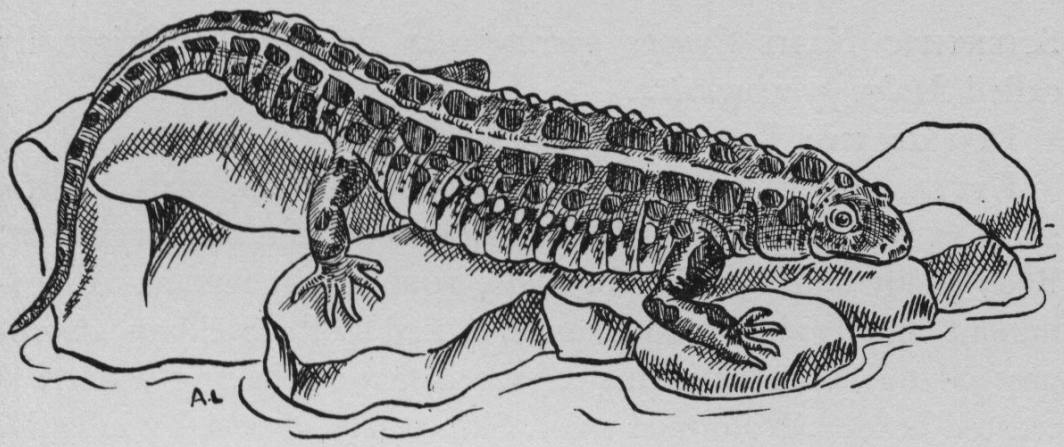
FOOD Similar to other newts but can take much larger prey, such as small fish, other smaller newts and the larger aquatic insects.

BREEDING Intermittent. Male performs a clumsy courtship by attempting to crawl under his mate, gripping her with arms upraised in her armpits. Spermatophores are laid and taken up by the female. Eggs are laid singly, among plants, or in small clumps. The young measure up to 8 cm. Metamorphosis in 3–4 months. Growth may be rapid and maturity reached in 2 years.

NOTE This species does well in the aquarium, remaining aquatic throughout life. It should be kept apart from smaller newts. The courtship behaviour is unusual. Has lived for 20 years in captivity.

VIVARIUM 5, 6, 10, 11. N.B. Largely aquatic.

IBERÍAN, SPANISH OR RIBBED NEWT



JAPANESE OR FIRE-BELLIED NEWT

SCIENTIFIC NAME *Cynops pyrrhogaster* Boie, 1826. Originally called *Molge pyrrhogastra.*

DISTRIBUTION Japan and China.

EXTERNAL FEATURES Grows to about 10 cm, male a little smaller. Head with wide cheeks, truncated snout and large eyes. Body stout and squarish in male, rounded in female. A prominent dorsal ridge in both sexes, caused by the backbone. Compressed tail, shorter in male, sword-shaped, having a narrow crested border. No dorsal crest. Skin warty, especially in male, or smooth with a throat-fold and prominent parotid region.

COLOUR Above: deep olive or black. Below: carmine with black spots. Lower edge of tail carmine, diminishing in colour in breeding male.

HABITS Similar to British newts but more sluggish and retiring. Probably more nocturnal. Mainly aquatic but occasionally comes on land. Occurs in hill streams and rice-fields.

HIBERNATION Similar to British newts, frequently in water.

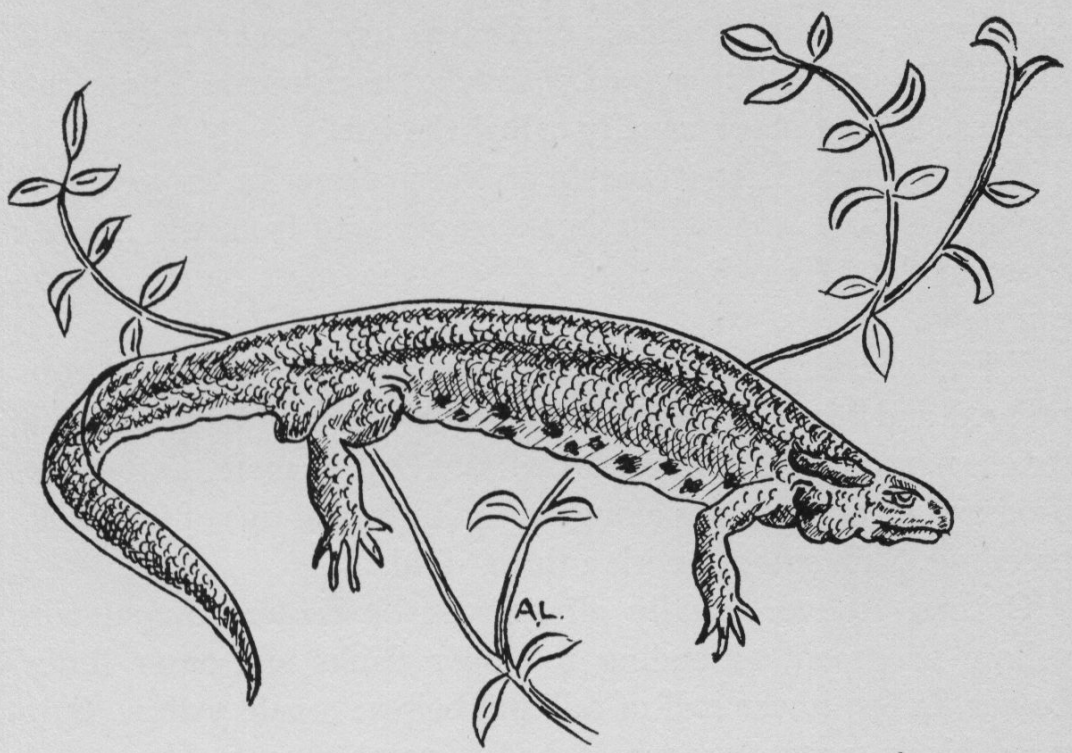
FOOD Similar to Smooth Newt; insect-larvae, molluscs and crustaceans.

BREEDING Male courts female after fashion of British newts. The tail is curved in courtship. A spermatophore is laid and picked up by the female. She lays her eggs among water-plants. Larvae are very dark and metamorphose in about 3 months, measuring about 3 cm.

VIVARIUM See Crested Newt.

NOTE Very little is known about the habits and breeding of this species. It lives well in the aquarium and more information is required about its life history. It has lived for 28 years in captivity.

JAPANESE OR FIRE-BELLIED NEWT



SPOTTED NEWT

SCIENTIFIC NAME *Triturus viridescens viridescens* Rafinesque. Originally called *Triturus* (*Diemictylus*) *viridescens*. Three subspecies. Young stage usually called the Eft.

DISTRIBUTION Eastern states of North America, from the St. Lawrence river to Georgia in the south, and from the Atlantic coast to the Mississippi Basin. The commonest North American newt.

EXTERNAL FEATURES Grows to about 8 cm, with head compressed and rounded snout. Low dorsal crest in both breeding sexes, narrower in female, broadly keeled in male. Latter also produces black tubercles along inner thighs and tips of toes when breeding. Skin smooth with a throat-fold.

COLOUR Above: usually olive-green or brown, tinged with yellow or green, extending to upper flanks and outer limbs. Lower flanks, lower half of tail and below: a pale yellow. Scattered black spots over whole body except throat. Along each side of dorsal line a row of bright red spots, ringed in black.

HABITS Similar to Smooth Newt. Sometimes remains entirely in water. Found in pools, ponds, swamps and quiet streams.

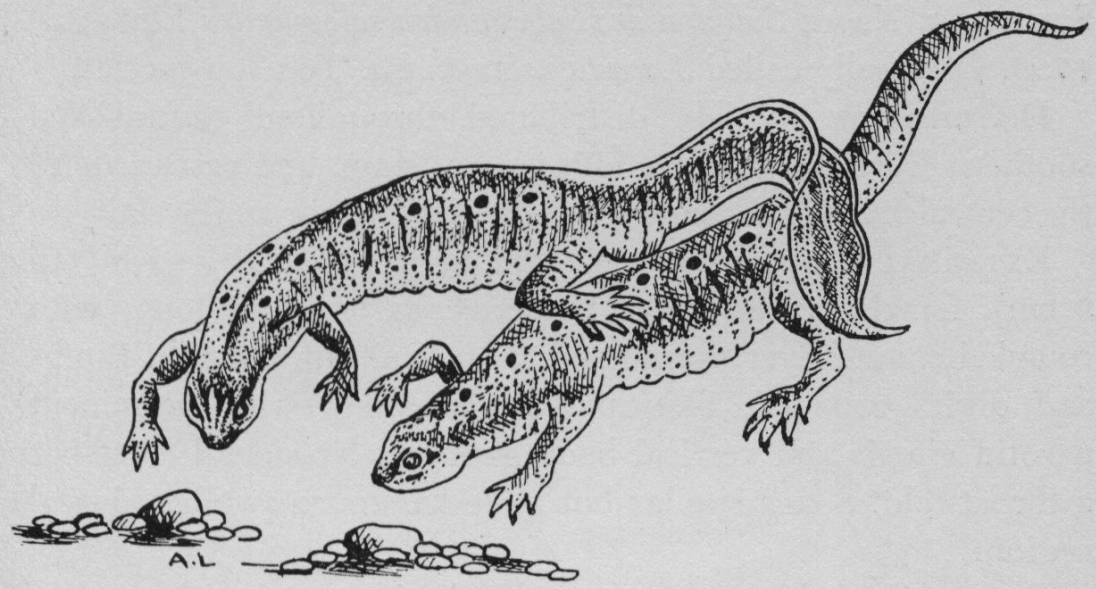
HIBERNATION Similar to Smooth Newt, in undergrowth and beneath stones, logs and leaves. Sometimes in water.

FOOD Similar to Smooth Newt. A variety of small, aquatic animals such as insect-larvae, crustaceans and worms.

BREEDING Breeds in spring, according to locality, and may occur as late as June. Male displays courtship behaviour of British newts, sometimes clambering on to back of female, in water, gripping her with hind-legs. A spermatophore is laid and taken up byfemale. Immature newts in the land stage (called Efts in America) may remain on land up to 3 years. They are often coloured orange-red with bright crimson spots. Eggs brownish, laid on plants. Larvae metamorphose in about 2–3 months, measuring 3·5 cm.

VIVARIUM See Crested Newt.

SPOTTED NEWT



EUROPEAN OR SPOTTED SALAMANDER

Scientific Name *Salamandra salamandra salamandra* Linnaeus, 1758. Originally called *Lacerta salamandra.* Ten sub-species.

Distribution Widely distributed throughout central and southern Europe, from Scandinavia to Spain, and eastwards to the central European countries. Also Asia Minor and Syria.

External Features Grows to about 19 cm total length (tail 9 cm), female larger. Head flattened, as broad as long, with rounded snout. Eyes prominent. Body and tail stoutish. Limbs and digits rounded. Skin pored and shiny with prominent parotid glands and vertical body grooves. No dorsal crest but a throat-fold. Sexes similar but male has more swollen cloacal region.

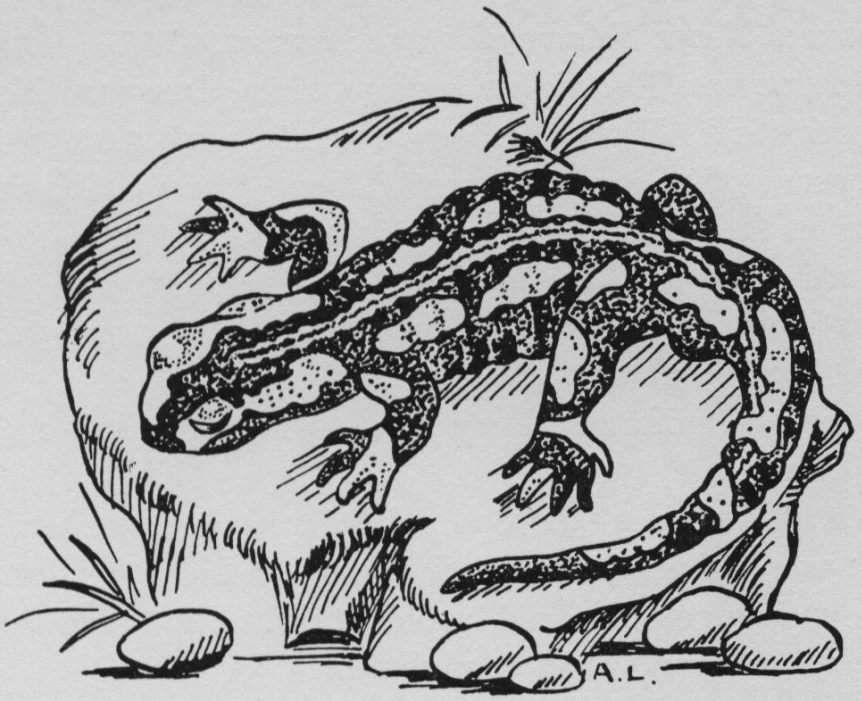
Colour Conspicuous. A glossy black, decorated with spots of bright yellow, orange or, sometimes, red. Striped forms occur. Eyes a deep lustrous brown.

Habits Terrestrial. Lives in damp, shady places in ditches, undergrowth, woodlands and among rocks. Rarely enters water and is a poor swimmer. Appears at nightfall or after rain. On irritation the skin secretes a milky fluid, highly distasteful and acting as a protection from enemies. Colours serve as a warning. The Continental name 'Fire-salamander' originated in the legend that it can live in fire. Still feared in some places but is, in fact, harmless. Slow and deliberate in movement.

Hibernation From October to March, or longer according to the season, in ditches, vegetation, under logs and stones or among rocks.

Food Small, live animals which it is able to catch, such as worms, insects, molluscs and crustaceans.

Breeding Mating occurs from spring to summer on land. The male makes a clumsy attempt to embrace the female by clambering on to her back. He lays a spermatophore which is taken up by the female. She produces at almost any season, but mainly in summer, from 10–30 gilled young, 2·5 cm long, by entering shallow water. The young metamorphose at 4 months,



leaving the water when about 5 cm long. Has been kept over 25 years in captivity.

VIVARIUM 1, 2, 3, 6, 10. N.B. Mainly terrestrial.

ALPINE SALAMANDER

SCIENTIFIC NAME *Salamandra atra* Laurent, 1768.

DISTRIBUTION The higher regions of the European Alps, Jura mountains and Albania, between about 800 and 3,000 metres.

EXTERNAL FEATURES Grows to about 11 cm in the male and 15 cm in the female. The body is less stout and a little more flattened than that of the Spotted Salamander, and the head proportionately larger. Vertical body grooves and very prominent parotid glands.

COLOUR A uniform, glossy black, without yellow markings. Eyes black.

HABITS Similar to the Spotted Salamander, but hardly ever enters water. Spends much of its time in hiding under stones, rocks and vegetation and avoids bright light and sunshine. Emerges after rain or after nightfall.

HIBERNATION Similar to the Spotted Salamander, from October to March, longer in the higher regions and severe seasons.

FOOD Similar to the Spotted Salamander. Various insects, slugs, worms and woodlice.

BREEDING Courtship on land, similar to the Spotted Salamander. Young are born alive on land, fully developed with lungs, usually two in number. There is no visible gilled stage. In all about 20 embryos are produced, of which the two survivors act as parasites, feeding on the remainder. In experimental work gilled larvae have been produced but this is unknown in nature.

VIVARIUM See Spotted Salamander.

NOTE The word Salamander is used in North America to cover all species of Urodeles, including newts. The word originated from the Greek, and refers to the species *Salamandra salamandra*, the legendary 'Fire Salamander' (q.v.). In European species the word is usually confined to this animal, and the Alpine Salamander. The genus *Triturus* and others are termed newts (from the Old English—Eft).

ALPINE SALAMANDER

AXOLOTL

SCIENTIFIC NAME The axolotl commonly seen in Europe is believed to be the permanent larval form of the Mexican Salamander *Siredon mexicana*, and not the Tiger Salamander *Ambystoma tigrinum* as formerly thought. 'Axolotl'—from the Aztec, meaning a 'water beast'.

DISTRIBUTION Certain deep, freshwater lakes around Mexico City. European specimens are probably the descendants of the original stock sent to Paris in 1864.

EXTERNAL FEATURES A large, aquatic, larval salamander, growing to about 25 cm. Head flattened, with blunt snout. Body stout and rounded, more so in female, with vertical grooves along flanks. Tail laterally flattened, and edged with prominent straight crest. Limbs small and weak. Large external gills and no eyelids. Skin finely granulated. Sexes similar but mature male has more prominent cloacal region and is somewhat smaller and slimmer and has a longer tail.

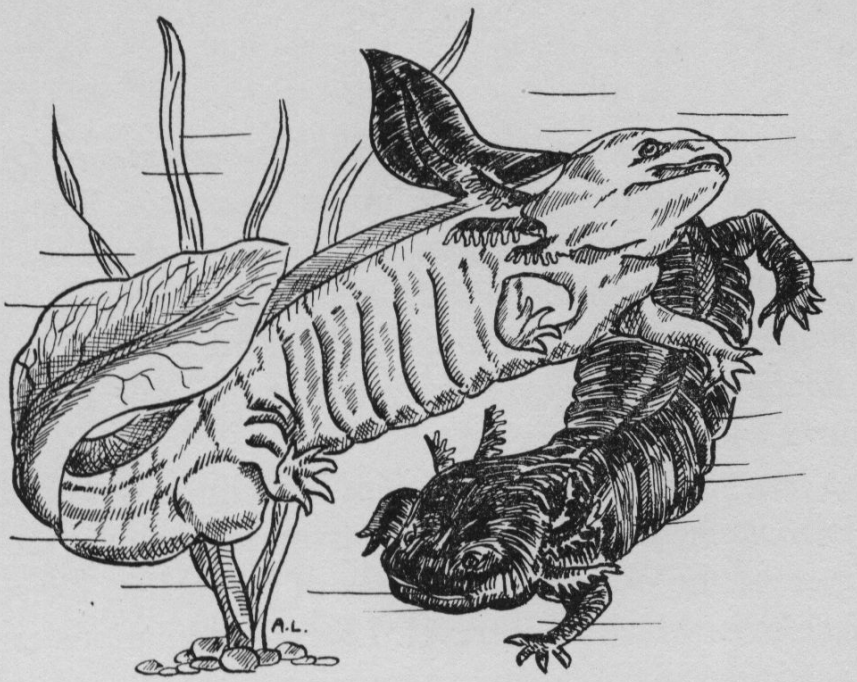
COLOUR A dark, purple-brown sometimes with darker spots. A pale, creamy-white variety has been established, with bright crimson gills.

HABITS Spends life in water. Sluggish and retiring but more active at night. Avoids bright light and occasionally surfaces for air. Remains still for long intervals except for a twitching of the gills.

HIBERNATION Doubtful. Will winter outdoors in England, in water beneath the ice.

FOOD Various small, aquatic animals, including its own young. Hunts by sight which is not very good.

BREEDING The axolotl is a perfect example of neotony, in that it can breed in the larval state. In the aquarium the male performs a clumsy courtship at almost any season. The usual spermatophore is laid and taken up by the female. She lays eggs in batches of spawn up to 1,000 in number, which adhere to plants and stones. Young axolotls, at first about 8 mm long, are about 12 cm long in 6 months. They can reach maturity in



12 months, and have been known to live for 25 years in captivity.

VIVARIUM 5, 6, 11 in summer. N.B. Aquatic.

NOTE The axolotl can be made to transform into the adult by thyroid treatment, or by allowing the water surface of its home to decrease by evaporation. It is used much in experimental work.

Snakes

Snakes or serpents, of the reptile sub-order *Serpentes* or *Ophidia*, are related to lizards within the order *Squamata*. They differ from lizards in having movable jawbones, of which the lower halves come apart at the tip during feeding, different scaling, and a shorter, fixed tail. Limbs are absent (vestigial in the family *Boidae*), and the eyes are without movable lids. There are about 2,500 living species.

Snakes can crawl, burrow, swim or climb by producing rhythmic movements of the numerous muscles along the body which operate the overlapping plates of the belly. These grip the surface over which they travel. Lateral undulations can also be produced, especially during swimming.

Prey consists of a variety of living animals, which may be eaten whole if small enough, and varying from insects to medium-sized antelopes. These animals are swallowed alive, or first killed by constriction or poisoning. Venomous snakes have specialized teeth, the fangs, which inject the venom produced in the poison gland (e.g. cobras and vipers). Most snakes are useful as they eat destructive rodents and other pests.

The tongue is a harmless aid to smell, which in the snake is a highly developed sense organ. Some have good vision but none can hear in the human sense. They are very sensitive to earth vibrations. From time to time the outer skin is sloughed, usually in one piece, coming away at the jaws and peeling off the body. Snakes will hibernate in temperate lands.

The young are hatched from eggs, or produced alive (*ovoviviparous*) and there is no parental care, except in a few cases, e.g. the Python which coils over her eggs.

Snakes range in length from a few inches to some 30 ft; the Anaconda of South America and the Malay Python (*Python reticulatus*) are said to reach this greater length. With the exception of the well-known Adder (family *Viperidae*) most

European snakes belong to the typical family, the *Colubridae*, including the harmless Grass-snake (*Natrix natrix*).

Snakes enjoy sunlight in moderation, and are fond of basking. Many live well in the indoor vivarium, which should contain dry earth or sand covered with dry leaves and moss, and a few rocks or some bark as places for retirement. Climbing snakes will require some branches. The vivarium must contain a drinking dish always kept filled with clean water. Some coarse vegetation (e.g. dead heather or a few small branches) will assist the snake in sloughing. Where possible sunshine should enter the vivarium for part of the day. Light and heat may be supplied by means of an electric light bulb. A garden reptiliary provides the best artificial home; the wall must be at least 3 ft high with an overhanging inner ledge, and constructed in the same way as the vivarium so that there are no possible means of escape. Escaped snakes can cause much alarm and distress to people not used to them. Tropical snakes require permanent heating.

Snakes usually enjoy gentle handling (probably the warmth of human contact is an inducement) and are best tamed this way. They may even take food from the fingers. This need not necessarily be given alive.

Food varies with each species, and most snakes will in time accept dead or killed food. In some cases where there is a hunger strike, forced feeding may become necessary, but this is a job for the expert as a snake's mouth is very delicate and easily damaged. Snakes sometimes suffer from infections of the skin and mouth caused by fungus parasites. A healthy snake can usually resist these infections and a good preventive is regular and varied feeding and dry, well-ventilated surroundings. A snake with wet skin may have difficulty in sloughing and is liable to attack from fungus. Mites on snakes must be removed as they sometimes carry a blood disease.

As some snakes eat lizards the two reptiles should be kept apart.

SCIENTIFIC NAME *Natrix natrix helvetica* Lacépède, 1789. Originally called *Coluber helveticus*. The sub-species *Natrix natrix natrix* Linnaeus, 1758, which is the type for this species, does not occur in Britain. In all there are 9 sub-species.

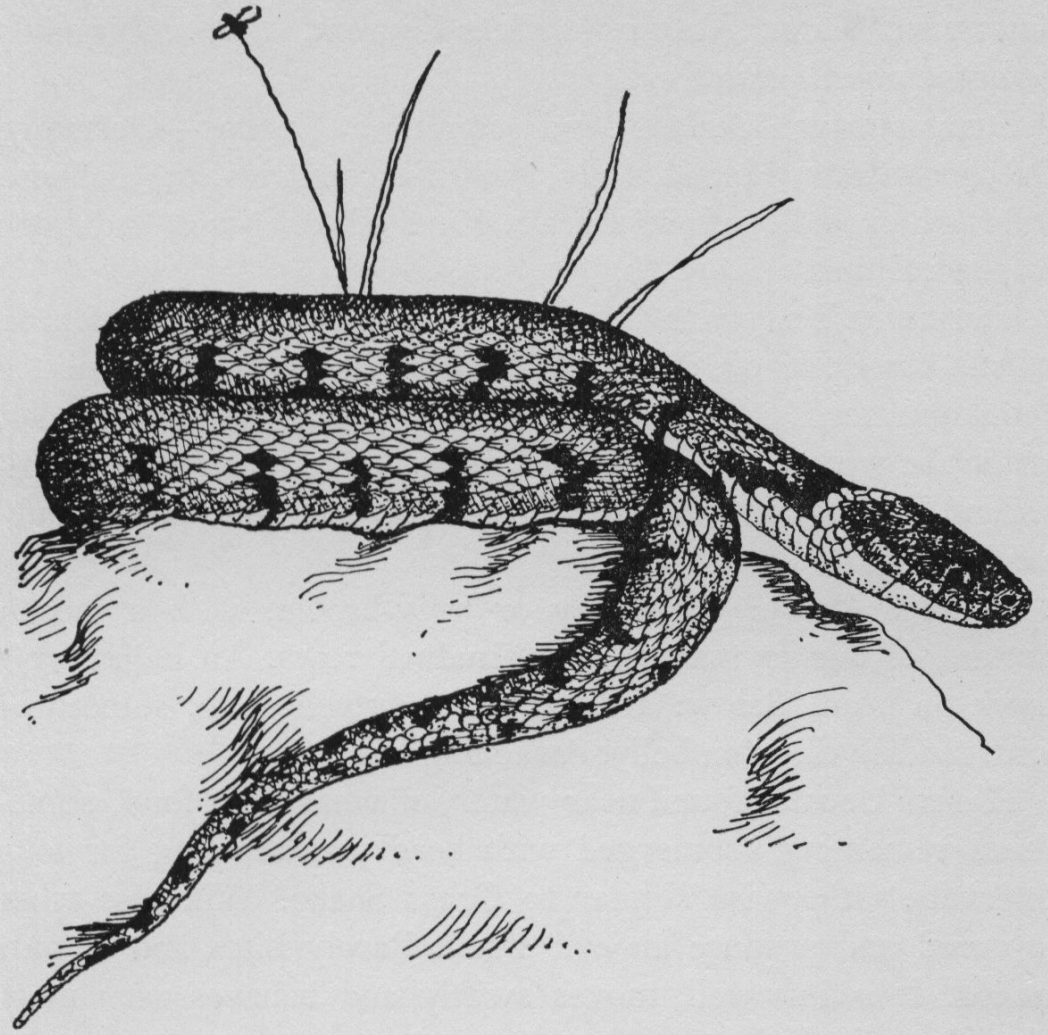
DISTRIBUTION Western Europe—Holland, Belgium, Italy, Switzerland and western Germany. In Britain mainly in the countries of England and Wales. Absent from Ireland and most of Scotland. Decreases in numbers northwards.

EXTERNAL FEATURES Grows to about 3 ft (90 cm) in the male, 4 ft (120 cm) in the female, occasionally longer on the Continent, but rarely so in Britain. The head, with large shields and distinct neck, has a slightly overlapping blunt snout, and lateral eyes with rounded pupils. Body and tail slender, latter about a quarter of the body length, broader at base in the male. Body scales keeled, in 10 longitudinal rows, ventral plates from 157–180, and paired sub-caudals from 50–88.

COLOUR Most variable. In Britain usually—above: brown, grey or reddish with an olive tinge, marked with narrow black bands or spots. Flanks barred with vertical black bands. Two crescent-moons of yellow or orange on nape of neck, missing in some old females, and bordered behind with two black triangular patches. Upper lip scales white or yellow, edged in black. Below: a chequered pattern in black and dull white. Colours much brighter in young. Sometimes called the Barred Grass-snake.

HABITS Usually occurs near water by ponds, ditches or streams, along field borders and in open woods, but also in stony ground, dried water-courses, low thickets and hill-slopes. Fond of basking and active when disturbed. An excellent swimmer. Harmless and easily tamed but hisses when captured. Voids an unpleasant, smelly secretion and may simulate death in the wild state. Rarely bites.

HIBERNATION October to March, in soft earth, vegetation, under logs or among stones and wood-piles, sometimes in large numbers in so-called winter-dens.



FOOD Mainly frogs, toads or newts, or fish. Prey caught in the mouth on land or in the water. May also eat birds' eggs and, more rarely, small mammals, lizards and nestlings.

BREEDING Sexes come together in late spring, about May. Male entwines his tail with that of the female during mating. Fertilization internal. Female lays, in July, from 10–50 dull-white, oval eggs, about 3 cm long, which are stuck together by gelatinous secretion, in hollows where leaves and debris collect, and manure-piles. Incubation 2–3 months. The young measure about 18 cm, appearing in September. Has lived for 9 years in captivity.

VIVARIUM 1*B*, 2, 3, 9.

DICED OR TESSELLATED SNAKE

SCIENTIFIC NAME *Natrix tessellata* Laurent, 1768. Originally named *Coronella tessellata.*

DISTRIBUTION Central and southern Europe—Germany, Czechoslovakia, Poland, Italy, the Alps countries, the Balkans, Asia Minor and southern Russia. Parts of north-west India and western China.

EXTERNAL FEATURES Grows to about 30 in. (76 cm), female a little larger. Head, distinct from neck, is narrow with pointed snout and small, pale, slightly dorsal eyes. Body and tail slender, latter about a quarter the body length. Body scales in 19 longitudinal rows, ventral plates from 160–187 and paired subcaudals from 48–89.

COLOUR Above: olive-grey or grey-brown, with a mosaic pattern of darker marks in longitudinal rows. An indistinct V mark on head. Below: a dirty white or yellowish, sometimes with reddish tinge on belly, darkening behind.

HABITS Usually found near water, of which it is fond, sometimes remaining submerged with head just showing for long intervals. Otherwise similar to Grass Snake. Will hiss when captured and produce an evil smell. Rarely bites and is soon tamed. It swims well, moves swiftly and behaves very much like Grass Snake.

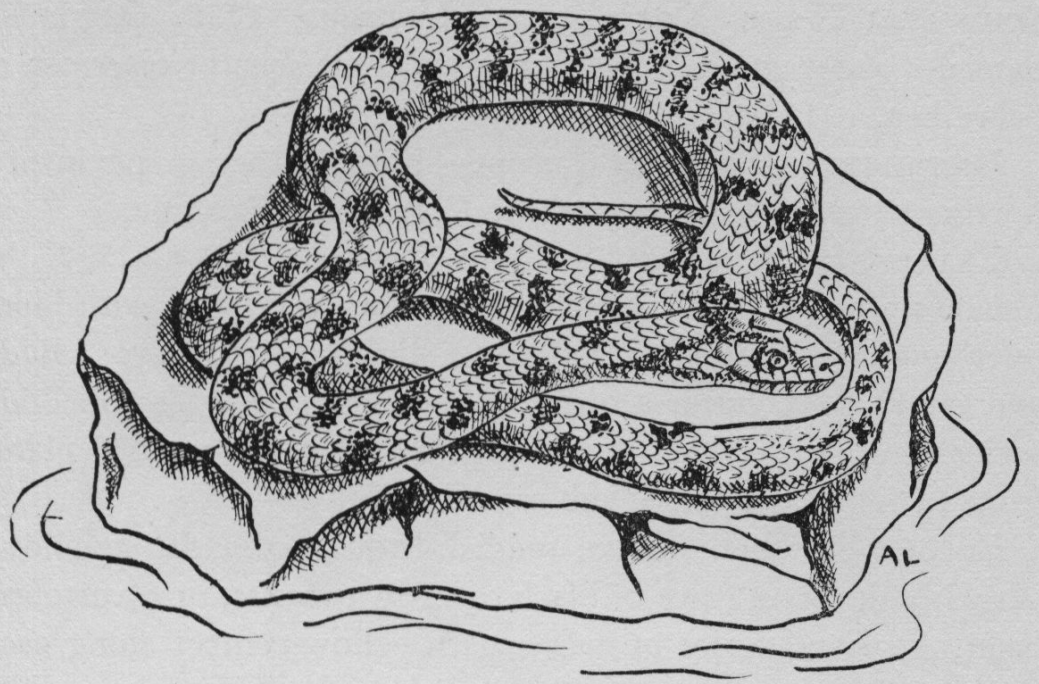
HIBERNATION October to March, in vegetation, under logs and stones, in rubbish or under wood-piles. Very much like Grass Snake.

FOOD Frogs, toads and newts, but specially fish.

BREEDING Sexes come together in late spring, April or May, the male mating with female in similar fashion to Grass Snake. The slightly smaller eggs, 5–25 in number, are usually laid in July in heaps of rotting vegetation or manure. Young measure about 16 cm, and hatch in about 12 weeks.

VIVARIUM See Grass snake. N.B. More aquatic.

NOTE The Tessellated Snake is very amenable to captivity and does not usually present any difficulty in feeding. Speci-



mens are known to have lived for as long as 10 years in the vivarium.

VIPERINE SNAKE

Scientific Name *Natrix maura* Linnaeus, 1758. Originally named *Coluber maurus*. The same as *Tropidonotus viperinus* of Schreiber, 1913.

Distribution Southern Europe—France, Iberian peninsula, northern Italy, north-west Africa, Corsica and Sardinia.

External Features Grows to about 32 in. (80 cm), the female up to 3 ft (90 cm). Head distinct from neck, with blunt overhanging snout and moderate, slightly dorsal eyes. Body and tail slender, latter a quarter or less the body length. Body scales strongly keeled, in 21 longitudinal rows, ventral plates from 147–164 and paired sub-caudals from 46–72.

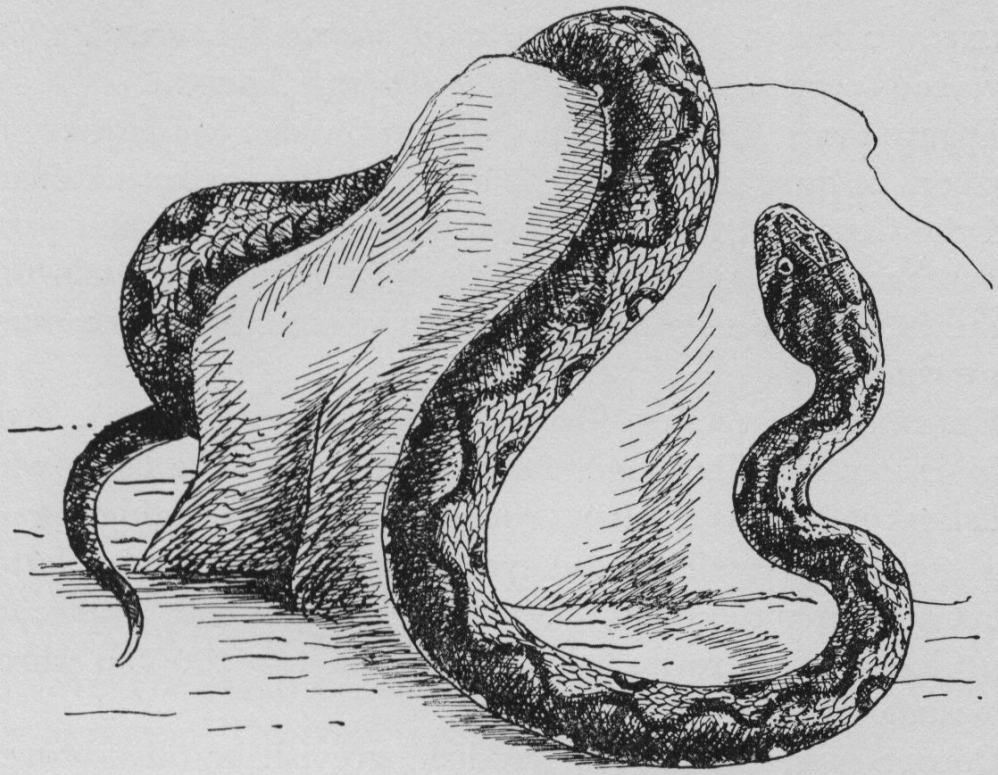
Colour Variable. Above: reddish-brown, greyish or yellowish with alternate rows of black or brown marks, or a vertebral band. A second series of marks with yellow centres along each flank, which alternate with the dorsal marks. Lip scales yellow edged in black. Black marks on head, dark bands on each temple and sides of neck. Below: yellowish or reddish, sometimes black, marked with irregular black squares.

Habits Inhabits borders of rivers, lakes and ponds and is fond of water. May occur at high altitudes. An excellent swimmer. Wild specimens are aggressive when handled, and because of this, together with the markings, are often mistaken for the Adder (*Vipera berus*). Otherwise similar to the Grass Snake. Becomes tame in captivity.

Hibernation Similar to Grass Snake, from October to March, but of shorter duration in the south. May assemble in large numbers in suitable places among tree-roots or in piles of debris and leaf-mould.

Food Frogs, toads, newts and occasional fish. Also small mammals and nestlings.

Breeding Sexes come together in late spring, the male entwining female with the tail. Female lays in May or June, preferring holes in the ground for her 4–20 white and faintly green eggs. Young, about 17 cm long, appear in August and usually



make for water. This snake has been known to live for 9 years in captivity.

VIVARIUM See Grass Snake.

NOTE *Natrix* is a large genus of snakes, three species of which occur in Europe.

SCIENTIFIC NAME *Coronella austriaca austriaca* Laurent, 1768. Two sub-species. Also called *Coronella laevis* Laurent.

DISTRIBUTION Europe, from southern Sweden and Norway to northern Spain and Portugal, Switzerland, the northern Balkans and the Caucasus. Now rare in Britain but some inhabit parts of southern England. NOTE Because of its rarity in Britain this snake is seldom seen wild. Continental specimens are much more common.

EXTERNAL FEATURES Grows to about 2 ft (60 cm), male smaller, occasionally longer on the Continent. The head, with indistinct neck, has a blunt, rounded and overhanging snout, and moderate laterally placed eyes. Body and tail slender, latter about a quarter the body length. The smooth body scales are in 19 longitudinal rows, belly plates from 153–200 and paired sub-caudals from 40–70.

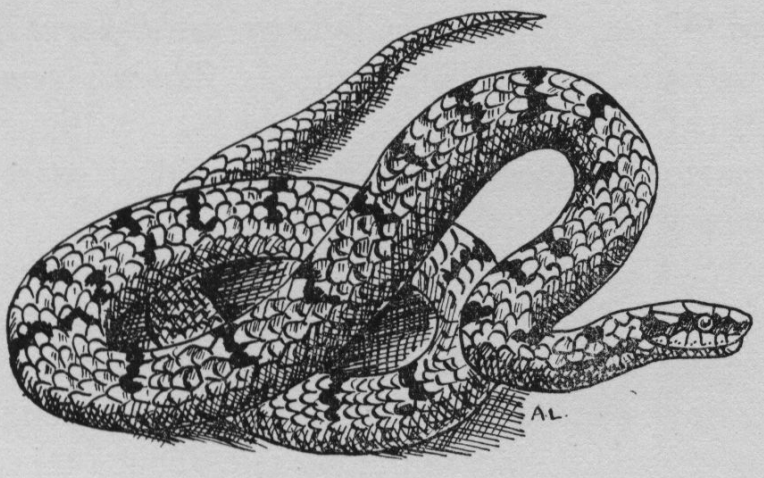
COLOUR Variable. Above: reddish, greyish or olive-brown, sometimes with pale, longitudinal stripes, but usually with deep brown, black or reddish spots in pairs in two rows along back, or as transverse bands. Small spots in each scale. A dark band through each eye from nostril to angle of mouth. Two reddish patches on nape of neck joining on top of head, which may be black. Below: variable, grey, yellowish, reddish or black, uniform or spotted in white, or with darker spots.

HABITS Inhabits dry and warm localities in heaths, rocks, open woods, thickets and on hill-slopes. Usually avoids water and is somewhat sluggish. Fond of burrowing. Sometimes mistaken for the Adder (*Vipera berus*). Usually bites when handled but is harmless and soon tamed.

HIBERNATION October to April in holes in the ground, under logs and in vegetation.

FOOD Mainly lizards, but occasionally small mammals, nestlings and insects. Larger prey is held in its coils to obtain a better grip. The prey is not actually killed by constriction.

BREEDING Mating occurs in May, the female producing from



2 to 16 living young, usually in August, measuring about 18 cm.

VIVARIUM See Grass Snake.

NOTE The genus *Coronella* contains 20 species, of which two are European. The body is covered with smooth scales.

DARK GREEN OR ANGRY SNAKE

Scientific Name *Coluber viridi-flavus viridi-flavus* Lacépède, 1789. Two sub-species. The same as *Zamenis gemonensis* of Schreiber, 1913.

Distribution Southern Alps, Italy, the Balkan coast and some Mediterranean islands.

External Features One of the largest European snakes. Can grow to 6 ft (183 cm) in the south of its range. Head elongated, distinct from neck, with rounded, overhanging snout, slightly hollowed on each side. Eyes large with rounded pupils. Body powerful and slender with long tail, about a third the body length. Smooth body scales in 19 longitudinal rows, from 160–220 ventral plates and 83–130 pairs of sub-caudals.

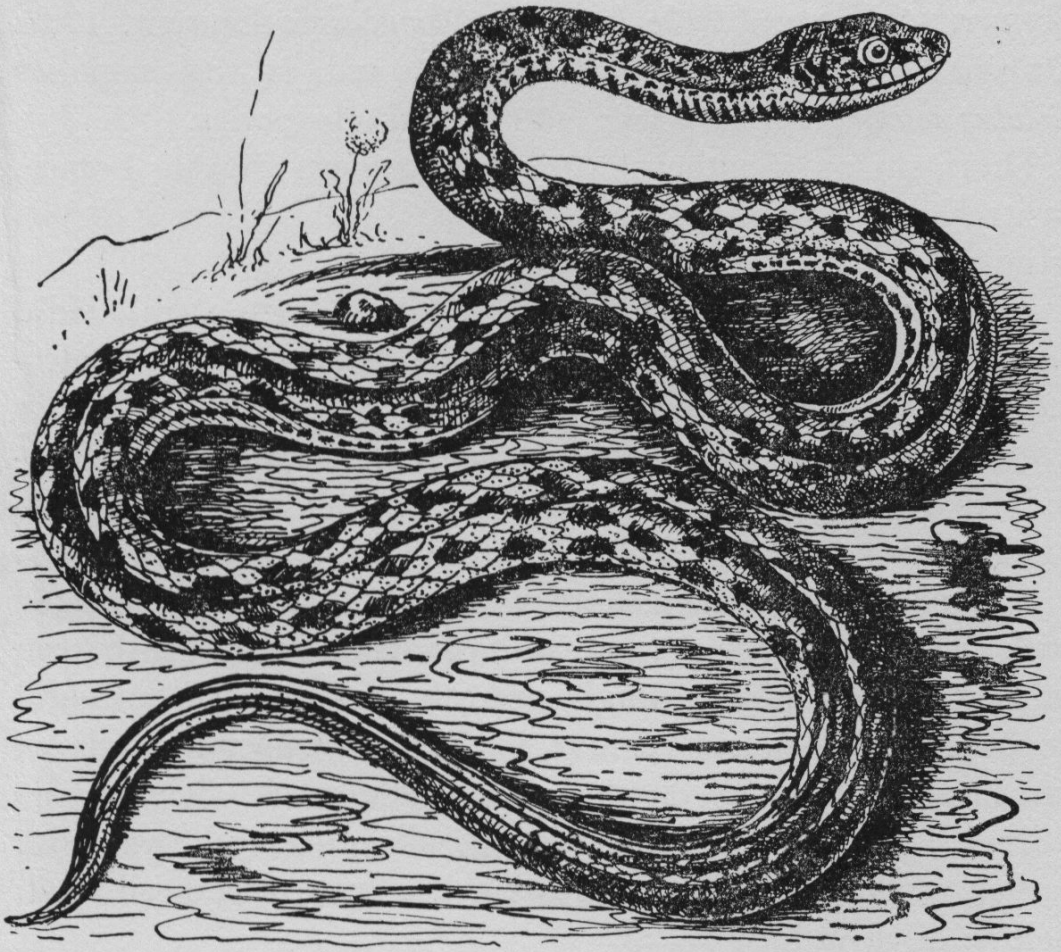
Colour Above: deep green or brown, with yellow spots in transverse rows in forward half of body, and in longitudinal rows in latter half following the scale rows to the end of tail. Yellow spots forming loose triangles on each scale. Head bluish-black, marked with lines and spots of yellow. Lip and eye scales yellow with black edges. Below: yellow or greenish, whitish or sometimes black, with dark markings along borders. Young specimens, above: grey-green or olive-green or almost black, especially on head, marked with yellow. A pale V or W may occur on head, continuing as a vertebral line. Below: a pale yellow.

Habits Occurs in drier spots in woodlands, among rocks and low thickets and in hedgerows and ditches. Seldom enters water and is a good climber. Although non-poisonous will bite fiercely when captured and is sometimes difficult to tame.

Hibernation October to March, in vegetation, holes in the ground, hollow trees and among rocks.

Food Lizards and other smaller snakes, small mammals, nestlings, birds' eggs and occasional amphibians.

Breeding Mates in late spring, about May, the female laying a small number of eggs, from 5–15, in June or July in holes in the ground. The eggs, about 3·5–4 cm long, are elongated,



whitish and covered with star-like marks. The young, about 20 cm long, appear in autumn.

VIVARIUM See Grass Snake.

NOTE Five species of *Coluber* inhabit Europe, in southern parts, growing to a large size. They make handsome pets, but may prove aggressive at first, and often refuse to feed. They are useful serpents in helping to keep down small rodents. Some species, called 'racers' in North America, are swift in movement.

AESCULAPIAN SNAKE

SCIENTIFIC NAME *Elaphe longissima longissima* Laurent, 1768. Originally named *Coluber longissima*, and is the same as *Coluber aesculapii* of Lacépède, 1789. Two sub-species.

DISTRIBUTION Southern Europe, northern Spain, France, Switzerland, Germany, Poland, Austria, the Balkans and Asia Minor.

EXTERNAL FEATURES Grows to about 5½ ft (165 cm). Head elongated with rounded snout and indistinct neck. Eyes moderate with rounded pupils. Slender body with shortish tail, a quarter or less the total length. Smooth body scales in 23 longitudinal rows, ventral plates from 210–248 and paired subcaudals from 60–90.

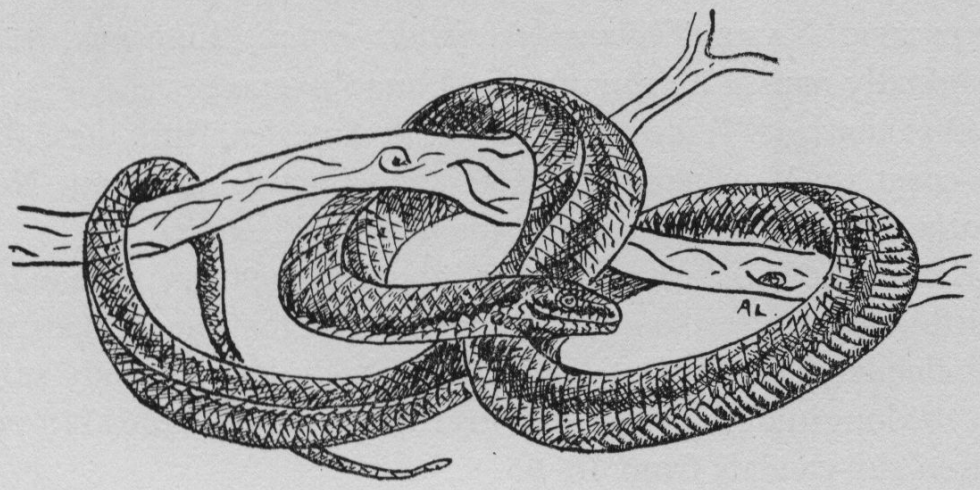
COLOUR Above: yellowish-grey, olive-brown or black, tinged with green, usually with small white spots on each scale to form an open meshwork. A single reddish or yellowish vertebral line, sometimes two, even four, may occur. Upper lips yellow, running into a mark on the nape of the neck. Below: pale yellow, lemon or greenish. Young, above: grey-brown with darker spots in longitudinal rows and a transverse head band. Below: olive-yellow.

HABITS Frequents woods and low thickets, often at high altitudes where rocks occur. Also ruins and piles of wood and debris. Usually avoids water and is an expert climber. Harmless but may bite when first handled. Usually tamed more easily than the Dark Green Snake. Has a powerful grip for its size.

HIBERNATION September to April, shorter in the south, in vegetation among ruins, rocks and in holes in the ground.

FOOD Lizards, small mammals, nestlings, birds' eggs and amphibians. Prey is constricted.

BREEDING Mating occurs in May or June, the female laying from 5–8 dull-white oval eggs, about 4 cm long, in July, in holes in the ground or among stones and roots. Incubation about 2–3 months. The young appear in September, measuring about 24 cm. Has lived for 4 years in captivity.



VIVARIUM See Grass Snake. Provide climbing perches.

NOTE This snake, a symbol in modern medicine, is thought to be connected with the god Aesculapius in the mythology of Greece and Rome. It was chosen by the priests of the temple at Epidaurus as the serpent with healing powers. To spread its influence, the Romans are said to have liberated specimens in the countries under their rule.

COMMON GARTER SNAKE

SCIENTIFIC NAME *Thamnophis sirtalis sirtalis* Linnaeus, 1766. Originally named *Coluber sirtalis*. Four sub-species.

DISTRIBUTION Widespread in North America, from the Atlantic coast to Minnesota, Missouri and Texas, and from Nova Scotia, Quebec and Ontario to the Gulf of Mexico.

EXTERNAL FEATURES Grows to about 3 ft (90 cm), the female a little longer. Head smallish, pointed with faint neck. Body and tail slender, latter about one-fifth the body length. Body scales in 19 longitudinal rows, ventral plates from 156–178 and paired sub-caudals from 76–95.

COLOUR Variable. Above: dark brown to greyish olive, sometimes greenish, with a vertebral band and two lateral bands, one on each flank covering the second and third rows of body scales. Bands coloured yellow or greenish, sometimes darker. Dark spots may occur between bands. Below: greenish, whitish or yellow with two rows of small, dark spots in forward half.

HABITS Prefers moist, open places in meadows, woods, marshes and along ditches and field borders. Found even in parks and dumps in built-up areas. Rather nocturnal, otherwise behaves in general like the European Grass Snake, especially when captured. Active and a good swimmer, but less inclined to enter water. Harmless and easily tamed. One of the commonest snakes of the Eastern states.

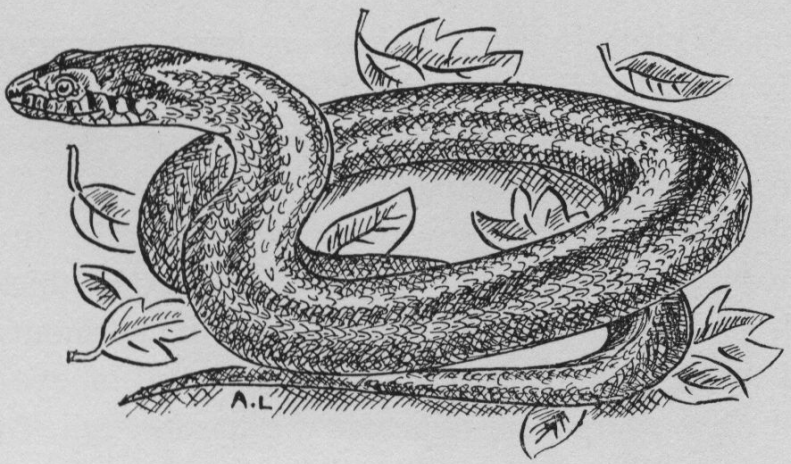
HIBERNATION From October to March, in vegetation or debris, under logs, stones or wood-piles.

FOOD Frogs, toads, newts and occasional fish, caught and eaten according to size. Fond of earthworms.

BREEDING Mating similar to the Grass Snake. Male seeks out female in springtime, the month varying with locality. Female produces up to 70 or more living young, measuring about 15–20 cm, in August.

VIVARIUM See Grass Snake.

NOTE This is the best-known and popular pet of American children and is safe to handle. Its wide distribution is probably



due to the high birth-rate. There is a somewhat similar species called the Ribbon Snake, *Thamnophis ordinatus* Linnaeus, 1758, with the lateral bands of yellow on the third and fourth rows of body scales. Habits and food similar.

INDIAN ROCK PYTHON

SCIENTIFIC NAME *Python molurus molurus* Linnaeus, 1758. Originally named *Coluber molurus*. Two sub-species.

DISTRIBUTION Indian peninsula, including Ceylon, from the Punjab to Bengal in the north.

EXTERNAL FEATURES Grows to about 12 ft (3 m 66 cm), rarely more, though said to reach 25 ft. Body thickset and powerful, with smallish, pointed head and blunt snout, distinct neck and short, stumpy, prehensile tail. Pupil of eye vertical. A pair of claws, larger in male, at the base of tail. Maxillary teeth large, also found on pre-maxillary bones (absent in Boas). Nose and first two upper lip scales pitted. Glossy body scales in 60–75 longitudinal rows, ventrals from 245–270 and paired sub-caudals 58–73.

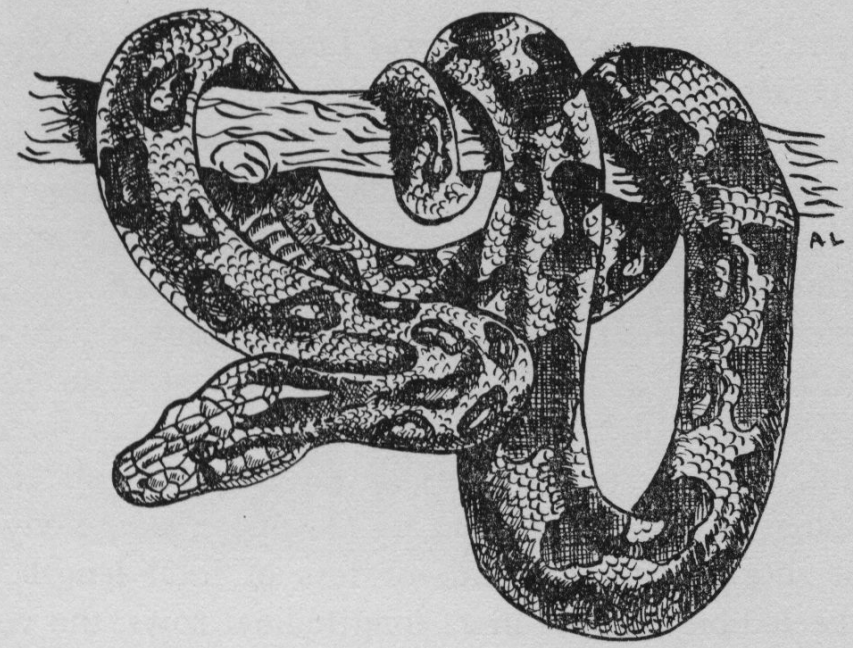
COLOUR Above: a bright yellow to cream or greyish-brown, with a series of large, elongated, rectangular marks in dark grey, brown or reddish, with a black edge. Flanks with small round spots, a lance-shaped mark on head and nape of neck, with a dark band on each side extending behind the eye to beyond angle of mouth. A stripe below each eye. Below: yellowish with a border of dark spots.

HABITS Found mainly in jungles, often in trees from which it hangs. Semi-aquatic. Somewhat sluggish and moves about slowly. Most popular constrictor in zoos and easily tamed, especially the pale form.

HIBERNATION Only in northern parts of its range, in debris, caves and hollow trees. Otherwise a summer sleep during dry spells.

FOOD Mammals, birds and reptiles, chiefly the former. Largest prey eaten probably medium-sized pigs or antelopes. Pythons are known to have eaten leopards and porcupines. Prey killed by constriction.

BREEDING Male coils with female, with tails entwined, using his spurs to excite her to mate. Female lays up to 100 elongated, oval, whitish eggs, about 12–13 cm long, in vegetation or debris.



She coils around her clutch to incubate for 6–8 weeks, during which time she does not feed or drink. Her body temperature is slightly raised and the coils twitch occasionally. Young on hatching measure about 2 ft 6 in. This python has lived for 20 years in captivity.

VIVARIUM 1*B*, 2, 3 (all heated and of suitable size), 4.

ADDER OR NORTHERN VIPER

SCIENTIFIC NAME *Vipera berus berus* Linnaeus, 1758. Originally named *Coluber berus*. Three sub-species.

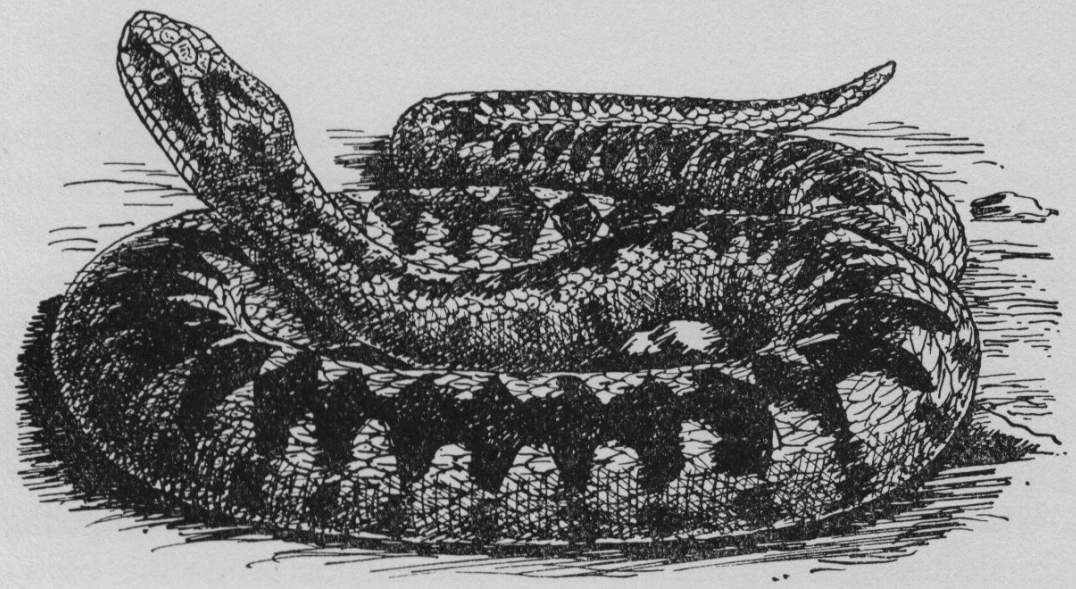
DISTRIBUTION Northern and central Europe, from 67° N latitude in Scandinavia to the southern mountain ranges. Extends across Asia to the Amur sea. In Britain widespread in most counties on the mainland. Absent from Ireland.

EXTERNAL FEATURES In Britain the female rarely grows more than 2 ft (60 cm), the male 18 in. (45 cm), longer on the Continent. The smallish, flattened head has a rounded snout. The moderate, laterally placed eyes have vertical pupils. Hollow poison-fangs occur in the front of the upper jaw. Body stout and tail short, about one-fifth or less of total length. Body scales, keeled on the back in 21 longitudinal rows, the ventrals from 132–150 and the paired sub-caudals from 24–46.

COLOUR Most variable. Above: male, greyish, whitish, yellowish or bluish. Female, brownish, reddish or black. Along the back a darker, wavy or zig-zag line, brighter in the male, which is diamond-shaped, sometimes straight or interrupted. A row of marks along each flank alternating with the dorsal pattern. A dark band from each eye to angle of the mouth and a dark V or X, sometimes distorted, on the nape of neck. Below: greyish, bluish or black, with white spots or brown with black marks. Occasional specimens jet-black.

HABITS Prefers dry situations in heaths, woodland glades, rocks and cliffs, ruins and mountain slopes, sometimes at high altitudes and occasionally near water. Usually avoids latter and is an indifferent swimmer. Fond of basking and is timid and shy, only biting when molested. The strike is very rapid but its other movements are sluggish. Largely nocturnal. Usually not amenable to captivity and not easily tamed. Has lived for 2 years in captivity.

HIBERNATION October–November to February–March in southern England, sometimes in large numbers, among rocks, in holes in the ground and under vegetation.



Food Lizards, small mammals, birds' eggs and nestlings, and occasional amphibians. Live food is stalked and killed first with a poisonous bite. A lethal dose for humans is 10 mg dry-weight. The bite can be dangerous to children and animals. Deaths among humans are rare.

Breeding Sexes come together in late spring, mating in May in southern England, possibly also a second time in the autumn. The young, from 5–20, are born alive from July to September, rupturing from a transparent membrane. They measure about 18 cm.

Vivarium 9. Must be escape-proof because of potential danger.

Note The Adder rarely lives for long in the indoor vivarium but may be kept successfully in the outdoor reptiliary. It frequently refuses to feed.

Lizards

Lizards belong to the sub-order of reptiles called *Sauria*, within the order *Squamata* (snakes and lizards) which numbers about 5,000 species, approximately half to each sub-order. Unlike snakes, to which they are related, the limbs are usually present, there are eyelids which move, and the bones in the lower jaw are firmly united. The scaling is quite different. Most are terrestrial; some are active as burrowers or climbers. There is a hibernating period in temperate species.

Basking is a favourite habit. Reproduction is by mating, the female laying eggs buried in the ground, or producing living young (*ovoviviparous*). These resemble the parents and are independent of their care. Unlike the *Amphibia* there is no visible gilled stage, and the skin is scaly.

Typical lizards, like the Common, Green and Wall Lizards, of the family *Lacertidae*, are well represented in Europe. The Slow-worm and Skink (families *Anguidae* and *Scincidae*) are lizards in which the reduction, even absence of, limbs and the elongation of the body is common. They burrow a good deal, the latter preferring dry, sandy soils.

Most lizards are insectivorous or carnivorous, catching food with their mouths and eating a variety of small animals. Some also eat fruit. The Chameleon is a peculiar exception, and catches food on the end of its sticky tongue. Its eyes have independent movement, the tail is prehensile and the limbs have grasping feet.

Geckos (family *Gekkonidae*) are active little lizards, often nocturnal, which can grip and run over vertical surfaces. The Monitors, which are mainly African and Asiatic, come within the family *Varanidae*. This includes the largest living lizard, the Komodo Dragon (*Varanus komodiensis*), which can reach a length of 12 ft. Two species of lizard (genus *Heloderma*) found in Mexico and the southern United States are poisonous. They are brightly coloured in black and yellow.

Lizards are caught for their skins and for human food.

Lizards are active creatures in motion, but spend long intervals at rest, especially when basking in sunshine. This they like to do at every opportunity, provided that the sun is not too hot. They are usually diurnal and will retire at the approach of darkness and during cold spells. The temperate species live best in the kind of open-air reptiliary described for frogs, in which the ledge above the enclosing wall must be sufficiently wide to prevent them climbing out. Tropical lizards may be placed outside during warm periods, otherwise they should be kept in a heated vivarium indoors. A covered heater-element may be used, or an electric-light bulb, the latter providing artificial light as well as heat. An indoor vivarium can also be placed in a sunny position near a window. Made to individual design it should be glass-topped or -fronted, have a door or lid for introducing food and a 'window' or two of perforated zinc for ventilation.

Lizards, like snakes, prefer dry surroundings, and the vivarium should contain dry earth or sand, with rock-work or bark for basking-platforms and hiding-places, and a flat dish of drinking water. They soon learn to accept food from the fingers and become very tame. Lizards hear well and will react to a call or a whistle. They will climb on to the hand or clothing but need careful handling as in many species the tail is easily broken.

Skinks, Slow-worms and other burrowing lizards require a sufficient depth of sand into which they can dig, while climbing lizards and the Chameleon need branches into which they can ascend.

Food consists of a variety of insects and their larvae, especially maggots and 'meal-worms,' wood-lice and spiders. Some species also eat fruit. The Slow-worm is very fond of slugs and earthworms. Variety of diet, especially for tropical lizards, keeps them healthy.

Lizards will sometimes live wild in a rockery or a wall in the garden and remain there for many years.

COMMON OR VIVIPAROUS LIZARD

SCIENTIFIC NAME *Lacerta vivipara* Jacquin, 1787.

DISTRIBUTION Widespread. In Europe from the 70° N latitude to the southern mountain ranges. In Asia eastwards to the Amur river. In Britain all counties on the mainland. The only reptile in Ireland.

EXTERNAL FEATURES Grows to about 16 cm total length (tail 10 cm), the female a little longer. Head longish and pointed, body slender, limbs shortish with moderate digits. Tail relatively short, thicker in male. From 25–37 longitudinal rows of body scales and 6–8 rows of belly plates.

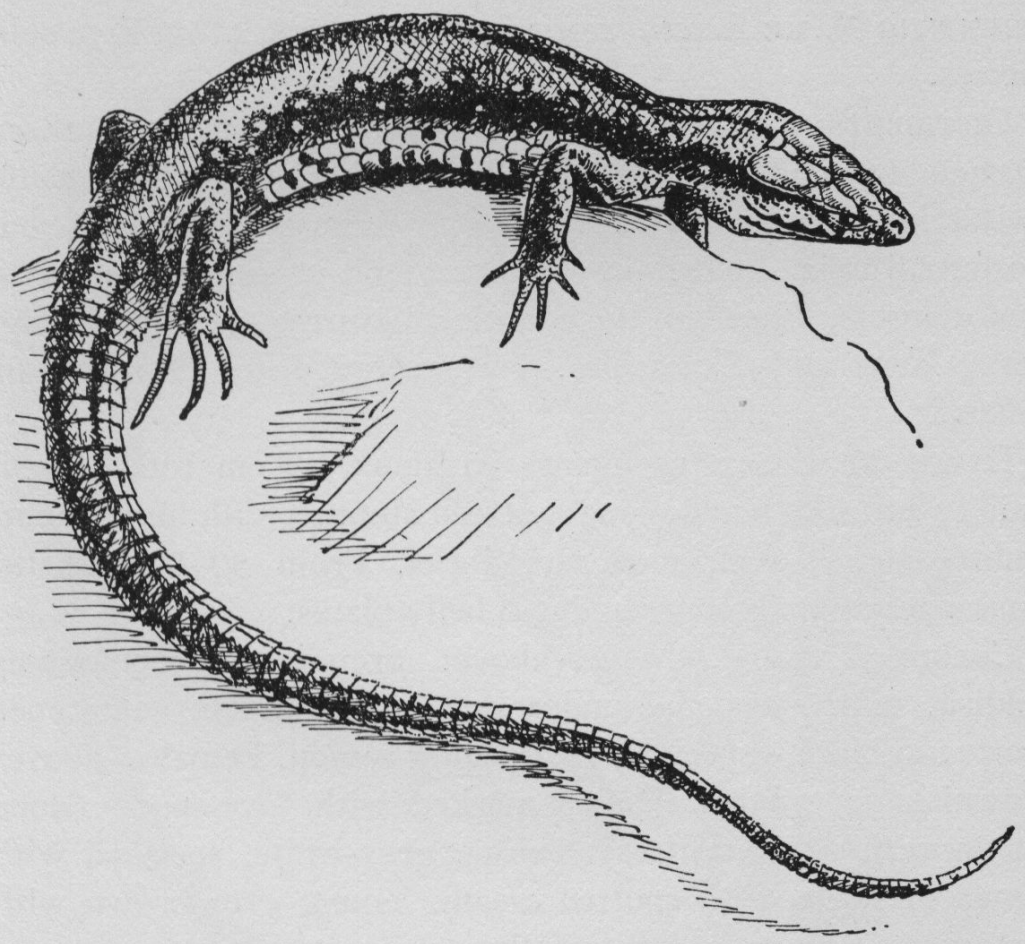
COLOUR Most variable. Above: brown, grey, black, yellow or reddish, with longitudinal rows of small clear spots. Often a dark vertebral line present. A clear lateral band with dark border, reddish-green or orange in male, spotted with yellow and black in female. Below: orange or vermilion, spotted with black in male, yellow or pale orange speckled with black in female.

HABITS Frequents drier spots in woodland glades, heather and bracken, also mountain slopes, ditches and country lanes. Fond of basking, its body flattened against warm surfaces of stone, bark, moss, etc. A good swimmer. Active and easily tamed.

HIBERNATION From October to March, in holes in the ground, under stones, logs and in drier vegetation. May reappear in warm spells in winter.

FOOD Small animals such as insects and their larvae, spiders and wood-lice.

BREEDING Mates in late spring, about May. Male grips female in mouth during mating. The female produces from 7–9 living young in July or August, which rupture from a transparent membrane. Occasionally soft eggs are laid. The young measure about 3 cm and are a deep brown or black. Has lived for 3 years in captivity.



VIVARIUM 1*B*, 2, 3, 8, 9, 14. N.B. Direct sunlight is important to most lizards.

NOTE The Common Lizard is very amenable to captivity and will frequently breed if given access to sunlight. A variety of diet is advisable, especially insects.

SAND LIZARD

SCIENTIFIC NAME *Lacerta agilis agilis* Linnaeus, 1758. Five subspecies.

DISTRIBUTION Western and central Europe, from southern Sweden to southern France, Belgium, Holland, Germany, Switzerland and parts of Hungary, Yugoslavia, Poland and western Russia. In Britain colonies found in sandy and heathland districts, especially the counties of Surrey, Dorset, Hampshire, Kent and Lancashire. Not recorded for Scotland or Ireland.

EXTERNAL FEATURES Grows to about 20 cm total length (tail 12 cm), the female longer. Head stoutish with blunt snout, limbs shortish with moderate digits. From 30–50 longitudinal rows of body scales and 6–8 belly plates.

COLOUR Variable. Male—above: grey-brown, sometimes reddish, with sides and underparts bright green, sometimes spotted in black, especially in breeding season. Female—above: brownish or greyish. Flanks marked with 'eye-spots' (deep brown with white centres); below: grey-white, speckled with brown or green or a spotted cream. Young grey-brown with 'eye-spots' and green-white belly.

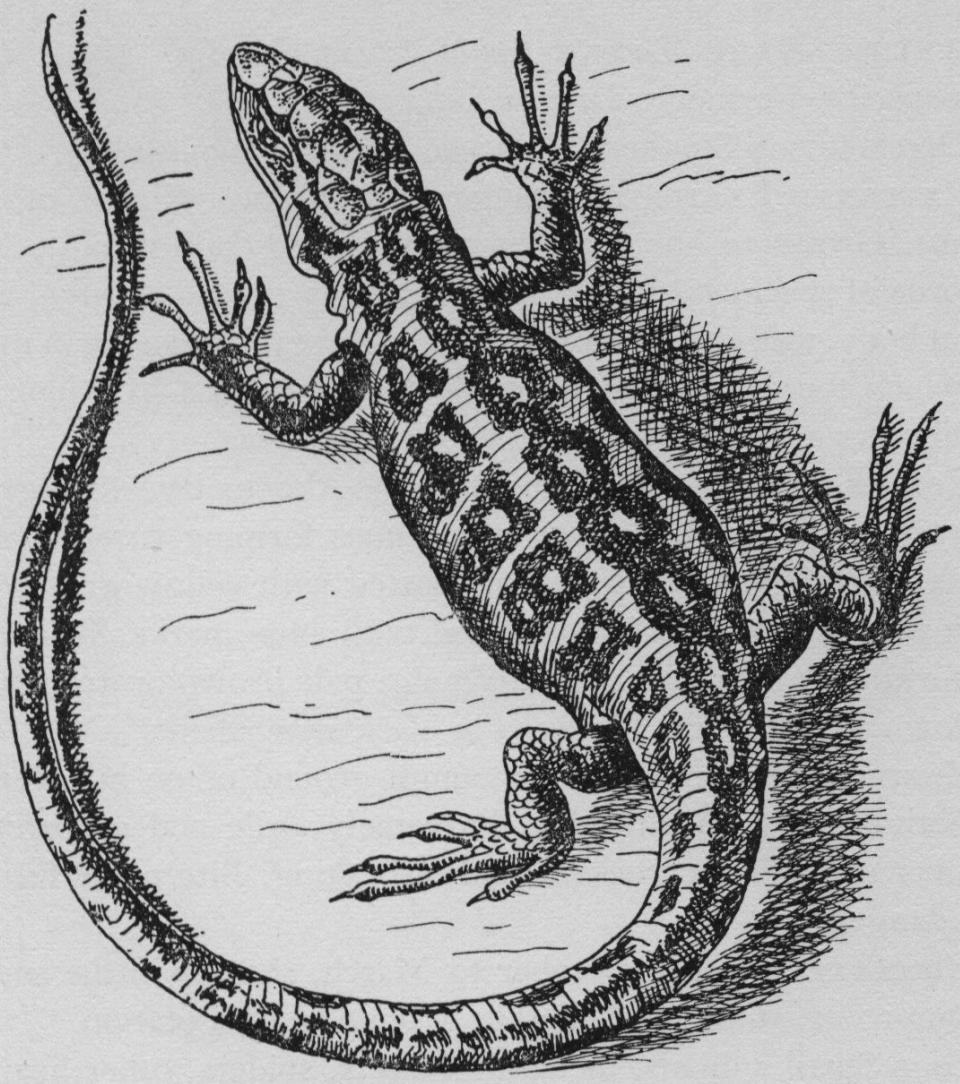
HABITS Inhabits dry, sandy localities, such as heaths, sand-dunes, woodland borders, waste ground and stony areas. General habits similar to Common Lizard.

HIBERNATION From September–October to March–April, in holes in the ground, under logs and stones, among debris and vegetation.

FOOD Similar to Common Lizard. A variety of insects, spiders and crustaceans. Catches larger prey.

BREEDING Mates from May onwards, the female laying from 5–15 yellowish oval eggs, about 12 mm long, buried in sand or soft earth, or under stones and logs. Incubation 2–3 months. The young measure about 4 cm of which the tail is 3 cm. Has lived in captivity for 2 years.

VIVARIUM See Common Lizard.



NOTE In cases where lizards lay eggs these can sometimes be hatched in a container, laid on dry sand and covered with moss which is kept damp. Incubate at temperatures between 75 and 80° F.

SPANISH, OCELLATED OR EYED LIZARD

SCIENTIFIC NAME *Lacerta lepida lepida* Daudin, 1802. Two sub-species. Formerly *Lacerta ocellata.*

DISTRIBUTION Southern France and Iberian peninsula.

EXTERNAL FEATURES The largest European lizard of this genus. Grows to about 60 cm total length (tail 40 cm), with records of specimens up to 90 cm. Head large and pointed, with stout body, well-developed limbs and long tail especially in male, in which the cheeks are more swollen. From 63–100 longitudinal rows of body scales and 8–10 belly plates.

COLOUR Variable, according to age. Above: brownish-green or reddish, with black spots, sometimes forming rosettes with black centres. Also dark green, spotted with yellow-green or a yellow network. Flanks ocellated with blue marks. Below: a uniform yellow or pale green. Young: pale brown or grey, with yellow and blue spots bordered in black along flanks.

HABITS Lives among rocks, rough ground or on hill slopes, sometimes at high altitudes. Extremely agile and a powerful climber of trees and rocks. Fond of basking. Bite powerful but not dangerous.

HIBERNATION From October to March, shorter in the south, among roots, stones, holes in the ground and vegetation.

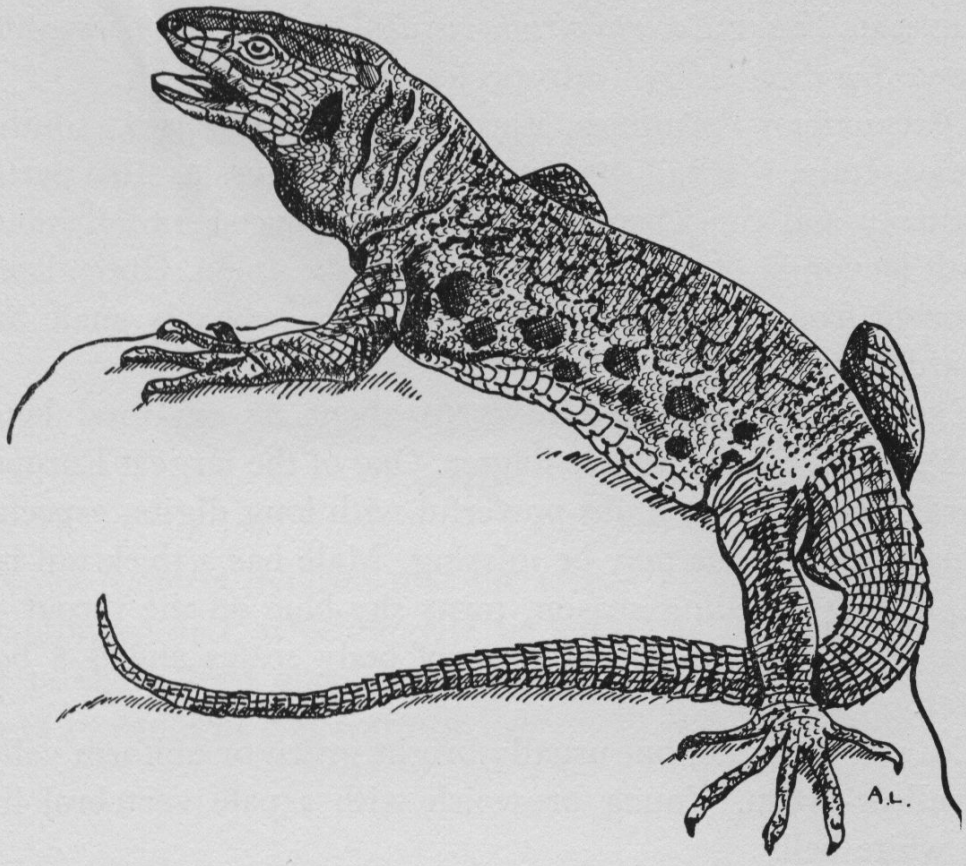
FOOD Small animals, including insects, spiders, other lizards, even small mammals, nestlings and birds' eggs. Fond of succulent fruit and soft vegetation, and of anything with a sweet taste.

BREEDING. Mates in late spring, the female laying from 6–10 oval eggs 18 mm long in holes in the ground, or among stones or roots. Incubation about 3 months. The young measure about 5 cm of which the tail is 4 cm. Has lived in captivity for 19 years.

VIVARIUM See Common Lizard.

NOTE Because of its size this lizard should be kept apart from smaller species, and provided with branches and rocks among which it can climb. A certain amount of sunshine is essential to good health.

SPANISH, OCELLATED OR EYED LIZARD



SCIENTIFIC NAME *Lacerta viridis viridis* Laurent, 1768. Originally named *Sep viridis*. Five sub-species.

DISTRIBUTION Southern Europe, northern Spain, southern France, Italy, the Balkans, and south-west Russia. Also parts of Germany and the Channel Islands. Introduced into Britain in south Devon in 1937, where it may still be found. Green lizards reported from other parts of Britain are probably male Sand Lizards.

EXTERNAL FEATURES Grows to about 38 cm total length (tail 25 cm), female a little longer. One of the largest European lizards. Head large, limbs powerful with long digits, especially in male. Ear-drums may be missing. Male has a thick tail-base and, during breeding season, turns sky-blue on the throat and sides of face. From 40–55 rows of body scales and 6–8 belly plates.

COLOUR Variable, but usually bright green or uniform yellow or yellow-green. Young brownish with a pale vertebral line, and white belly.

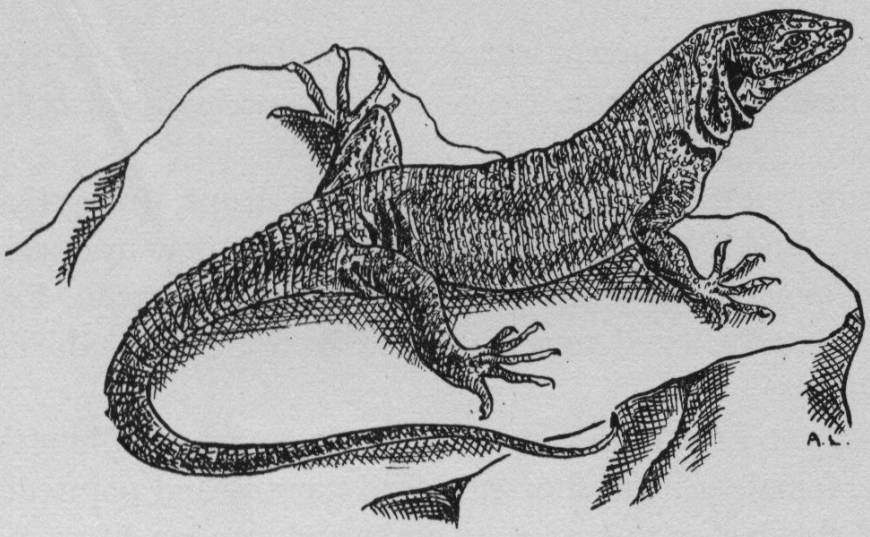
HABITS Found in fields, among rocks and waste ground and along woodland borders. Fond of basking—is a good climber and swimmer. Active by day but retires during hot spells. Has a powerful bite but is not dangerous.

HIBERNATION From October to March in holes in the ground, heaps of vegetation or among tree-roots. Shorter period in southern regions.

FOOD Small animals such as insects, spiders and crustaceans, also smaller lizards, small mammals and birds' eggs. Eats occasional fruit.

BREEDING Mates in late spring and female lays in May or June from 5–20 dull-white oval eggs about 16 mm long in soft earth or holes in the ground. Incubation 2–3 months. The young measure about 4·5 cm. Has lived for 10 years in captivity.

VIVARIUM See Common Lizard.



NOTE Reports indicate that the Green Lizard suffers from a monotonous diet, which should be varied as much as possible, and is short-lived and prone to skin complaints if not given access to sunlight and warmth.

WALL LIZARD

SCIENTIFIC NAME *Lacerta muralis muralis* Laurent, 1768. Originally named *Seps muralis*. Up to 14 sub-species have been described.

DISTRIBUTION Central and southern Europe, from Holland, Germany and Poland to the southern mountain ranges. Also the Channel Islands (Jersey). Introduced into Devon, England in 1937 but believed now to be extinct. Since established in other places.

EXTERNAL FEATURES Grows to about 20 cm total length (tail 14 cm), female a little shorter. Head narrow and pointed, body and tail slender, with moderate limbs and slender digits, especially male. A throat-fold. From 42–84 longitudinal rows of body scales and 6 rows of belly plates.

COLOUR Most variable. Above: grey, brown or black, with a greenish tinge and two whitish, yellow or green lines, sometimes as spots along each flank, the lower continuing into the tail. Lower flanks spotted with areas of blue, green, yellow or white. Sometimes a dark vertebral line. Below: white, yellow or orange, spotted in black along sides. Throat and belly in male usually cream, bordered with reddish-brown or blue.

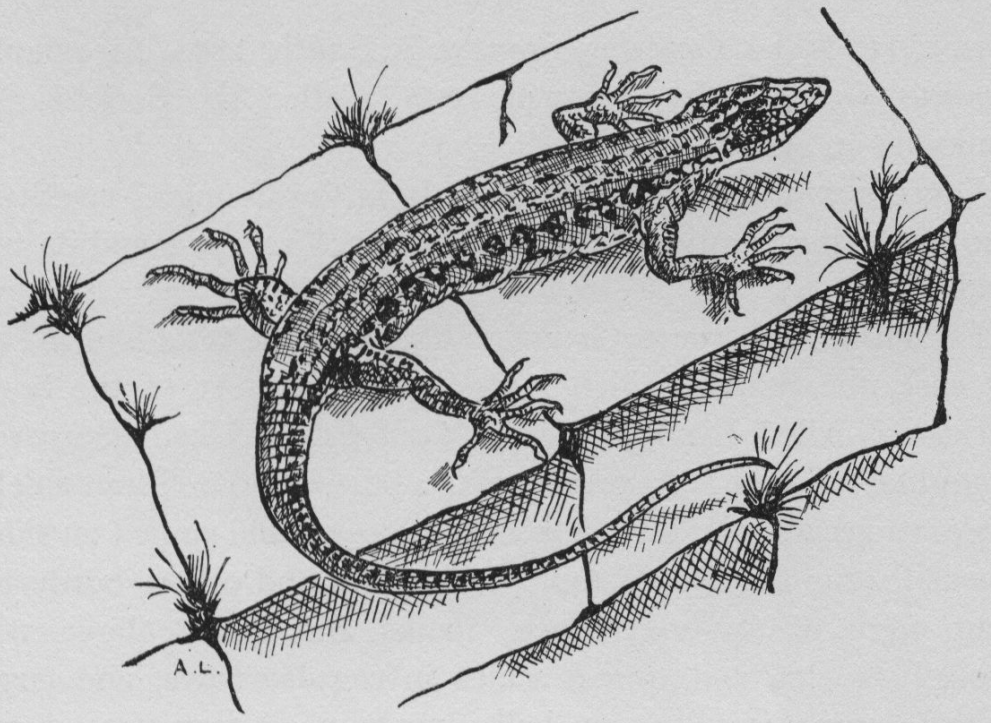
HABITS Inhabits stony areas, ruins and rocks where it is often seen in basking attitudes. Very active and a good climber. Often lives in gardens and rockeries.

HIBERNATION October to March, shorter in the south, or not at all, among stones and rocks or in holes in the ground.

FOOD Mainly insects and other small animals and occasional fruit and soft plants.

BREEDING Mates in April, the female laying from 3–9 whitish oval eggs, about 10 mm long, in May or June. Incubation about 2 months. The young measure about 6 cm total length. A female sometimes lays 2–3 eggs at intervals. Has been kept in captivity for 3 years.

VIVARIUM See Common Lizard.



NOTE Specimens spoken of as 'wall lizards' cover a number of species in the various Mediterranean islands, Greece, Italy and Spain. The genus *Lacerta* contains in all 30 species.

GREAT GIRDLED OR LORD DERBY LIZARD

SCIENTIFIC NAME *Cordylus giganteus* A. Smith, 1844. Also named *Zonurus derbianus* by Gray in 1845. Called the Sungazer or Sonkyker in Africa.

DISTRIBUTION South Africa, mainly in the Orange Free State, also bordering frontiers of Cape Province, Transvaal and Basutoland.

EXTERNAL FEATURES Grows to about 34 cm total length (tail 16 cm), the female a little larger. The largest of the South African Girdled Lizards (family *Cordylidae*). Head depressed, triangular, longer than broad, with pointed snout. Head shields large, rough and flat on top, strongly keeled and spined on sides, especially the four large spines over neck and others bordering front edge of ear-hole. Back, flanks and limbs above with strongly keeled and spined scales in regular rows, and large, smooth, squarish plates on belly in about 22 transverse rows. Tail with large, spiny, keeled scales in regular rows above, smooth scales underneath. Limbs moderate in size.

COLOUR Above: uniform yellow-brown or dark brown, sometimes with darker patches. Dark on top of head, palest on snout, yellow-brown on sides of head and flanks. Below: straw-yellow. Young, yellowish, banded with dark brown.

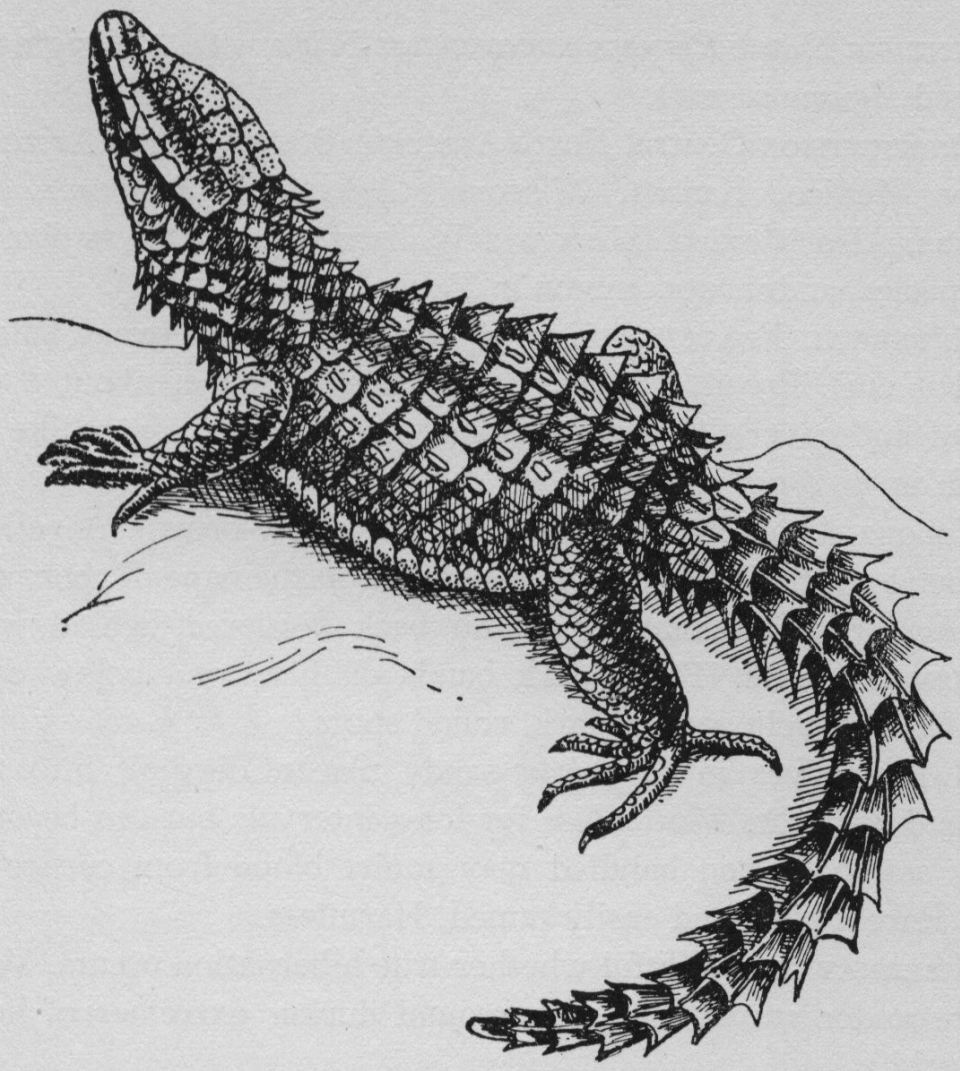
HABITS Lives mainly among rocks in open veldt country, spending long daylight hours on small hillocks or ant-hills, with head and fore-body raised to face the sun, hence its name. Hides when disturbed or retires among rocks and into rodent burrows. Some species are said to grip tail in mouth and roll into a ball of protective spines. Struggles to resist exposure of soft underparts. Harmless and easily tamed.

HIBERNATION Doubtful. Retires during very hot spells.

FOOD Insects and other small animals, with occasional plants.

BREEDING Mates in late South African spring, the female producing a pair of living young, about 12 cm long. Members of this family have lived for 4 years in captivity.

VIVARIUM 1*B*, 2, 3 (heated), 4. Provide loose soil or sand.



NOTE These Girdled Lizards appear to live well in captivity if supplied with warmth and variety in their diet. They are tame and easily handled, and will remain for long intervals in the same position.

TEXAS HORNED LIZARD

Scientific Name *Phrynosoma cornutum* Harlan, 1825. Originally named *Agama cornuta.*

Distribution Central North American States, chiefly Arizona, New Mexico, Kansas, Missouri, Arkansas, Oklahoma and Texas. Also Mexico. Most widely distributed of the twelve or so species, and most common in Texas.

External Features Grows to about 15 cm total length (tail 4 cm). Broad, flat body, toad-like in shape, about 6 cm broad and covered with scales and spines. Latter horn-like on head, up to 6 cm in length.

Colour Above: some shade of dull yellow-brown. A yellow stripe along the back, two dark patches on the nape of neck, and three pairs of rounded spots on back bordered behind with yellow crescents. Three dark bands on head and below each eye. Below: yellow with dark, round spots.

Habits Lives in hot, dry, sandy places, digging into the ground at night. Motionless for long intervals but can become very active. When handled may squirt blood from corner of eye. Rarely bites and easily tamed. Harmless.

Hibernation Doubtful whether true hibernation occurs. Will retire under stones and into ground during extremes of heat and cold.

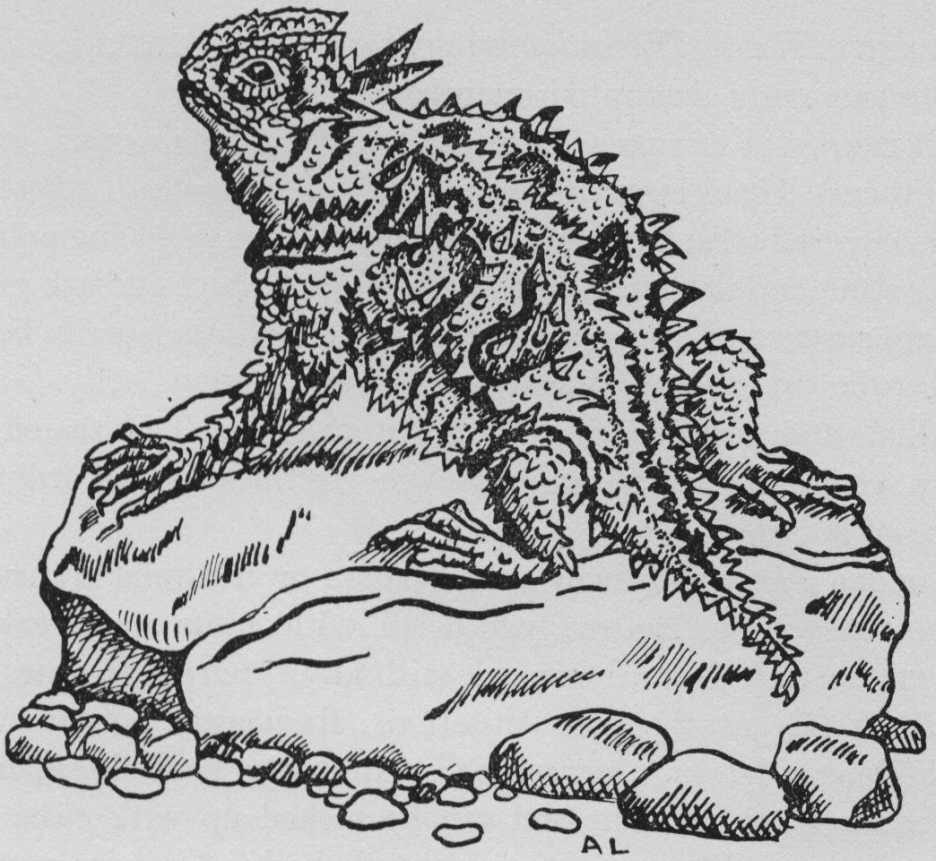
Food Insects and small animals, caught on the tongue. For this reason and because of its shape the Horned Lizard (genus *Phrynosoma*) is commonly called the Horned 'Toad'.

Breeding Mates in warmer seasons, the female producing from 6–12 living young which rupture from a transparent membrane. Captive specimens in Europe have lived little longer than 1 year.

Vivarium See Girdled Lizard.

Note The spine-like projections of these American lizards serve as a protection, and may also have something to do with their dry surroundings. A parallel occurs in the African Girdled Lizard (q.v.).

TEXAS HORNED LIZARD



STUMP-TAILED SKINK

Scientific Name *Trachydosaurus rugosus* Gray, 1827.

Distribution Australian mainland.

External Features Grows to about 35 cm total length (tail 6 cm). Head large, triangular and depressed, distinct from neck, covered with large, rough shields. Snout short and pointed. Body stout and flattened, with large, rough scales on back giving the appearance of a fir-cone. Smaller and smoother scales below. Scales lie in 20–23 longitudinal rows around body. Limbs smallish and stout, each with 5 short digits. Tail scaled like body, very thick and stumpy, varying in thickness according to store of fat.

Colour Above: brownish with spots or irregular transverse bands of yellow. Below: yellowish with spots or streaks of brown. Inside of mouth pinkish with large, purple tongue.

Habits Occurs in drier situations, frequently burrowing in soil. Fond of basking, occasionally climbing. Very sluggish and deliberate in movement and can be picked up with ease. Bite rather strong. Often caught accidentally by head in wire-netting. Easily tamed.

Hibernation Not in true sense. Will retire in hot spells buried in soil or vegetation.

Food Various small animals, worms and insects, birds' eggs, also soft plants and fruit. Food stored as fat in tail.

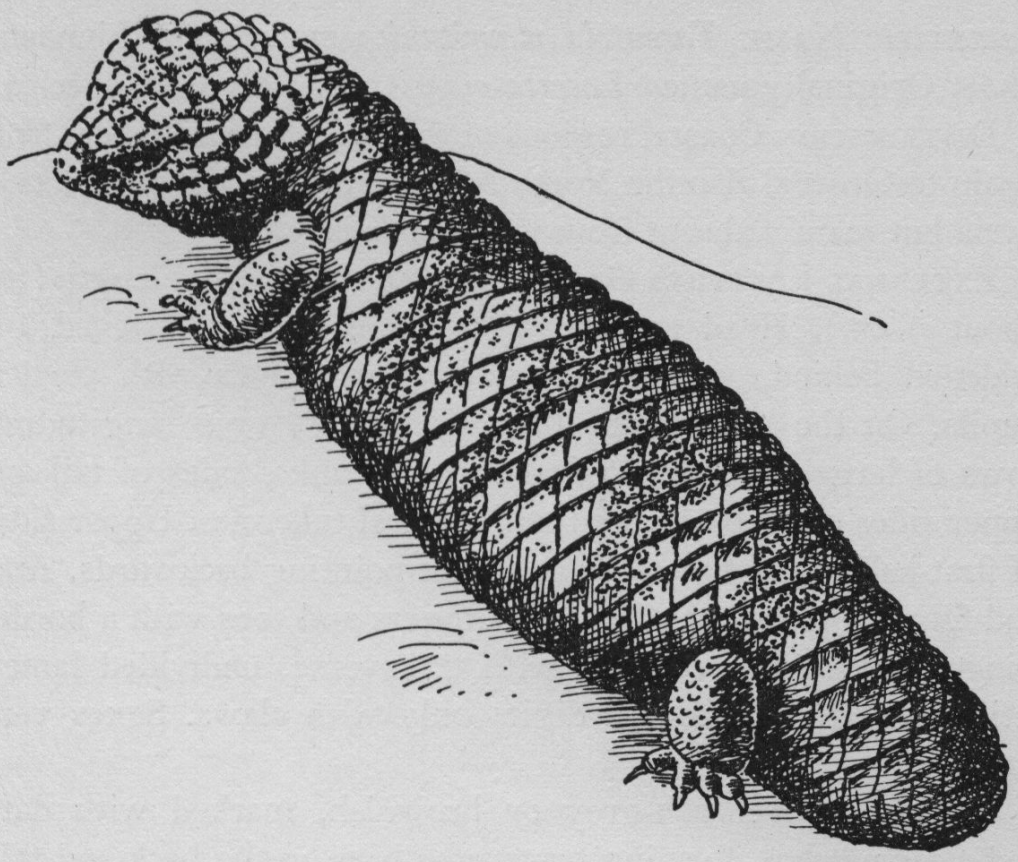
Breeding Mates in Australian spring, the female producing one, or possibly two, living young about half the length of mother.

Vivarium See Girdled Lizard.

Note Skinks (family *Scincidae*) compare with Slow-worms (family *Anguidae*) in many cases where elongation of the body and reduction of the limbs take place. It is thought that they are following the line of evolution taken by snakes.

Australia is one of the main strongholds of skinks. They form a large family numbering about 600 species. Some grow to a length of 2 ft.

STUMP-TAILED SKINK



COMMON GECKO

SCIENTIFIC NAME *Tarentola mauritanica mauritanica* Linnaeus, 1858. Originally named *Lacerta mauritanica*. Two sub-species.

DISTRIBUTION Coastal regions of the Mediterranean Sea, from Spain to Greece, also the North African coast to Egypt. Parts of Syria but mainly absent from western Asia.

EXTERNAL FEATURES Grows to about 15 cm total length (tail about 8 cm). Head covered with small scales, flattened and widened behind, with blunt snout. Large eyes with vertical pupils. On the back of the flattened body 7 or 9 longitudinal rows of large, strongly keeled scales. Flanks, sides of tail and upper sides of limbs covered with conical tubercles. Upper sides of first half of tail has spiny tubercles pointing backwards. Anal and femoral pores missing. Five fingers and toes with a border fringe. Undersides covered with transverse, undivided lamellations. Third and fourth digits only with claws. Sexes very similar.

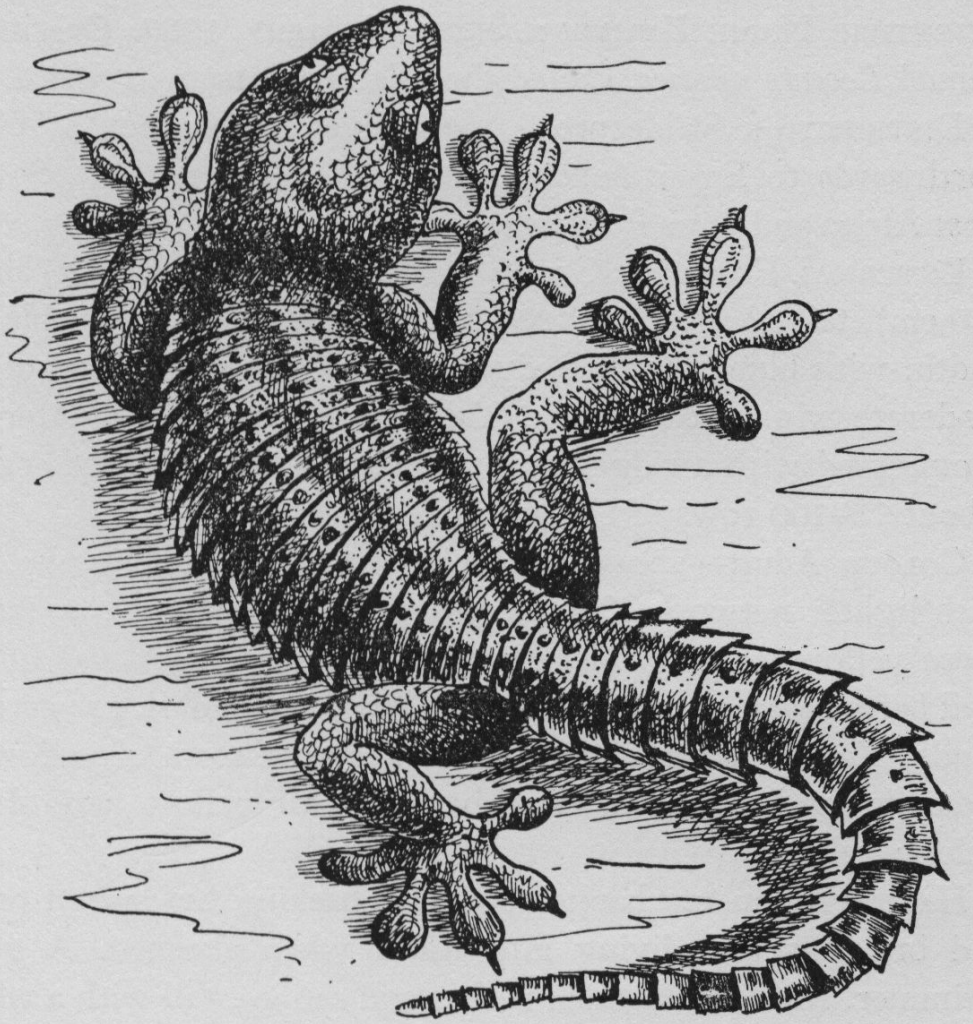
COLOUR Above: ash-grey or brownish, marked with dark and clear patches, forming transverse bars on the back and tail. A black band on each side of head passes through each eye. Below: whitish. Depth of colour varies with surroundings.

HABITS Frequents walls and rocks, occasionally trees, and is commonly found in buildings. Active by day as well as evening and fond of sunshine. Tends to live in one spot which is used as a retreat and from which it emerges to catch food or bask. Can grip vertical surfaces with its sucker-like feet and moves rapidly when hunting or if disturbed. Easily tamed.

HIBERNATION Doubtful, but retires in very hot or cold spells.

FOOD Various insects and other small animals. For this reason is encouraged to live in inhabited dwellings.

BREEDING Mates usually in spring, the male gripping the female. Fertilization internal. Female lays, usually in pairs, oval dull-white eggs, about 12 mm long, during late spring and summer in holes in the ground or on ledges in buildings. Incu-



bation about 4 months, the young measuring about 3–4 cm. Has lived in captivity for 7 years.

VIVARIUM 1*B*, 2, 3 (heated), 4, 8 (heated). Guard against escapes.

NILE MONITOR

SCIENTIFIC NAME *Varanus niloticus* Linnaeus, 1766. Originally named *Lacerta nilotica*. Called the Water Leguaan in Africa.

DISTRIBUTION Widespread, near rivers, from South Africa northwards to Egypt (excluding dry Kalahari region), South-west Africa and Cape Province.

EXTERNAL FEATURES Grows to about 5 ft total length (about 150 cm), tail 3½ ft (about 105 cm). Head long, about double the width, with blunt snout. Body slender, limbs strong and digits moderate with strong claws. Tail long and powerful, laterally compressed with a ridge formed by two rows of keeled scales. About 75–100 rows of belly plates.

COLOUR Adult—above: brownish-grey to dark olive-brown, with lighter network of scattered yellow 'eye' spots, or transverse yellow-green bands, especially on head, back and limbs. Tail barred with yellow. Below: yellowish with dark grey cross-bands. Young: black above with transverse rows of yellowish spots, striped on head. Tail barred with yellow and black. Below: yellow.

HABITS Frequents banks of rivers, basking by day on rocks and branches and diving into water when alarmed. A good swimmer. Moves in sudden rushes and can use tail with a whip-like action as an efficient means of defence. Hisses loudly when alarmed and may feign death. Caught as food and for its skin.

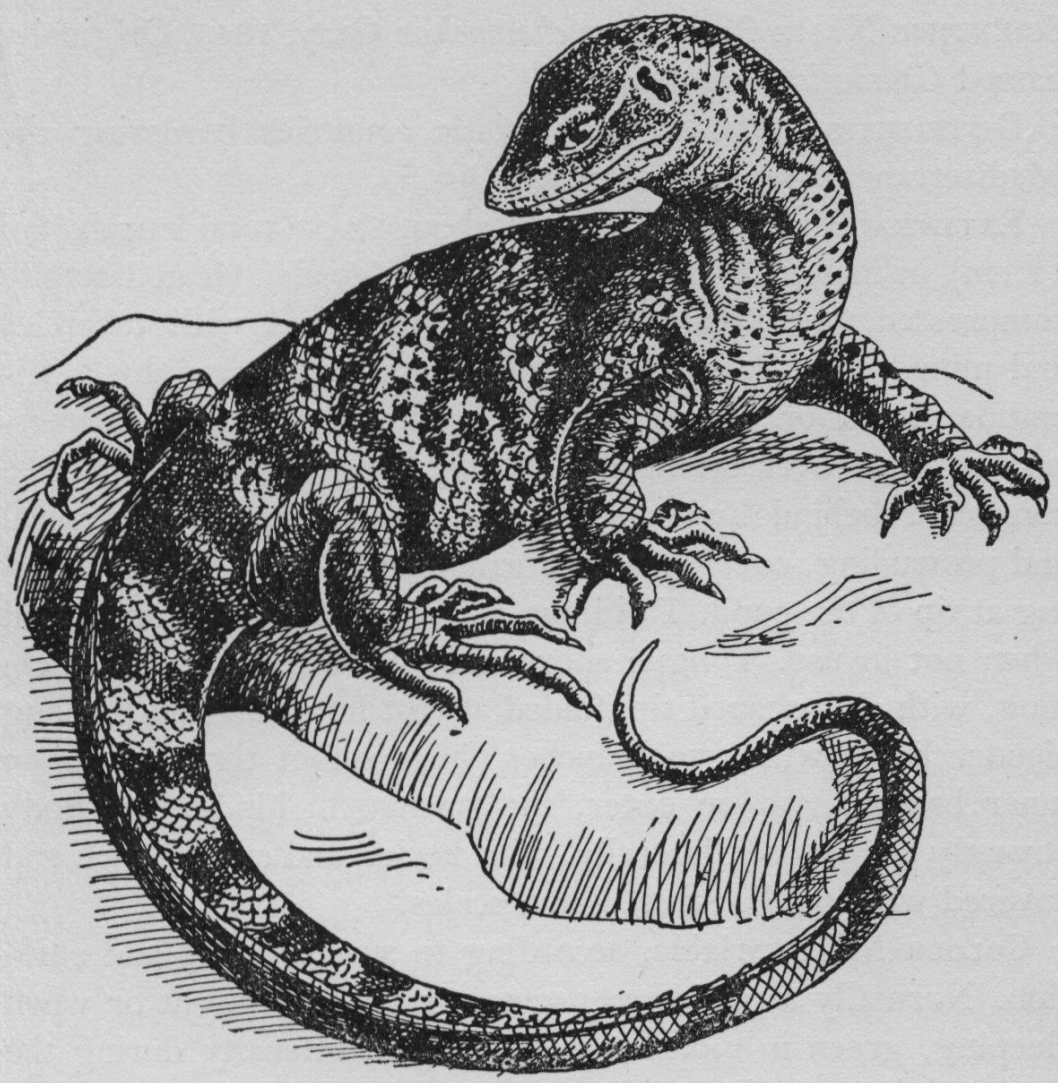
HIBERNATION Doubtful.

FOOD Various animals including crabs, mussels, crocodiles' eggs, smaller mammals, birds and fish.

BREEDING Mates in late African spring, the female laying from 40–60 whitish oval eggs, about 6 cm long, usually in a hole dug in a termites' nest. Incubation about 9–10 months. The young measure about 23 cm, at first feeding on termites, then making for water. Has lived in captivity for 6 years.

VIVARIUM 1B, 2, 3 (heated), 4, built to suitable size.

NOTE Monitors include some of the largest living lizards and are confined to the Old World, where they are sometimes



called iguanas; this is misleading as the latter (family *Iguanidae*) are mainly New World lizards. Monitors in Africa are called leguaans, and in Australia, goannas.

COMMON CHAMELEON

SCIENTIFIC NAME *Chamaeleon chamaeleon* Gray, 1845. Originally named *Chamaeleon vulgaris.*

DISTRIBUTION African and Asiatic countries bordering the Mediterranean Sea, and southern Spain.

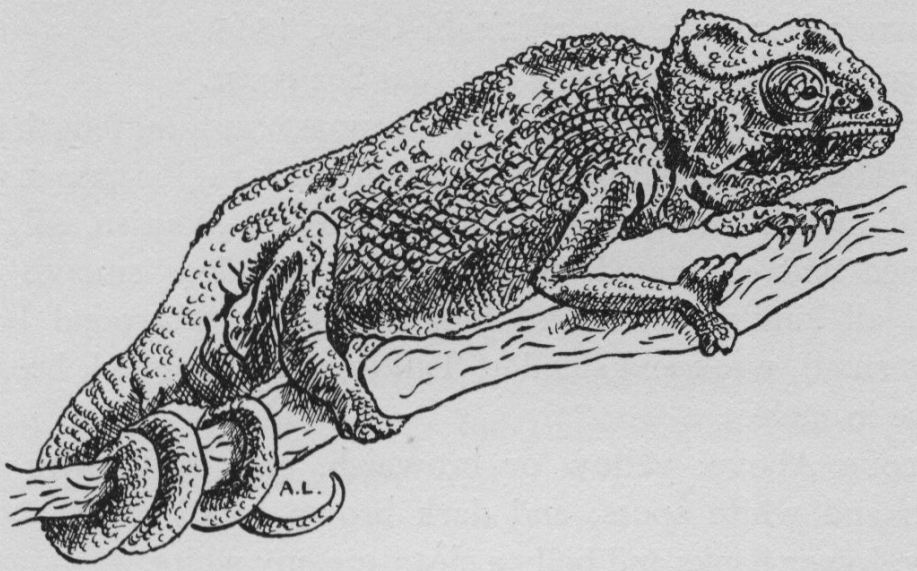
EXTERNAL FEATURES Grows to about 23 cm total length (tail 11 cm) in male, 27 cm (tail 13 cm) in female. Head laterally compressed, with blunt, curved snout ridged with tubercles and minus appendages. Faint neck region, covered by a triangular hood or casque formed by a strong, curved, tuberculated ridge over the head, and one along each side, all three connected behind by an angulated cross-ridge. Eyes conical and protruding, covered with a granular lid with minute opening at tip of the pupil. Tail long, thicker at base in male, curled when not in use. Tongue short and protrusible, about 15 cm long, with club-shaped tip, folded at rest in a chin-pouch. Long slender limbs with two branches (in fore-foot three digits on inner branch, two on outer, the reverse in hind-foot). Body strongly compressed laterally, with keeled and curved back and covered with small, tuberculated scales.

COLOUR Most variable, according to surroundings and emotion. Normally a pale, green-grey or white at night or when sleeping, green in morning increasing in intensity during the day, dark brown, almost black, when alarmed, hunting or when handled. Normally a pale line from chin to vent and two or three rows of pale spots along flanks.

HABITS Lives mainly in bushes or trees in plantations, woods, orchards and oases, moving slowly by gripping branches deliberately with each hand-like foot in turn, using tail as extra support. Sometimes stays motionless for hours, blending closely with surroundings. When alarmed may emit a bird-like chirp, hiding behind branches to avoid enemy and tending to climb upwards. Eyes move independently and tail is prehensile. Harmless and defenceless, relying on camouflage for protection.

HIBERNATION Doubtful.

COMMON CHAMELEON



Food Numerous insects and other small animals, caught within range of tongue, or after slow stalk, with great rapidity and accuracy.

Breeding Mates in late spring, the female laying from 20–30 small whitish eggs in a hole dug in the ground. The young hatch in summer, measuring about 7 cm total length (tail 3 cm). Does not appear to live more than 18 months in captivity, unless given individual attention.

Vivarium 1*B*, 2, 3 (heated), 4, 8 (heated). Provide climbing perches.

COMMON OR OFFICINAL SKINK

SCIENTIFIC NAME *Scincus officinalis* Gray, 1845.

DISTRIBUTION The Sahara and Red Sea coast.

EXTERNAL FEATURES Grows to about 20 cm total length (tail 8 cm). Head short and pointed, without neck region, snout with ventral mouth blunt, and eyes small. Body stoutish, slightly flattened and elongated. Scales small, rounded, smooth and shiny, all similar, in 26–28 longitudinal rows around body. Limbs small, weak and slender. Tail thick and pointed, broader at base in male.

COLOUR Above: yellow or brownish, each scale with tiny brown and white spots, and dark brown bands across body. Below: lower flanks and belly a clear, creamy white.

HABITS Inhabits dry, sandy areas. Rather quick of movement, especially when capturing prey or escaping. A rapid and frequent burrower. Fond of basking on small hillocks of sand or tufts of vegetation. Harmless and rarely bites. Reputed since earliest times for its healing properties.

HIBERNATION. Doubtful. Will retire in very hot spells.

FOOD Various small animals such as insects, crustaceans, spiders, even scorpions, which are pounced on rapidly.

BREEDING. Mates in early spring, the female producing 2–4 living young about 4–6 cm long.

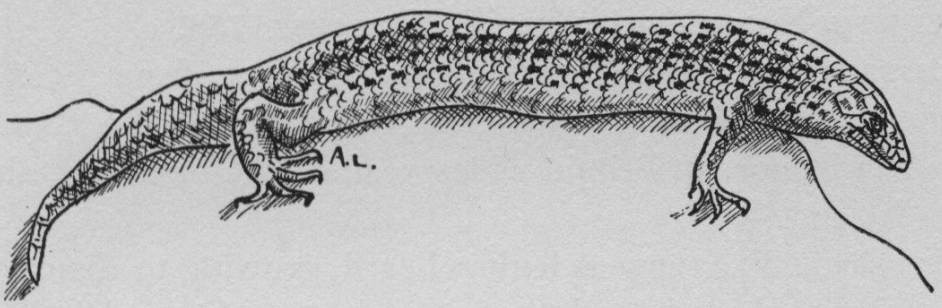
VIVARIUM See Girdled Lizard.

NOTE The name 'seps' is sometimes used for members of the Skink family. It is of Greek origin, meaning 'of evil repute,' since many are feared, even today. These lizards are harmless, although some tend to resemble snakes, having elongated bodies. Has lived for 2 years in captivity.

The surroundings in which they are kept should be dry and warm, and sandy for preference. A drinking dish in a corner is necessary, also a suspended light-bulb to produce an atmosphere of sunlight when this is lacking.

Other species of skinks suitable for the vivarium are: the Ocellated Skink (*Chalcides ocellatus*), North Africa and Asia

COMMON OR OFFICINAL SKINK



Minor, about 8 in.; the Algerian Skink (*Eumeces Algeriensis*), North Africa, about 18 in.; the Blue-tongued Skink (*Tiliqua skincoides*), Australia, about 18 in.

SCIENTIFIC NAME *Anguis fragilis* Linnaeus, 1758.

DISTRIBUTION Central and southern Europe, from the Arctic Circle to the Mediterranean and eastwards to the Caucasus and Asia Minor. In Britain widespread on the mainland, absent from Ireland.

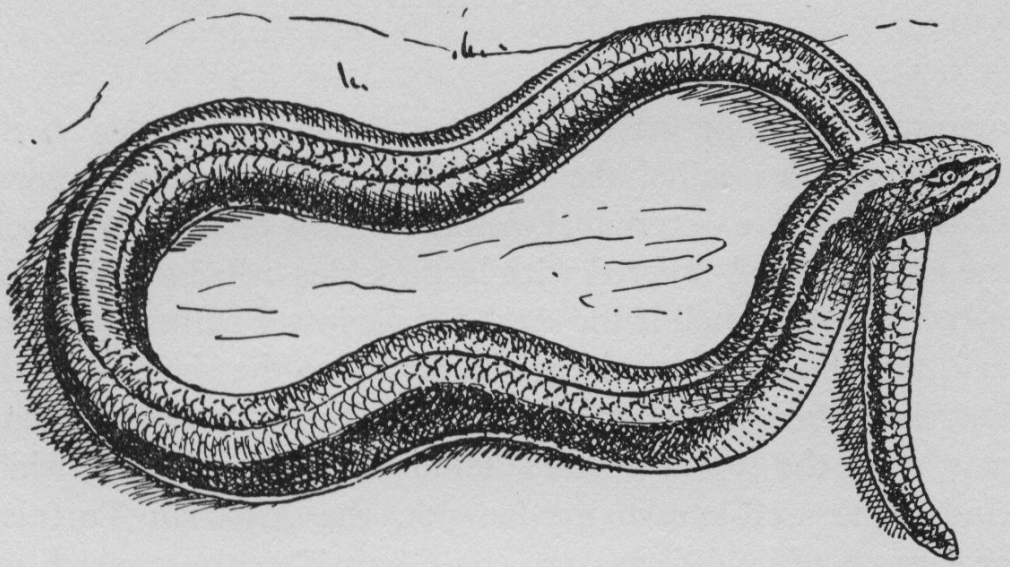
EXTERNAL FEATURES A legless lizard, growing to about 18 in. (46 cm) total length (tail 30 cm), and 20 in. (50 cm) in female (tail 27 cm). Head lizard-like and smallish, without neck region in female, slightly so in male. Eyes small, with lids and rounded pupils. Body long and slender, with tapering tail, thicker at base in male, and blunt if damaged, which is common in the wild. Body scales small and smooth, in 24–28 longitudinal rows around entire body. The Slow-worm is a limbless lizard.

COLOUR Variable. Above: bronze, hazel-brown, greyish, deep brown, even black, sometimes with a series of darker spots or one, even two, dark vertebral lines especially in female. Below: dull-white, grey or putty with or without darker spots. Throat sometimes brownish and some specimens, usually males, with numerous scales here and there coloured a deep blue. Young: above: grey-white or silvery, with a head spot and dark vertebral line. Below: deep brown or black.

HABITS Frequents dampish places in woods, open plains, field and lane borders, rubbish-dumps and near wood-piles. Fond of basking but avoids extreme heat and cold. Burrows in soft soil and enters holes. Retires into rodent burrows and under logs. Not very active, shy and timid, but rarely bites. Easily tamed. Useful in the garden.

HIBERNATION From October to March, in holes in the ground, under wood-piles and in heaps of rubbish or vegetation, often in animal burrows. Sometimes gather together in large numbers like snakes.

FOOD Various small animals, including insects, woodlice and worms, but especially slugs. Food usually sought in evening or after rain and seized deliberately and slowly in the jaws.



BREEDING Mates from April to June, the male gripping the female in its jaws. Fertilization internal. Female produces from 6–24 living young, usually in August or September, which rupture at birth from a transparent membrane. They measure from 4–5 cm total length, tail about 4 cm. Has lived in captivity for 46 years.

VIVARIUM 1*A*, 2, 3, 9, 10. A good supply of loose soil required.

Tortoises

Tortoises, including marine forms, or turtles, belong to the order of reptiles called the *Chelonia*.[1] These peculiar animals possess a box-like external skeleton which is fused to the backbone and ribs, and covered with large scales called shields. The upper half of this shell is the *carapace*, the lower half the *plastron*. Head, tail and limbs can be withdrawn into the shell when the owner is sleeping or alarmed. Some chelonians are purely land forms, as in the typical tortoise family, the *Testudinidae*, which includes the well-known garden pet, the Algerian Tortoise. The largest of land forms are the Giant Tortoises, which are also the longest-lived animals in the world today. One specimen is known to have existed for 150 years. The shells of these land tortoises are domed and the feet stumpy, with short claws. They are chiefly vegetarian. Water Tortoises, or terrapins, are semi-aquatic in fresh water, having more flexible, flattened limbs with sharp claws and a flatter shell. They are mainly carnivorous and hunt their food in the water, and are fond of basking at the water's edge. Chelonians breathe by a pumping action of the neck and may sometimes hiss when the neck is withdrawn suddenly. They possess no teeth but have a horny beak, and although not dangerous can give a painful bite.

Like all reptiles, tortoises mate by a union, the female afterwards laying her eggs in soft earth. Terrapins and turtles come on land to lay their eggs in the same way. There is no parental care, and the eggs are incubated by the warm soil. The babies when hatched are able to care for themselves. Temperate species hibernate, the land forms burying themselves in soil or vegetation and the terrapins in mud, sometimes under water.

The *Chelonia* date back over 150 million years and number about 300 living species.

[1] In America the word turtle is used as a general term for all chelonians, i.e. land turtles, sea turtles, etc. In Britain it is used for the marine form only.

Tortoises require very little attention provided they are given plenty of sunlight and enough of the correct food. Land tortoises may be kept in a garden enclosure during summer (a low frame of wire-netting is sufficient to prevent straying) in which a drinking dish of fresh water is sunk to ground level. Shelter from wind and rain and from excessive sunshine must be provided. The vegetarian tortoises will eat various greenstuffs, including lettuce and cabbage leaves, dandelion leaves, the tops of root-crops, soft fruit and bread which is soaked in jam. They are best hibernated—and they show signs of hibernation usually in October—in a box of dry leaves or hay stored in a dry place away from draughts. They will only hibernate if kept at outdoor temperature, e.g. in a garage or outhouse. Tortoises must be protected from rain and cold weather since they are imported from warmer countries than ours.

Terrapins, which are carnivorous, will feed on various water animals, earthworms, pieces of raw meat, fish and occasional water-plants. They eat in water and there should be a sufficiently large and deep enough place for them to swim in. Their outdoor enclosure should have a low wall with a ledge to prevent escape, since they can climb, and a land space of loose soil for basking and in which the female can lay her eggs. Temperate species normally hibernate quite well out of doors in this country.

Young tortoises and terrapins are best brought indoors in cold weather. They will live quite well in a dish or aquarium of shallow water containing an island placed in a sunny window. Eggs, which are laid in the soil, should not be tampered with as they stand a better chance of hatching if left alone. Those found on the surface should be buried two inches deep in soft soil in a box in the exact position in which they were laid, and kept in warm surroundings (a greenhouse or airing cupboard) covered with a sheet of glass. They should not be touched or moved again.

IBERIAN OR ALGERIAN TORTOISE

SCIENTIFIC NAME *Testudo graeca* Linnaeus, 1758. Also named *Testudo ibera* by Schreiber in 1912.

DISTRIBUTION North-west Africa, Spain and northern Balkans, Mesopotamia and Persia.

EXTERNAL FEATURES Grows to about 30 cm. Shape very similar to Greek Tortoise. Main differences—posterior lobe of plastron has a flexible ligament, especially in female; fifth neural shield in large specimens; only 24 marginals, the shield over the tail being single; scales on fore-limbs large; a spur-like tubercle behind each thigh. Sometimes called the Spur-thighed Tortoise. Tail shield in male curved, in female flat.

COLOUR Carapace yellowish or pale olive-brown, each shield edged in black and marked with irregular dots. Plastron a yellow-brown. Sometimes whole shell is a uniform brown.

HABITS Similar to the Greek Tortoise. Perhaps less hardy in Britain.

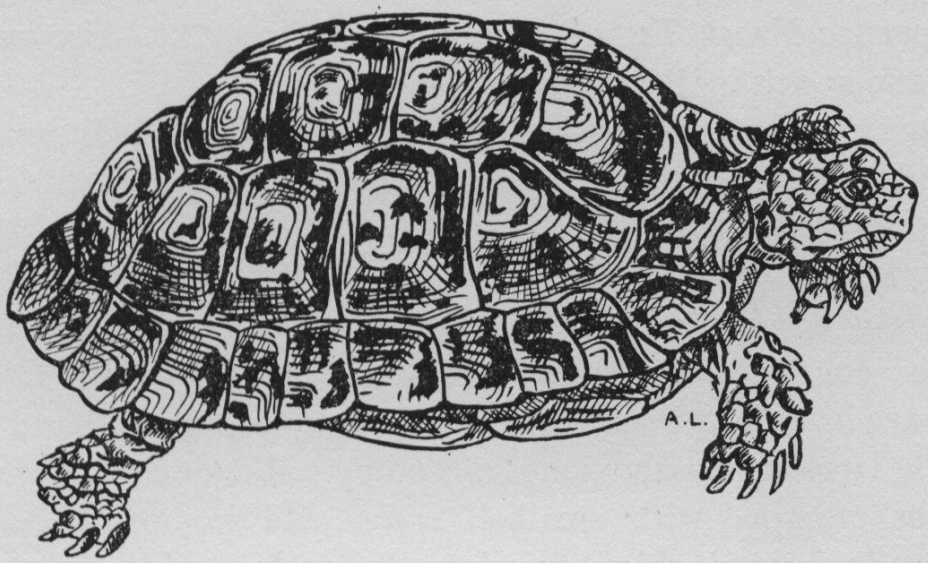
HIBERNATION Similar to the Greek Tortoise. In Britain specimens should be allowed to hibernate by October, in dry, cold, and draught-free surroundings. A box containing hay or dry leaves, placed in an unheated outhouse or shed, is a suitable hibernaculum. Tortoises which are allowed to roam the garden do little damage provided sufficient food is put down. Various greenstuffs, soft fruit and vegetables may be given, and shelter provided against inclement weather and excessive sunshine. Drinking water in a shallow dish is important. The Algerian Tortoise has been known to live for over 100 years. Gilbert White's 'Timothy' was kept for 54 years.

FOOD Similar to the Greek Tortoise.

BREEDING Similar to the Greek Tortoise.

VIVARIUM 8, 12, 13. Benefits from direct sunlight.

NOTE This tortoise is the popular pet sold in shops in Britain, and often called, erroneously, the Greek Tortoise. Eggs, often infertile, are frequently laid but will not hatch unless incubated in dry warm surroundings. They should be removed from the



nesting site and placed in a box of dry sand (buried about 2 in. deep) in exactly the same position in which they are found, i.e. without rotating the egg. Incubate at about 75° F. and do not disturb. The young should not be handled too often. They require warmth and, if possible, sunlight, also a selected diet of young greenstuff and fruit.

GREEK OR HERMANN'S TORTOISE

SCIENTIFIC NAME *Testudo hermanni* Gmelin, 1788. Also named *Testudo graeca* by Schreiber in 1912.

DISTRIBUTION Balkans, parts of Italy and some Mediterranean islands. Also southern France. Appears to be absent from Greece.

EXTERNAL FEATURES Grows to about 30 cm. Carapace strongly domed, without a ridge, and with smooth border, united to the plastron by a suture. Plastron flat in female, concave in male, a little shorter than carapace behind. Head with single large shield above nose. Stumpy tail ends in horny spur. Limbs stumpy, with smallish scales and immovable claws. Tubercle behind thigh missing. In male, tail longer with marginals above ending in a projection. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 25 marginals plus nuchal. (Marginal above tail is double.)

COLOUR Carapace a bright yellow, with a central, brown mark on each shield. Latter edged in black. Plastron brownish, with a black irregular band along border. Head, limbs and tail grey-brown.

HABITS Terrestrial. Inhabits sandy places and wooded areas, or among rocks. Diurnal and fond of basking but sensitive to cold. A hardy species even in Britain. Slow in movement.

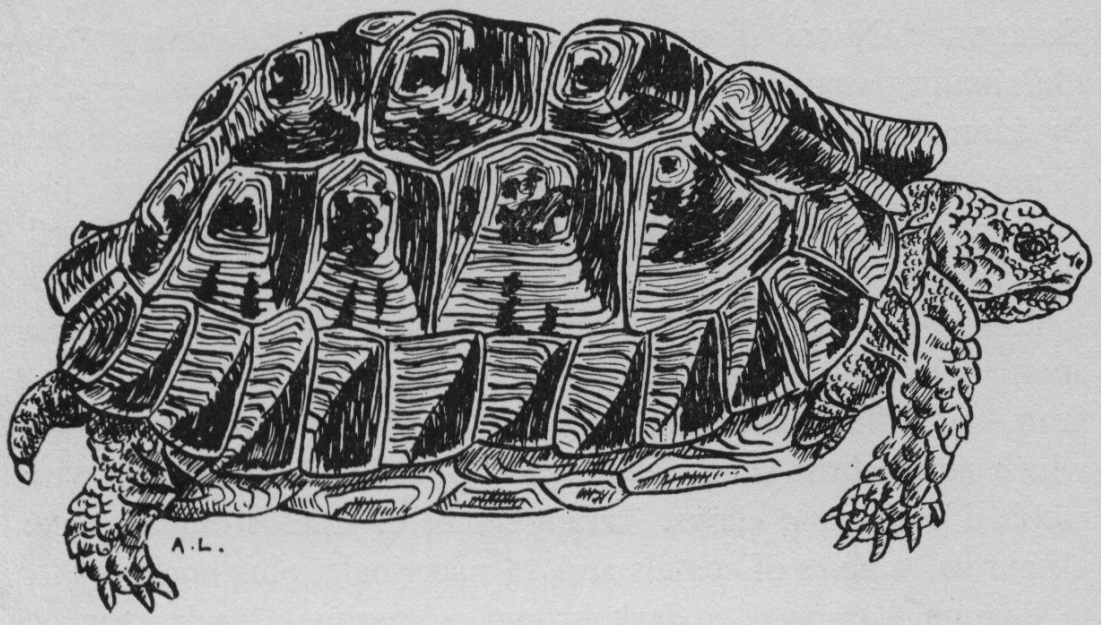
HIBERNATION October to March, in soft earth among rocks and in vegetation. May appear in mild weather.

FOOD Almost exclusively vegetarian. Plants, soft leaves and fruits preferred.

BREEDING Usually in late spring. Males, which sometimes fight, court females by butting their flanks and uttering hisses. Male climbs on to back of female and fertilization is internal. Female lays from 4–12 dull-white spherical eggs, about 3·5 cm in diameter, in soft earth in early summer. Incubation from 3–4 months, the young measuring about 4 cm. The Greek Tortoise has lived for 90 years in captivity.

VIVARIUM 8, 12, 13. Benefits from direct sunlight.

GREEK OR HERMANN'S TORTOISE



NOTE This species does not appear to exist in Greece in spite of its name. It is not so often seen on the market. Specimens are usually more brightly coloured than *Testudo graeca*. Most deaths in Britain are due to escaping tortoises which wander about and may eventually be killed by frost or from lack of food. They are best kept in a proper enclosure or in a garden from which there is no escape.

CAROLINA BOX TORTOISE

SCIENTIFIC NAME *Terrapene carolina carolina* Edwards, 1750. Originally named *Cistudo carolina* Also named *Testudo carolina* by Linnaeus in 1766. Called the Common Box Turtle in North America. Four sub-species.

DISTRIBUTION South-eastern and eastern States of North America.

EXTERNAL FEATURES Grows to about 15 cm, male a little smaller. Carapace dome-shaped, more so in female which has a faint keel. Plastron divided into two movable, hinge-like lobes, which can seal the shell. Upper jaw hooked and limbs scaly with webbed digits and claws. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 25 marginals, plus nuchal.

COLOUR Carapace, a dark brown, sometimes black, marked with yellow. Plastron blackish with yellow marks. Head, limbs and tail brown marked with yellow or orange.

HABITS Mainly woodlands, making for damp areas during dry spells. A good swimmer but prefers land. May retire into mud during very hot spells. Diurnal in habits and inclined to bite.

HIBERNATION From November to May. Digs itself into soil, sometimes under water.

FOOD Omnivorous. A variety of animals, including worms, insects and fish, also carrion. Fruit and soft plants.

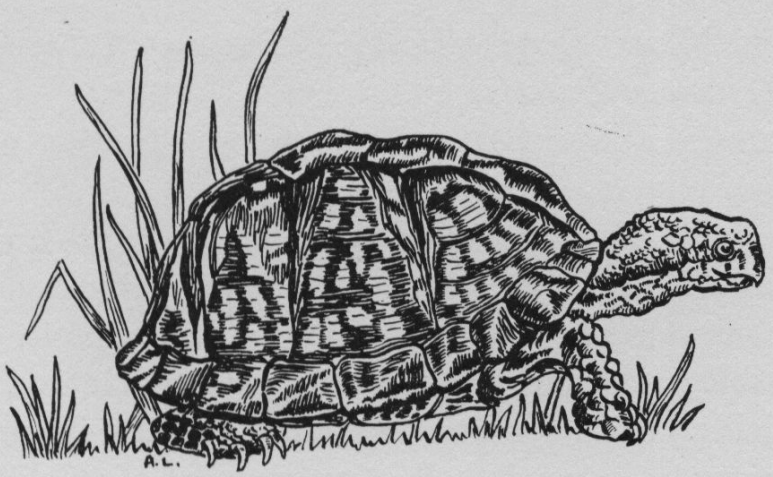
BREEDING Mating usually occurs on land in June. Female lays about 4 oval white eggs, 3·5 cm long, in a hole in the ground which she digs with the hind-feet. Incubation 3 months, the young measuring about 3 cm. A specimen has been kept for 123 years in captivity.

VIVARIUM 8, 12, 13. Semi-aquatic.

NOTE Box tortoises, so named from the way the shell closes, are looked upon as terrapins which are reverting to a land existence. They are hardy in captivity and should live for many years.

A smaller species, the Ornate Box Tortoise (*T. ornata*), occurs in the Western States. It is attractively marked in reddish-

CAROLINA BOX TORTOISE



brown with yellow spots and radiating stripes on the carapace. It prefers drier, more open country.

EUROPEAN POND TORTOISE

SCIENTIFIC NAME *Emys orbicularis* Linnaeus, 1758. Originally named *Testudo orbicularis*.

DISTRIBUTION Central and southern Europe, north-west Africa and western Asia.

EXTERNAL FEATURES Can grow to 35 cm, sexes about equal. Carapace flattened, elliptical and joined to plastron by a ligament. Plastron convex in female, concave in male. Limbs flattened, with flexible, webbed digits and sharp, curved claws. Head with large shields. Tail long and pointed, especially in male whose cloaca protrudes beyond shell. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 24 marginals, plus nuchal. Plastron: 6 pairs.

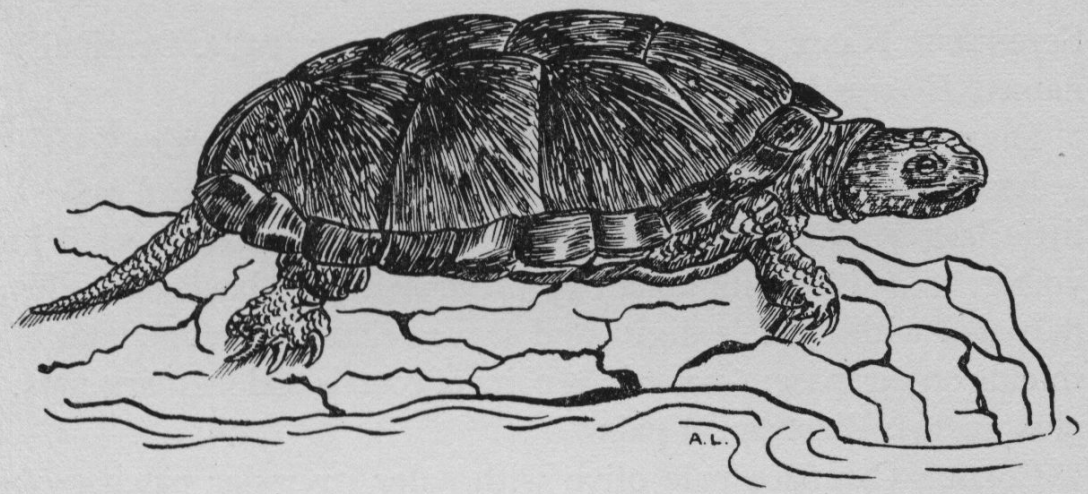
COLOUR Carapace a deep brown or reddish-brown, with patches or streaks of yellow, dull in old specimens. Plastron greenish, brown or black. Head, limbs and tail black, marked with yellow underneath. Top of head spotted.

HABITS Inhabits borders of lakes, ponds, etc, spending much of the time on land in warm weather, retiring into water in bad weather or at night. Can move actively on land but is best at swimming, and enters water when disturbed.

HIBERNATION From October to March, in soft earth or mud, usually under water. May emerge in mild weather during winter.

FOOD Mainly carnivorous, catching live, aquatic animals, from insects to fish and amphibians, with the mouth and tearing prey apart with claws. A partial scavenger and eats occasional aquatic plants.

BREEDING Throughout the warmer season, commonly in March. Male approaches female, usually in water, and after swimming around her, sometimes pushing and biting, clambers on to her back in order to mate. Fertilization internal. From 3–16 dull-white oval eggs, with a leathery shell 3 cm long, are laid by the mother in a hole she excavates in soft, damp ground with her hind-feet. Incubation about 4 months, the baby tor-



toises measuring about 5 cm including the tail. A specimen has lived for 120 years in captivity.

VIVARIUM 7, 9, 11, 12. May attack smaller animals. Benefits from direct sunlight.

NOTE This hardy terrapin, once a native in Britain, lives well in captivity. Sunlight is beneficial.

SPANISH TERRAPIN

SCIENTIFIC NAME *Clemmys leprosa* Schweigger, 1814. Originally named *Emmys leprosa.*

DISTRIBUTION Spanish peninsula and north-west Africa.

EXTERNAL FEATURES Grows to about 20 cm, the female a little larger. Shape terrapin-like. Carapace flattened, keeled in young, joined by a ligament to plastron. Head largish. Limbs flattened with flexible digits and curved claws. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 24 marginals, plus nuchal. Plastron: 6 pairs.

COLOUR Carapace pale olive with paler irregular patches on each shield. Plastron yellowish, soft parts olive with orange or yellow streaks or spots. A round orange spot behind each eye and a ring around each ear. In the young the deep olive carapace has an orange patch on each shield.

HABITS Similar to European Pond Tortoise, perhaps more aquatic. Spends long intervals basking in the sunshine on floating logs. Can produce a peculiar musk odour from scent glands in cloaca.

HIBERNATION Similar to European Pond Tortoise, on land or in water. Retires later, occasionally not at all, because of its more southerly range.

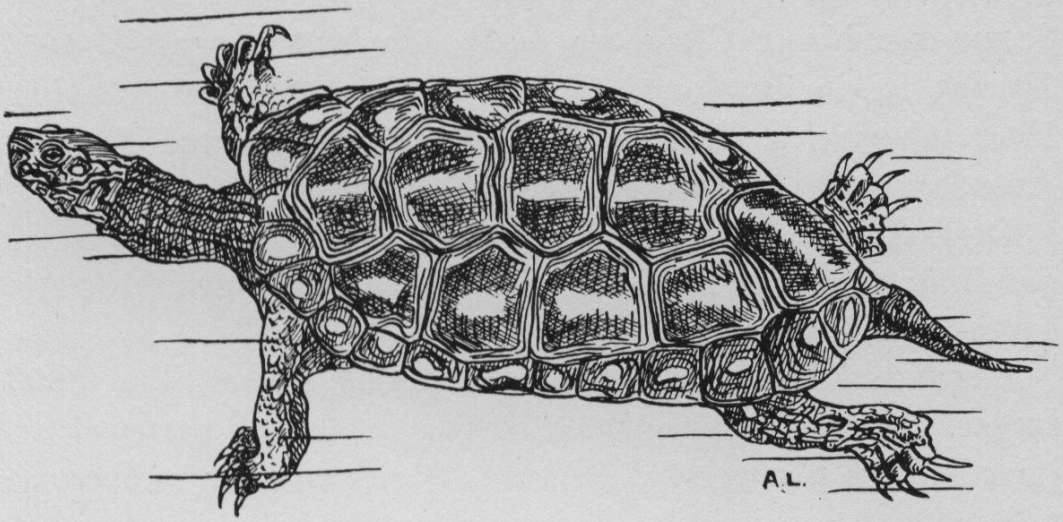
FOOD Similar to European Pond Tortoise. Various small aquatic animals, such as insect-larvae, crustaceans, molluscs and fish, also aquatic plants.

BREEDING Similar to European Pond Tortoises. The male clambers on to back of female to mate, the female laying about 6–10 eggs. These are buried in a nest which she excavates with the hind-feet.

VIVARIUM See European Pond Tortoise.

NOTE This species appears to be less hardy in captivity than the European Pond Tortoise and requires greater protection from sudden changes in temperature. European species of terrapins, or pond tortoises, number only 3. The majority of these fresh-water chelonians occur in North America.

SPANISH TERRAPIN



PAINTED TERRAPIN

Scientific Name *Chrysemys picta marginata* Aggassiz, 1857. Species originally named *Testudo picta* in 1783 by Schneider. Four sub-species. The above is the Central Painted Turtle in America, and is the best-known sub-species.

Distribution The central States of Illinois, Kentucky, Michigan, Indiana, Ohio, Virginia, Pennsylvania and New York. Also south-east Canada.

External Features Grows to about 12 cm, the female larger. Shape terrapin-like. Carapace oval and flattened and joined to the plastron by a suture. Digits entirely webbed and tail moderate in length. Head with undivided skin. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 15 marginals, plus nuchal. Plastron: 6 pairs. Neurals alternate with costals, but are confluent in Eastern Painted Turtle.

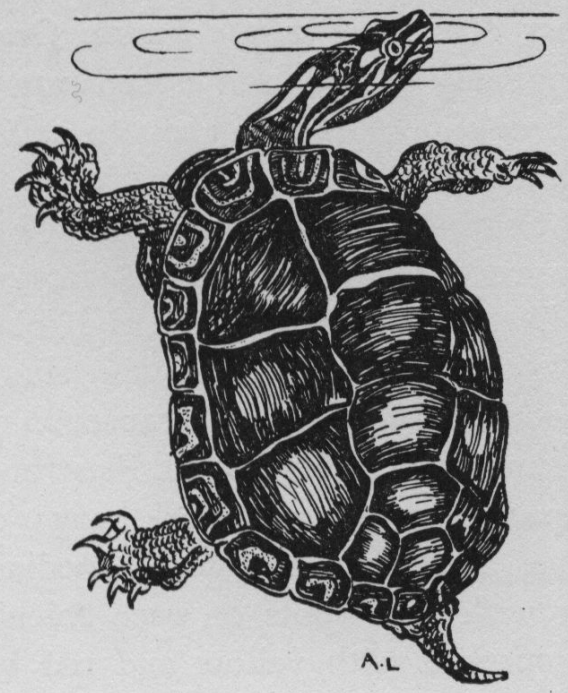
Colour Carapace a dark brown or blackish, with yellow dorsal line and yellow marks on costals. Marginals red with crescentic black marks. Plastron yellow or rose with a symmetrical dark area in the middle line. Head, limbs and tail brown, marked with symmetrical yellow and red bands. Three bands along the neck, one passing to the chin and one to each eye.

Habits Inhabits borders of lakes, ponds and streams. Very aquatic and usually seen basking on logs and vegetation which floats on water. Retires at night and makes for water when disturbed.

Hibernation From October to April in soft ground or mud, sometimes under water.

Food A variety of smaller aquatic animals, including insects, crustaceans, molluscs, fish and amphibians. Usually feeds under water. Eats occasional plants.

Breeding Similar to European Pond Tortoise. The male swims around the female, often attempting to bite her and vibrating the finger-tips against her face. Mating normally in June. Female lays on average 9 oval, dull-white eggs, 3–4 cm



long, in holes in soft ground. Incubation about 3 months, the young terrapins measuring about 4 cm.

VIVARIUM See European Pond Tortoise.

NOTE Specimen illustrated is the Eastern Painted Turtle (*Chrysemys picta picta*).

ELEGANT TERRAPIN

SCIENTIFIC NAME *Pseudemys scripta troostii* Gray, 1870. Dark males were originally placed into a separate species, *Emys troostii*, by Holbrook in 1842. The above is called the Troost's Turtle in North America. Three sub-species.

DISTRIBUTION South-eastern States of North America.

EXTERNAL FEATURES Grows to about 18 cm, the female larger. Shape terrapin-like. Carapace flattened and joined to plastron by a suture. Digits strongly webbed with sharp claws. Head smallish. Arrangement of shields on carapace: 5 neurals, 4 pairs of costals and 24 marginals, plus nuchal. Plastron: 6 pairs.

COLOUR Carapace brownish with dark brown or black marks and yellow stripes. Each marginal with a median yellow band. Plastron yellow with dark spots on each shield. Head, limbs and tail brown marked with yellow and red bands. Sides of head and neck with 3–7 yellow stripes extending backwards from behind the eye, the upper one including a blood-red elongated patch. Male often melanistic.

HABITS Similar to Painted Terrapin. Very aquatic and fond of basking.

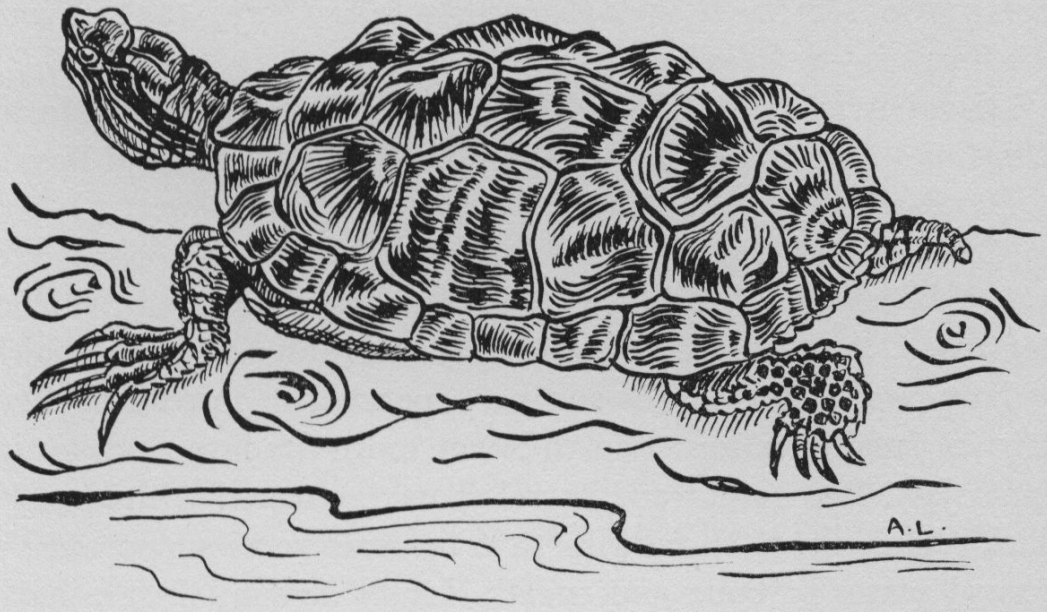
HIBERNATION Similar to Painted Terrapin. From October to March, on land or buried in mud under water.

FOOD Similar to European Pond Tortoise. A variety of small aquatic animals, such as insect-larvae, crustaceans, molluscs and fish, with occasional plants.

BREEDING Similar to Painted Terrapin. Female lays about 10 white eggs, 3–4 cm long, in a nest excavated in the earth. Incubation is about 3 months, the young measuring 4 cm.

VIVARIUM See European Pond Tortoise. Note below is important.

NOTE Most American specimens of terrapins sold as pets are juveniles which originate from the Gulf states. They are not easily reared in countries with cold winters and require constant warmth (not below 75° F.), maximum sunlight, and a variety of diet. Apart from small aquatic animals they will eat



chopped raw meat and fish, and often a quantity of aquatic plant life and tender greenstuff. Two common complaints are poor shell growth (lack of calcium) and a form of rickets caused by a vitamin deficiency.

MISSISSIPPI ALLIGATOR

SCIENTIFIC NAME *Alligator mississippiensis* Gray, 1831. From the Spanish—*una lagarta*, a lizard.

DISTRIBUTION The United States of America, from North Carolina to the Rio Grande, especially in the Mississippi Basin.

EXTERNAL FEATURES Can grow to 16 ft (about 490 cm), but specimens of 12 ft or more (about 370 cm) are now considered rare. Male larger, heavier, with longer head. Head longish and depressed, snout broad and rounded, neck stout with two pairs of large scutes forming a square, separated in middle by two pairs of smaller scutes. Fourth lower tooth fits into a socket in upper jaw. Body stout and barrel-shaped, covered with strong, thick plates, those on back in 18 transverse rows supported by dermal plates of bone underneath. Limbs strong, fingers half-webbed, toes two-thirds webbed.

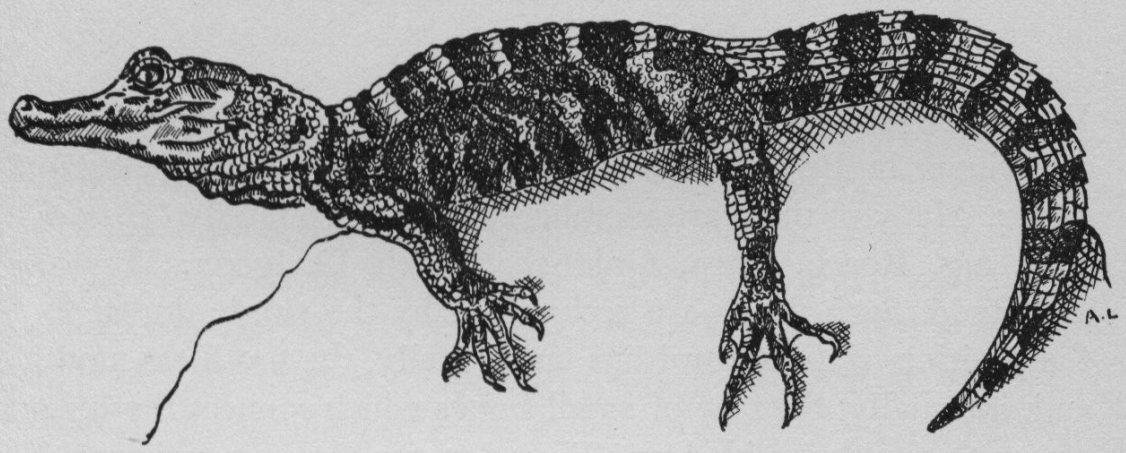
COLOUR Above: greenish-black or dark brown, the male brighter during breeding. Below: yellowish. Young brownish with yellow transverse bands (see illustration).

HABITS Inhabits water of smaller rivers, or swamps, lying submerged but with snout just exposed, or on mud-banks and logs. Dives to bottom if disturbed. May dig a cave in bank below water. Retreats to larger bodies of water with oncoming drought. Can produce a hissing roar. Specimens are bred on farms, and caught, for skins.

HIBERNATION Buries in mud or holes in ground during colder periods or in very dry spells.

FOOD Numerous water animals, including fish, water fowl, mammals, also carrion. Not considered dangerous to man except when large.

BREEDING May to July, the males seeking mates, fighting fiercely and roaring loudly. Female constructs a nest of leaves, twigs and debris about 3 ft high and 8 ft in diameter, on river bank, laying from 20–30 white oval eggs, about 5–9 cm long, in top of nest. Incubation about 2 months, the young appearing in, usually, October, about 20 cm long. There is no parental care



and the young make for water. Sometimes mother may construct a cave nearby. A Paris specimen has lived for 73 years and one in London for about 100 years.

VIVARIUM 7, 8, 11, 12. Outdoors in summer only. Will attack smaller animals.

Cold-water Aquarium Fish

With one or two exceptions the cold-water fishes seen in aquariums in Britain belong to the class of Bony Fishes, or *Pisces*. Many of them are members of the Carp family (*Cyprinidae*), e.g. Roach, Carp, Goldfish, Tench, Gudgeon, Minnow and Rudd. Such fishes are recognized by the single dorsal fin, the position of the ventral fins on the belly, the toothless mouth and, internally, the row of small bones which connect the inner ear with the swim-bladder. They are mainly vegetarian, also taking small water animals, and the breeding males produce whitish tubercles on the head and gill covers.

Some, like the Carp and Tench, are extremely hardy and can withstand long exposure to air and foul water. They lurk in mud and water-plants, whereas Roach, Rudd and Minnow are more lively, roving in shoals. The Gudgeon is a bottom-feeder with a ventral mouth.

Other bottom fish are the Loach (family *Cosbitidae*) and Miller's Thumb, small fish which hide under stones. Another small fish, the Stickleback (family *Gasterosteidae*), displays parental care. The male builds and guards the nest in which the eggs are laid. This can be watched in an aquarium. It is largely carnivorous.

Other carnivorous fishes, much larger, are the Perch and the Pike, which as adults become solitary, lurking in reeds to rush out at their prey. The former (family *Percidae*) has two dorsal fins, the first with spiny rays, ventral fins on the chest and a mouth with many sharp teeth. The Pike, one of our largest fresh-water fish (family *Esocidae*), has very sharp teeth and is called, not undeservedly, the fresh-water wolf.

The goldfish and its varieties are domesticated ornamental fishes of the Carp family which have great beauty of colour and shape, and normally live in the aquarium.

About 37 species of British bony fishes occur in fresh water.

Fishes, as gill-breathing animals, respire in water and utilize the dissolved oxygen which passes through the water surface, or is released by water-plants. The amount of water which will support a fish population in any given tank is largely dependent upon the ratio of the water volume to its surface area. The larger the latter the more oxygen can be dissolved in a given time.

Fish consequently live better in shallow water, below a large surface, than in a deep, narrow tank, or narrow-necked container like a goldfish bowl.

Fish swimming at the surface and gulping air with the mouth are usually suffering from oxygen shortage, which may be due to overcrowding, bad water, a poor oxygen supply or a rise in temperature. An approximate rule for avoiding overcrowding is about three inches of fish to a gallon of water. Polluted water, with an obvious bad odour, is usually the result of decomposition, caused by allowing uneaten food or dead fish to remain in the tank. Bacterial action which causes this decay can be arrested by placing the tank in brighter light. This will also help to overcome the third cause of oxygen shortage, poor oxygen supply, as plants produce oxygen in the presence of sunlight. To avoid a rise in temperature the tank should not be placed in direct sunlight, but near a window, in moderate lighting, using the plants as a screen. Place these along the back of the tank, window side, anchored in well-washed aquarium sand or gravel, which slopes from the back towards the front. Excessive debris will then collect towards the front and can be removed by the siphon method.

'Green water,' caused by excessive growth of algae, is a healthy sign but unsightly, and can be remedied by introducing a few water-fleas. Snails will help to clean the glass from algal growth, but may attack the plants.

Fish of similar size may be associated together, the docile kept apart from the aggressive kind. Fish live, grow and breed more easily in ponds where greater space and natural food are found.

COMMON CARP

SCIENTIFIC NAME *Cyprinus carpio* Linnaeus, 1758.

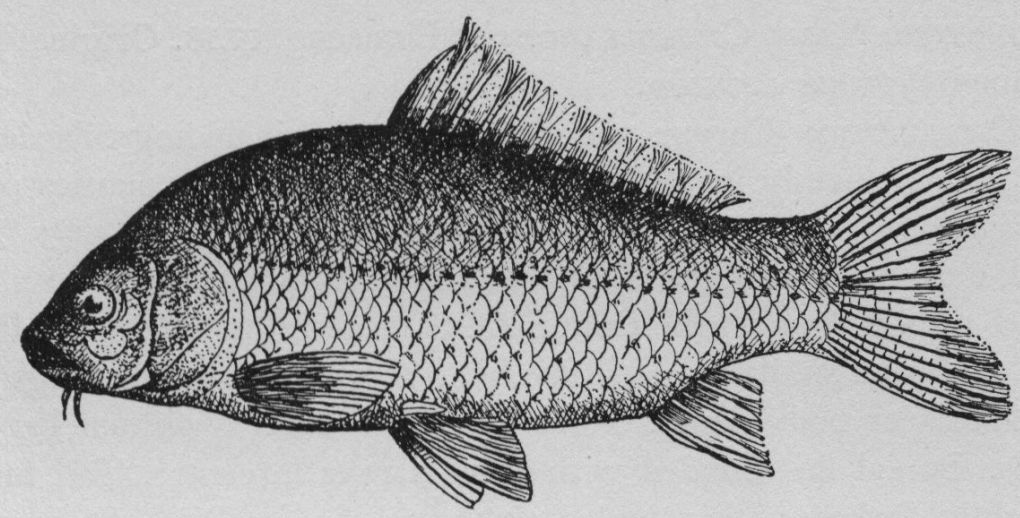
DISTRIBUTION Widespread over Europe and Asia. Probably Asiatic in origin. In Britain, probably introduced. Known as early as 1496 in England and the early seventeenth century in Ireland. Introduced into North America and other countries.

EXTERNAL FEATURES Average adult size in Britain about 4 lb, measuring about 18 in. (45 cm). A record for Britain is 26 lb, Germany 70 lb, and South Africa 41 lb. Shape elongated, the body depth about half body length. Profile of smallish, low-set head forms a steady contour with back. Snout blunt and lips fleshy with one pair of reddish barbels at corners of mouth and another pair, shorter and paler, on upper lips. Dorsal fin long and concave, longest rays in front but first 3 or 4 rays short. Tail fin well forked, anal fin short. Fin-rays soft, approximately as follows: dorsal 22, pectoral 17, ventral 9, anal 8, caudal 17–19. Large scales, fan-shaped, numbering 34–40 along lateral line. Breeding male produces white tubercles on head and gill covers, female in season becoming swollen with eggs.

COLOUR Golden olive-brown or bluish-green, darkest on head. Eyes with golden iris; fins dark brown, even black, lateral line interrupted. Belly whitish-yellow. The Golden Carp or Hi Goi is a variety, also Leather and Mirror Carps.

HABITS Inhabits quiet waters in lakes, ponds and moats, especially on monastery sites, also backwaters, preferring to lurk in the plants or on the bottom by day. At evening rises to surface and can be heard making sucking noises as it feeds. Sluggish in movement and very tenacious of life. Can stand long emergence, extremes of temperature and shortage of oxygen. Praised by the fresh-water angler for its intelligence in avoiding capture. Sense of hearing and smell said to be good. Average life about 14 years.

HIBERNATION Usually retires into mud or debris in deepest part of its home during the colder months, from about November to April.



Food Very varied. Small water animals of all descriptions, aquatic plants and occasional carrion. Fond of nosing in mud for food.

Breeding In early summer, usually May or June. Male chases or 'drives' female through water-plants, where she lays numerous greenish eggs about $\frac{1}{3}$ mm in diameter. In a female weighing 10 lb were found 700,000 eggs. Maturity usually reached in 3 years, the fish weighing about $\frac{1}{2}$ lb. Hybrids with other fish occur. Has lived in the aquarium for 6 years (a Mirror Carp for 24 years). A record weight for Mirror Carp—44 lb, measuring 3 ft 7 in. (British).

Aquarium 5 or pond. A hardy fish.

CRUCIAN OR BRONZE CARP

SCIENTIFIC NAME *Carassius carassius* Linnaeus, 1758. Originally named *Cyprinus carassius*.

DISTRIBUTION Europe and northern Asia, including Siberia. In Britain mainly in the eastern and south-eastern counties of England.

EXTERNAL FEATURES Grows to about 12 in. (30 cm) and up to 3–4 lb, longer on the Continent. A record for Britain is 4 lb 11 oz. Shape similar to Goldfish, with more arched back, length about twice body depth. Snout blunt, lips fleshy, without barbels. Dorsal fin rounded with longest rays in centre. Tail fin slightly forked with rounded tips, anal fin smallish, fin-rays soft, approximately: dorsal 21, pectoral 14, ventral 9, anal 9, caudal 19. Large scales, fan-shaped, numbering 28–35 along lateral line. Breeding male has tubercles on head. A slimmer variety with more forked tail is called the Prussian Carp (formerly *Carassius gibelio*).

COLOUR Variable. Olive or greenish-brown or dull bronze, darkest on head, grading to brass-yellow on sides. Medium eyes with greenish-black iris. Dorsal fin grey-black, lower fins reddish. Belly brownish-yellow.

HABITS Similar to Common Carp. Lives to about 7 years. Sometimes young specimens occur in great numbers in certain ponds.

HIBERNATION Similar to Common Carp, retiring into hollows or mud in deeper water.

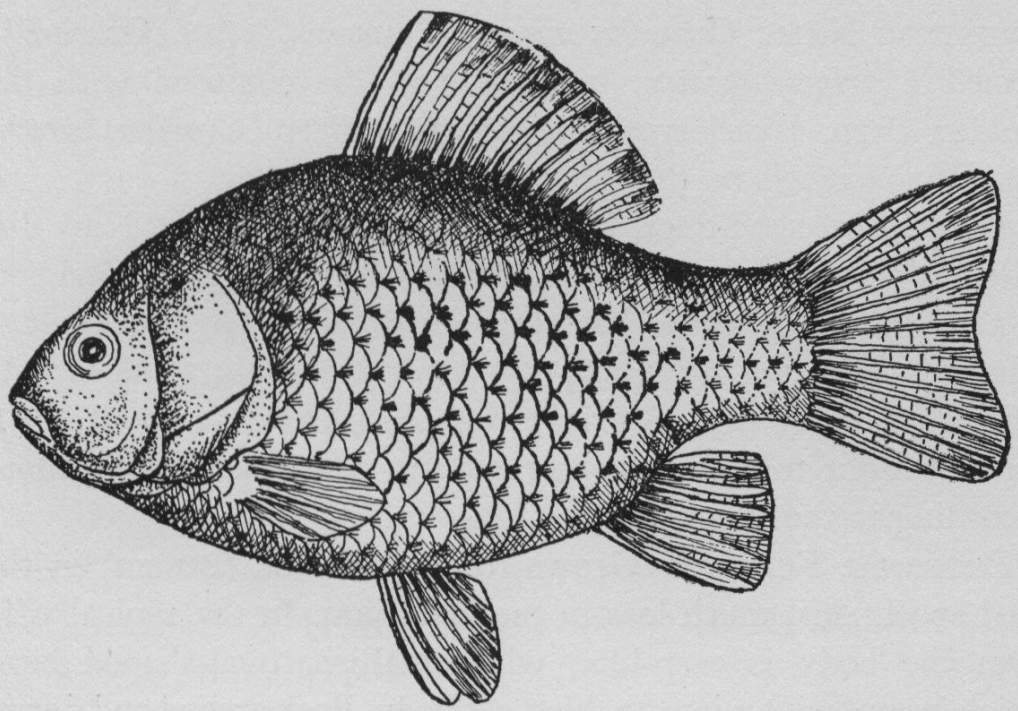
FOOD Similar to Common Carp. Various small water animals, aquatic plants and aquatic worms.

BREEDING Similar to Common Carp. The male chases the female during courtship, and if it is to breed in captivity requires ample space in which to perform. Female lays 100,000–300,000 small eggs among plants in shallow water.

AQUARIUM 5 or pond. A hardy fish.

NOTE This is the carp, apart from the Goldfish, which is most frequently on sale in pet shops in Britain. The Crucian Carp is

CRUCIAN OR BRONZE CARP



more common in Britain than the Common Carp, and small specimens are popular as aquarium fish. They are hardy and live well in the garden pond.

COMMON GOLDFISH

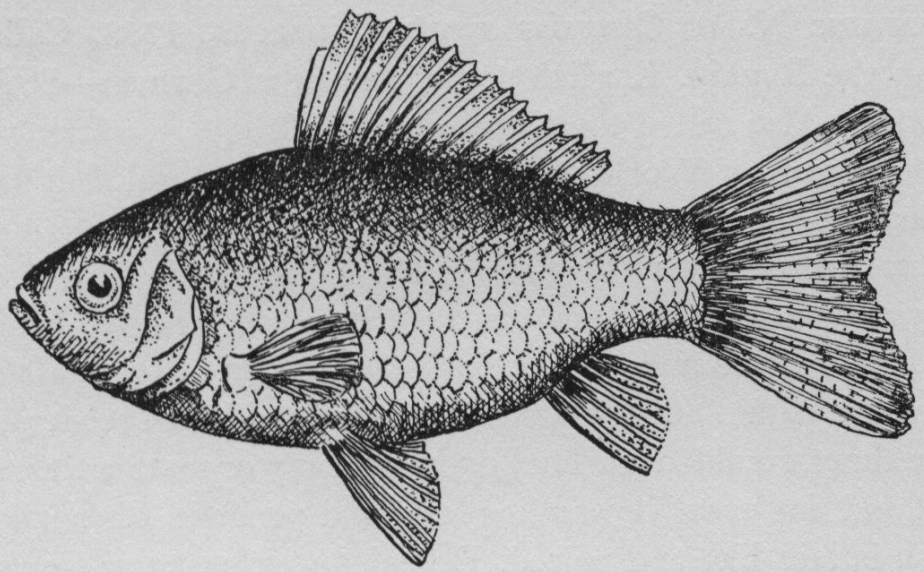
SCIENTIFIC NAME *Carassius auratus* Linnaeus, 1758. Originally named *Cyprinus auratus*, but must not be confused with the Golden Carp, a variety of the Common Carp (*Cyprinus carpio*) which has barbels on the mouth.

DISTRIBUTION Oriental in origin. China and Japan. Now distributed throughout the world as an aquarium and pond fish in many fancy varieties, both in colour and shape, the result of selective breeding from the ancestral stock. Introduced into Britain probably in the early seventeenth century, about 1611. First brought to France as a present to Madame la Pompadour according to the historian.

EXTERNAL FEATURES Grows to about 12 in. (30 cm) in the feral specimens, much less in the aquarium. In the typical wild form the body is carp-like, with smallish, oval-shaped head which is confluent with the thick-set body. Back arched and dorsal fin long, with almost straight margin. Fin-rays soft, approximately: dorsal 22, pectoral 15, ventral 9, anal 8, caudal 25–30. Large scales fan-shaped, numbering about 25–30 in the lateral line. No barbels and tail fairly forked. Breeding male has tubercles on head and gill covers. The sketch shows the Common Goldfish as bred to the standards required for show purposes. Some of the modifications produced from the wild type are: Lionhead (a raspberry-like head), Telescope-eyed (protruding eyes), Fantail (double-tailed), Shubunkin (variegated colouring), Veiltail (double-flowing tail), and Celestial (upturned eyes).

COLOUR Wild specimens, called Chinese carp, are a dull, greenish-olive, darkest above. The Common Goldfish may be orange, silver, light or deep gold, even black, either separately or multi-coloured. All baby goldfish exhibit the ancestral colour and go through a series of colour changes. Reversion to type always occurs in feral specimens, as has happened in Madagascar. For a perfect Common Goldfish a deep golden orange is preferred.

HABITS Similar to Common Carp. Has lived for 18 years in



the aquarium. A record British specimen—2½ lb, measuring 14 in. long, 6 in. deep.

HIBERNATION Similar to Common Carp at normal temperatures.

FOOD Similar to Common Carp.

BREEDING Similar to Common Carp.

AQUARIUM 5 or pond. A hardy fish.

NOTE The Goldfish frequently breeds in the aquarium, sometimes when only 3–4 in. long, provided that it has reached maturity. A pair of adults require a change of surroundings by themselves with ample space in which to perform. A supply of natural food is given to induce courtship and laying, the water maintained at cool temperatures, and the female provided with a spawning bed. Suspending a bunch of water-plants from a floating cork is one method. This can afterwards be removed with the eggs to safeguard the fry from the parents. Most fish devour their young on occasions.

VEILTAIL OR JAPANESE FRINGETAIL

SCIENTIFIC NAME *Carassius auratus* Linnaeus, 1758. Called in Japan the Ryukin. English name, from the German—Schleierschwanz. Also called the Nagasaki Goldfish.

DISTRIBUTION World-wide as an ornamental goldfish for the aquarium.

EXTERNAL FEATURES This goldfish variety is known from drawings in Japan as early as the sixteenth century. Probable origin is China and thence to Japan via the Ryuku Islands, hence the name. Some standards, set by goldfish breeders, are: body short, rounded and chubby, with shiny or matt scales, short head and flat eyes. Lower fins long and pendent, especially tail which is lace-like and paired. Dorsal fin at least three-quarters as high as body, sail-like and carried erect. A form known as the Telescopic Veiltail Goldfish, with protruding eyes, has been produced in America by crossing the Japanese Fringetail with the Chinese Telescopic-eyed Goldfish.

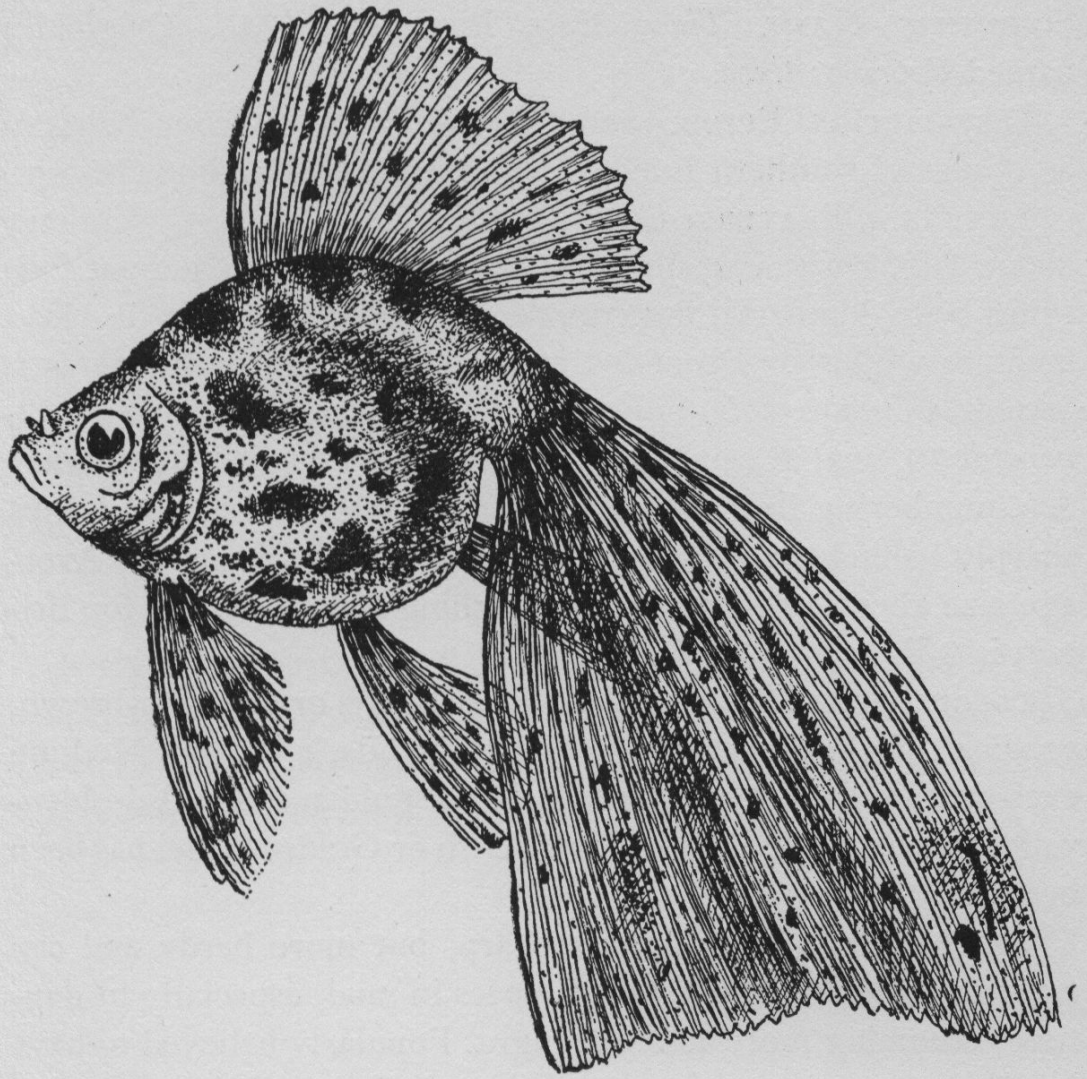
COLOUR Most variable. Shiny scaled forms in orange, yellow, black and silver or combination of all four. Matt scaled forms in blue, mauve, orange or yellow, or combination, with black spots. An all-black specimen, much prized, is called a Moor.

HABITS Similar to Common Carp. A half-hardy variety of goldfish which requires plenty of space and close attention to diet. Swims with a wriggling motion of the body, which gives graceful movements to the drooping tail. Will not winter outdoors satisfactorily in this country and does not tolerate violent fluctuations in temperature.

HIBERNATION Similar to Common Carp if kept at normal temperatures. As this variety is best wintered indoors, hibernation will not occur and feeding should continue, although in smaller quantities.

FOOD Similar to Common Carp, but is inclined to have intestinal disorders because of cramped organs. Should not be fed too frequently on the artificial goldfish foods. Chopped earthworm, *Tubifex* and *Daphnia* are recommended in the diet.

VEILTAIL OR JAPANESE FRINGETAIL



BREEDING Similar to Common Carp. Many of the young of this variety will not resemble the parent, since the various characteristics (i.e. colour, shape, fins, etc.) can only be maintained by selective breeding. The careful breeder will 'cull' his stock through various generations, picking out certain specimens so as to breed in the different 'points' which are required.

AQUARIUM 5. Half-hardy fish.

GREEN TENCH

SCIENTIFIC NAME *Tinca tinca* Linnaeus, 1758. Originally named *Cyprinus tinca.*

DISTRIBUTION Europe and Siberia. Missing from Norway and parts of southern Europe. Widespread throughout Britain.

EXTERNAL FEATURES Grows to about 2 ft (61 cm), weighing about 8 lb. Shape carp-like, more elongated, length about four times body depth. All fins rounded including lobes of tail. Head medium with short, rounded snout and a small barbel at each corner. Fin-rays soft, approximately: dorsal 11, pectoral 17, ventral 10, anal 9, caudal 19. Scales small, rounded and numerous, numbering from 90–120 along the lateral line, which dips sharply behind the gill-cover. Body covered with mucus. Average size about 12 in. (30 cm), weighing 1 lb. A record for Britain is 7 lb.

COLOUR Somewhat variable. Deep olive or blackish-brown, grading to a paler shade on belly. Fins dark brown. Medium eyes with red or brown iris inside a golden ring. A golden-yellow variety called the Golden Tench or Golden Schlei has been bred.

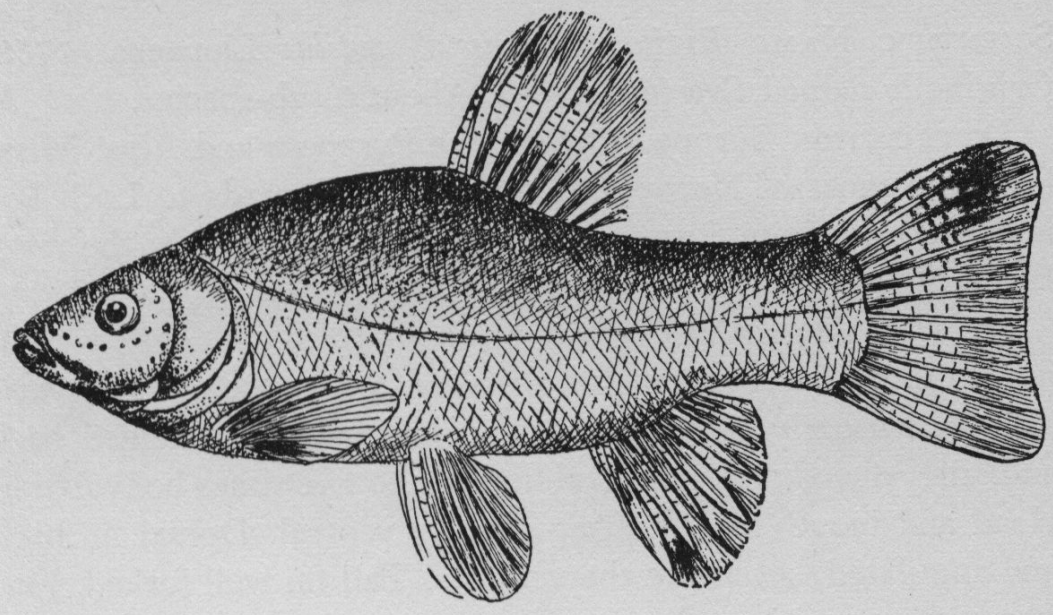
HABITS Similar to Common Carp, but more hardy and can exist in very foul water. Often buries in mud, especially in daytime, becoming more active at night. Popularly believed to have healing properties with other fish and often called the Doctor Fish. Even more sluggish than Carp. Average life about 7 years.

HIBERNATION Similar to Common Carp. Will bury into mud, sometimes completely out of sight.

FOOD Similar to Common Carp. Especially fond of small aquatic molluscs and crustaceans.

BREEDING Mating similar to Common Carp. Breeds from May to August, the female depositing numerous small greenish eggs among water-plants in shallow water. A 3-lb female can lay about 300,000 eggs.

AQUARIUM 5 and pond. A hardy fish.



NOTE Like carp, this fish displays considerable intelligence and may be trained to take food from the fingers. It will also react to sounds and movements of the owner which are associated with feeding.

SCIENTIFIC NAME *Rutilus* (*Leuciscus*) *rutilus* Linnaeus, 1758. Originally named *Cyprinus rutilus*. About 6 sub-species.

DISTRIBUTION Europe, north of the Pyrenees and Alps. Missing from most of Norway. In Britain northwards to Loch Lomond, absent from Cornwall. In Ireland local, mainly the river Blackwater.

EXTERNAL FEATURES Grows to about 12 in. (30 cm), weighing up to 1¼ lb. A record for Britain is 3 lb 14 oz. Shape variable, but usually elongated, with narrow body, rounded back and fairly deep belly, length about four to five times body depth. Head and mouth small, latter slightly ventral. Dorsal fin high and angulated, set above the ventrals. Tail fin well forked. Fin-rays soft, approximately: dorsal 10, pectoral 17, ventral 10, anal 13, caudal 19. Largish, fan-shaped scales, numbering from 40–46 along the lateral line. Breeding male has tubercles, as in Carp.

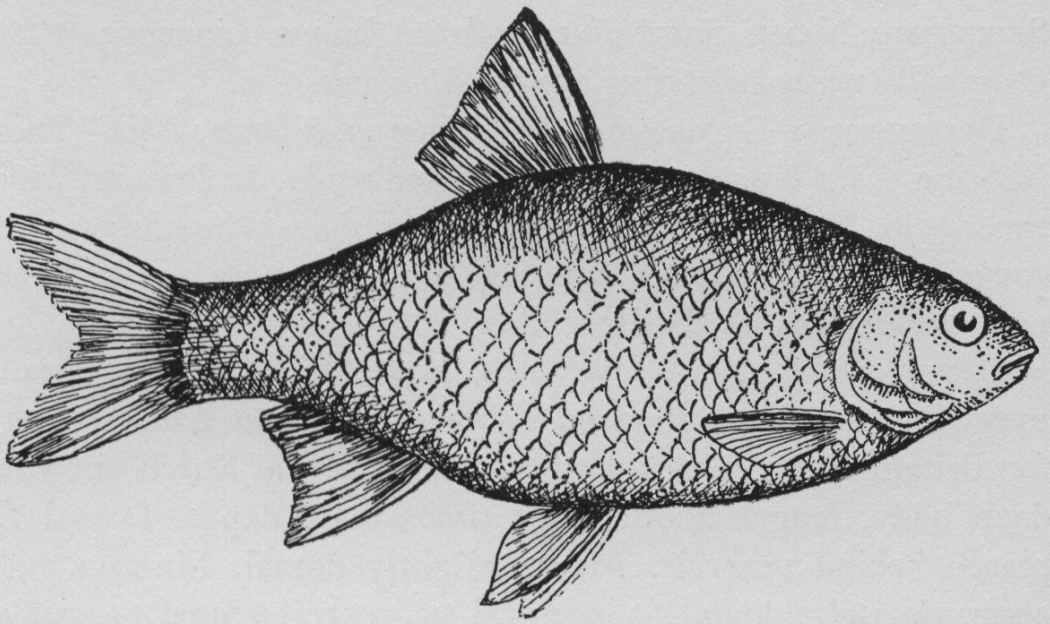
COLOUR Variable. A dark green, bluish or brown with a metallic lustre caused by angle of light, paler on sides. Smallish eye with yellow iris. Fins reddish, the anal and ventrals especially a deep red. Belly silvery-white.

HABITS Lives in shoals in rivers, canals, ponds and lakes, even brackish water. Lively in action and wary of danger. Usually in constant motion, keeping to deeper water in daytime, feeding in shallows in the evening. A favourite with the angler. Not easily acclimatized to the aquarium. Average life about 6 years.

HIBERNATION Retires to deep water in November and remains in a dormant condition until spring.

FOOD Water-plants, small aquatic animals and insects. Food sometimes taken at the surface.

BREEDING From May to June in Britain. The fish assemble in shallow places, the males 'driving' the females which lay on average 100,000 small greenish eggs among water-plants. Hybrids with Rudd common. Has lived for 7 years in captivity.



AQUARIUM 5 and pond. A hardy fish but lives best in the pond.

NOTE The Roach is perhaps more sought after by the angler than the fish-keeper. Although sensitive to captivity and prone to disease it can, with a little care, be acclimatized to the cold-water aquarium. Specimens up to 6 in. are best and these can be kept in good health for a number of years.

RUDD OR RED-EYE

Scientific Name *Scardinius erythrophthalmus* Linnaeus, 1758. Originally named *Cyprinus erythrophthalmus.*

Distribution Europe and the Caucasus, Siberia, Asia Minor. Missing from Norway and Iberian peninsula. In Britain, widespread in England and Wales, commonest in the eastern counties. Largely absent from Scotland. Common in Irish lakes and known there as the Roach.

External Features Grows to about 12 in. (30 cm), usually exceeding the Roach in size and weighing about 2 lb. A record for Britain is 4½ lb. Shape very similar to the Roach but with deep body, length about three times body depth. Dorsal fin placed behind ventrals. Mouth slightly dorsal. Fin-rays soft, approximately: dorsal 11, pectoral 16, ventral 9, anal 14, caudal 19. Large fan-shaped scales, numbering about 39–42 along the lateral line. Breeding male has tubercles on head. (The sketches of Roach and Rudd should be compared.)

Colour Variable. Brown or bronze, tinged with green or blue, paler on sides. Fins reddish, blood-red in ventrals and anal and tips of caudal. Eye small with orange-yellow iris, flecked with red. Belly silvery. Varieties known as the Golden and Silver Rudd have been bred.

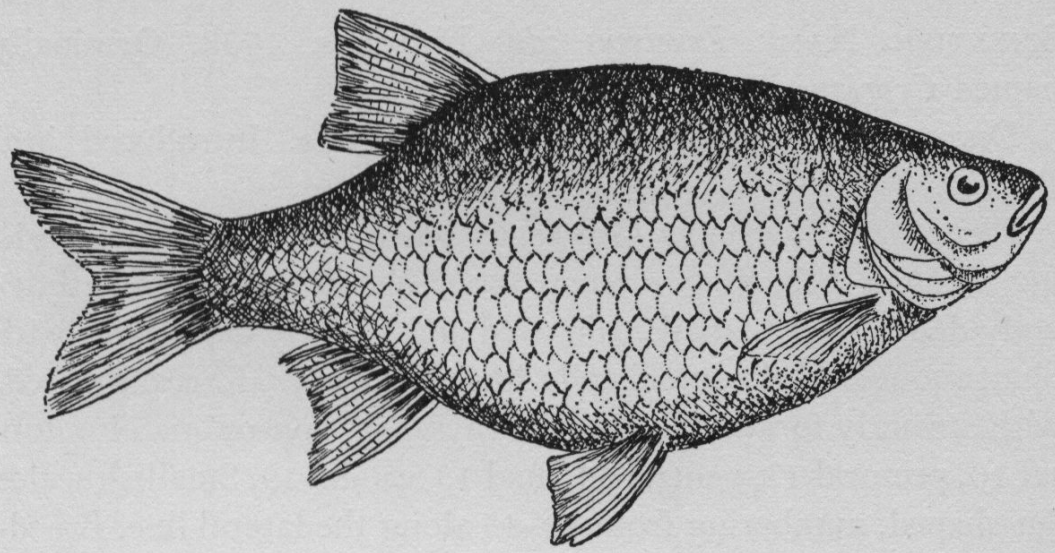
Habits Very similar to the Roach. Lives in shoals in rivers, canals, ponds and lakes, preferring still and slow-running water. Often mixes with Roach and other fish. In constant motion but not so active as Roach. Lives well in the aquarium. Average life about 5 years.

Hibernation Similar to the Roach. Retires into deeper water in cold weather, remaining dormant until spring.

Food Similar to the Roach. Various small aquatic animals and water-plants.

Breeding Similar to the Roach, usually from May to June, the female laying an average of 100,000 small eggs. Hybrids with Roach common. Has lived for 10 years in the aquarium.

Aquarium 5 and pond. A hardy fish.



NOTE The Rudd is much more amenable to captivity than the Roach, especially those specimens taken from still water. Their attraction in a well-planted aquarium is not generally realized, even among fish-keepers.

SCIENTIFIC NAME *Leuciscus idus* Linnaeus, 1758. Originally named *Cyprinus idus*.

DISTRIBUTION Europe and northern Asia. Introduced into Britain.

EXTERNAL FEATURES Grows to about 1 ft (30 cm), weighing about 4–5 lb. Body elongated and slender, about four times body depth. Head small, truncated and slightly depressed, with blunt snout slightly dorsal and rather large eyes. Fins angulated, with strongly forked tail fin. Fin-rays soft, approximately: dorsal 10, pectoral 17, ventral 11, anal 13, caudal 19. Smallish scales fan-shaped, numbering from 40–45 along the lateral line. Breeding male has tubercles.

COLOUR Blackish-blue with a metallic lustre grading to whitish on the sides. Dorsal and caudal fins blue-grey, lower fins reddish. Eye fairly large with yellow iris. Belly silvery. A variety known as the Golden Ide or Orfe has been bred.

HABITS Prefers the pure and colder waters of rivers, also streams and lakes, even brackish waters, where it lives in shoals. Somewhat shy and a fast swimmer, rising to the surface in the evening. Lives for about 9 years.

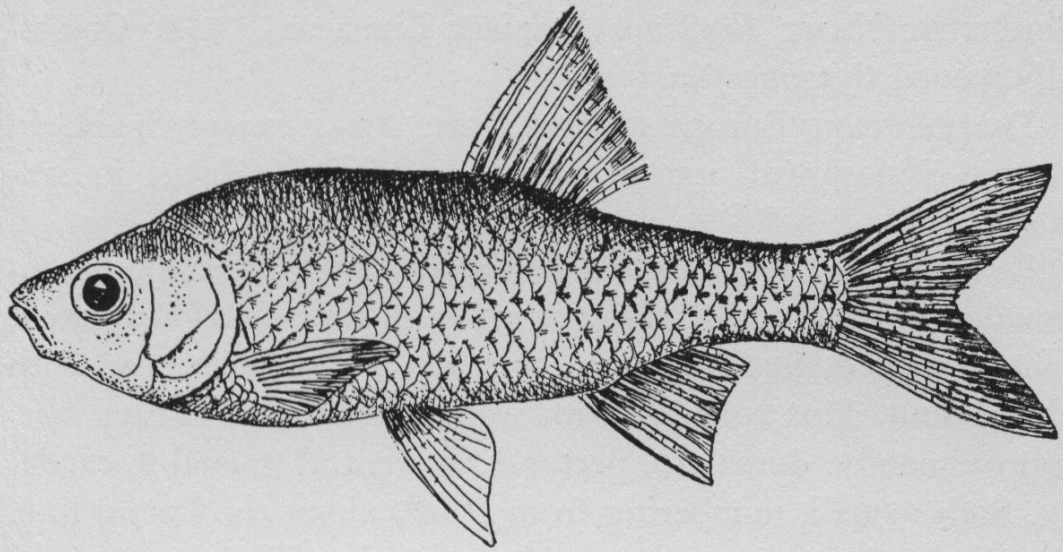
HIBERNATION Similar to Roach. Will retire during the winter months into deeper water, lying dormant until the spring.

FOOD Small aquatic animals, such as insect-larvae and crustaceans, also soft plants. Will rise to surface to take prey which has fallen into water.

BREEDING. Similar to Roach, from April to May. The male actively 'drives' the female during courtship, chasing her through the water until she deposits her spawn, up to 100,000 or more eggs, among the water-plants.

AQUARIUM 5 or pond. A hardy fish.

NOTE Because of its colour and grace of movement the Orfe is much favoured as an aquarium or pond fish. It has lived for nearly 30 years in captivity. It is not undeservedly called the 'aristocrat of the cold-water aquarium fish.' Adult specimens



are an attraction in the garden pool. A record size for Britain—21½ in.

SCIENTIFIC NAME *Phoxinus phoxinus* Linnaeus, 1758. Originally named *Cyprinus phoxinus*.

DISTRIBUTION Europe and northern Asia, except Spain. In Britain widespread, except northern Scotland. Local in Ireland.

EXTERNAL FEATURES Grows to about 4 in. (10 cm), exceptionally to 6 or 7 in. (18 cm), the males smaller. Body elongated, spindle-shaped, five times the body depth. Smallish head with blunt snout. Fins rounded with well-forked tail. Fin-rays soft, approximately: dorsal 10, pectoral 16, ventral 9, anal 9, caudal 19. Scales small, numbering from 80–90 along the lateral line. Breeding specimens produce white tubercles. The three-spined Stickleback is sometimes called a Minnow, but is a separate species.

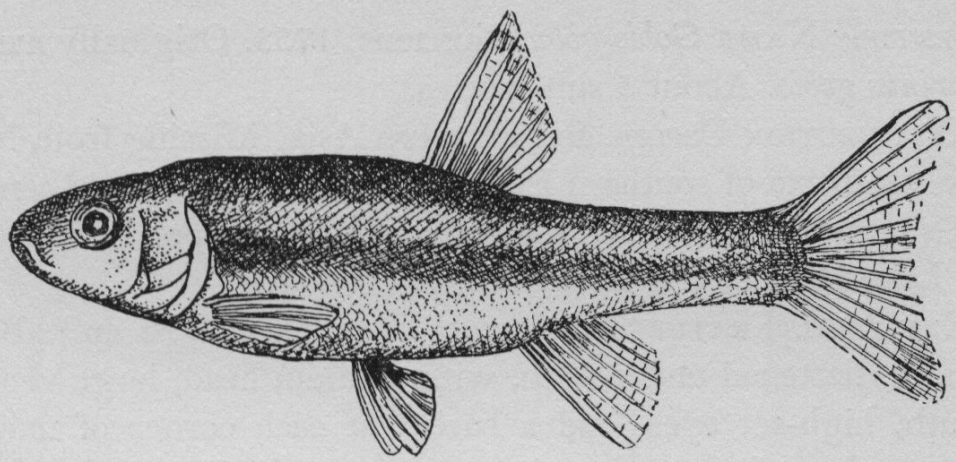
COLOUR Variable according to surroundings. Dark brown-green or silver-grey with irregular dark spots, bars or sometimes a continuous vertebral line. Along each flank a golden or yellow line, below this more greenish-yellow. Angles of mouth carmine, throat sometimes black. Eyes with silvery iris speckled with gold. Belly silvery-white. Colours intensified in breeding specimens, especially male, which is very handsome. It becomes almost soot-black, with belly, mouth and paired fins scarlet. Often a black spot at tail-base.

HABITS Prefers shallow, clear waters with gravelly beds, often living in large shoals. Inhabits streams and small tributaries or the borders and backwaters of rivers and lakes. Lively and active, also very inquisitive and is attracted by any unusual object. Becomes very tame. Lives well in a pond but not always so in the aquarium.

HIBERNATION Retires to deeper water in late autumn, hiding under stones, etc, until the spring.

FOOD Small water animals, including insect-larvae, occasional plants and carrion. Is used as a live bait by the angler.

BREEDING From May to June, the male 'driving' the female



which lays from 700–1,000 minute eggs among gravel-beds and between stones. Has lived in captivity for 13 years.

AQUARIUM 5 or pond. A hardy fish but lives best in a pond. Running water an asset.

NOTE Once they have adjusted themselves to aquarium conditions, Minnows will live well in captivity and are in continual movement. They are also inquisitive in habit, soon learning to feed from the fingers. In a large aquarium they swim in shoals, following the leading fish wherever it moves. A male Minnow in breeding colours is a beautiful sight.

Scientific Name *Gobio gobio* Linnaeus, 1758. Originally named *Cyprinus gobio*. About 5 sub-species.

Distribution Europe and northern Asia. Missing from Norway and parts of southern Europe. In Britain, mainly in central and southern England, missing from Scotland, parts of Wales, the Lake District and Cornwall.

External Features Grows to about 8 in. (20 cm). Body slender, flattened underneath, with medium head, large ventral mouth, high-set eyes, and a barbel at each corner of mouth. Length about four to five times body depth. Dorsal fin rather high set, tail fin well forked. Body scales large, numbering from 39–45 along the lateral line. Fin-rays soft, approximately: dorsal 10, pectoral 15, ventral 8, anal 9, caudal 9.

Colour Variable, according to surroundings. Grey to brown, even reddish, with a silvery or golden tinge, broken by blue-black or deep brown spots and marks, especially along lateral line. Fins brownish, dorsal and caudal fins speckled with brown or grey. Large dorsal eyes with golden iris. Belly whitish-brown. Colour change strongly marked and tones well with surroundings.

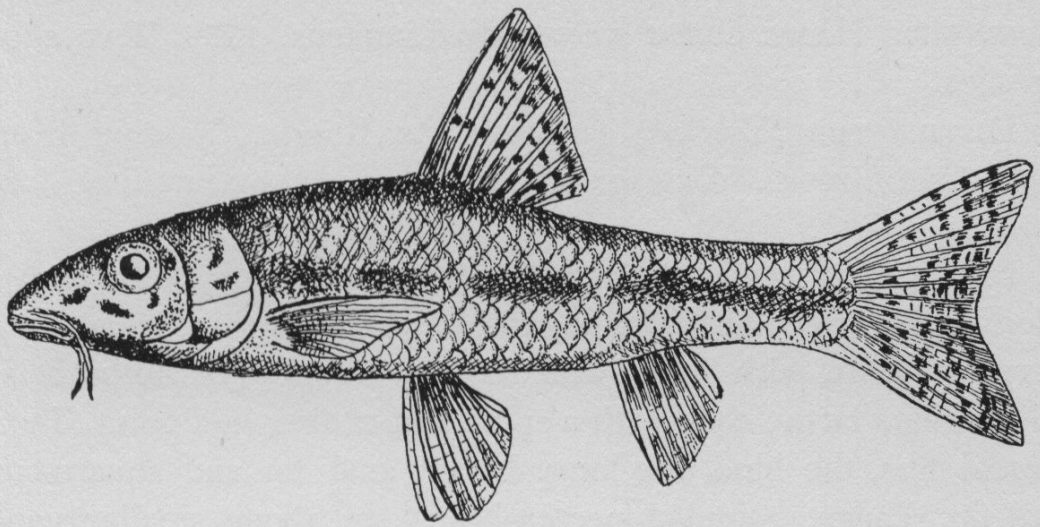
Habits A gregarious, bottom-living fish. Lives in shoals, inhabiting gravel-beds in shallower waters of streams, ponds and borders of lakes and rivers. Seldom rises to surface. Lively in movement.

Hibernation Retires to deeper water, in gravel hollows or under banks, remaining dormant during the cold weather.

Food Plants, small water animals, fish-spawn and carrion. Uses the barbels as organs of touch.

Breeding From May to June, the female laying numerous small pale-blue eggs, usually in gravel and stones, in running water wherever possible. Has lived for 5 years in the aquarium.

Aquarium 5 or pond. Shallow or running water recommended.



NOTE Small specimens may be used in the cold-water aquarium as scavengers, as they will seek out and devour any food which may be overlooked by other fish.

BULLHEAD OR MILLER'S THUMB

SCIENTIFIC NAME *Cottus gobio gobio* Linnaeus, 1758. Two subspecies.

DISTRIBUTION Europe, eastwards to Russia. Missing from Spain and Greece. Widespread in Britain except, possibly, Ireland.

EXTERNAL FEATURES Grows to about 4 or 5 in. (10–13 cm). Body elongated and flattened, widest in gill region. Head very large and flat, with large, wide mouth, dorsal eyes, no barbels. Gill-covers large, each with a spine and ending in a point. Two dorsal fins, the hind one long. Large anal fin and square-cut tail fin. Large, rounded pectoral fins set above smaller ventrals. All fins with spiny rays, except ventrals, approximately: 1st dorsal 8, 2nd dorsal 16, pectoral 14, ventral 5, anal 13, caudal 13. Head and body without scales. Receives its two common names from its shape.

COLOUR Variable, according to surroundings. Grey to brown spotted with dark brown sometimes in transverse bands. Small dorsal eyes with red iris. Fins banded with brown stripes, dorsal fin reddish. Belly grey-white.

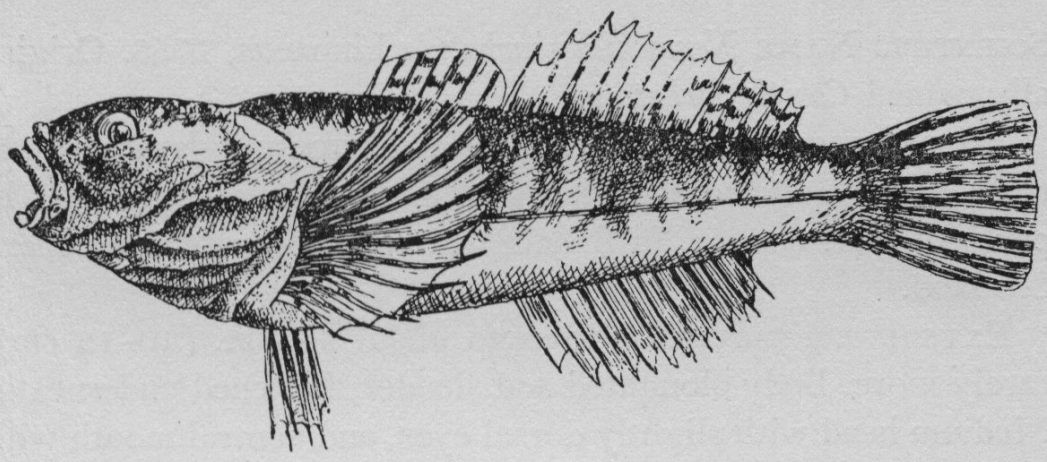
HABITS Inhabits gravel-beds in shallow waters, especially of streams and brooks. Rather solitary, hiding under stones and moving only to escape or capture prey. When attacked erects the spiny gill-covers, sometimes causing death to other fish and birds from choking. Easily tamed but does not normally breed in the aquarium.

HIBERNATION Becomes dormant in the colder months and remains hidden under stones, etc.

FOOD Various small water animals, especially fish-eggs and insect-larvae. Very voracious for its size.

BREEDING March or April, sometimes later. Male excavates a shallow depression, about 10–12 cm across, under or between stones, into which it invites the female. She lays a spawn mass of large pinkish eggs, about 2 mm in diameter, 700–1,000 in number. The male guards these and the newly hatched young

BULLHEAD OR MILLER'S THUMB



for some weeks, until they disperse. The breeding male is very plucky and will even attack a human hand.

AQUARIUM 5 or shallow pond.

NOTE There appears to be no records of the breeding of this fish in the aquarium. Shallow, well-aerated water is necessary and one pair of adults are provided with a gravel floor spread over with stones, among which the male can excavate a nest.

COMMON OR STONE LOACH

Scientific Name *Nemachilus barbatula* Linnaeus, 1758. Originally named *Cobitis barbatulus*.

Distribution Europe and Siberia, China and Japan, sometimes at high altitudes. Missing from Scandinavia, the Iberian peninsula and Greece. In Britain widespread except in northern Scotland.

External Features Grows to about 4–5 in. (10–13 cm), rarely more. Body elongated and slender, flattened underneath. Medium head with slightly dorsal eyes, and ventral mouth with six barbels on upper lips, shortest pair in front. Length about seven or eight times body depth. Dorsal fin high and angulated, paired and caudal fins rounded. Body scales very small, covered with mucus. Fin-rays soft, approximately: dorsal 10, pectoral 12, ventral 7, anal 7, caudal 19.

Colour Variable, according to surroundings. Dark green or brown, marbled with brownish-black irregular marks and spots, more yellow on sides. Dorsal fin, caudal and pectorals similarly marked, the others more yellow. Small eyes with bluish iris. Belly whitish. Colour change strongly marked.

Habits Lives in shoals on gravel-beds of streams, rivers and lake borders, preferring clear, running water. Active when in movement but usually lies quietly under stones or other cover. Sometimes rises to take in air which can be respired through the intestinal wall. Strongly affected by thundery weather, when it may swim in curious, spiral movements.

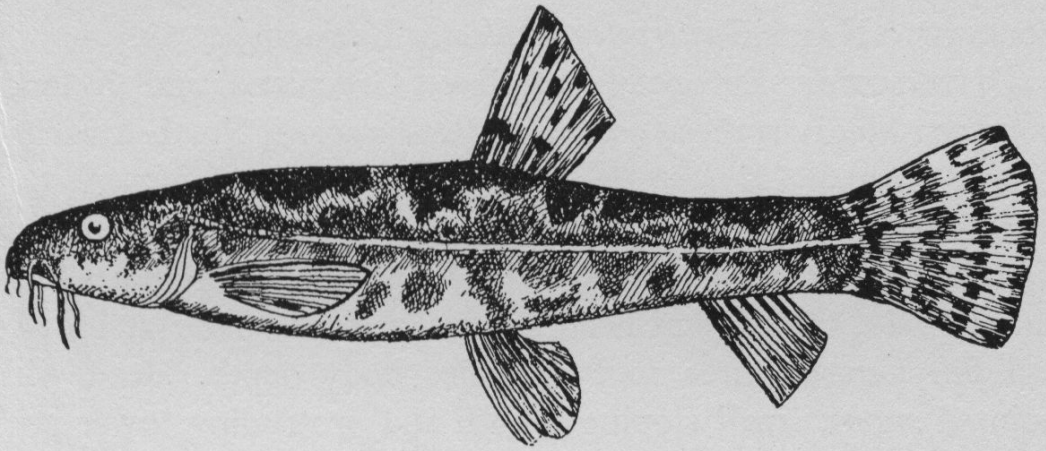
Hibernation Retires to deeper water under stones, etc, where it remains dormant until the warmer weather.

Food Various small aquatic animals, especially insect-larvae, fish-spawn and occasional plants.

Breeding Similar to the Minnow, as early as March–April in England, as late as August in the colder parts of its range. Little is known of its breeding habits.

Aquarium 5 or shallow pond. Running water recommended.

COMMON OR STONE LOACH



NOTE Loaches kept in aquaria live best in shallow, well-aerated water. Stones under which they can lie should be provided and the tank placed in a cool spot. There appear to be no records of aquarium-bred specimens.

THREE-SPINED STICKLEBACK OR TIDDLER

SCIENTIFIC NAME *Gasterosteus aculeatus* Linnaeus, 1758.

DISTRIBUTION European coastline, Greenland and Iceland, northern Mediterranean coastline. Pacific coast (North America, China, Japan and Korea). Widespread in Britain.

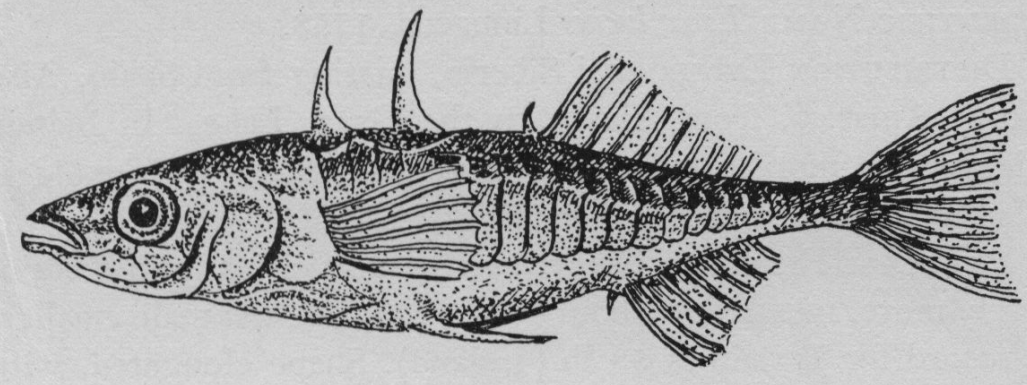
EXTERNAL FEATURES Grows to about 3 in. (8 cm), occasionally longer. Shape elongated, moderately compressed from side to side, tapering at head and tail. Very slender at base of tail fin. Length three to four times body depth. Head with pointed snout, small sloping mouth and protruding lower jaw. Dorsal fin with straight border, preceded by 3 (rarely 2 or 4) sharp, curved spines, the third nearest fin smallest. Anal fin below, with straight border and small spin in front. Ventral fin, each a single curved and forked spine, placed below the squarish pectorals. Fin-rays approximately: dorsal 3 spines 11, pectoral 10, ventral 1 spine, anal 9, caudal 12. Scales in the form of large, protective shields, most varied in number and size, numerous in marine forms, far less so in fresh-water specimens. Inland individuals usually with shields confined to behind the gill-covers, the rest of the body naked.

COLOUR Bluish-black or greenish-brown, silvery on sides. Fins transparent and greenish, throat a faint rose, especially in male. Large eyes with silvery iris. Belly silvery. Colours intensified in breeding specimens, especially male, whose back and sides become lustrous and marked with dark vertical bands, throat and chest a deep crimson and eyes emerald-green. Belly of female turns yellowish.

HABITS Frequents fresh, brackish and salt waters, even the sea-coast, especially in the northern parts of its range. Lively and gregarious, very inquisitive and a pugnacious fighter, especially the breeding male. A favourite with children. Average life about 3–4 years.

HIBERNATION Stays in deeper waters, remaining dormant until the warmer weather, but may continue to feed.

THREE-SPINED STICKLEBACK OR TIDDLER



Food Varied, including different small water creatures and occasional plants.

Breeding From April to June. Male, in courtship dress, selects a site in shallow water and builds a nest at the bottom, first clearing a space, of plant debris which is cemented together with a kidney secretion. Material is gathered, and obstructions carried away, with the mouth. The nest is rounded, about 1 in. in diameter, and domed. Into this the male forces a hole. Invited females, sometimes three or four, enter this, the first forcing a passage through to the other side to make a tunnel in which eggs are laid. About 50 yellowish eggs, $\frac{1}{4}$ mm in diameter, are laid by each female. The young hatch in about a fortnight, each about 4 mm long. The male guards the nest and young with great courage, attacking any intruder big or small. Rival males fight fiercely, using the erected ventral spines in attack. Maturity is reached in one year. Has been kept 3 years (from the egg) in the aquarium.

Aquarium 5 or shallow pond.

PIKE OR PICKEREL

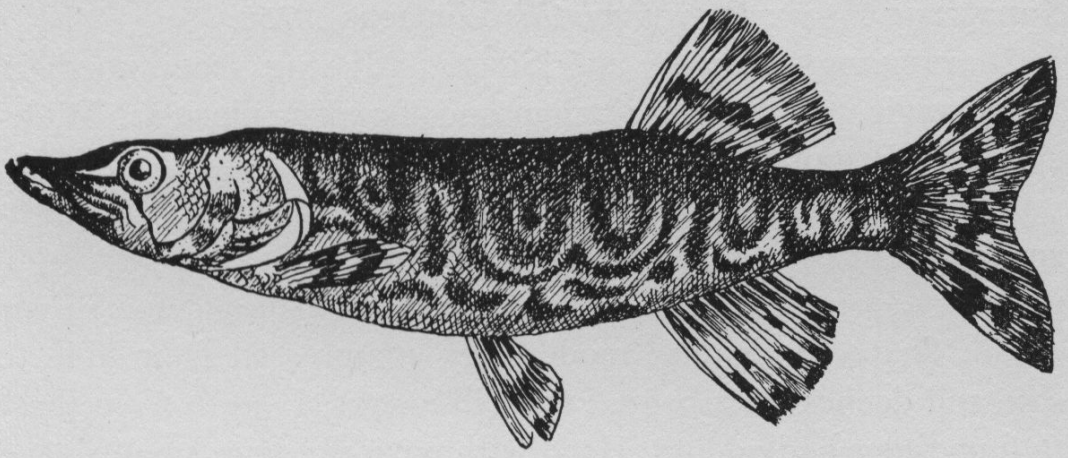
SCIENTIFIC NAME *Esox lucius* Linnaeus, 1758.

DISTRIBUTION Europe and Siberia, missing from Spain. Also North America, from Alaska to the Great Lakes. In Britain widespread, more locally in Scotland, and is one of our oldest inhabitants among fresh-water fish.

EXTERNAL FEATURES Grows to about 30 or 40 lb in Britain, rarely more, measuring about 45 in (114 cm), the male smaller. A record for Britain is 53 lb (Ireland). Shape elongated, with large, long and flattened head. Mouth with powerful jaws, wide gape, large sharp teeth, the lower jaw protruding. Length six times body depth. Dorsal fin large and close to caudal fin, immediately above anal fin, all with straight borders. Rounded pectorals towards front of body and ventrals about half-way back. Tail fin moderately forked. Fin-rays approximately: dorsal 19, pectoral 14, ventral 10, anal 17, caudal 19. Scales small and rough, numbering from 125–130 along the lateral line.

COLOUR Variable. Greenish-grey to black, paler on sides, with irregular yellow marks sometimes forming transverse bands. Colour more intense in breeding specimens, turning green with yellow marks. Paired fins reddish, the others more brownish with black streaks. Eyes large, closely set, with yellow iris. Belly white, dotted with black. The young, or Pickerel, is pale, transparent-like, grey-white with darker vertical bars along flanks.

HABITS Frequents reed-beds or gaps among water-plants in rivers, lakes, streams and sometimes ponds and gravel-pits where it may be the only resident fish. Solitary, rarely moving except for a faint waving of the pectorals and tail fin, and then only when disturbed or attacking prey, which it does with a short, savage rush. Often known as the 'fresh-water tiger.' Extremely voracious and has a powerful bite. Will sometimes attack a submerged human hand or leg in mistake for food. Sense of sight and hearing said to be good. Average life probably not more than 15 years.



HIBERNATION Lurks in deeper water but may continue feeding if not too cold.

FOOD Most variable. All forms of smaller water animals, including other fish almost its own size, amphibians and water fowl or small, swimming mammals.

BREEDING Early, from February onwards in Britain (Ireland) and as late as May in southern Germany. Female retires to backwaters, accompanied by one or two males who rub against her body to encourage spawning. Large yellowish eggs, about 3 mm in diameter and sticky in nature, are laid among plants in shallow water. They are said to be carried on the legs of water fowl. A female weighing 30 lb may lay about 300,000 eggs. The young grow rapidly, up to 8–10 in. (20–25 cm) in the first year, and 12–14 in. (30–35 cm) in the second. The Pike-perch is a separate species introduced from the Continent. A specimen has lived for 14 years in captivity.

AQUARIUM 5 (small specimens) or pond. Will attack other fish.

PERCH

SCIENTIFIC NAME *Perca fluviatilis* Linnaeus, 1758.

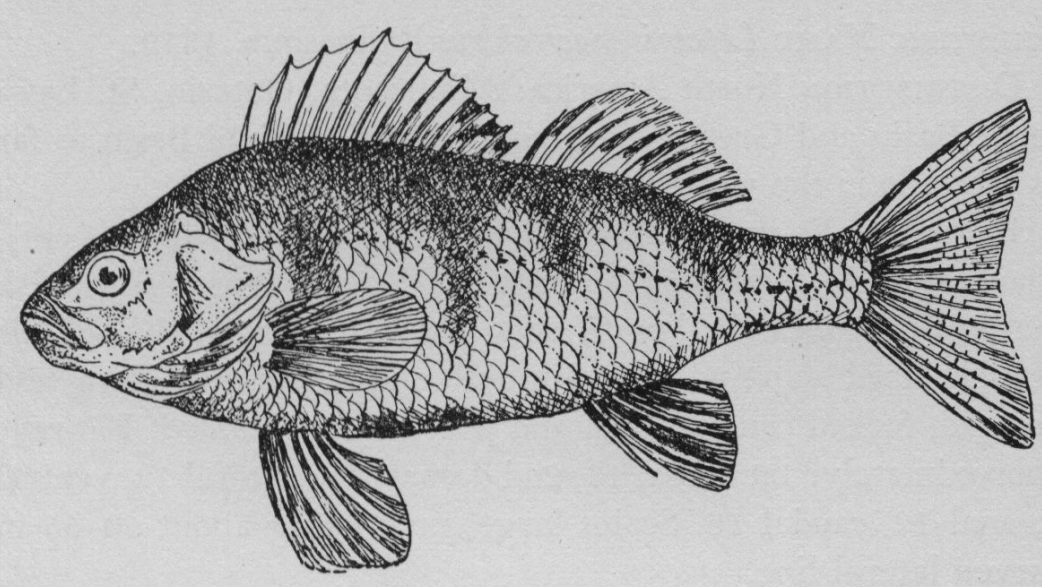
DISTRIBUTION Europe and Sibera. Missing from northern Scandinavia, the Iberian, Italian and Greek peninsulas. Widespread in Britain, except northern Scotland.

EXTERNAL FEATURES Grows to about 1 lb in Britain, measuring about 9–12 in. (23–30 cm). Continental specimens commonly reach 3 lb. A record for Britain is 8 lb and for Russia 10 lb. Shape elongated, moderately compressed from side to side and deepest just behind the gill-covers. Length from three to four times body depth. Head with powerful jaws smallish and slightly pointed, rising sharply into a hump on the back. Two separate dorsal fins, the first longer and with projecting bony rays, the second with soft rays. Spines on pointed gill-covers. Pectoral fins rounded, set above ventrals. Caudal fin slightly lobed. Fin-rays approximately: 1st dorsal 16, 2nd dorsal 15, pectoral 15, ventral 6, anal 10, caudal 17. Scales moderate and rough, numbering from 54–70 along the lateral line. Sexes very similar.

COLOUR Variable. Olive-green or blackish-green, with 5–9 brownish-black vertical bars, sometimes as spots, extending on to the sides. Sides golden yellow. First dorsal fin blue-grey with a dark spot at hind end, second dorsal yellowish with reddish border. Lower fins and caudal orange-red or yellowish. Moderate eyes with golden-yellow iris. Below whitish.

HABITS Inhabits rivers, lakes, ponds and gravel-pits, rarely growing large in latter situations. Sometimes occurs in brackish waters and in inland seas, such as the Baltic and Caspian seas. Roves about in shoals and is very gregarious when young. Later becomes more solitary, remaining hidden among water reeds with which it camouflages well. May suddenly die due to shock, e.g. when hooked. A carnivorous feeder, attacking its prey with a sudden rush.

HIBERNATION Retires to deeper water in autumn, remaining dormant until the warmer season, in March or April.



FOOD Most small water animals such as other smaller fish, worms, insect-larvae, crustaceans and amphibians.

BREEDING From March to May among water-plants in shallow places. The female lays ribbons of jelly-like spawn containing whitish eggs which lie in festoons among plants. A female of $\frac{1}{2}$ lb may lay about 300,000 eggs. The young reach about 1 in. in the first year, 6 in. (16 cm) in the third. Maturity is reached in three years. Hybrids occur with the Ruffe. A specimen has lived for 6 years in captivity.

AQUARIUM 5 (small specimens) or pond. May attack other fish.

COMMON SUNFISH OR COMMON BLUE GILL

Scientific Name *Lepomis macrochirus* Rafinesque, 1819.

Distribution North America: Minnesota, Ontario, St. Lawrence Basin and Great Lakes, south of Mississippi Basin as far as Georgia in the west. Elsewhere introduced.

External Features Average adult size about 7 in. (18 cm), shape rounded, body depth about half length, typical of sunfish family (*Centrarchidae*), with soft and spiny rayed dorsal fins united. Head short with hard mouth and pectoral fins long and pointed, forked caudal. Anal and post-dorsal rounded. Fin-rays approximately: 1st dorsal 10, 2nd dorsal 10, pectoral 12, ventral 6, anal 12, caudal 18. Scales large, numbering about 50–55 in curved lateral line.

Colour Above: olive-green with about 5 greenish cross-bands over back. Below: reddish-brown, especially on throat. Blue patch on lower gill borders and mouth. Eye large with blue-grey iris.

Habits Occurs mainly in lakes and ponds with moderate vegetation, also in quieter pools of streams, living in shoals. Active and rather pugnacious. A favourite with American children, and popular with the angler.

Hibernation Lies dormant in deeper water during cold months.

Food Smaller water animals of all descriptions such as insects and larvae, worms, crustaceans, and smaller fish.

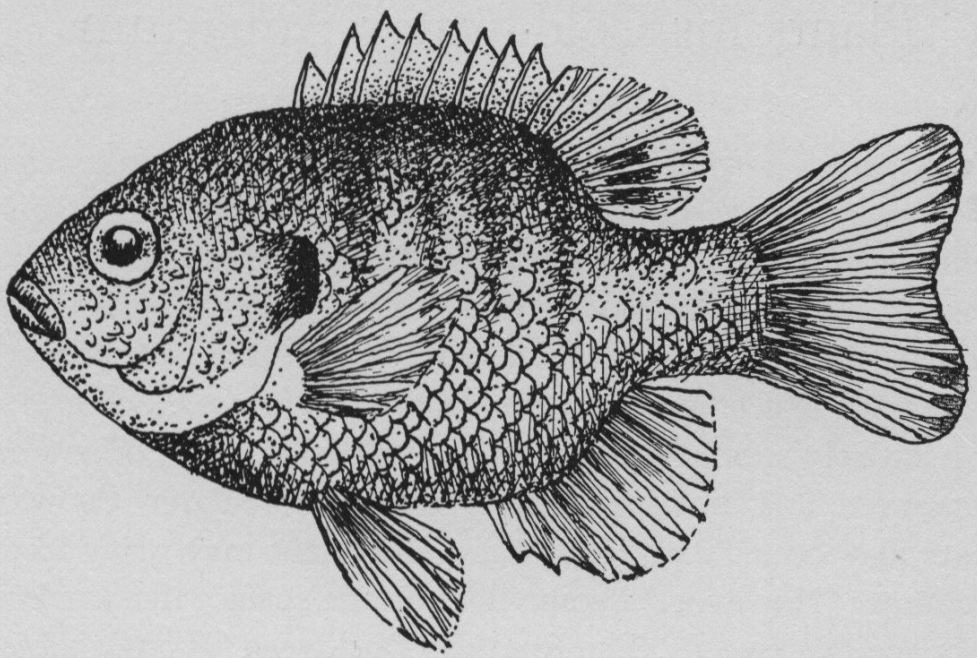
Breeding Breeds in spring, the male excavating a shallow depression in gravel, guarding the eggs laid by the female.

Aquarium 5 or pond.

Note This is a popular aquarium fish, about which more information on the life history is required. Has been known to breed in ponds in a number of places. Has lived for 8 years in the aquarium. As with other perch-like fishes it may become pugnacious and attack smaller kinds, and is best isolated from those which cannot defend themselves.

Other members of this family seen in the aquarium are: The

COMMON SUNFISH OR COMMON BLUE GILL



Small-mouth Bass (*Micropterus dolomieu*) and Large-mouth Bass (*M. salmoides*). Both grow to about 16 in. Body more slender, scales smaller, and dorsal fins more separated. Great Lakes area. The Peacock-eyed Bass (*Centrarchus macropterus*). Similar in shape to Sunfish, with blue 'eye-spot' on front dorsal fin. Southern United States.

Plants for Cold-water Aquariums

Water-plants normally found in aquariums are mostly species of Flowering Plants or Angiosperms. Flowers among aquatic plants are usually small and modified, and sometimes submerged, e.g. the Hornwort. Leaves are often long or finely branched when submerged so as to expose a large surface to the water with which there is an interchange of gases. Some plants have entirely submerged leaves, e.g. *Myriophyllum*, others have submerged and floating leaves, as in the Water Crowfoot. Roots may occur, e.g. *Hottonia*, or the plant may grow loosely in clumps (Hornwort); some float on the surface like the Frog-bit or the Duckweeds. The Rootless Duckweed (*Wollfia michelii*) is considered the smallest British flowering plant.

Water-plants, which are adapted to an aquatic environment, obtain their growth-building 'foods' from the water. These are the dissolved mineral salts and the gas, carbon dioxide. With the aid of the green colouring matter *chlorophyll*, and the use of sunlight as a source of energy, carbon dioxide and water are converted into starch by a process common to green plants, called *photosynthesis*. A certain amount of starch is stored in those parts of the plant, such as the 'winter bud' or *turion*, which survive the cold season and grow out in the following spring.

Aquarium plants serve four main purposes: they are ornamental, they oxygenate the water, provide spawning-beds for fish and newts, and give shade or cover to small animals and fry. There are about twenty native species of aquatic plant suitable for either one or all of these purposes.

Aquarium plants thrive best in 'matured water,' i.e. water which has been standing for some time in the aquarium. Mineral salts accumulate as the result of the death and decay of plant and animal matter, and the decay of animal waste, which appears as a dark sediment, called detritus, on the floor of the aquarium.

In moderation this is not harmful to the fish or other animals, and it is beneficial to the plants which also require sufficient lighting for the process of photosynthesis. This results in the production of oxygen often visible as small bubbles streaming out of the leaves.

For tidiness, and to encourage growth, submerged plants should be anchored in small bunches in a layer of garden soil placed on the floor of the aquarium. Over this is spread a layer of well-washed gravel or aquarium sand. *Elodea*, Hornwort, Milfoil, *Hottonia* and *Potamogeton* may be treated in this way, and the Duckweeds and Frogbit allowed to float on the surface. Duckweeds make good spawning-beds for newts and fish, and Frogbit provides a screen against excessive light.

A good, healthy growth is a sign of 'balance' in the aquarium. Excessive light, however, may encourage algal growth, which covers the glass, turns the water green or chokes the aquarium plants. These algae should be checked with the aid of water fleas and snails, or removed by hand. Sometimes it is necessary to remove all plant matter and reset the tank. Excessive algal growth may occur more seriously in a pond which can also become choked with dead leaves. Plants which are thin-looking and pale or elongated between the leaf whorls may require more light, or may be short of a necessary 'food.' A move of the tank and the addition of some matured water may remedy this.

Although not usually the primary attraction of an aquarium the plants in it help considerably towards its maintenance as well as artistic layout. With the correct proportion and balance (in a pictorial sense), plants and rocks can make an aquarium an object of beauty, constant interest and pleasure.

AMERICAN WATER WEED OR WATER THYME

SCIENTIFIC NAME *Elodea canadensis* Linnaeus, 1758. Originally named *Anacharis alsinastrum* by Babbington.

DISTRIBUTION Temperate and tropical America. Introduced into Europe and now widespread. First reported in Britain in 1836 (Ireland) and reached England by 1842.

EXTERNAL FEATURES A dark green, many-branched perennial with numerous oval leaves, finely serrated along the edge and arranged in whorls of, usually, three. Easily breaks and grows from separate pieces. Abundant, white roots grow out of branches to anchor plant and derive nourishment from bottom. Dies down in autumn, forming compact lateral branches as 'winter-buds' which sink to the bottom and grow out in the following season.

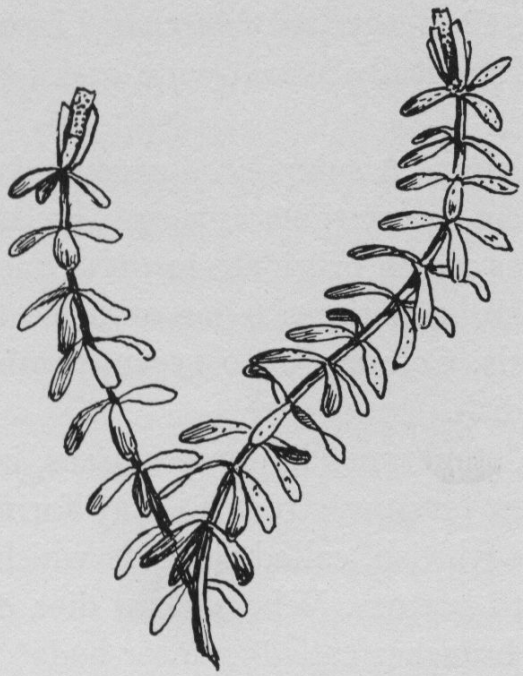
HABITS Grows sometimes in dense masses in ponds, pools, water-tanks, lake borders and backwaters of rivers. At one time a great nuisance and hindrance to water traffic when this was common. May flourish excessively for a while, then die off.

REPRODUCTION Flowers on stalks grow separately on male and female plants, from the angles of the upper leaves. Male flowers with stamens, female flowers with long floral tubes which reach the surface. Stamens detach, reach surface, shedding pollen which floats to the female flowers. Flowers unknown in Britain, except occasionally in the aquarium, and reproduction is mainly vegetative.

USE IN THE AQUARIUM An excellent oxygenator, hardy grower and good spawning-bed for fish and newts.

Two plants often seen in the aquarium and spoken of as *Elodea densa* (with large, soft leaves) and *Elodea crispa* (with crisp, curly leaves) are now established in certain parts of Britain. They are considered as separate species, native to the subtropics, and called *Egaria densa* and *Largarosiphon major* respectively.

AQUARIUM or pond. A rapid grower which needs checking.



NOTE The sudden appearance and rapid growth of this plant in nature (it can choke a waterway) may necessitate severe checking in the aquarium. It is best planted in clumps of two or three branches, each with growing tips, which are loosely anchored in the sand. These will soon take root and can later be removed and shortened if growth becomes too excessive. *Elodea* from the Greek *helodes*, 'growing in watery places.'

HORNWORT

SCIENTIFIC NAME *Ceratophyllum demersum* Linnaeus, 1758.

DISTRIBUTION Practically world-wide and fairly common in Britain.

EXTERNAL FEATURES A submerged perennial which grows as an elongated stem, sometimes many feet in length, with numerous branches which originate in the angles of the leaves. These are hair-like, sometimes twice or three times branched, and grow in whorls. Colour a deep green, turning reddish with age. Flowers reddish.

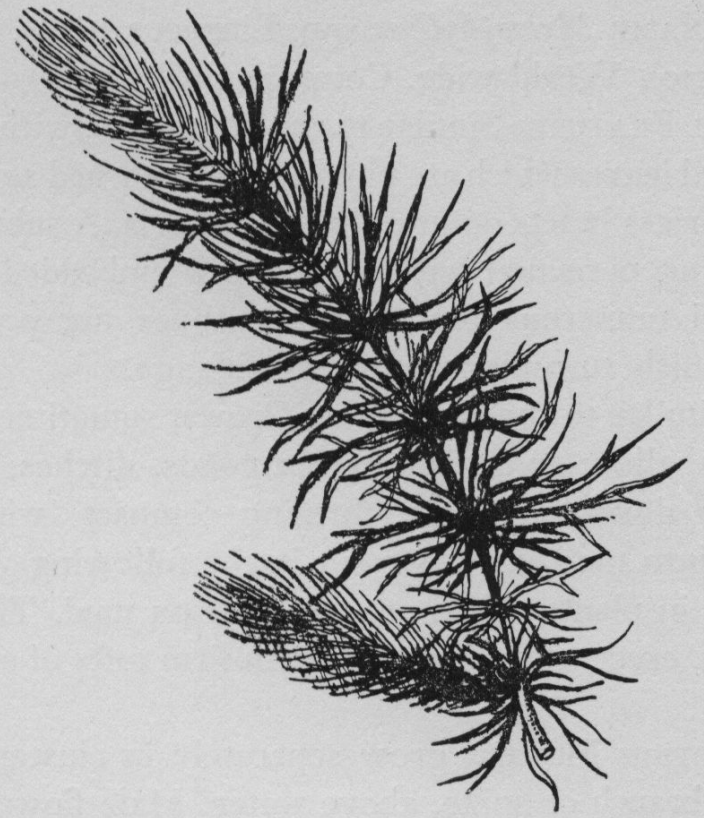
HABITS Grows, sometimes in dense masses, in shallow water of ponds and lakes or slow streams. May form branches with finer leaves, often whitish, called rhizoids which act as anchors and attach plant to bottom. Whole plant dies down in winter, forming compact branches called 'winter-buds' which sink into mud and grow out in the following season.

REPRODUCTION Flowers grow under water in separate clusters in the angles of the leaf-whorls. Male flower has stamens enclosed by a petal-sheath, female flower a single ovary with style and stigma, also enclosed in a petal-sheath. Ripe stamens detach, float to the surface and rupture. Liberated pollen then sinks slowly to reach the female flowers. This is one of the few cases of underwater pollination in Flowering Plants. Seeds sink into mud to germinate later on, rising to the surface when about 10 cm long.

USE IN AQUARIUM A shelter for small animals, a good oxygenator and a spawning-bed for fish, especially the carp family.

AQUARIUM or pond. Prolific grower.

NOTE *Ceratophyllum* (from Greek *keras*, a horn, and *phullon*, a leaf) is a prolific grower in suitable waters. In the aquarium it will sometimes break up, reduce in size and even disappear. This will serve as an indicator that there may be insufficient light, or that certain plant foodstuffs are lacking in the water. The addition of some filtered rainwater can often remedy this.



MILFOIL

Scientific Name *Myriophyllum* spp. Linnaeus, 1758.

Distribution World-wide. Common in Britain.

External Features Similar to the Hornwort, with whorls of finely divided leaves which are pinnate, not branched as in former. Small, colourless bracts occur at base of whorls. A submerged or partly floating perennial with a rootstock embedded on pond-bottom, and numerous branches sometimes many feet long. Colour greenish, turning deep brown with age.

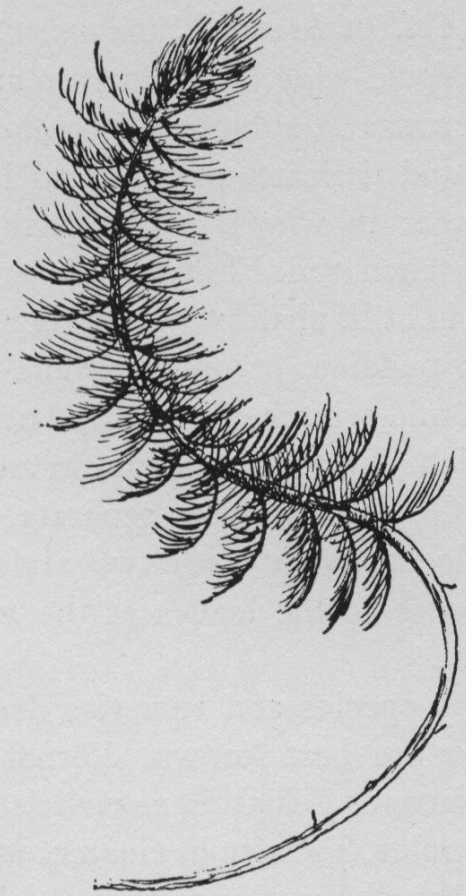
Habits Similar to the Hornwort. Grows, sometimes in dense masses, in shallow or deep water in ponds, ditches, lakes and canals. Dies down in winter, forming compact 'winter-buds' which sink into mud, growing out in the following year. Land forms occur in plants which are stranded on mud. These grow out as short, erect, stout branches with firm tufts of close, fern-like leaves.

Reproduction Flowers grow separately in clusters, usually on an erect branch or spike, above water. Male flower has four pale petals with an outer calyx and four to eight stamens. Female flower a single ovary within a calyx. Also, occasional bi-sexual flowers. Pollination by wind.

The two commoner species are: The Spiked Milfoil (*Myriophyllum spicatum*). Flowers produce from 3 in. erect stems emerging above water, male flowers at the top. Found in Europe and northern Asia, widespread in Britain. The Whorled Milfoil (*Myriophyllum inundatum*). In deeper water, totally submerged, flowers growing in angles of upper leaves, sometimes from a short branch above water. Common in Europe and northern Asia, somewhat local, even scarce, in Britain.

Use in Aquarium Similar to Hornwort. A shelter for small animals, a good oxygenator and a spawning-bed for fish.

Aquarium 5 or pond.



NOTE The Milfoil (Greek *murios*, a thousand, and *phullon*, a leaf) can tolerate a wide range of temperatures, and grows in tropical as well as cold-water aquariums. Plants found in stagnant water appear to grow best.

WATER STARWORT

SCIENTIFIC NAME *Callitriche* spp. Linnaeus, 1758.

DISTRIBUTION World-wide, in temperate and tropical waters.

EXTERNAL FEATURES A submerged or floating aquatic with slender branches and delicate, green, oval leaves which grow opposite one another in whorls. Occasional rootlets occur but plant not normally anchored. Flowers pale green.

HABITS Occurs in still, shallow water such as ponds, ditches, water-tanks, even puddles, or on wet mud. Sometimes grows quite strongly in mid-winter. Compact, lateral branches form 'winter-buds' which sink to the bottom in autumn.

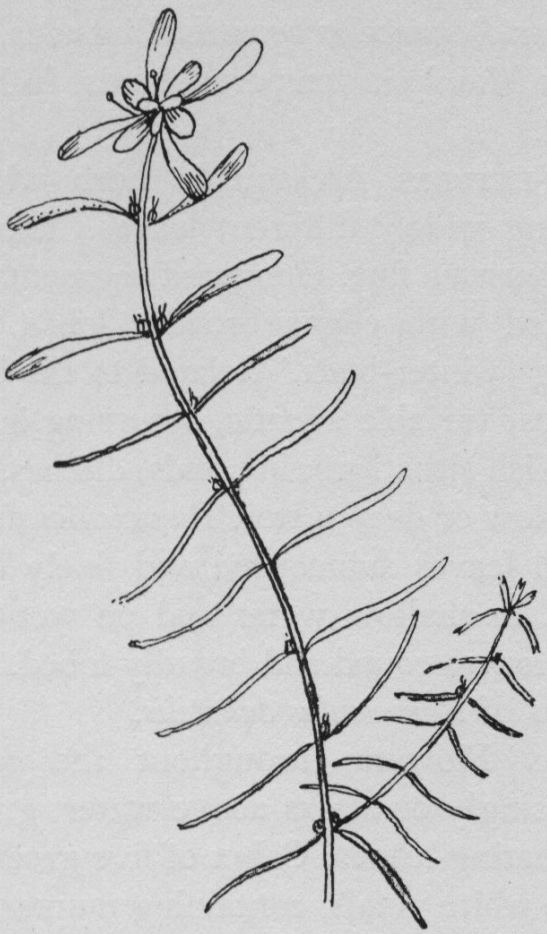
REPRODUCTION Greenish flowers separate, the male a single stamen, the female an ovary with two styles, which grow in clusters in the angles of the leaves at the surface. Pollination probably by insects.

Of the numerous species and varieties described for Britain the following two are best known: Vernal Water Starwort, *Callitriche verna* Linnaeus. Floating as well as submerged leaves, the latter more slender. Former in clusters at the surface, from which grow out the flowers. Common in Britain. Autumnal Water Starwort, *Callitriche autumnalis* Linnaeus. Totally submerged with only the finer type of leaf. Very local in Britain and considered rare.

USE IN AQUARIUM A good oxygenator. An excellent spawning-bed for newts. If collected in quantity and shaken in a bowl of water a good crop of small aquatic life may often be secured as food for newts and fish.

AQUARIUM or pond.

NOTE *Callitriche* (Greek *kalos*, beautiful, and *thrix*, hair) requires careful control in the aquarium, as it may grow out of hand and choke the other plants. Its more or less permanent growth will give colour to an otherwise bare-looking tank during the winter months.



WATER CROWFOOT OR WATER BUTTERCUP

SCIENTIFIC NAME *Ranunculus aquatilis* Linnaeus, 1758.

DISTRIBUTION Mainly in temperate lands. In Britain abundant and widespread.

EXTERNAL FEATURES An aquatic herb with a branching system producing widely different leaves. Those below water divided into numerous fine, elongated segments, those floating flat and rounded with edges broadly lobed. Dies down in autumn forming 'winter-buds.' Related to the buttercup.

HABITS A most variable aquatic, occurring in different freshwater and brackish situations, in ponds, ditches, canals and lake borders, in shallow or deep water. *Ranunculus fluitans*, chiefly in streams, has all leaves submerged and finely divided. *Ranunculus hederaceus*, in shallow water and on wet mud, has small flowers and all leaves round and broadly lobed. These two may only be varieties of *Ranunculus aquatilis*.

REPRODUCTION Flowers throughout the season. Flowers buttercup-like, singly on stalks above water, growing from the angles of the floating leaves. Calyx of five green sepals, corolla of, usually, five white petals, containing numerous stamens and oval carpels. Pollination by insects.

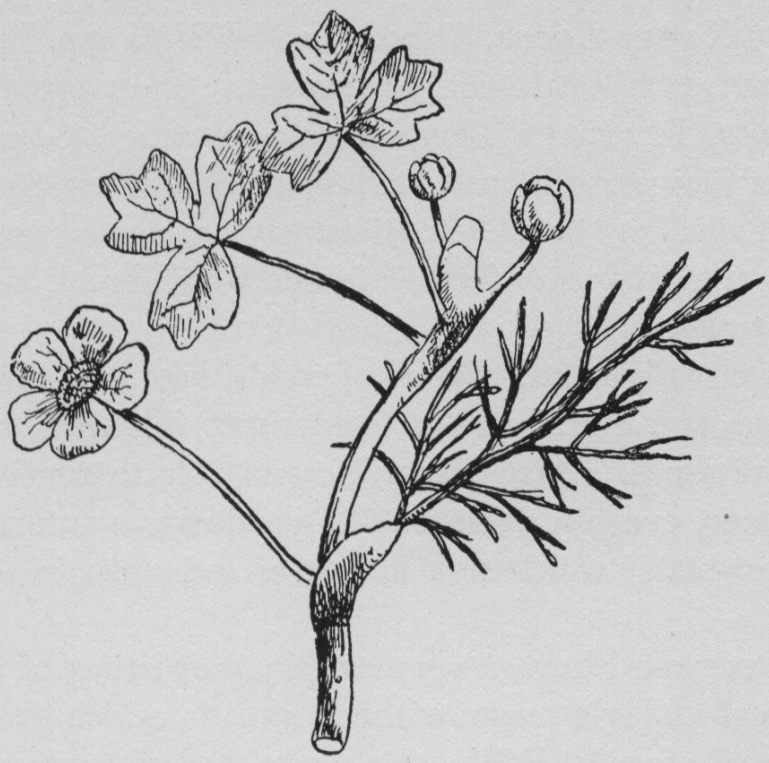
USE IN AQUARIUM Mainly for show, especially in garden ponds. A good oxygenator. The leaves are eaten by some terrapins. A suitable nesting-place for the Water Spider.

POND mainly.

NOTE The Water Crowfoot may sometimes be grown in the aquarium, under suitable lighting and given an adequate supply of mineral salts. Well-matured water is beneficial, as with all water-plants grown in a confined space. Normally it grows best in outdoor pools and is an attraction because of the numerous white flowers.

It is possible to grow a plant entirely of fine leaves if it is kept below the surface, under a barrier of fine wire-netting. Newt larvae and fish-fry can use this for shelter from their parents, which cannot pass the netting.

WATER CROWFOOT OR WATER BUTTERCUP



SCIENTIFIC NAMES *Lemna*, *Spirodela* and *Wollfia* spp. Linnaeus.

DISTRIBUTION World-wide, in temperate and tropical waters.

EXTERNAL FEATURES Tiny, floating aquatics. Some of the smallest of Flowering Plants. Each plant a tiny stem from which grows out a leaf or 'frond.' Rootlets may or may not occur. May spread by the growth of further fronds which break away from the parent plant.

HABITS Usually in still waters of ponds, lake borders, ditches, water-tanks and even puddles, sometimes in dense masses to cover large areas. Tenacious of life and able to survive in the foulest water, even on damp mud. Dies down in autumn, forming 'winter-buds' which sink into mud and grow in following season.

REPRODUCTION Flowers very simple, consisting of a pair of stamens and a single ovary within a sheath, which grow along edge of fertile fronds. Pollination probably by insects.

The British Duckweeds are as follows:

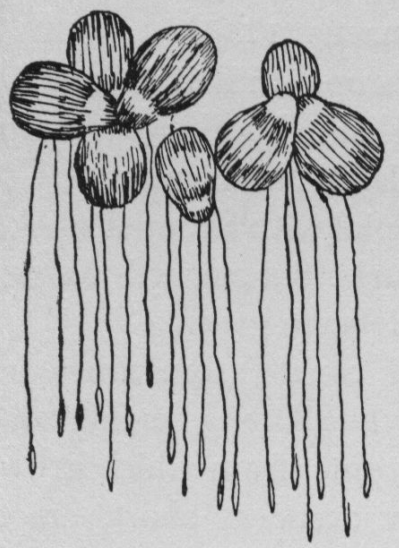
(1) Greater Duckweed, *Spirodela polyrrhiza* (Linnaeus), formerly named *Lemna major*. The largest British Duckweed. Has numerous rootlets. Very common in Britain but rarely flowers.

(2) Lesser Duckweed, *Lemna minor* Linnaeus. Fronds thick and glossy, each with a single rootlet. Commonly flowers, producing fertile patches, a pale yellow colour. Very common in Britain.

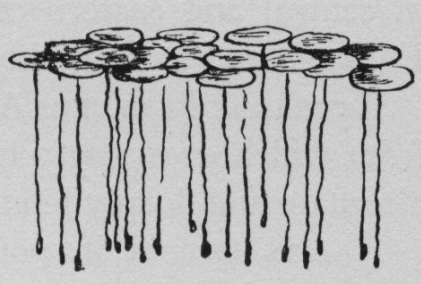
(3) Ivy-leaved Duckweed, *Lemna trisulca* Linnaeus. Narrow, pointed frond with stalks, which tend to remain attached in chains. Two smaller fronds remain attached to a larger third, giving an 'ivy-leaf' appearance. Each frond with a single rootlet. Slightly submerged. Local in Britain, rarely flowers.

(4) Gibbous Duckweed, *Lemna gibbosa* Linnaeus. Fronds with a thick, spongy tissue underneath, and each with a single rootlet. Local in Britain and rarely flowers.

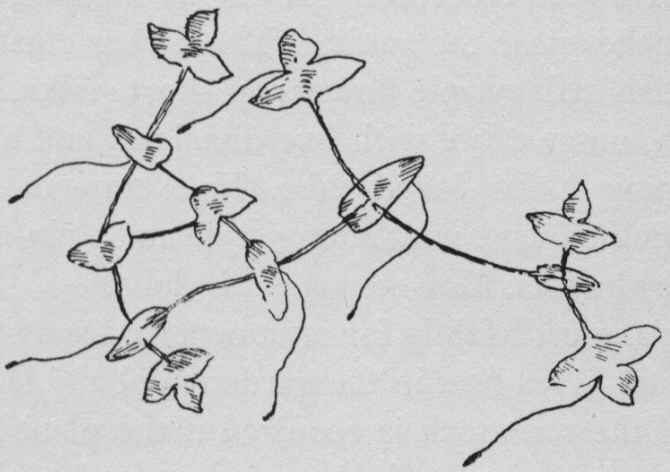
(5) Rootless Duckweed, *Wollfia michelii* (Linnaeus). Formerly



Greater Duckweed



Lesser Duckweed



Ivy-leaved Duckweed

Lemna arrhiza. The smallest British flowering plant, about 1·5 mm in diameter. Flowers, with single stamens, grow on top. In Britain mainly the south-eastern counties.

USE IN AQUARIUM Ideal as shade plants and for sheltering small water animals and fish-fry. Duckweeds help to purify water.

AQUARIUM or pond. Needs checking.

WATER VIOLET OR FEATHERFOIL

SCIENTIFIC NAME *Hottonia palustris* Linnaeus, 1758.

DISTRIBUTION Central and northern Europe. In Britain mainly in central and eastern counties of England. Local in western England, and Ireland. Absent from Scotland. Not common.

EXTERNAL FEATURES A floating perennial with a rooted stock, from which grow leafy branches in whorls. Submerged leaves, alternate and deeply pinnate. Colour a delicate green.

HABITS Occurs in ponds, pools and canals, sometimes in large patches. Produces numerous rootlets but is mainly anchored by an underground stem, or rhizome, from which grow out further branches. Land forms may occur as short, erect branches growing out of mud at water's edge. The whole plant dies down to the rootstock in winter.

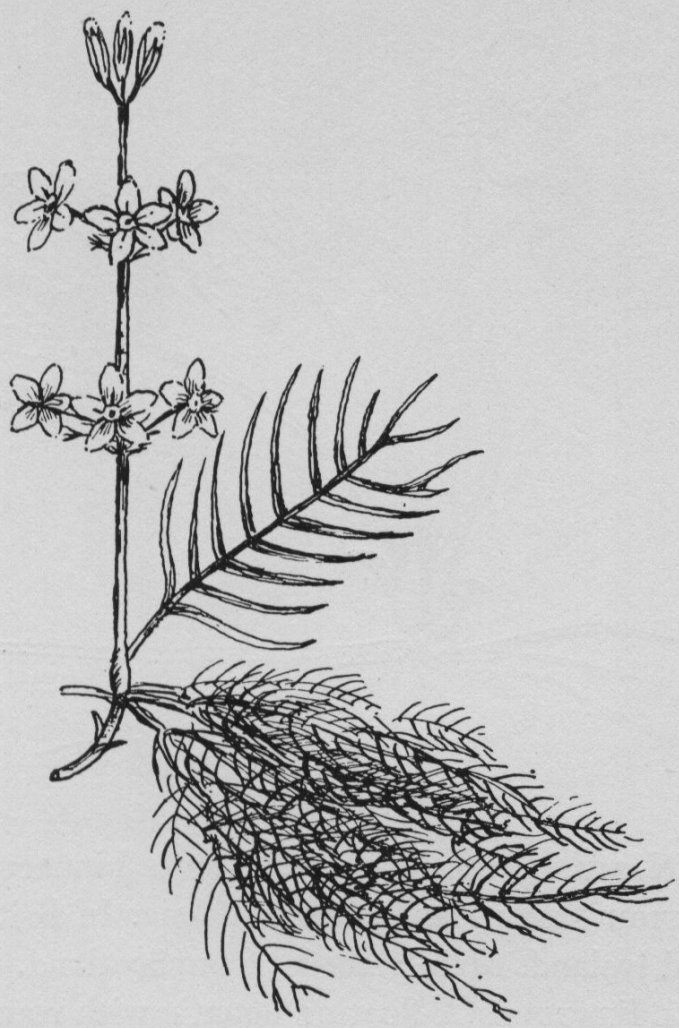
REPRODUCTION An erect stem grows out of centre of whorls of floating branches near the surface. These bear clusters of three to five smallish, pale purple flowers on short stalks. Each flower with a green, outer calyx with five divisions, and a pale purple corolla forming a five-lobed tube. Five stamens within surrounding a single ovary with a long style and a pin-head stigma. Pollination by insects. Flowers appear in June.

USE IN AQUARIUM Mainly for ornament or a spawning-bed for fish and newts. Lives best in the garden pool and is very attractive. Part of the rootstock is required if the plant is to propagate elsewhere, as pieces of the branches tend to die off when separated from the parent. A suitable nesting-site for the Water Spider.

POND mainly.

NOTE *Hottonia*, named after a Dutch botanist, Petrus Hotton, may be grown permanently from the perennial rootstock which is planted in a garden pond. The whorl-like leaf growth and spikes of delicate purple flowers are most attractive.

WATER VIOLET OR FEATHERFOIL



FROGBIT

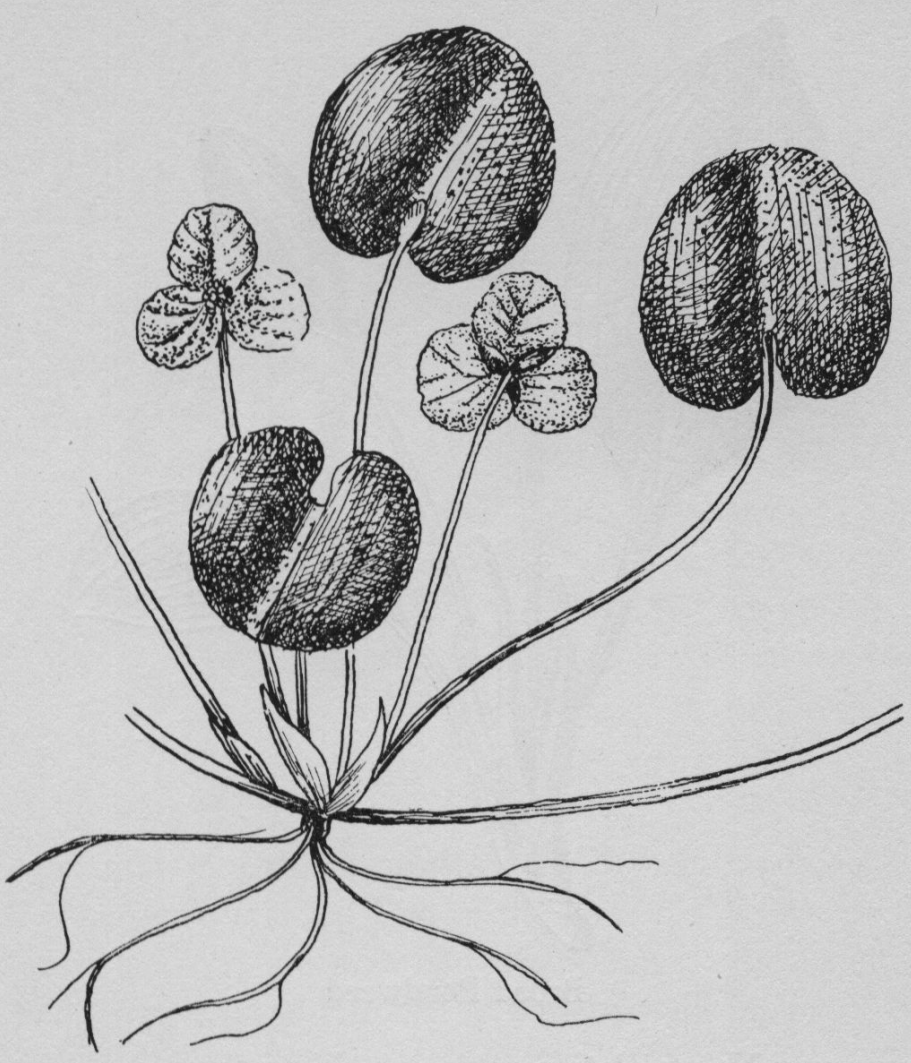
Male

SCIENTIFIC NAME *Hydrocharis morsus-ranae* Linnaeus, 1758.

DISTRIBUTION Europe and northern Asia. In Britain most of England and Ireland. Mainly absent from Scotland.

EXTERNAL FEATURES A floating aquatic with rounded leaves, about 2 in. (5 cm) across, each with a double lobe at the leaf-base, from which the veins radiate, and a slightly pointed tip. Leaves occur in rosettes from a tiny stem, with numerous hair-like roots below. Rosettes are connected by lateral branches from the parent plant.

HABITS Grows in quiet waters of ponds and ditches, usually sheltered, and may completely cover an area as the dominant plant. Lateral branches terminate as 'summer-buds' which grow into further rosettes. 'Winter-buds' appear in autumn lightly sheathed in a pair of scale-leaves and hang downwards. These detach and sink to the bottom with growing tip pointed upwards. They develop the following spring and float to the surface.



Female

REPRODUCTION Flowers grow on separate plants. The male rosette produces two to three large, greenish-white flowers from a sheath on a long basal stem or pedicel. Male flowers with three to twelve stamens within a perianth of three small green outer segments and three large white inner ones. Female plant produces single flowers from a sheath on a short pedicel. Perianth as in male flower, with a single, many-styled ovary.

USE IN AQUARIUM An attractive and useful shade plant. Affords cover for fish-fry and encourages growth of natural food. Eaten by terrapins.

AQUARIUM or pond.

Broad Pondweed

SCIENTIFIC NAME *Potamogeton* spp. Linnaeus.

DISTRIBUTION World-wide, in temperate and tropical waters.

EXTERNAL FEATURES An aquatic herb with perennial rootstock and long floating, usually forked, stems bearing alternate narrow elongated leaves with parallel veins. A large group with as many as thirty British species. There is much variation, also many hybrids.

HABITS Occurs mainly in fresh water of ponds, lakes and rivers, sometimes in dense masses, the brownish-green leaves entirely covering the water.

REPRODUCTION Flowers small and sessile in a spike which rises above water. Four stamens and four ovaries in a perianth of four scale-like segments, producing nut-like fruits.

Curly Pondweed

Two common British species are: Broad Pondweed, *Potamogeton natans* Linnaeus. One of the largest Pondweeds. Floating leaves stalked, thick, broad and oblong; submerged leaves thin and narrow, even reduced to a mere stalk. Spike of flowers dense, about 1 in. long on a long stalk. Occurs in almost any situation in stagnant or running water. World-wide and common in Britain.

Curly Pondweed, *Potamogeton crispus* Linnaeus. All leaves submerged and thin, narrow, and with wavy edges. Flowers few, about three to six at some distance from each other. Mainly Northern Hemisphere and Australia. Common in Britain in rivers and ponds.

USE IN AQUARIUM Mainly for show and shade. Leaves and stalks eaten by terrapins.

POND mainly. Roots require thinning out from time to time.

WILLOW MOSS

SCIENTIFIC NAME *Fontinalis antipyretica* Hedwig.

DISTRIBUTION Mainly temperate lands in Northern Hemisphere.

EXTERNAL FEATURES A submerged aquatic moss of many slender flexible branches. May grow up to 3 ft long. Lower parts often minus leaves, dark green or brownish. Upper branches with pale green leaves in three rows. Leaves thin, oval with pointed tip, strongly keeled, and variable according to the variety. Capsules in which spores develop sessile, greenish, almost hidden among the leaves, cylindrical and oblong in shape. Peristome bright red. Sexes of plant separate, bearing the reproductive organs. The variety *gracilis* has reddish, more slender and smaller leaves and grows in mountain streams; the variety *gigantea* is very robust, fewer branches, with wider leaves turning coppery-brown with age.

HABITS Grows in ponds and rivers, sometimes in dense masses, either free or attached to stones, tree-roots and waterlogged wood. Rarely fruits except when exposed above water.

REPRODUCTION *Fontinalis* is one of the few British mosses which are aquatic. Unlike the Flowering Plants mosses do not grow flowers to produce seeds, but a structure, resulting from a sexual act, called a *sporogonium*. This grows from the fertilized female organ, usually on a separate female plant, as a swollen structure, the *capsule*, supported on a stalk. From the capsule are liberated a great number of *spores*, which are windborne and germinate into new moss plants under suitable conditions. Mosses also increase by fragmentation of the parent plant. This is the normal method with *Fontinalis*.

AQUARIUM or pond.

NOTE *Fontinalis* tends to become covered with a sediment in the aquarium. This collects on the keeled leaves, but can be washed off if the plant is removed and shaken in water. Specimens are best arranged in small clumps, anchored to a piece of stone or lead, for easy removal. Where they are found growing

naturally on rock, they can be set out in the aquarium using the rock-work as part of the scenery.

Pond Life

Various aquatic animals, apart from the larger amphibians, fish and terrapins, make interesting pets and useful educational subjects in the aquarium. Insects, *Mollusca* and *Crustacea* are groups of animals represented in ponds and suitable for this purpose.

Insects have a complicated life-history, passing by metamorphosis through a number of stages, which are typically: egg, larva, pupa and adult. The adult has a body divided into head, thorax and abdomen, and possesses three pairs of legs. There are usually two pairs of wings. In aquatic insects, such as the beetles (*Coleoptera*) and bugs (*Hemiptera*), all stages occur in water, although the adult can leave at will. In dragonflies (*Odonata*) the adult is airborne. The two-winged insects (*Diptera*) have many species with aquatic larvae, e.g. midges and mosquitoes. Since respiration in insects is atmospheric the aquatic stages must surface at intervals for air. They are usually very predaceous, especially the dragonfly and beetle larvae, and, to a lesser extent, the bugs. The Water Spider is an interesting aquatic species of the *Arachnida* (body in two parts, a cephalothorax and abdomen, and legs in four pairs). It builds a web containing air below water.

Certain *Mollusca*, or 'shell-fishes,' occur in water. Water snails, with a single shell (univalves), crawl about on a broad foot, and are chiefly vegetarian, feeding with a mouth which is provided with a rasping tongue-like *radula*. Mussels have two shells (bivalves), through which protrudes a foot used to pull themselves through the mud. Feeding is by a filter action through siphons. Some of the snails are air-breathers, coming to the surface for fresh supplies.

The *Crustacea* in fresh water are for the most part small creatures, with the exception of the crayfish, which makes an

unusual aquarium subject. Crustaceans are largely marine (crabs and lobsters are well-known examples) and may be described as animals without backbones, possessing a hard shell-like skin and numerous jointed limbs.

All these groups of animals are without backbones, that is they are invertebrates. Invertebrates are far more numerous than the more familiar vertebrates, and are usually much smaller creatures.

Provided that the correct food is given most of these creatures require little attention and will live satisfactorily in small containers of natural water (even in jam-jars). They should not be overcrowded and predaceous kinds should be kept apart from the more docile specimens. However, even a water beetle may attack and kill a dragonfly larva much larger than itself if hungry. Snails will feed on algae and plant debris, and can be given lettuce leaves. Mussels filter their food from the water, and both these molluscs are useful in the aquarium as scavengers and cleaners. Beetles will feed on other small water animals, and on earthworms and raw meat (the Silver Water Beetle eats algae when adult) and their containers must be covered to prevent escape since they may crawl out. Dragonfly larvae, like water-bugs, will take small water animals, including other insect-larvae, tadpoles and crustaceans. Insect-larvae require a stalk or leaf of a water-plant up which to climb when about to transform into the adult. Predaceous specimens are best kept separately, or in pairs if they are to breed.

The Water Spider requires plants in which to spin its web and small water animals upon which to feed. The Water Louse (*Asellus*) is a favourite food.

The Crayfish will live best in well-aerated water of an alkaline nature. It is mainly a scavenger.

By paying attention to the water and not allowing it to become foul it is possible to keep many of these animals in small containers for as long as three years.

GREAT DIVING BEETLE

SCIENTIFIC NAME *Dytiscus marginalis* Linnaeus, 1758.

DISTRIBUTION Northern and central Europe, Siberia and, possibly, North America. In Britain widespread.

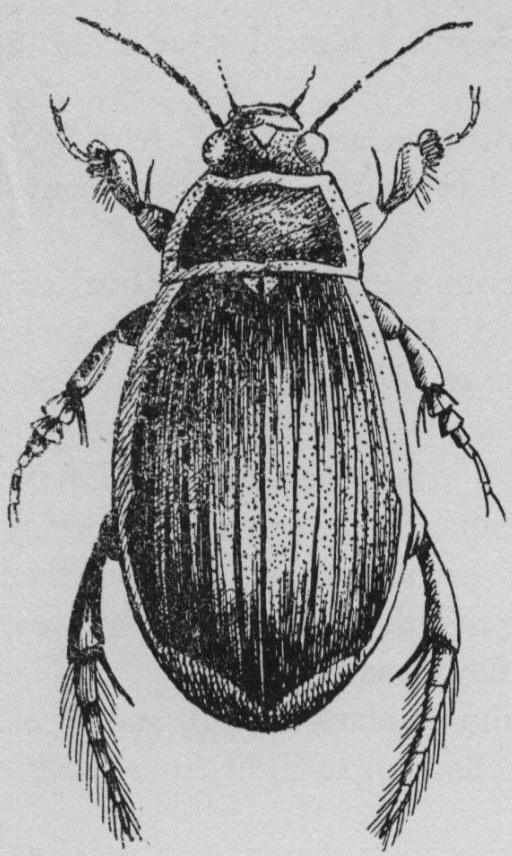
EXTERNAL FEATURES Adult: about 3 cm long, body oval, flattened with smallish head set deep into thorax. Mouth parts for biting, with stout double-toothed mandibles. Long, slender antennae and large eyes. Wind-covers stout, smooth in male, furrowed in female (not always). Hind-legs large and oar-like. Fore-limbs of male with rounded sucker. Larva: grows to about 5 cm, body elongated and cylindrical, tapering at both ends. Head flat with small eyes and distinct neck. Sharp, curved, perforated mandibles, used for piercing and sucking juices of prey. Legs long and tapering, ending in double claws. Spiracles open into twin air-tubes at end of body.

COLOUR Adult, above: chestnut-brown with yellow stripes along border of thorax and wing-covers. Below: yellowish with darker lines along segments.

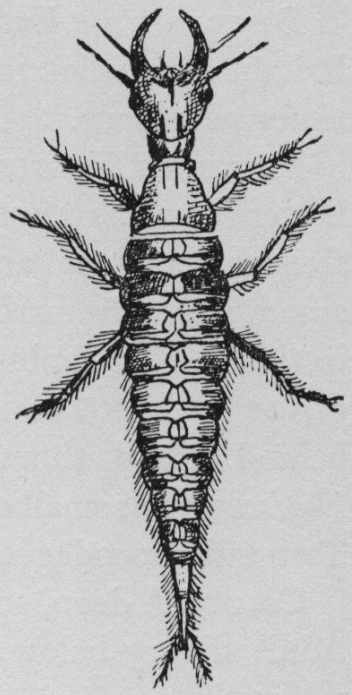
HABITS Found mainly in heavily planted ponds and ditches, even in foul water or where leaves accumulate. Both larva and adult are carnivorous, catching food by the mouth and gripping with legs. Sometimes scavenges. Larva usually crawls among plants; adult swims gracefully with oar-like motions of hind-legs. Surfaces at intervals to breathe by protruding abdomen to obtain air which, in adult, is collected as a flattened bubble under the wing-covers. Adult produces an unpleasant odour, probably protective or as a communication with its kind. Is long-lived, and usually flies on warm nights to seek another pond.

FOOD All forms of water life, even newts and fish. Very predaceous.

BREEDING To mate, the male grips female from above with suckers. Fertilization internal. Female lays each single egg in stem of water-plant, making an incision with her ovipositor, which is armed with two sharp plates. Larva hatches in about



Adult



Larva

three weeks, and with successive changes of its chitinous skin may reach full development in four weeks. To pupate, larva leaves water, crawls a few feet away and excavates a round hole in soft earth, often in a vertical bank. Pupa at first whitish, then becomes dark. Adult emerges in about three weeks and seeks water.

USE IN AQUARIUM An interesting and educational subject, easily kept even in a small container, but must be isolated because of its aggressive habits.

SCIENTIFIC NAME *Hydrophilus* (*Hydrous*) *piceus* Linnaeus, 1758. Originally named *Dytiscus piceus*.

DISTRIBUTION Europe, northern Asia and North Africa. In Britain somewhat rare and very local but in latter case sometimes numerous.

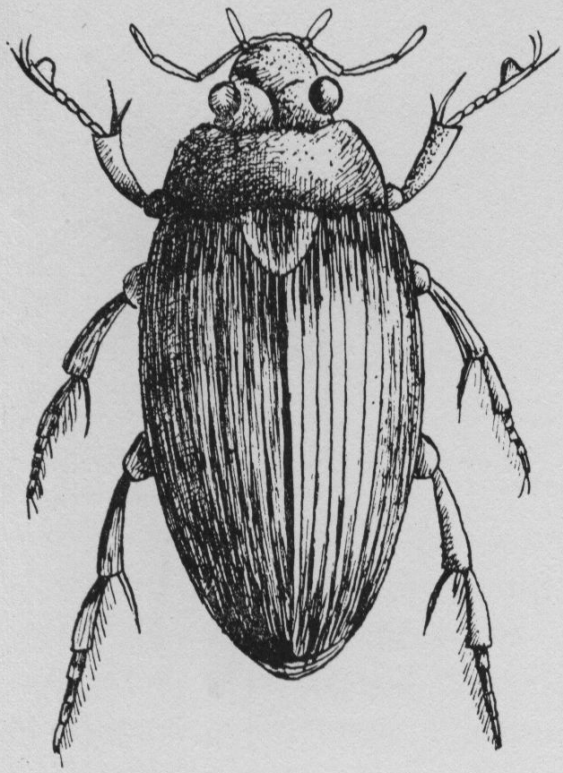
EXTERNAL FEATURES Adult: about 4 cm long, body oval and flattened, tapering slightly behind. Head medium with long, slender antennae and smallish eyes. Wing-covers stout and smooth, faintly furrowed. Hind-legs long, with spike-like projections. Fore-limbs of male with triangular suckers. Larva: grows to about 7 cm elongated, somewhat flattened and tapering behind. Head short and broad. Legs longish, less so than *Dytiscus*, with small eyes. Piercing mouth-parts for sucking prey. Two tail appendages contain the functional air-tubes.

COLOUR A deep, sooty brown, almost black in adult and larva. Adult silvery below, caused by reflection of light from the air reservoir.

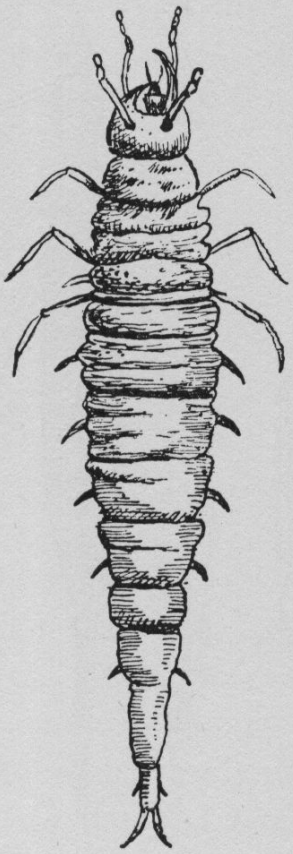
HABITS Occurs in heavily planted ponds, ditches and canals. The adults swim about slowly or climb among plants, surfacing at intervals to breathe, head uppermost. Body is tilted so that one antenna is protruded, and air is pumped under wing-covers, also into air reservoirs on underside. Flies at night. Larva crawls among plants and is more active. Collects air at surface by protruding the breathing tube at end of abdomen.

FOOD Adult is mostly vegetarian, eating water-plants, mainly algae, but will feed occasionally on small animals or carrion. Larva carnivorous and very predaceous, eating all forms of small animals especially water snails.

BREEDING Mating similar to *Dytiscus*. Female spends 5–7 hours near surface, upside-down, building a cocoon attached to some floating object. Cocoon spherical, whitish, about 1·5 cm long, with a peculiar mast-like projection of unknown function. About 100 eggs laid on cocoon roof which hatch in about two weeks, the larvae boring through wall. Pupation similar to



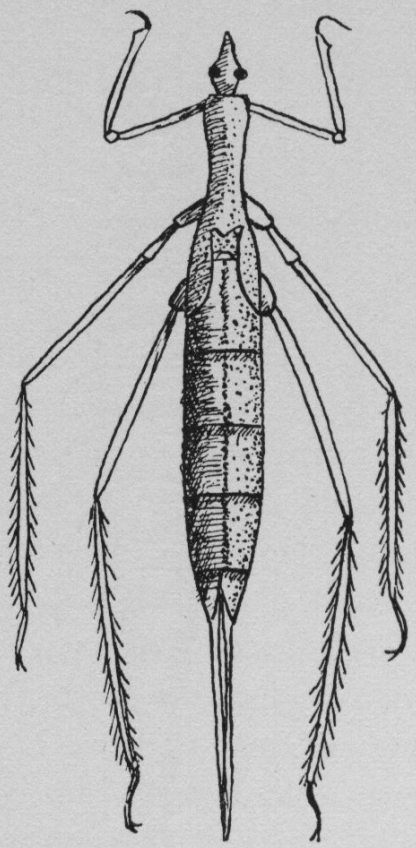
Adult



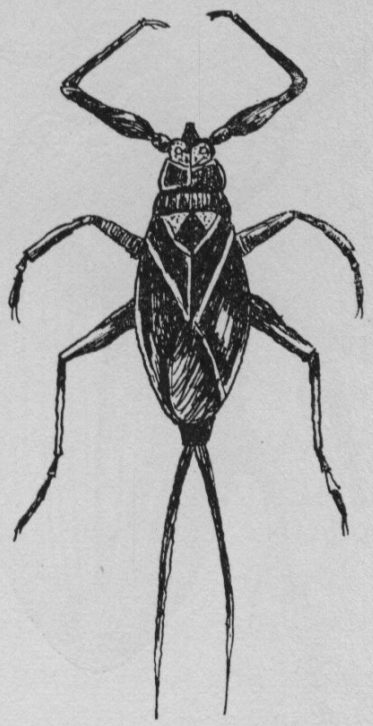
Larva

Dytiscus. Adult emerges in about three weeks after pupation and enters water.

USE IN AQUARIUM The adult, if obtainable, makes an interesting educational subject and may be kept with other animals of similar size. The larva should be isolated.



Water Stick Insect



Water Scorpion

SCIENTIFIC NAMES *Nepa*, *Ranatra*, *Notonecta* and *Corixa*.

DISTRIBUTION World-wide.

DESCRIPTION Water-bugs, of the Insect order *Hemiptera*, are recognized by the mouth-parts which form a jointed, piercing beak, bent backwards under the thorax when at rest. Wings, usually four, of aquatic bugs have the front pair half horny and half membranous lying flat along the back. Antennae hidden underneath head.

HABITS Mostly found in shallow, stagnant waters, sometimes brackish, rich in organic matter, and water-plants. Food, including small fish and amphibians, from which juices are sucked with piercing beak, is caught with bent forelimbs. Air taken in from surface through respiratory tube at end of body. Young, hatched from eggs, resemble parents minus wings and develop through stages, called *instars*. Examples are:

Greater Water Boatman Lesser Water Boatman

Water Stick Insect, *Ranatra linearis* Linnaeus. Body stick-like, about 3·5 cm long, with slender legs, front pair bent and used pincer-like to catch prey for which it waits. Long, paired respiratory tube at end of body. Eggs laid on water-plants. Slow-moving, fairly common, found mostly in southern England.

Water Scorpion, *Nepa cinerae* Linnaeus. Body flat and leaf-like, about 2 cm long, with respiratory tube. Front legs used as in *Ranatra*, habits similar. Widespread and common though not abundant in Britain.

Greater Water Boatman or Backswimmer, *Notonecta* Linnaeus. About four British species. Body wedge-shaped, strongly keeled on back, up to 1·5 cm long. Head large with large eyes. Hind-legs long and oar-like. Active predators, swimming jerkily on back which is silvery due to air reservoir. Eggs laid in water-plants. Hibernation in mud. In Britain widespread and common.

Lesser Water Boatman, *Corixa* Geoffrey. Rather similar to *Notonecta*, but much smaller, up to 12 mm. Body flattened below and swims right way up. Habits similar, common and widespread.

Use in Aquarium Educational subjects and interesting to watch in movement and when catching food. Feed on small living prey or small pieces of raw meat.

SCIENTIFIC NAME *Unio pictorum* Linnaeus, 1758. Originally named *Mya pictorum*.

DISTRIBUTION Europe, Asia and North Africa. In Britain: England and Wales, mainly in south, absent from Scotland and Ireland.

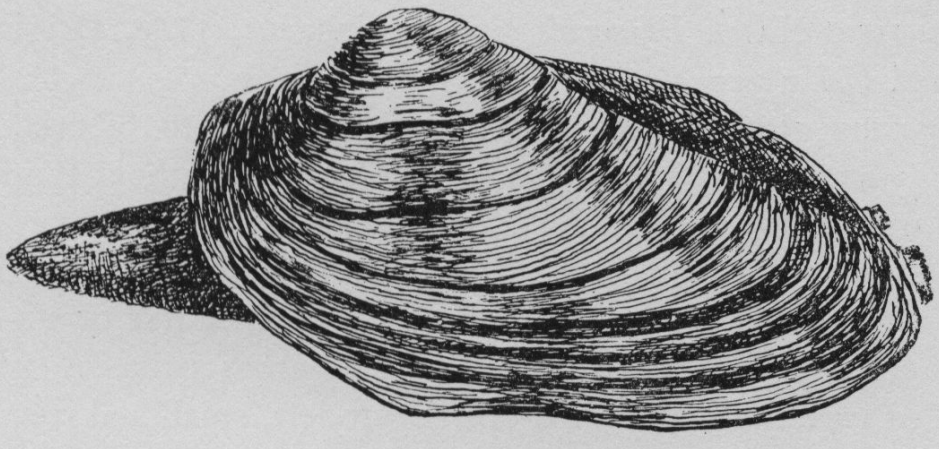
EXTERNAL FEATURES Shell in two halves, called valves, hinged at top, oblong and compressed, from 8–10 cm long and 3–4 cm deep. Variable in shape but with anterior side short, posterior side long and gently sloping. Shell covered on outside with thin skin and often with algal growth. A large, broad tongue-shaped foot. Siphons show as two apertures in mantle at hind margin, upper short and lower long.

COLOUR Skin brownish through which appears the yellowish ground tint in concentric lines with centre near top of shell, sometimes with pale green rays at hind end. Inside of shell pearly with distinct muscle impressions.

HABITS Lives in mud or sand of pools, lakes and rivers in which it slowly moves by use of foot. This protrudes forwards and downwards from valves into mud, swelling at tip to obtain a grip, and pulls shell after it. Process then repeated. Can shut valves tightly by powerful muscle action. The valves were once used to hold the artist's colours, hence the name of this mussel. A lammelibranch, bivalve mollusc, respiring under water.

FOOD Microscopic life, mainly plants, which are taken in with water by ciliary action through upper, or inhalant, siphon, collected in mantle chamber, thence passed to mouth. Water expelled by lower, or exhalant, siphon.

BREEDING Sexes separate, looking alike externally. Eggs, fertilized within the body of the female, are laid in spring and summer and develop for about two months in outer gill-chamber. They pass winter there and emerge in spring from exhalant siphon as a larval form, called a *glochidium*. Larva swims with snapping movements of valves and fastens on to a fish with its hooks, becoming parasitic for a few weeks. Later falls off and



grows to adult form. Gills develop by third year, and mussel is mature in fifth.

USE IN AQUARIUM Mussels are useful as water-purifiers because of their filter-feeding action, but may disturb plants by movement. Water circulation through siphons can be observed by adding a harmless coloured fluid to water.

NOTE Some other British species are:

The Pearl Mussel (*Unio margaritifer*), up to 14 cm long and 6·5 cm deep with oblong, compressed rough brown shell, soft parts greyish, tinged with red. A more northerly species, occurring among stones and gravel of hill streams. Once collected for pearls, the best valued at about £4.

The Swollen River Mussel (*Unio tumidum*). A more solid, thicker shell, glossy brown with greenish lines of growth. Body greyish. Shell up to 8·5 cm long. Habits and distribution similar to *U. pictorum*.

The Swan Mussel (*Anadonta cygnea*). Oval shell with swollen foreparts and straight-edged hinge, coloured greenish-yellow with thin, glossy brown skin and well-marked lines of growth. Body grey, tinged with red. Common in ponds and slow waters. Up to 17 cm long and 9 cm deep. Can live up to 14 years.

SCIENTIFIC NAME *Planorbis corneus* Linnaeus, 1758. Originally named *Helix cornea.*

DISTRIBUTION Europe and Asia, eastwards to Siberia, and mainly a northerly species. In Britain local throughout England, also parts of Wales, Scotland and Ireland.

DESCRIPTION Shell glossy brown or olive, about 2 cm high and 8 mm broad, shaped like a ram's horn with five or six convex coils. Lines of growth close-set across coils. A white-shelled variety occurs. Shell opening to left, small and rounded. Head small with long, slender tentacles. Foot small and rounded. Body colour a deep, reddish brown, also in the albino form which has a reddish body and pale shell, often seen in the aquarium.

HABITS Similar in general to the Fresh-water Whelk. Body can retire deeply into shell. Prefers clearer waters in which plant life is abundant. Movements rather slower than those of the Fresh-water Whelk. A pulmonate, univalve mollusc.

FOOD Plants and decaying vegetable matter. Feeds in the same way as the Fresh-water Whelk.

BREEDING Similar to Fresh-water Whelk. Female lays from 50–120 eggs in one season, in clumps of rounded or shield-shaped jelly, about 1–1·5 cm across, each containing about 20–40 eggs, on plants and stones. Young hatch in about 15 days.

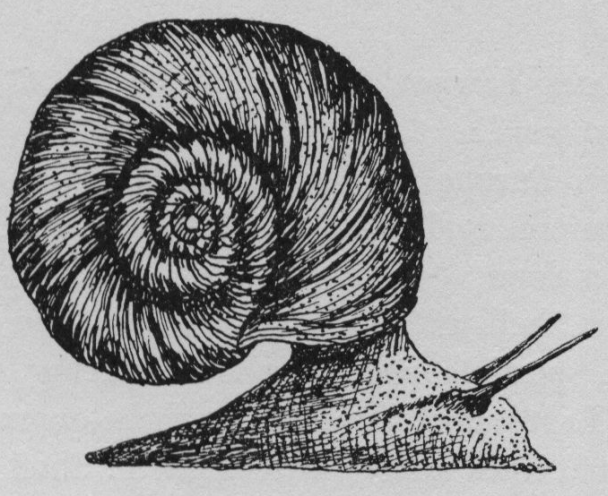
USE IN AQUARIUM Similar to Fresh-water Whelk. Usually not so destructive to plants.

NOTE Further British species are:

The Twist Trumpet Snail (*P. contortus*), a thick, smooth, dull brown shell about 6 mm across, of about eight coils. Upper side flat, under side concave with crescentic aperture. Not active. Common in ponds, rivers and ditches.

The Button Ram's Horn (*P. spirorbis*). A thick shell, dark horn colour, of six rounded coils, flat spire and rounded aperture. About 6 mm across. Inhabits shallow, grassy pools.

The White Ram's Horn (*P. albus*), thin, semi-transparent,



whitish shell of five coils with spiral striations. Up to 8 mm across. Common in ditches, ponds and canals.

FRESH-WATER WHELK OR GREAT POND SNAIL

SCIENTIFIC NAME *Limnea stagnalis* Linnaeus, 1758. Originally named *Helix stagnalis.*

DISTRIBUTION Europe and Asia as far as India, North Africa. In Britain common in England and Wales, local generally in Ireland and Scotland.

DESCRIPTION Shell thin, greyish, from 3–5 cm long and 1·5–2·5 cm broad, spiral-shaped, long and tapering, with seven or eight whorls. Last whorl large, about three-quarters of the size of shell. Striated lines appear with growth. Shell opening oval, on right side. Some varieties with dark, pale or banded shells. Latter may be covered with algal growth or worn away in parts. Head large with long, tapering, triangular-shaped tentacles. Foot broad, edged in yellow, body colour greyish-brown.

HABITS Occurs, sometimes in great numbers, in ponds, lakes, canals and slow-moving rivers, sometimes in stagnant water where organic waste has accumulated. Crawls about slowly on foot over bottom or among plants and debris. Rises to surface at intervals to take in fresh air into lung chamber which opens directly from body. Can withdraw body into shell. A pulmonate, univalve mollusc.

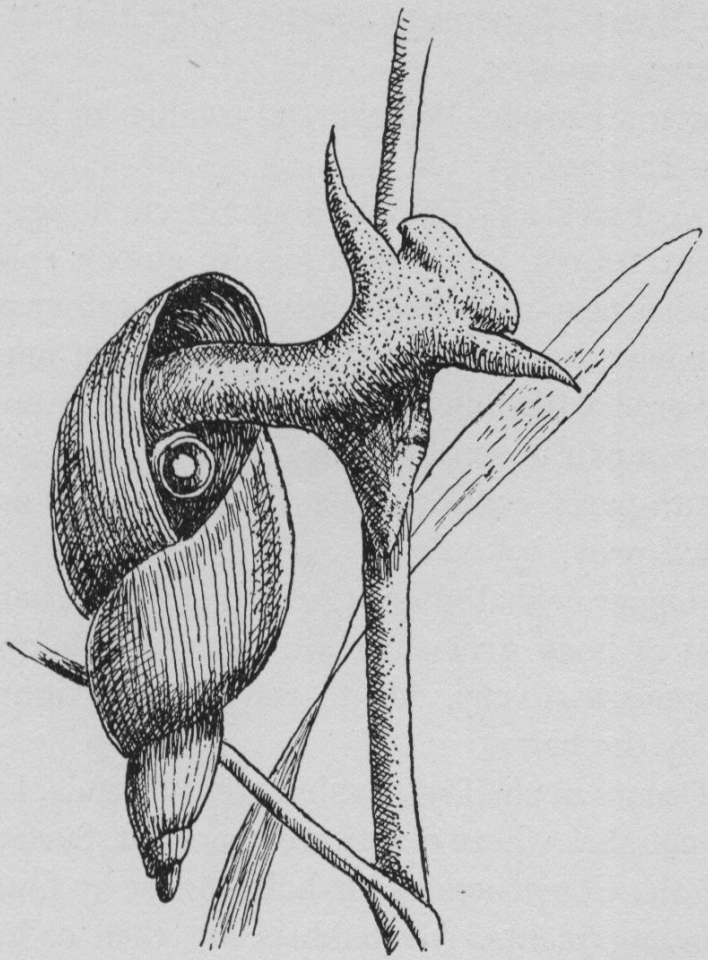
FOOD A scavenger, feeding on water-plants and decaying leaves, also carrion, even attacking live animals such as small fish and newts. Food rasped away with ribbon-like tongue, the *radula,* which is covered with numerous rows of horny teeth.

BREEDING A hermaphrodite animal. Mating occurs, the female laying from 50–100 eggs in a curved, cylindrical, jelly-like mass about 2·5–4 cm long, according to age of snail, on plants and stones. Young hatch in about 10–15 days.

USE IN AQUARIUM Of interest educationally. A scavenger which also helps to clean the glass of algal growth, but will also attack plants when hungry.

NOTE Further British species are:

The Marsh Limnea (*L. palustris*). Slender-shaped but more



solid shell of about six whorls, dull yellow and with thick lip and oval aperture. Usually coated with mud. Widespread in stagnant pools and ditches. About 2 cm long and 1 cm broad. Common.

The Dwarf Pond Snail (*L. truncatula*). Similar to a small Marsh Limnea but brownish, more glossy shell of six turreted whorls. Often found on mud beside ditches and pools. Is the second host of the liverfluke parasite of sheep.

The Ear Pond Snail (*L. auricularia*). Shell with large aperture and short spire of four to five whorls, a glossy yellow horn colour. Foot bordered with yellow. Length 3·5 cm and 3 cm broad. Local in stagnant waters, mainly in England and Wales.

WATER SPIDER

Scientific Name *Argyroneta aquatica* Clerck, 1757. Originally named *Araneus aquatica.*

Distribution Europe. Widespread colonies in Britain, mainly in southern England.

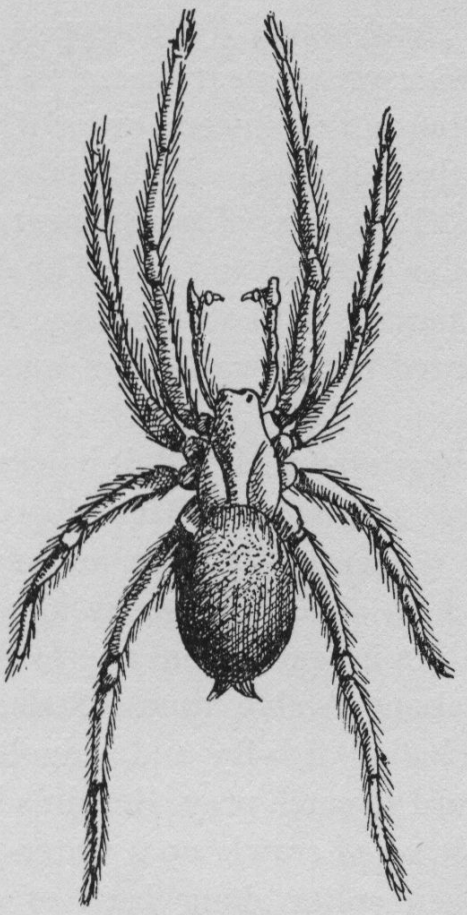
External Features Female about 1 cm long, male much larger, about 1·5 cm, an unusual feature among spiders. Abdomen somewhat pear-shaped, slightly flattened, four pairs of long and slender legs, more so in male. Body, except upper cephalothorax, covered with fine hair-like growth, also on legs. Four pairs of eyes, a pair of sensory palps, with processes in male, and biting mouth-parts containing a pair of sickle-shaped claws which poison prey.

Colour Upper cephalothorax, which is free of hairs, reddish-brown, rest of body greyish or olive-brown. Below water the abdomen appears silvery, due to reflection of light on the air caught up by the hairs.

Habits Occurs in shallow, fresh water of ponds, lake borders, canals and marshes where plants are abundant. Surfaces for fresh supplies of air. Constructs an air-bubble nest by first weaving a flat web among plants. Air bubbles are then collected at the surface, taken down to web and released underneath. Buoyancy of accumulating bubbles forces up web into shape of a bell, about 1 cm in diameter, which reflects the light giving the appearance of a ball of mercury. Spider rests, feeds, moults and mates in bell. It moves about independently among water-plants, sometimes swimming through water with walking movements of legs. More active at night. Hibernates in bell which is sealed off or sometimes in cavities like empty snail-shells which are filled with air.

Food Numerous small aquatic animals, especially crustaceans like the Fresh-water Louse (*Asellus*).

Breeding May to August. Female lays from 60–100 eggs in top of bell in a strengthened cocoon-like web which is then sealed off from rest of bell by a web-platform. Young hatch in



about 20 days, then rest for about 14 days, finally biting out of cocoon and leaving bell to fend for themselves.

USE IN AQUARIUM A very interesting educational subject with unusual habits. Can be kept in a small container, but is best by itself, except when breeding, because of tendency towards cannibalism.

SCIENTIFIC NAMES *Aeschna* and *Agrion* spp.

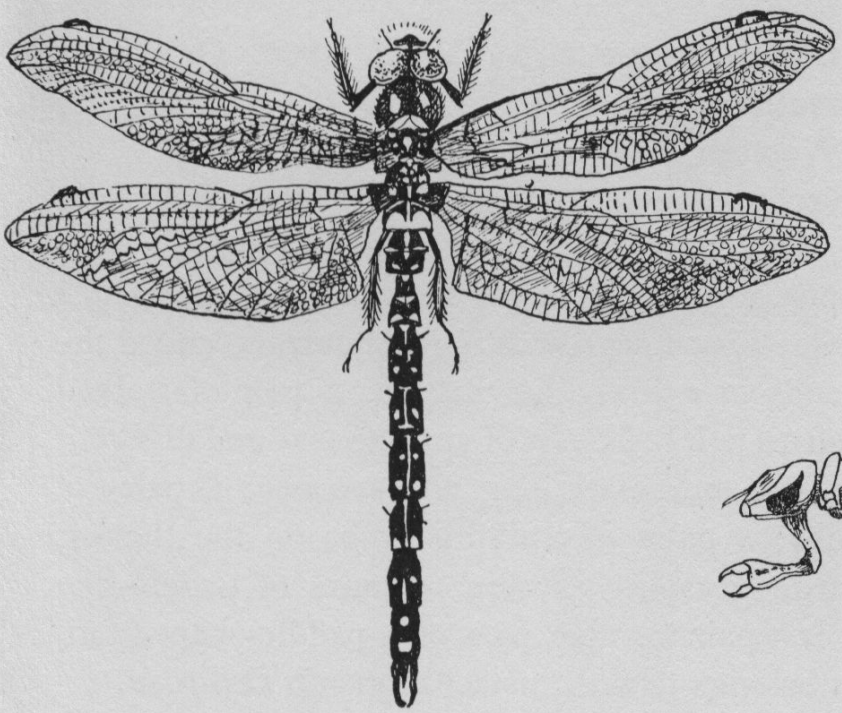
DISTRIBUTION Widespread, near water, in Europe and Asia.

DESCRIPTION Dragonflies, insect order *Odonata*, are long, slender and brightly coloured, with mobile heads, large eyes and short antennae. Two pairs of transparent wings, with a network of veins, similar in shape and size. The dull-coloured larva is shaped like the parent, with strong legs, rudimentary wings and a peculiar, jointed labium called the 'mask,' which ends in jointed hooks.

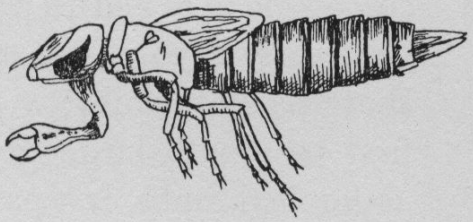
HABITS Mostly near water, the adult hawks for other insects, especially mosquitos and midges. Mating occurs during flight, the female laying numerous eggs on or near water, also on plants. These hatch in about six weeks into a larva or *naiad*, which grows and lives in water from one to three years, moulting at intervals, about twelve times. Stalks numerous small water animals, including fish-fry and tadpoles, with its mask, which shoots forward to catch prey. Respires in water or at surface. At final moult *naiad* crawls up a water-plant out of water and rests. Skin then splits along back of thorax, head and thorax with bunched legs appearing through slit. Adult rests before finally pulling abdomen clear of empty skin. Wings gradually expand as blood is pumped into veins, the whole emergence taking two to three hours. The two groups of *Odonata*, both found in Britain, are distinguished by the position of the wings at rest and the respiratory mechanism of the larva.

Aeschna spp. (Group *Anisoptera*). Large, powerful adults about 7 cm long, rapid and noisy in flight and very predaceous. Wings when at rest horizontal. Larva about 4 cm long, strong and fat, with five to six small projections at hind end. Water is pumped in and out of the anus, passing over respiratory gills within the food passage. By propelling water from body larva shoot forwards.

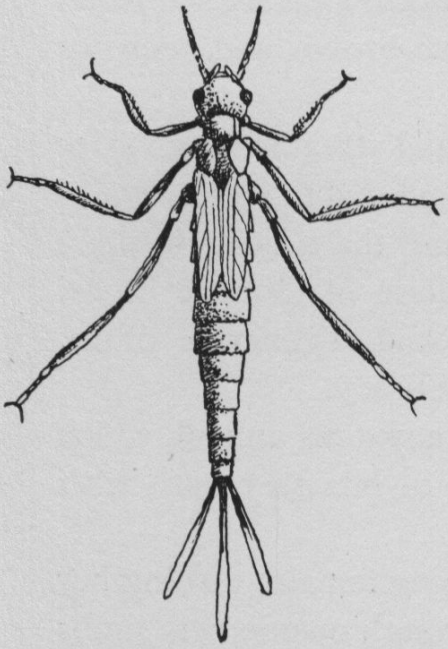
Agrion spp. (Group *Zygoptera*). Small, graceful, slender adults, about 4 cm long, with wings vertical when at rest and



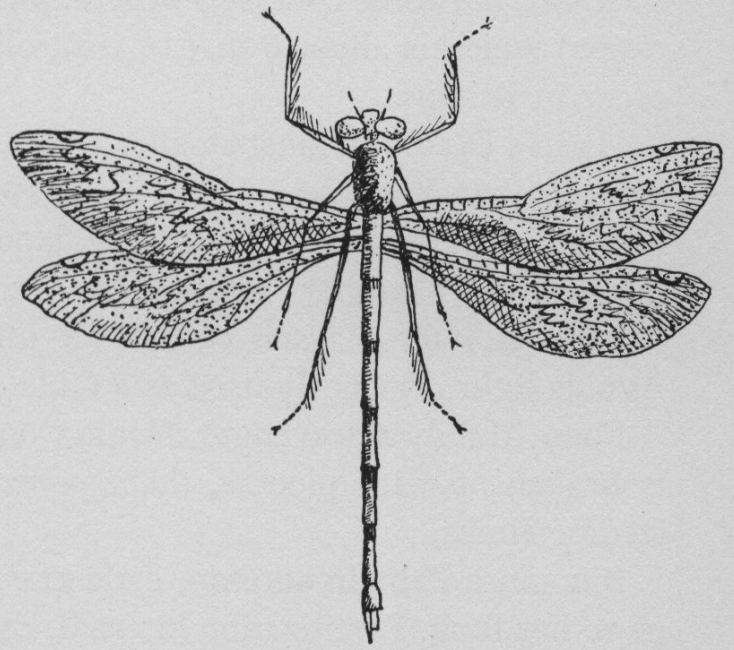
Aeschna Adult



Aeschna Larva



Agrion Larva



Agrion Adult

narrow at point of attachment. Larva with long, slender body about 3–4 cm long, powerful legs and three long projections at end of body containing air-breathing tubes. Swims by undulating the compressed body from side to side.

SCIENTIFIC NAME *Astacus torrentium* Wolf, 1806. Originally named *Cancer torrentium.*

DISTRIBUTION Western Europe, including Britain.

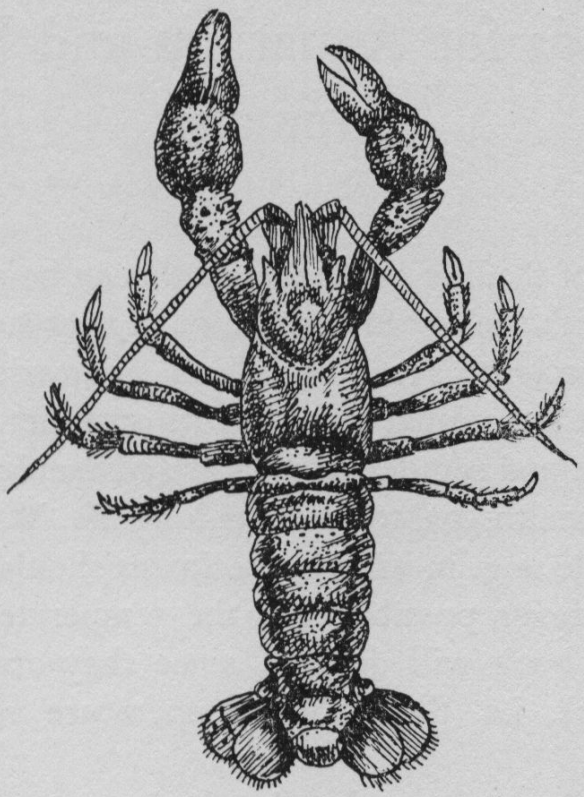
EXTERNAL FEATURES Grows to about 3 in. (8 cm). Body lobster-like covered with hard cuticle and segmented. Each segment with an upper *tergum* and lower *sternum*, each bearing a pair of jointed limbs. Fused segments in forequarters, called the carapace, which ends in a beak-like *rostrum.* A pair of stalked compound eyes and 19 pairs of limbs of varying size and different uses: first 2 pairs the antennae, long and sensory; 6 pairs of short feeding limbs; 5 pairs of walking limbs on the thorax, first pair with large grasping pincers; 6 pairs of paddle-like abdominal limbs, last pair forming part of a paddle-shaped tail, the *telson. Astacus* belongs to the crustacean group *Decapoda.*

COLOUR A general greenish-brown (French, *Écrevisse à pattes blanches*), not to be confused with *A. fluviatilis* (*Écrevisse à pattes rouges*) which is about 6 in. (15 cm), olive-brown, and does not occur in Britain.

HABITS Occurs in most smaller rivers and streams which arise from chalk or limestone. Hides under stones and moves by walking limbs, or swims backwards by flapping the telson. Respires through gill chambers situated on the base of thoracic limbs. Moults at intervals and can throw off and regenerate limbs. Avoids light. Formerly used as a table delicacy.

FOOD Mainly a scavenger, feeding on any dead animal, which is broken up with pincers, then passed in bits to mouth with feeding limbs.

BREEDING Pairs in autumn, male grasping female, turning her on to her back. Fertilization internal, through openings in limbs on thorax. Eggs or 'berries' laid in about November, becoming attached by stalks to abdominal legs of female. Young hatch in early summer, somewhat similar to adult in appearance, remaining for a while clinging to mother.



USE IN AQUARIUM An unusual educational subject. Requires well-aerated, shallow, alkaline water.

NOTE Crayfish may be sought after in clear gravel stretches of streams, where they are known to occur, by lifting stones under which they hide. Small traps containing bait have proved successful.

Live Foods for Aquarium and Vivarium Animals

The problem of feeding captive animals can be solved by providing them with their natural food, or as near to it as possible. With exotic species this may be difficult, and various foods must be tried so that the animal can select its own diet.

A varied diet and regular feeding are advisable to keep specimens in good health, and to promote long life. When food is not readily available, e.g. in winter, specimens should be allowed to hibernate wherever possible. All the temperate species mentioned in this book will do this, since they are cold-blooded (*poikilothermous*), i.e. their body temperature varies with the surroundings.

In the following paragraphs, live foods are recommended for the various groups.

Newts and Salamanders Young: Infusoria, *Daphnia*, *Tubifex* and other small water animals, according to size. Adults: the foregoing, plus small earthworms, crustaceans, small slugs, various insects and their larvae and small pieces of raw meat, given on land or in water as the case may be.

Frogs and Toads Tadpoles: algae; and when the legs appear, chopped earthworms, raw meat and animal flesh. Adults and metamorphosed young: insects and their larvae, crustaceans, snails and slugs, given according to size.

Lizards Insects and their larvae, spiders, crustaceans, raw meat. Soft fruit for some species.

Snakes Young: insects, earthworms and young amphibians. Adults: amphibians, birds' eggs, fish, small birds and mammals, given according to the species (see text).

Fish Young: Infusoria, *Daphnia*, *Tubifex*, *Enchytraeus*. Adults: in addition to the above, insects and their larvae, small earth-

worms, frog-tadpoles, and if vegetarian, algae and soft water plants. Occasional small supplies of prepared fish foods, biscuit crumbs, oatmeal and Bemax. (Warning—too much of this may cause indigestion or water-pollution.)

CARNIVOROUS FISH Raw meat, smaller fish, small amphibians, various water animals and earthworms.

TORTOISES Vegetarian kinds: lettuce leaves, dandelion leaves, soft plants and fruit. Carnivorous kinds: small water animals, earthworms, tadpoles and insects.

ALLIGATORS Raw meat, various dead animals and fish.

NOTE Access to water, either for drinking or for wetting the skin (i.e. amphibians), is most important.

SCIENTIFIC NAMES *Chlamydomonas*, *Spirogyra*, *Volvox* spp.

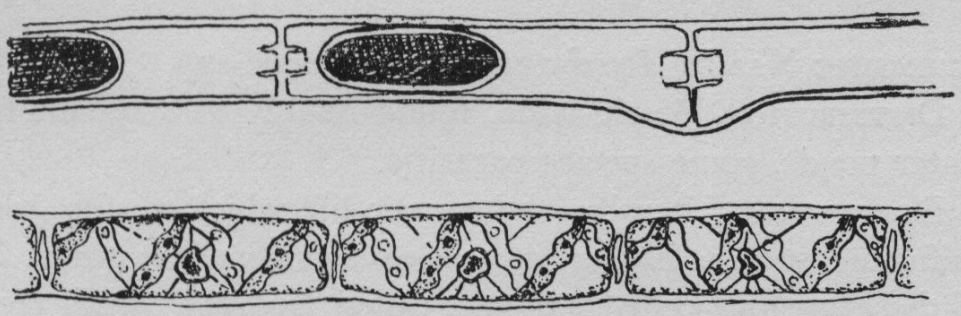
DISTRIBUTION World-wide, mainly in still, fresh water.

DESCRIPTION The simplest of living, green plants, ranging from microscopic, one-celled forms to seaweeds many yards long. Structure simple. Reproduction is vegetative, where the cells or plants split up, or sexual, where special cells (*gametes*) unite to produce a new plant. In lower forms resting cells (*zygosorpes*) are formed and may be carried to new places by wind or moving animals. Algae are among the first to colonize virgin water. Some common pond-algae are:

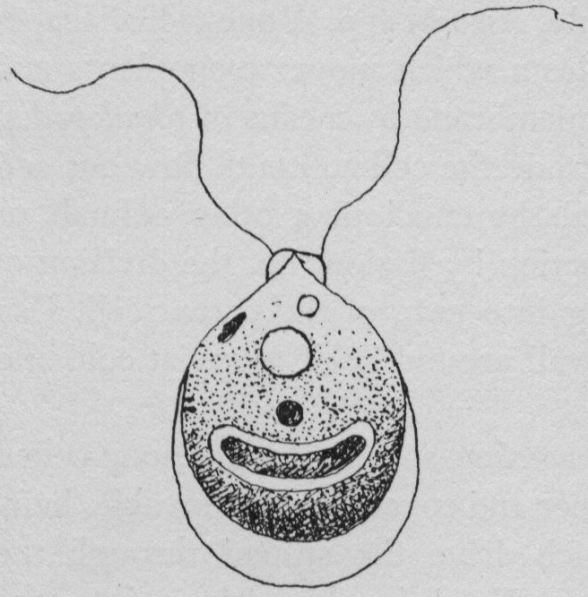
Chlamydomonas spp. Microscopic one-celled, pear-shaped algae contained within a stiff cellulose wall, and possessing two threads (*flagella*) at pointed end with which they swim actively. Chlorophyll occurs in the *chloroplast*. At intervals a cell comes to rest, withdrawing flagella, the nucleus within divides and a number of daughter cells are produced. Sexual reproduction results from the union of special cells, the *gametes*, which form the *zygote*. As a *zygospore*, with thick, resistant cell-wall, the plant can withstand adverse conditions, such as drought, winter and lack of suitable food. Later it divides into numerous daughter cells which take up the active life. *Chlamydomonas* and allies produce the green colouration common to stagnant water in summer.

Blanket Weed, *Spirogyra* spp. and allies. Algae with thread-like or filamentous growth, the elongated cells growing end to end. *Spirogyra* contains a chloroplast forming one or more spiral ribbons through the cells. Vegetative reproduction by division of cells which are independent. There is a sexual method in which contents of cells in a 'male' filament pass across to those of a 'female' filament, or it may take place between adjacent cells. The resultant thick-walled zygospores resist drought and winter conditions when the plants die away, later growing into new plants. *Spirogyra* and its allies form the floating pond-scums of stagnant water, which are buoyed up by the oxygen they produce.

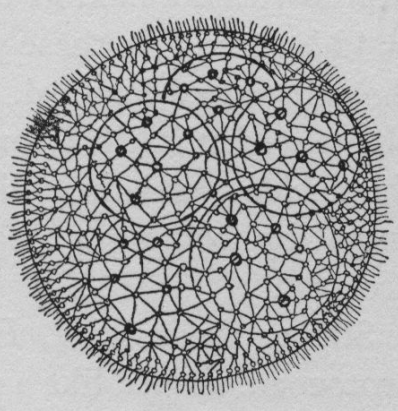
Globe Animalcule, *Volvox* spp. A colonial alga of ponds, just visible to the naked eye, forming a hollow sphere of numerous



Spirogyra



Chlamydomonas



Volvox

green cells, each with a pair of flagella, the globe revolving slowly through the water. Certain larger cells minus flagella divide to form daughter colonies within the globe, subsequently liberated by the parent colony.

Collection Algae may be collected in pond-water or allowed naturally to inoculate jam-jars of tap-water placed in open sunlight. Encourage growth with a few drops of milk or a pinch of chemical food as given to garden plants.

Use as Food One-celled algae, i.e. 'green water,' is useful for early rearing of baby fish, amphibian larvae and *Xenopus* tadpoles, also for breeding water crustaceans (q.v.). Filamentous algae are eaten by tadpoles, aquatic tortoises and the Silver Water Beetle.

SCIENTIFIC NAMES *Amoeba* and *Paramoecium* spp.

DISTRIBUTION World-wide, found mainly in stagnant fresh-water ponds, some species parasitic.

DESCRIPTION Literally, the aquatic life which results from an 'infusion' such as hay or lettuce leaves steeped in water. Most of these are one-celled animals, called *protozoa*, which feed on smaller animals and plants, and bacteria, also each other. Some examples are:

The Changeable Animalcule, *Amoeba* spp. A one-celled shapeless mass of greyish protoplasm which moves over plants and stones within a flexible cell membrane by means of *pseudopodia*, or 'false feet.' As these protrude the cell contents flow out and the cell moves forward. Feeds by enveloping other animals or plants within itself. Reproduction by fission, i.e. the division of the nucleus, and the splitting into two, of the parent cell. Can encyst by forming a tough wall around itself to resist cold and drought.

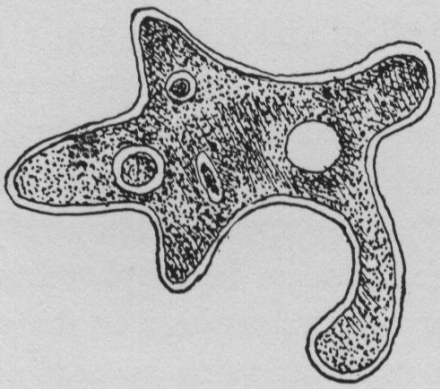
Slipper Animalcule, *Paramoecium* spp. An active, one-celled protozoan, shaped like a slipper and covered with movable, hair-like growths, the cilia, which drive the animal through the water in a corkscrew action. Food is also driven into the 'mouth.' Reproduction, by conjugation, is complicated, and results in numerous daughter cells.

NOTE This life forms part of the essential population required to maintain a 'balanced' aquarium. It helps to check the increase of microscopic plant life (the cause of green colouration) of water, and in turn is the food of many young or small animals.

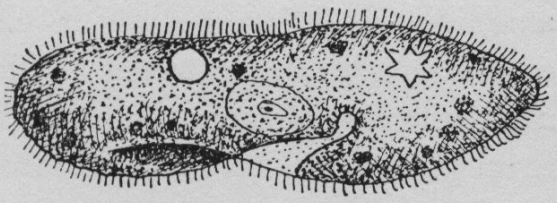
COLLECTION Collect in natural water and add to a jam-jar containing an infusion. Some methods are:

Boil some wheat, rice or oat grains in distilled water. Strain into jam-jars and allow to stand for a few days. Add natural water, containing *protozoa*, in about equal quantity.

Add boiled egg-yolk, mixed into a paste, to jars of natural water containing *protozoa*.



Amoeba



Paramoecium

Treat jars of natural water, especially if *Paramoecium* is present, with some cabbage water, white flour paste or a food extract such as Horlick's, Bemox or Oxo.

Steep hay or horse manure in distilled water for a few days. Strain into jam-jars and inoculate with natural water. Place all cultures in moderate sunlight, at summer temperature.

USE AS FOOD Excellent for early stages of fish and carnivorous amphibian larvae, such as newts.

SCIENTIFIC NAMES *Lumbricus*, *Allolobophora* and *Eisenia* spp.

DESCRIPTION Earthworms or Oligochaetes are segmented annelids which live mainly in earth and are world-wide. Body cylindrical, more flattened at hind end. (Bristle-like hairs, the *chaetae*, protrude from the skin.) Thirty or so species. They vary from about 1 in. to 12 ft (in Australia) and are hermaphrodite, coming to the surface after rain or on warm evenings to mate. They are food to many animals and of great value to man in breaking up and aerating the soil. Eggs are laid in capsules. Some common examples are:

Common Earthworm, *Lumbricus terrestis* Linnaeus. From 9–30 cm long, brick-red or violet above, yellowish below. Chiefly in fertile soil containing humus, common in gardens.

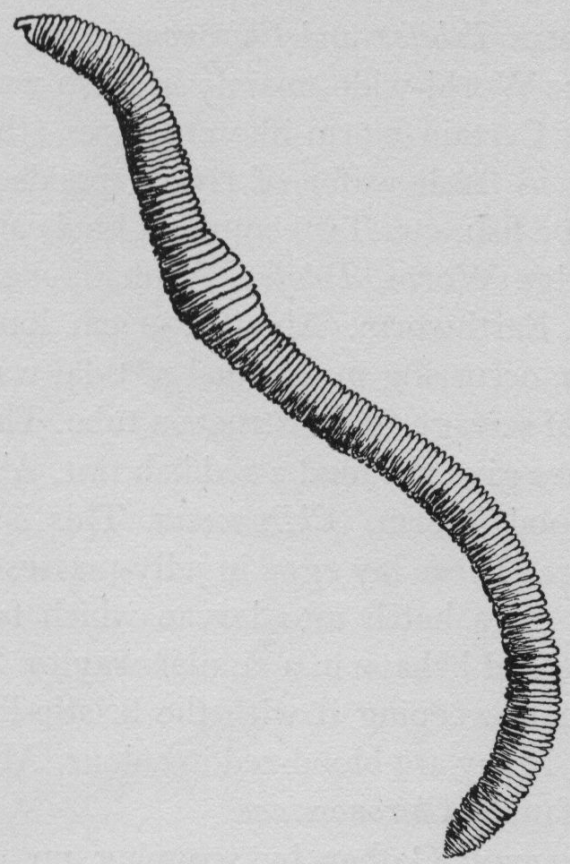
Allolobophora caligmosa Savigny. From 4–7 cm long, pink in front, more greyish at hind end. Habitat as for *Lumbricus*.

The Brandling Worm, *Eisenia foetida* Savigny. From 3–12 cm long. Colour variable, red, purple or brown with bands of red-brown alternating to yellow. Mainly in manure piles.

HOW TO COLLECT After rain insert a garden fork in grass lawns and gently tap with hand. The disturbance of the soil will bring worms to surface. Also dig over rich humus soil or compost heaps. To increase numbers prepare a patch of soil by digging in vegetable garden and kitchen waste, including used tea-leaves, cover with sacking and keep constantly damp.

USE AS FOOD Excellent food for all amphibians (adults and tadpoles), slow-worms, young snakes and fish. Given according to size and chopped up for fish. The Brandling Worm is looked upon as poisonous to fishes, but appears suitable for amphibians and reptiles.

NOTE Should amphibians refuse to eat when offered food, the earthworms may be dropped into the vivarium. They may burrow into the soil, but come to the surface when the toads, salamanders, etc, are in search of food, i.e. at night. Slow-worms will discover them during burrowing activities.



SCIENTIFIC NAMES *Tubifex* and *Chironomus* spp.

DISTRIBUTION World-wide, mainly in fresh water.

DESCRIPTION Certain worm-like creatures (the term is very general) occur in fresh water of rivers, ponds and lakes, and serve as food for fish, etc. Two common kinds are:

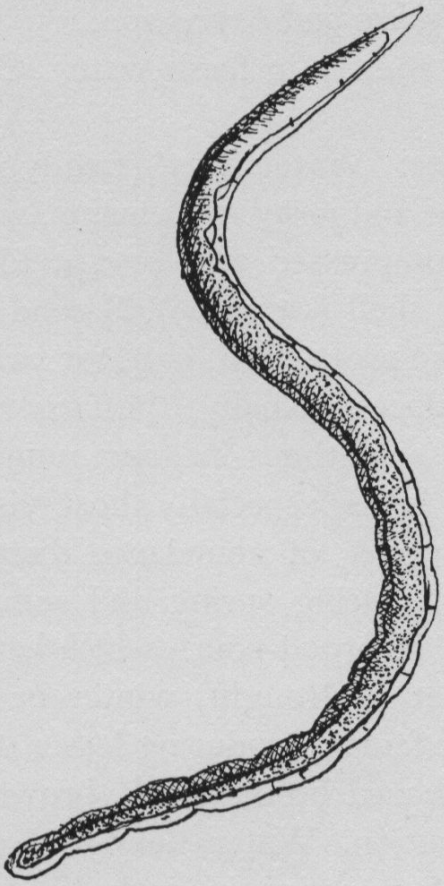
(1) The Sludge Worm, *Tubifex*. A small, segmented annelid related to the Earthworm. About 2–3 cm long, slender and usually reddish, occurring in the mud of tidal waters, especially near outflows of sewage. It constructs a tube. The dense masses of waving bodies give the mud a reddish tint. About 50 species.

(2) The 'Blood Worm,' *Chironomus*. This is really a larval stage of a midge. These lay eggs in jelly-masses along the edge of water. The eggs hatch into larvae which fall to the mud, where they live and behave in a similar way to *Tubifex*, waving in the water and sweeping it with the bristle-like attachments to collect food. Many are blood-red in colour. About 200 British species in the family *Chironomidae*.

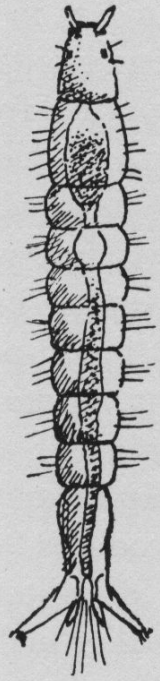
HOW TO COLLECT Gather by scooping up mud containing specimens which can then be strained through a fine mesh, e.g. an old silk stocking. These worms keep for some days in clean, fresh water. *Chironomus* midges may be encouraged to lay in shallow pans of matured water enriched with a meat extract, e.g. Oxo, a little milk, or horse manure. This helps to encourage bacteria as food for the midge larvae. *Tubifex* will breed in shallow water containing a layer of soft river mud to which is added vegetable matter. The water should be changed every few days to keep it fresh.

USE AS FOOD Excellent for fish and newts, especially the young of both, when cut up into small pieces.

NOTE The 'White-worm,' *Enchytraeus albidus*, is often given as a fish food and is useful to young newts and salamanders. This is a small, whitish, terrestrial worm related to the Earthworm, which is obtainable from dealers. It is cultured in boxes of loose soil to which a portion of bread soaked in milk is added,



Tubifex



Blood Worm

as food. Glass is laid over the soil and the box kept in a cool, dark place. This worm is not aquatic, as sometimes stated. There are about 14 British species of *Enchytraeus*.

SCIENTIFIC NAMES *Daphnia*, *Cyclops* and *Cypris* spp.

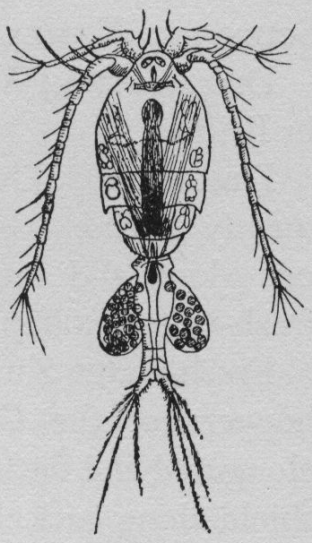
DISTRIBUTION World-wide, mainly in fresh water. Common and abundant in Britain.

DESCRIPTION *Daphnia* Muller. 'Water fleas' (family *Daphnidae*), so called from their shape and jerky movements, are small crustaceans. Body laterally compressed and, except for head, usually enclosed in a bivalve shell (carapace). Second pair of antennae large with feather-like projections, used for swimming and sweeping in food. Reproduces sexually, the larger female using a brood-pouch. Occurs, sometimes in great numbers, in stagnant waters of ponds and lakes, especially those visited by farm animals, appearing in cycles of abundance dictated by temperature and food supply. During spring and summer female produces 'summer eggs' in brood-pouch which hatch into sexless daughters. With onset of drought, winter or lack of food smaller males appear, the female producing lesser numbers of 'winter eggs' in a strengthened brood-pouch, brown-red in colour. These require fertilization. Water fleas feed on one-celled algae and bacteria. Most active in early morning or evening. About 24 British species in this family.

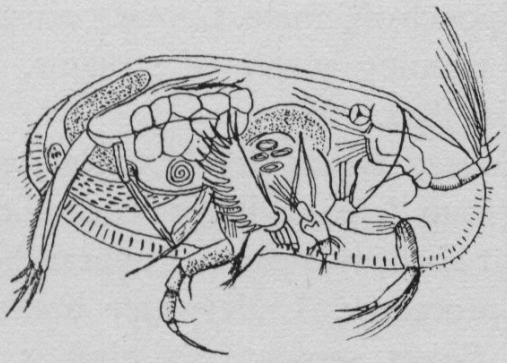
Cyclops Muller. A small crustacean commonly found with *Daphnia*. Body pear-shaped and segmented, with forked and feather-like tail. Two pairs of antennae, second pair long, unforked and feathered in female, used for swimming. A pair of brood-pouches attached to hind end of female. Sexes separate, male smaller. Young develop through a complicated series of stages. Larva called a *nauplius*. Feeding habits similar to *Daphnia*.

Cypris Muller. Another small fresh-water crustacean, with oval, unsegmented body, and seven pair of legs mostly hidden by the laterally compressed mussel-like bivalve shell. Reproduction by pairing, eggs laid on water-plants. Development a complicated metamorphosis. Food is animal and vegetable matter.

Daphnia



Cyclops



Cypris

CULTURE Three methods are as follows:

Steep some garden soil, dry fresh horse manure or cooked liver in water for two days. Strain water into 2-lb jam-jars each containing about half an inch of fine silt. This produces a crop of bacteria in a few days. Add *Daphnia*, etc.

Place jars of pond-water in sunlight to produce 'green water.' Add crustaceans which will feed on algae.

Ferment some wheat bran in water (2 tablespoons to each 2-lb jar). Add 1 part mixture to 50 parts pond-water and inoculate with *Daphnia*.

WATER SHRIMP AND WATER LOUSE

SCIENTIFIC NAMES *Gammarus* and *Asellus* spp.

DISTRIBUTION World-wide in fresh and salt water. Common in Britain.

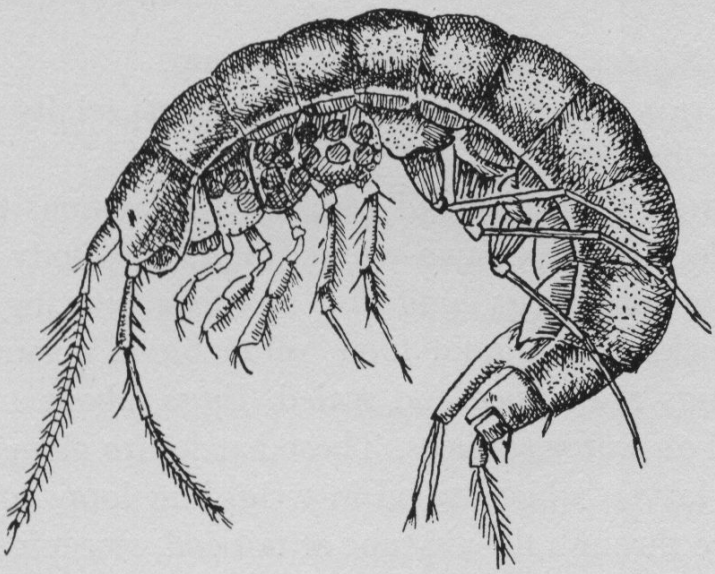
DESCRIPTION These are crustaceans, a group of invertebrates, mainly marine, which are segmented animals with hard, chitinous skins and numerous many-jointed limbs. Two common fresh-water examples are:

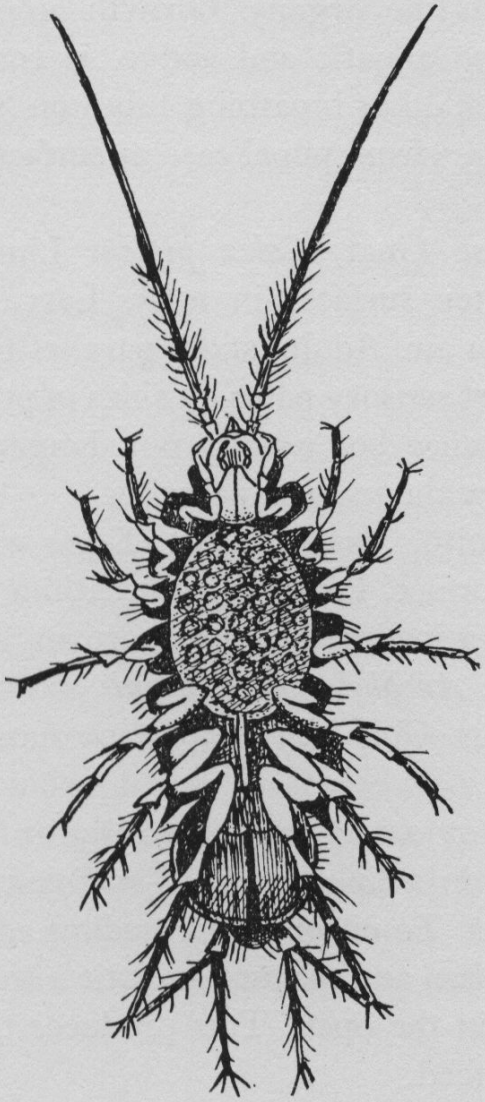
Fresh-water Shrimp, *Gammarus* Faber. Related to the Sand-hoppers of the Crustacean group *Amphipoda*. Body arched, elongated and flattened laterally, about 2 cm long, with a dorsal shield along back. Eyes compound and two pairs of long slender antennae. Underwater breathing through specialized legs, other legs used for swimming. Sexes separate and reproduction by pairing, smaller male holding female on top. The eggs develop in brood-pouch of female. *Gammarus* usually prefers well-oxygenated and running water of streams. Food sifted into mouth with special legs.

Fresh-water Louse, *Asellus* Geoffrey. Related to wood-lice of the Crustacean group *Isopoda*. Body broad and flattened, about 2 cm long without shell, two pairs of unbranched antennae, first pair with long processes. Underwater breathing is through specialized legs. Sexes separate, of similar size, and reproduction by pairing. Eggs develop in brood-pouch of female. *Asellus* lives in clear, still waters, crawling about among plants and debris, especially rotting leaves and wood, and is mostly a scavenger.

HOW TO COLLECT AND CULTURE Collect *Asellus* by removing plant debris from ponds, especially leaves. Keep and breed in shallow water of slightly acid pH containing decaying leaves and twigs. Collect *Gammarus* from clear streams by driving fine net through standing plants. Keep and breed in shallow, well-oxygenated water matured with *Algae* and *Infusoria* (which see).

USE AS FOOD Eaten by aquatic newts and salamanders, water-tortoises and fish.





SCIENTIFIC NAMES *Culex* and *Anopheles* spp.

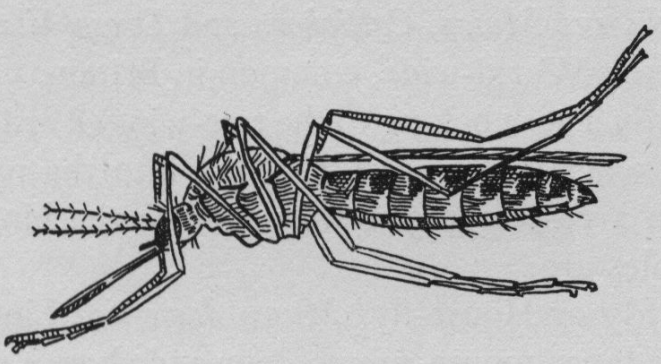
DISTRIBUTION World-wide, near water, especially in tropics. Common in Britain.

DESCRIPTION Mosquito and gnat are synonymous terms for a group of blood-sucking, two-winged flies. The body is slender, about 6 mm long, legs long and mouth a piercing proboscis used for sucking up liquid food, often blood (plant juices in male). Wings are veined and scaled. Eggs, about 1 mm long, usually laid on water surfaces. These hatch into elongated, free-swimming larvae which travel in wriggling loops and breathe from surface through the air-tube at tail end, sweeping food into mouth with brush-like organs. Growth accompanied by skin moults. Pupa, also aquatic and active, is comma-shaped with paddle-like 'tail' and has breathing tubes on 'head.' It does not feed. Adult emerges from pupal case at surface. Some examples are:

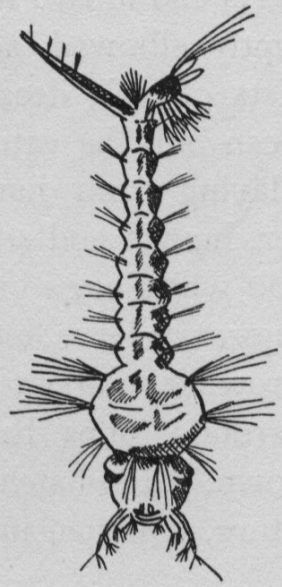
Common House Gnat, *Culex pipiens* Linnaeus. Eggs laid vertically on water surface, in rafts. Larva hangs vertically when breathing in air. Adults stand parallel to surface when at rest and have short sensory palps on sides of proboscis. Common in Britain, a nuisance but usually not dangerous. These mosquitos do not carry the malaria parasite.

Malaria Mosquito, *Anopheles* spp. Eggs with air floats laid singly on water surface. Larva when breathing lies horizontally. Adult when resting inclines body at sharp angle and has palps as long as proboscis. *Anopheles muculipennis* occurs in some marshy districts in Britain. Only the anopheline mosquito carries the malaria parasite.

HOW TO COLLECT AND CULTURE Mosquito larvae and pupae may be gathered in a fine net from stagnant pools, rain-butts and water-troughs. To encourage breeding add some milk to a mixture of meal-bran and manure and stir into a large container of rainwater left in the open. This produces the *Infusoria* upon which the larvae feed.



Adult



Larva

Pupa

USE AS FOOD Given to fish, aquatic newts and salamanders, water beetles, spiders, bugs, etc.

NOTE Although here intended as a food the nuisance and danger of these blood-sucking insects is fully appreciated. Fish and frogs are often placed in open waters to discourage the anopheline mosquito. The Guppy (*Lebistes reticulatus*) of Central America has been deliberately introduced into many tropical countries as part of the campaign against malaria.

SCIENTIFIC NAMES *Musca*, *Calliphora* and *Drosophila* spp.

DISTRIBUTION World-wide, common in Britain.

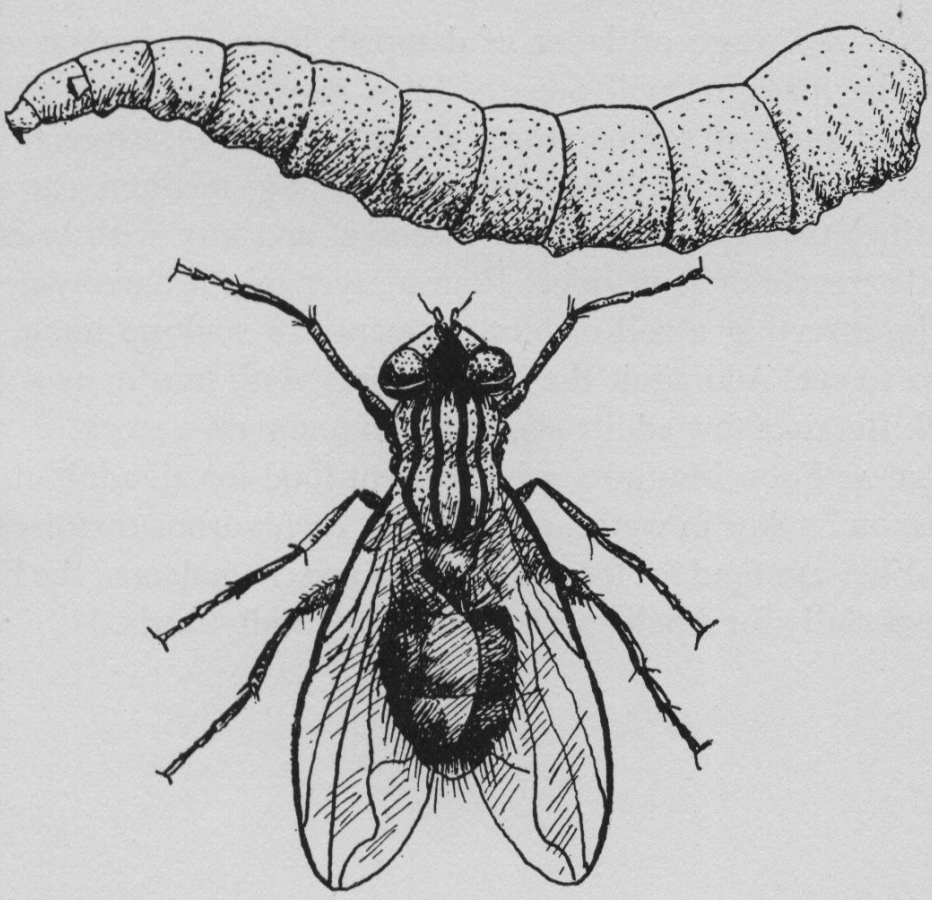
DESCRIPTION These belong to the two-winged order of insects, the *Diptera*, which hatch from the egg into the maggot, then pass through a resting pupal stage before reaching the adult. Some examples are:

Common Fly or House-fly, *Musca domestica* Linnaeus. Body about 0·8 cm long, mouse-grey colour and thorax marked with four narrow black bands. Head with large, compound eyes, more widely spaced in female. Sucking mouth-parts end in two fleshy lobes. Wings, with the centre vein abruptly elbowed, set at angle to body when at rest. Food consists of soft, decaying organic matter, also human food, which can only be eaten in liquid state. Breeds by mating, female laying from June to October in Britain, in fresh organic matter, human and animal faeces (especially horse manure), about 150 white eggs in five or six batches in lifetime. White legless maggot or larva hatches in about twenty-four hours, feeding and growing to about 1 cm in two to five days. Larva pupates in ground, pupa barrel-shaped, about 5 mm long, later turning brown. Adult hatches in one to four weeks according to temperature, commencing to lay about a fortnight later.

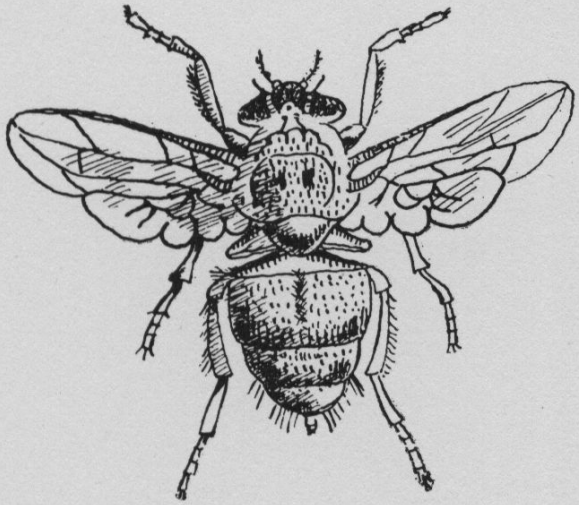
Blow-fly or Bluebottle, *Calliphora* spp. Body about 11 mm long, thick-set, bluish-grey, wings strongly veined. Life-history similar to House-fly. Adults attracted by decaying flesh in which eggs are layed.

Fruit-fly or Banana Fly, *Drosophila* spp. A small fly with similar life-history to House-fly. Feeds and breeds on decaying fruit and house refuse.

HOW TO COLLECT AND CULTURE May be caught in fly-traps with conical aperture below, set over raw meat as bait. To breed place a fish-head or piece of raw liver in a shallow tray in open, to encourage blow-flies to lay (dampened wheat-bran for House-fly and rotting fruit for Fruit-fly). When bait is infected



House-fly



Blow-fly

place in airy cage on layer of dampish loam or sand in which later the maggots will pupate. Flies may be cultured all year round at summer temperature (about 75–80° F.), especially the Fruit-fly. For latter add some thickening medium (agar or gelatine) to water, heating to dissolve, and mix with bran and a little treacle or fruit-juice. Pour a layer into a narrow-necked bottle, inserting a roll of blotting-paper to soak up liquid, and allow to set. Add adult flies and stopper with muslin or cotton-wool. Retain a few adults each time to maintain a stock.

Use as Food Maggots are excellent food for all adult amphibians, on land or in water, also lizards, carnivorous tortoises and fish. Flies are food for frogs and toads and chameleons, the Fruit-fly especially for small species and young individuals.

Tracks and Signs of British Animals

Alfred Leutscher

Eels: a Biological Study

Leon Bertin

Fastness of France

The Massif Central

Bryan Morgan

Realms of Water

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Grow Cacti

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