LECTOR

BRITISH REPTILES.

C. C. HOPLEY

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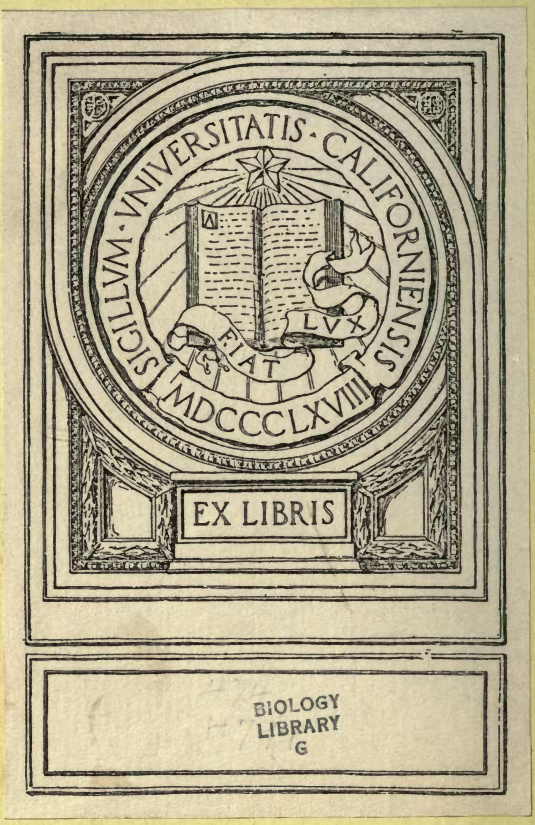

BRITISH NEWTS. [*Frontispiece.*

The Young Collector Series.

BRITISH REPTILES

AND

BATRACHIANS.

BY

CATHERINE C. HOPLEY,

Author of "Curiosities and Wonders of Serpent Life," "Aunt Jenny's American Pets," etc., etc.

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CONTENTS.

INTRODUCTION.

THIS little book differs in several notable particulars from most of those of the "Young Collector" series that have already appeared. First, the creatures herein described are living pets, the occupants of the Vivarium and not the Cabinet. Next they are few; the intention of these volumes being to treat of British species only, and Britain has but few reptiles. Thirdly, though still comparatively small creatures, they belong to the important group of *Vertebrata* or back-boned animals.

Those of our young collectors who have already possessed themselves of Kirby's, Butler's, Woodward's, and Skuse's contributions to this series, will have observed that the Insects, Shell-fish, and Crustaceans treated of are boneless; and that, compared with the rest of the animal kingdom, all are very small creatures. It is worthy of note that out of the seven sub-kingdoms in which zoologists have generally arranged the inhabitants of the globe, six are composed entirely of these small, boneless creatures, while the one remaining sub-kingdom, animals with a bony skeleton, the *Vertebrata*, embraces the largest and the most important groups, including man. Persons who have acquired the habit of observing nature—those particularly who incline to the study of animated nature—cannot fail to be impressed by its teeming life in myriad forms. Even in a city during the summer, birds and insects are abundant; and we have only to place some pond weed in a glass bowl of water, and a world of life will soon inhabit it. Should our home be in rural districts, and our inclination lead us to study the denizens of trees, streams, or meadows, we become fairly puzzled as to which class of beings to choose and where to begin. Within a square foot of soil on the bank where we rest we may, with an ordinary magnifier, see more living

creatures than we can count. Let us stoop over a brook or a rain-pool on a warm, sunny day, and again we shall find it impossible to calculate the number and variety of minute objects that in diverse movements are flitting, darting, swimming, in an independent existence. The more powerful our magnifying glass the more bewildering are the wondrous forms of microscopic creatures revealed to us. At the seaside, on the surface of the waves, and in the depths of the ocean, living forms are not less numerous. By this we can understand how it is that while our great naturalists have arranged all known animals under—say seven grand divisions, six out of the seven embrace only small, boneless, and, to a great extent, microscopic beings.

Included among the largest of these boneless creatures are our familiar acquaintances of the garden and the shore,—worms, slugs, spiders, beetles, butterflies,—all insects, in fact—snails, centipedes, crabs, lobsters, star-fishes, jelly-fishes, sea anemones, and many others that will occur to the memory as being boneless and bloodless. By "bloodless," not having red blood is to be understood; and as it happens that all animals with a bony frame possess red blood, Aristotle divided the animal kingdom into two great groups, "those with blood and those without blood."

But the fluid circulating through the bodies of insects, worms, shell-fish, etc., though nearly colourless, answers to the blood of quadrupeds, and is so spoken of by physiologists; therefore we may dismiss any reference to the fluids of the body, and retain the distinction of bones and no bones—correctly speaking, *Vertebrate* and *Invertebrate* animals—as the most explicit and comprehensive mode of separating the two great groups. All animals with a bony skeleton, whether seal, fish, frog, or elephant, being formed on a similar plan, of which the solid structure, the backbone, is the chief support; and this backbone being composed of a number of small bones—*vertebræ* (see skeletons, pp. 26, 82)—compactly jointed together, the term *Vertebrate* has been chosen to designate them. Excepting serpents and some of their allies vertebrate animals have four limbs, but never more than four. In the seal these four limbs are paddles; in the fish they are its two pairs of principal fins, the pectoral and ventral fins; in the bird the two fore limbs become wings; in ourselves arms; in the frog and the elephant they are four legs. We are apt to speak of four-footed animals as "quadrupeds," in distinction to bipeds, but while frogs, newts, and lizards have each four legs we do not associate them with quadrupeds; though Aristotle did call them "Oviparous, or egg-laying quadrupeds." The great Cuvier divided the egg-producing animals into birds, insects, and reptiles; the latter including

serpents, lizards, turtles, crocodiles, and frogs; and, like Aristotle, he called the four latter "oviparous quadrupeds." Linnæus called all reptiles "Amphibious animals," but the study of the frog family, and the fact that they begin life like a fish, breathing through gills, has caused them to be separated from the class *Reptilia* and formed into a distinct class, the *Batrachia*, from βατραχος, a frog. They include a great many species in different parts of the world, while those at home are confined to frogs, toads, and their relatives the newts. *Batrachians* are true *Amphibians*, living alternately both in water and on land.

It is quite worth the attention of students to compare the progressive systems of some of our best-known naturalists. A general comprehension of the animal kingdom may be thus obtained; and a knowledge of the terms most frequently employed will be of use in whichever branch he desires to study.

Aristotle divided living beings into eight groups; viz.—

Those with Blood.

1. Viviparous four-footed animals; 2. Birds; 3. Oviparous four-footed animals; 4. Fishes.

Those without Blood.

5. Soft animals (Cephalopods, etc.); 6. Soft animals with shells (Mollusca); 7. Insects; 8. Shelled animals (echini, snails, and mussels, etc.).

For a long while, in classifying "reptiles" and insects much confusion prevailed. The latter were "serpentes" because they creep; while the former were sometimes called "insects," because they lay eggs. It is not uncommon even now for the uneducated to speak of small reptiles as "insects."

Regarding classification Cuvier wrote—"It will be found that there exist four principal forms, four general plans on which all animals seem to have been modelled;" viz.—

1. *Animalia vertebrata;* 2. *Animalia mollusca;* 3. *Animalia articulata;* 4. *Animalia radiata.*

The last named is designated by Owen "a chaotic group," and by Huxley a "radiate mob;" but even now, as the microscope reveals fresh organisms and unsuspected relationships, zoologists differ in the arrangement of these sub-kingdoms. It must not be thought, therefore, that in criticising the classifications of those great men who may be termed the Fathers of Zoology, any slur is cast upon their work. In the labour of their lives they achieved results which have been starting-points for their successors.

Biology, comparative anatomy, embryology, paleontology, chemistry, and microscopy now help to throw light on the great work of Zoology. To one or other of these branches scientific men of the world are devoting themselves, and especially to the study of Cuvier's "Radiate mob," in which debate is still active and decision uncertain.

In comparing the following tables, it will be seen that for the very lowest forms the name *Protozoa* (first animal) is generally accepted. So, also, is *Mollusca* for shell-fish, the word having been retained ever since Aristotle, who thus distinguished the group. Darwin describes the *Protozoa* as "animals composed of gelatinous material, showing scarcely any traces of distinct organs." "Uni-cellular animals," Dallas calls them, "in which the functions of life are performed by its simplest element, the cell." They are mostly microscopic. The *Protozoa* are sometimes placed first, sometimes last in the arrangement of "Types," "Divisions," or "Groups," which words seem to be displacing the old-fashioned and somewhat unmeaning term "Kingdoms." The later and more intelligent arrangement is to begin with the lowest forms, the mere specks of protoplasm, and work upwards through the more complex organisms to the *Vertebrata*. Dallas, in *The Natural History of the Animal Kingdom* (1856), was, I believe, the first English naturalist who introduced this rational method. His divisions were then five, viz.—

1. PROTOZOA.—Composed of a simple cell, or an aggregation of cells.
2. RADIATA.—With parts arranged round a common centre.
3. ARTICULATA.—Including an immense diversity of forms, vermes, insecta, crustacea, etc., etc.
4. MOLLUSCA.—Shell-fish and cephalopods.
5. VERTEBRATA.

Huxley, in his *Classification of Animals* (1869), wrote:—"It seems to me that the whole animal kingdom cannot be divided into fewer than eight primary groups, no two of which are susceptible, in the present state of knowledge, of being defined by characters which shall be at once common and diagnostic." He arranges them thus,—

VERTEBRATA.

MOLLUSCA.	ANNULOSÆ.
MOLLUSCOIDÆ.	ANNULOIDÆ.
CŒLENTERATA.	INFUSORIA.

PROTOZOA.

Mivart, in his introductory pages to *The Common Frog*, (1874), gives seven great groups, "each of which is characterised and defined by certain points of structure possessed by the animals which compose it, and which serve to distinguish them."

1. ANNULOSA.—With bodies composed of a series of segments or rings, placed one behind the other, as in earth-worms, centipedes, wood-lice, all insects, lobsters, crabs, scorpions, spiders, and leeches.
2. MOLLUSCA.—Snails, slugs, cuttle-fish, and shell-fish.
3. MOLLUSCOIDÆ.—Sea-squirts or *Ascidians* (sometimes called *Tunicates*), and lamp shells, together with minute aquatic animals in compound aggregations.
4. ANNULOIDÆ.—Star-fishes, sea-urchins, together with internal parasites (tape-worms, etc.), and their allies.
5. CŒLENTERATA.—Sea anemones, jelly-fish, polypes, and the coral animals.
6. PROTOZOA.—Sponges, the Infusoria, and all the lower forms of animal life.
7. VERTEBRATA.

Dr. Henry Alleyne Nicholson, in his popular *Manual of Zoology* (1878), gives six types or plans of structure, technically known as "Sub-kingdoms," viz.—

1. PROTOZOA; 2. CŒLENTERATA; 3. ANNULOIDÆ; 4. ANNULOSA; 5. MOLLUSCA; 6. VERTEBRATA.

Cassell's Natural History (1881), edited by Prof. Martin Duncan, is also a popular work. His sub-divisions of the *Invertebrata* are six, differing somewhat from those given above, viz.—

1. MOLLUSCA; 2. ARTHROPODA; 3. VERMES; 4. ECHINODERMATA; 5. ZOOPHYTA; 6. PROTOZOA; with two intermediate groups, MOLLUSCOIDÆ and TUNICATA.

There has lately (1884) been translated into English an important work, *The Text-Book of Zoology*, by C. Claus, of the University of Vienna. He says:—"In the present state of science we consider it convenient to distinguish *nine* types as the chief divisions, and to characterise them as follows,—

1. PROTOZOA.—Minute, and without cellular organs.
2. CŒLENTERATA.—Radiate animals segmented into 2, 4, or 6, with a central body cavity.

3. ECHINODERMATA.—(Spiny skin) radiating in mostly 5 directions, with a calcareous dermal skeleton.
4. VERMES.—Bilateral, without jointed appendages.
5. ARTHROPODA.—Bilateral, with jointed appendages.
6. MOLLUSCOIDÆ.—Bilateral, unsegmented animals, with tentacles or spirally rolled buccal arms.
7. MOLLUSCA.—Bilateral, soft, unsegmented, without a skeleton for locomotion ; either bivalve or monovalve.
8. TUNICATA.—Bilateral, unsegmented animals, with sac-shaped or barrel-shaped bodies.
9. VERTEBRATA.

In the latest important work, *The Standard Natural History* (1885), in six large volumes, by the leading American biologists, all the great naturalists of the day have been compared and are quoted. In it are given nine Divisions or Branches, with a prospective tenth, the PROTISTA, those very primitive forms in which animal and vegetable life are so blended that it is scarcely possible to distinguish the one from the other.

Branch I. PROTOZOA.
,, II. PORIFERATA.—Sponges.
,, III. CŒLENTERATA.—Jelly-fish and corals, hydroids, or plant-like animals of beautiful forms (Zoophytes).
,, IV. ECHINODERMATA.—Star-fishes, etc.
,, V. VERMES.—Of which the *annelidæ* are the highest type ; segmented or jointed worms and leeches.
,, VI. MOLLUSCOIDÆ.—Including Polyzoa (many animals in colonies) somewhat plant-like, and often mistaken for seaweeds.
,, VII. MOLLUSCA.—Shell-fish, etc.
,, VIII. ARTHROPODA.—Jointed legs or "foot-stalks." Insects, and the *Crustacea*.
,, IX. VERTEBRATA.

The foregoing tables show us that later scientific research has led to sub-divisions of certain types or groups, so that Cuvier's four have been more than doubled. For example, Insects and Crustacea (with jointed limbs) are separated from the worms and leeches ; and instead of being only a *class* of the extensive sub-kingdom ANNULOSA are now the "Branch" or Sub-Kingdom ARTHROPODA. Having, however, the "ringed," "jointed," or "segmented" bodies as well as appendages, they are, as Kirby tells us in his Introduction to *British Butterflies*, "called variously *Arthropoda*, *Annulosa*, or *Articulata ;*" the latter word having

reference to the jointed *bodies* in opposition to the bony articulations of the VERTEBRATA.

Again, regarding the little animals, the "Pets" of these pages they formerly belonged to the class *Reptilia*, of which *Batrachia*, *Sauria*, *Ophidia*, *Chelonia*, were four orders. But now, as already explained, BATRACHIA is a class by itself, of which Frogs and Newts are two orders, *Anoura* (without tails) and *Urodela* (with long tails), or, as our latest authority, Boulenger, distinguishes them, *Ecaudata* and *Caudata*.

And it is quite possible that renewed studies of the *Reptilia* may lead to still farther divisions of Groups; because, since the publication of any of the works above quoted, a very remarkable discovery has been made in some members of the lizard tribe—no less than the existence of a third eye near the top of the head, and directed skywards. *Anguis fragilis*, our English slow-worm, is one of the lizards in which vestiges of this surprising organ have been detected, and which will be further described in its place.

And this discovery is said to have been brought about through the study of some small marine creatures which have not even a head! They are *Acephalous molluscs*, commonly known as "sea-squirts," but scientifically *Tunicates*, or *Ascidians*, the former word implying a tunic-like covering, and the latter their form, which is

Fig 1. (Half natural size) *a*, incurrent aperture; *b*, excurrent aperture.

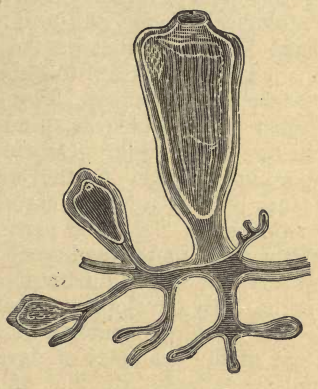


Fig 2.

something like a leather sac or bottle (fig. 1). Just now I spoke of the microscope revealing new organisms and unexpected relation-

ships, and here is a case in point. These *Tunicates*, belonging to the division or sub-kingdom MOLLUSCOIDÆ, were for a time regarded as zoophytes, some of them sociably living, several in a colony, like buds on a stem, and even fixed to one spot (fig. 2).

Though in their adult state they possess but slight indications of sensibility, they have a heart, respiratory organs, and some of them a single eye in the middle of their transparent body; but in external form they have no resemblance whatever to a vertebrated animal. Some features in their early development, however, give promise of better things. They are at first free-swimming tadpoles, with an indication of backbone; and when we come to talk about the frog we will give another glance at these *Tunicates*, which just now appear to be exciting much interest among biologists. A very large collection of them, brought home in the *Challenger*, after the voyage of 1872-76, has been lately arranged in 102 species, and described for the first time by Prof. Herdman (1886), stimulating researches in various other classes of vertebrates. Not even yet, though specialists have been hard at work in their various branches, are the results of the *Challenger* expedition fully known. Each year new species of minute organisms are described and announced; almost daily is new light thrown on hitherto doubtful biological questions; and thus it is that new classifications and additional Sub-kingdoms are so frequently established.

It has been in order to convey some insight into the intricacies of zoological science, and to introduce the three-eyed lizards, that I have dwelt somewhat on the Invertebrated groups. And there remain a few words still to be added concerning embryology; the structure of the embryo, or immature animal, being, in the eyes of most living biologists, even more important for classification than that of the adult. Darwin affirmed it to be "one of the most important subjects in the whole round of natural history," because there is a law in embryonic development that—to quote Darwin again—"various parts in the same individual which are exactly alike in the embryonic period, become widely different, and serve for widely different purposes, in the adult state." And it is the early development that indicates the adult relationship, whether to bird, mammal, or fish. This will be evident when, as one of the examples of development, we come to compare the Tunicate tadpole with that of the frog. The eggs of frogs and newts being transparent, the development can be watched from day to day, almost hourly, indeed, in a favourable temperature. And in the whole range of natural history there can scarcely be a more interesting and engrossing study than to contemplate the

gradual transformation of an egg into a tadpole. As far as a certain stage the process or progress is the same in all eggs, whether of birds, fishes, or reptiles; but we will reserve the examination of the frog embryos for the present. Enough has been said in this already lengthened Introduction to the Vertebrates.

REPTILES AND BATRACHIANS.

CHAPTER I.

REPTILES GENERALLY.

THERE are certain characteristics which belong alike to the whole of the class *Reptilia*, and for the present we may include the *Batrachia*. All are cold-blooded; that is, they have not sufficient warmth in themselves to maintain a given bodily heat under adverse circumstances. In popular words, they are "obedient to surrounding temperature." Human beings, by the healthy circulation of the blood, and independent of external changes, maintain a temperature of about 98°, which is called "blood heat." We suffer discomfort from cold when the degree is much below this; and we suffer from a feverish condition when the blood is much over-heated; but reptiles, notwithstanding inability to maintain such bodily warmth, suffer neither from excessive cold nor extreme heat. In the latter case they are in greater vigour, more alive, in fact; and in the former condition they succumb even to the verge of death without suffering. In winter, burying themselves in the cold damp soil, their vitality is at its lowest. some have been known to be actually imbedded in ice and yet revive by a gradual thaw, and this for successive winters. I have heard of snakes being found frozen and as brittle as a dry stick, but recovering by gradual warmth.

On the contrary, in the summer many of them endure tropical heat, and lie basking under a sun, similar exposure to whose rays would destroy the life of some animals.

In hot countries the regularly recurring period of torpor is æstivation, when many reptiles bury themselves in the mud, and are literally baked up in a temporary tomb. In cooler countries the hibernation is on the approach of cold weather. The total

suspension of vital forces is something like what vegetation undergoes. Circulation and respiration are arrested, and in many cases it is difficult to decide whether life is extinct or not; but with the return of spring the sun causes the juices—whether animal or vegetable—to flow once more, and the whole system is set in working order again. Reptiles belong only to the tropical and temperate climates. In the frigid zones they do not exist. The suspension of animation during winter in the cooler latitudes is a beneficent law of nature; for the food on which the smaller reptiles usually subsist is also gone, and they conveniently hibernate until insect life revives. Reptiles are long-lived; but as they sleep so many months at a time, and exhaust themselves so little, even during their liveliest seasons, there seems no reason why life should not be prolonged.

The circulation of reptiles is less complete than that of birds and mammals, the blood being only partially aërated; mingled arterial and venous blood is sent to the lungs and through the system, no part of which is supplied with pure arterialised blood. The heart in general is formed of at most three cavities instead of four, two auricles and one ventricle; the latter receiving the blood from the two former, *i.e.*, venous blood from the system and aërated blood from the lungs, producing what we should call poor blood, having fewer of the red corpuscles, and, in the animal, a consequent sluggishness of movement, insensibility, and slow organic functions. In intelligence reptiles rank only a little above fishes. Their powers of endurance, however, are very great. They can do without food for a long while, and even without air, and do not appear to suffer from an injury which to the higher animals would cause great pain; as, for instance, the lopping off of a finger, or even a hand, or an inch or so of tail. Imagine the "to do" of a monkey under such circumstances.

All reptiles are oviparous, producing young from an egg, the covering of which may be membranous, leathery, or calcareous. In some cases the young are born alive, but that is only because the eggs have been already hatched within the parent. For the different conditions the terms oviparous, viviparous, and ovoviviparous are used. All reptiles cast their skin at irregular periods, at least once, but more frequently four or five times during the year. This is called sloughing or desquamation; the latter word, as it signifies rather a coming off of the scales, is not always applicable; for unless the creature is in adverse circumstances the slough is cast *entire*. All the reptiles I have ever watched under favourable conditions cast their coat entire, beginning at

the mouth. In the account of each we shall recur again to this subject.

In the above particulars all reptiles and batrachians are alike; but in form and action no single class of animals are less alike. To compare one with another and the various orders—some with four legs, some with two legs, or no legs, with a tail and without, some covered with a hard, solid case, others with strong plates, some with scales, and some with only a soft, smooth, and exceedingly sensitive skin, some with a spine reduced to a few joints, while in others it is extended to three or four hundred vertebræ; some with eyelids and others without, we should scarcely pronounce them all of a class, and yet their internal organism is alike in all. Their movements are as varied as their form. Among them some fly, others creep, crawl, or glide. A frog "hops," *leaps* really, and with wonderful skill and precision, and swims in the true scientific manner; a tortoise creeps, and to save its life it can only creep, therefore never attempting escape in peril, it retires within its fortress, and is there safe. There are frogs and lizards that live in trees and can fly, but not with wings.

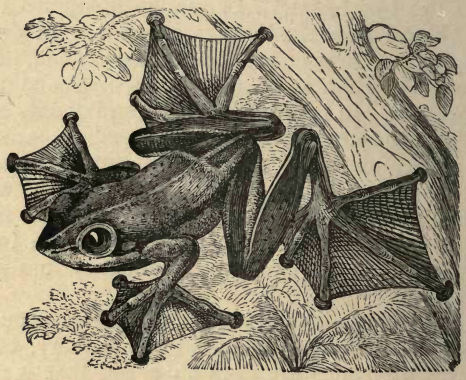


Fig. 3.—Flying Frog.

The frog (fig. 3) has exceedingly long fingers and toes, with a strong membrane between each, so that when outspread they are like four fans, each covering some considerable space, and enabling it to take leaps from branch to branch, or to let itself down to the ground and up again supported by these four fans, like parachutes, to break its fall. The little flying lizard, *Draco volans* (fig. 4), is similarly sustained in its leaps, but by five or six of its middle ribs,

which are extremely elongated, and covered with the extended skin of its sides.

The most active among reptiles, and possessing the most varied movements, are lizards and snakes, which latter, strange to say, though without legs, wings, fins, or any other appendages to assist locomotion, can do all and much more than all the rest can do. They can even let themselves down from a tree, or spring from branch to branch as easily as the flying frogs and lizards, swinging like an acrobat, springing, leaping, and climbing like a monkey, and when on the ground vanishing like a flash in their swift gliding. Without hands the constricting snakes can grasp their prey with the coils of their body; without fins they can swim like a fish; and they can even do two or three things at once through the wonderful adaptation of their spine to meet emergencies. It is the peculiar construction of the spine which enables them to accomplish all this. Owen, Huxley, and other distinguished anatomists write enthusiastically of the beautiful adaptation of a snake's spine to its needs. Each vertebra is elaborately articulated to the next and to the ribs by *eight joints;* and each interlocks with the one next to it by a cup and ball-shaped process. Here (fig. 5) you see a front and a back view of one single vertebra, and can imagine the pliancy of movement all these cup and ball arrangements would give to a long spine, and why they are justly called *vertebræ*, from *verto*, to turn. The

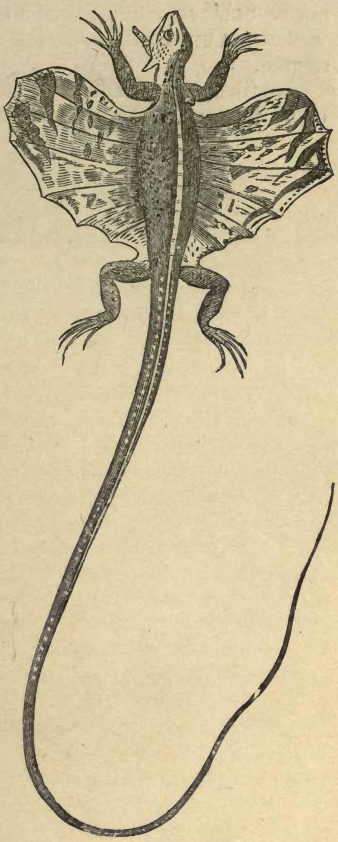


Fig. 4.—Flying Lizard.

Fig. 5.—
a, posterior view. *b*, anterior view.

above achievements relate more particularly to the constricting snakes. Our British species are similarly endowed, if in a less degree.

Reptiles are, for the most part, carnivorous; a few are vegetable or fruit-eaters, and some are both.

CHAPTER II.

THE OPHIDIA.

First let us decide their true place in the great Animal Kingdom that includes such perplexing myriads to be classified. Snakes having, for their size, more *vertebræ* in their spinal column than any other animals, claim, of course, to be assigned to the sub-kingdom Vertebrata. And that they are true reptiles is no less evident, therefore they belong to the Class Reptilia. But here arises a question which formerly caused much difference of opinion, on account of the many creatures of a snake-like form that exist; such as the little slow-worm, which is still known as *anguis*, though not a snake. There are also some frogs (as the *cœcilia*), a few fishes, and many lizards, even some very large worms, all of which are snake-like in form and without limbs. For us of to-day these difficulties have been cleared away, the true snakes have been separated from the rest, and the question, therefore, "What kind or Order of reptiles are they?" is answered by Order Ophidia. Next there come *sub-divisions* and *sub-orders*. Snakes are divided into Venomous and Non-venomous, and are arranged in three sub-orders; viz., *Colubrines*, the harmless snakes; *Viperines*, the vipers; and the *Venomous Columbrines;* the latter, having the form and aspect of harmless snakes, though venomous. You may easily discern the great difference between these latter and the vipers on your next visit to the Zoological Gardens. The Cobra and the Ophiophagus are slender and symmetrical, like the harmless Indian river snakes on the opposite side of the Reptilium and our English ring-snake; and unless you knew them already you would not suppose them to be so deadly. But the African Puff-adder, and the Rattle-snakes, thick, heavy, flat-headed, and rough-scaled, seem to betray their venomous qualities at once. Thus the three sub-divisions are—

1. Ophidia colubriformes.
2. Ophidia colubriformes venenosi.
3. Ophidia viperiformes.

Two of our English snakes belong to the first and one to the third sub-order.

There is a prevailing impression among persons who have not given any special attention to *snakes* or *serpents* that the two words imply different kinds of reptiles, the latter being often associated with the more formidable and dangerous, and the former with the less harmful kinds. A snake and a serpent are one and the same reptile, the distinction being philological and not zoological. The word "serpent" is from the Latin *serpo*, to creep, and this from the Greek ἕρπω. *Serpo* or *herpo* had reference to the creeping movements, and was applied to crawling creatures generally. So also was the Saxon word "snake," from *snaca*, used for all the small reptiles of northern Europe. The two words belong to the history of Great Britain. "Serpent" having been introduced by the Romans became incorporated with the language of the country long before the northern invaders made their appearance here. From the Romans came tales of enormous and fearful serpents; and when the Scandinavians arrived and talked of their snakes, the word would represent only the smaller reptiles peculiar to the north. The truly English, or rather British word, "snake," came easily from all or any of the words expressing the same in the language of our northern visitors; the Danes, with their *snog* or *snekke*, the Anglo-Saxon *snaca*, the Swedish *snok*, and the Icelandic *snakr*, *snokr*, all implied small creeping things, and would naturally represent the same in Britain.

The Greek word for a snake exclusively was *ophis*, from οφις, whence we obtain the scientific word which heads this chapter, also ophiology, ophidian, etc.; while the word *serpo*, *erpo*, or *herpo*, gives its name to the science of reptiles generally, Herpetology, with Herpetologist, or Erpetologist, etc. For a true snake the Latin is *anguis* and *coluber*, the former signifying the strangling, constricting habits, the latter the coiling, winding movements.

One or two other ideas—now, I trust, fast being discarded—are that snakes are "slimy," and that their tongue is an instrument of injury; and yet, notwithstanding its extremely slender and hair-like tips, that it is used (as some old writers have represented) to lick a large, rough-coated animal all over before it is swallowed; a task in comparison with which that of Sisyphus would be easy; the said lubrication being about as practicable as to lay the dust of London with a watering-pot. The reputed "sliminess" probably originated in the sliding, gliding, noiseless movements of snakes, and which may convey an idea of slipperiness, particularly in the smooth-scaled kinds; but which,

however, are, in common with the rest, perfectly dry and clean. The tongue of a snake acts as a feeler, an instrument of touch and of investigation, particularly in the dark, conveying information of surroundings—so to speak—to the owner of the delicate organ. It is formed of a double muscle, or pair of muscles united from the root to near the tip, where they divide, and terminate in those slender, hair-like filaments which are so alarming to the ignorant. The illustrations (fig. 6) are from nature and the exact size. The largest (*a*) is that of a Jamaica boa; the small slender tongue (*b*) is that of a South-American snake somewhat smaller than our English ring-snake; and the shortest (*c*) is that of a very young African viper, a short and stout little reptile

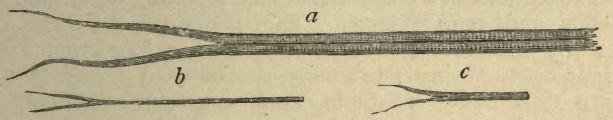


Fig. 6.—Illustration of tongues. From nature by the Author.

that has imparted this character to its tongue. The tongue of the British viper would be slender and larger than *b*. Being so delicately constructed and liable to injury, it is provided with a sheath, which lies along the mouth, and the aperture to which is forward, about where the tip of the tongue in the mouths of other animals is when at rest. The snake has no necessity to open its mouth to use this tongue which is in such constant requisition; a tiny aperture in the upper lip, "a chink in the rostral shield" permits its exsertion and the free play of the sensitive tips.

Another remarkable peculiarity in snakes is a volitional action of the trachea or windpipe, which can be brought forward beyond the mouth. Though snakes can do for a considerable time without breathing, there are occasions when they require to take fresh breath when it would be impossible to do so; as, for instance, while feeding, when the mouth and throat are completely gorged with their prey. In this case the adjustable windpipe advances, and may sometimes be seen hanging an inch or so out of the mouth, and having at its extremity a sort of lip or valve, very flexible, and opening or closing as the air is drawn in or expelled. This trachea, or air-tube, being also a very delicate organ, and liable to injury through the intrusion of dust, or of particles of fluff, etc., from the prey which is being swallowed, can be opened or closed at will by this mobile valve at its entrance. The anterior portion of the trachea lies along the mouth when at rest,

and in a sheath. The aperture is then exactly opposite, and close to, the nostrils, through which only a snake breathes. Should you happen to see one yawning, which it not unfrequently does, you will be able to observe the two apertures, and probably both in action; that for the egress of the tongue, close to the chink in the lip for its exsertion, and that of the windpipe just behind and upon the tongue sheath.

The elongated form of snakes causes corresponding variations in their principal organs. One lung (the other is only rudimentary) occupies nearly two-thirds of the body; the trachea conveying air into this is also much lengthened. So are the liver, the œsophagus, and the stomach, etc. There are yet other remarkable modifications in a snake's anatomy, adapting its structure to its habits and requirements. The bones of the head, and particularly those of the lower jaw, are "loose," *i.e.*, united only by elastic ligaments instead of being consolidated as in mammals; and are thus easily separable, stretching apart, enabling the reptile to swallow food of much greater bulk than itself. Snakes feed seldom, and no wonder, for the process cannot be agreeable. Fortunately for them their sense of taste is dull, as they have no means of freeing their prey from its fur or feathers. Luckily, too, their digestion is powerful, as the prey must be swallowed as it is, bones and all. The constricting snakes can retain an animal in their coils till they are ready to swallow it; the venomous snakes can kill with the poison fang and wait their time; but many others, like our two little English snakes, can neither constrict nor poison, but must hold their prey in their mouth when caught and

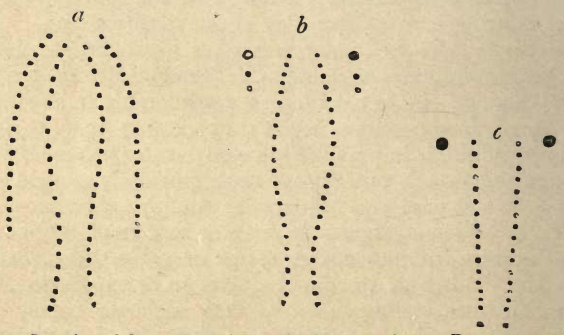


Fig. 7.—Interior of the roof of the mouth, the upper jaws. Dots represent the teeth.

not let go for a single instant, or it would escape. The teeth are great assistants, being numerous, very long and fine, and all

slanting backwards, so that it is impossible for an animal held by them to retreat. All snakes are furnished with palate teeth, two rows extending backwards and all curved and slanting in the same manner. The upper and lower jaws are also well supplied, so that we may call them six rows of teeth. In a non-venomous snake their position may be represented as in *a* (fig. 7). In the viper the upper jaw is extremely short, and furnished with only the poison fang (*c*); a cobra and some other venomous colubrines have one or two simple teeth in addition to the fangs (*b*). All these finely pointed and delicate teeth, having a good deal of strain upon them during the process of feeding (not for mastication, but to retain bulky prey), are liable to get broken off or to come out easily; but buried in the gum are always a plentiful supply of young teeth ready to replace them. Snakes can renew their teeth throughout life, or until very old age or infirmities overtake them. There was a python of at least thirty years old at the Zoological Gardens who had ceased to renew its teeth. They were by degrees lost and not replaced, and the poor old snake had great difficulty in feeding, but, as a rule, nature has beneficently supplied them with these all-important assistants towards supporting life.

We have seen that a snake can exsert, withdraw, and safely enclose its tongue; that its head can expand out of all proportion, and regain its form without inconvenience; that it can manage its trachea so as to breathe when its mouth and throat are gorged; and now we shall see that it can move its ribs, every single pair of them, as easily as we can move our arms or fingers. The ribs are elaborately articulated with the spinal column, as described on p. 19, and expand for the reception of bulky food. They are also used as legs, and upon the tips of them the snake walks or glides. In the larger snakes it is not difficult to watch the action, like undulations, beneath the skin. Three or more sets of ribs are in motion at the same time, but in regular and wave-like succession, the "wave" as it were, started with the anterior ribs, passing down through the entire length of the snake, and succeeded by another and then another set, as the first movement passes on; just as you see a long streamer or a curtain-fringe moved by the wind, wave after wave following in succession, so that you can scarcely define where each undulation begins, all moving on harmoniously. When a serpent is actually progressing, every single pair of ribs is, of course, in action: but should only one part of the body be stirring, the ribs at that part only may be active. To each pair of ribs one of the broad under scales (ventral *scutæ*) is attached by muscles, so that these also move

along in turn, like a foot, to its special pair of ribs. Just so many *vertebræ* as a snake has in its spinal column, so many ventral plates or *scutæ* there are; and by these broad under-scales you can always ascertain how many joints there are in the spinal

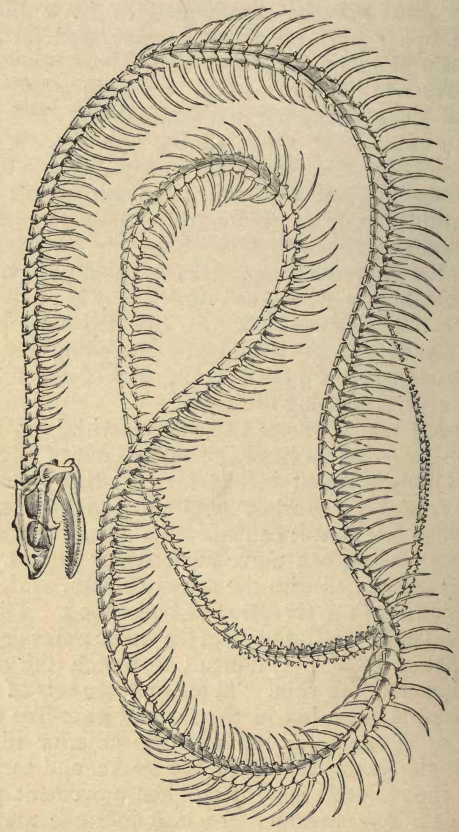


Fig. 8.—Skeleton of a snake.

column. The very long snakes have three or even four hundred *vertebræ* in their spine, smaller snakes perhaps only one hundred and fifty or two hundred. Where the tail begins the ribs of course cease, but the tail bones are reckoned among the *vertebræ*. As a general rule vipers have short tails; and the long,

slender, harmless snakes very long tails, tapering so gradually that you cannot readily decide where the tail begins. But there are exceptions. When a snake is about to cast its cuticle you will see it pushing its jaws against the gravel in the cage or whatever rough surface may be there, and turning its head over to rub first one side and then the other and the top. Presently the skin is loosened round the lips, and by continual rubbing and being pushed folds back, the upper part over the head and the lower over the throat; and when the head is free no more rubbing is necessary, as the snake has only to crawl, and keep on crawling as it emerges bright and beautiful from the slough. It is as if some one were pulling off your tight coat sleeve beginning at the shoulder, the sleeve turning inside-out as it is drawn down to the wrist, only the person holding your sleeve remains still, while you (like the snake) move away and leave it. The shoulder represents the head of the snake and the wrist the tail. The last few inches of tail generally slip out unreversed. If a snake is in good health and sheds well, the whole process does not occupy many minutes, but if the skin is in an unhealthy condition the snake has more difficulty, or makes no effort, and the cuticle comes off in pieces. A very curious and interesting object is the cast-off coat, showing the imbricated arrangement of the "scales," so called because externally they have this appearance from the folds in the skin, though unlike the scales of some fishes which come off separately, the snake skin is entire. The eye covering is round and clear, like a miniature watch glass; snakes not having eyelids can never close their eyes, which are protected by this transparent covering. It is cast with the cuticle; and if you examine the slough of a snake you will observe that the transparent eye scale is of a stronger texture than the rest, and set in a framework of small scales; while on the reverse side it stands out distinct from them in a cup-like form, as here represented (fig. 9). This little drawing, taken from nature, is a trifle exaggerated in order to show the form distinctly. The period of sloughing is irregular, sometimes once but more frequently four or five times a year. Snakes are fastidious creatures, and whenever their coat is soiled or uncomfortable they doff it and come out resplendent in a new one, which displays its colours to perfection. The snake, too, feels invigorated, and is ready for dinner, having been somewhat an invalid for several days previously, and hidden in some corner declining food. Young snakes invariably cast their cuticle at a very early day, and very frequently while growing.

Fig. 9.

It only remains to say that the form and position of the head

shields are chiefly considered in the classification of snakes, and are of great importance for the distinction of species and genera. Each shield is named according to its position on the head; as, for example, the upper or lower labials or lip-shields; rostral, or beak-shields; nasal, ocular, etc.; and it is desirable to be acquainted with these distinctions, as they characterise lizards as well.

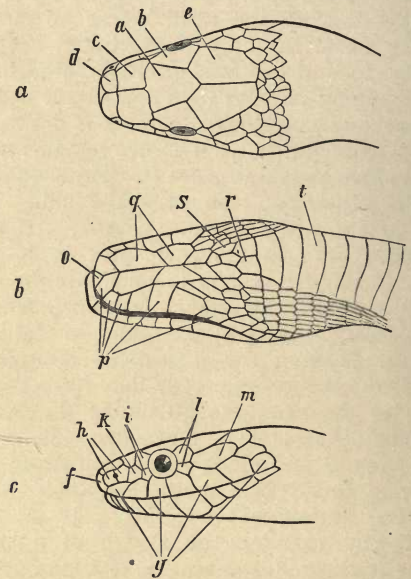


Fig. 10.—*a*, Dorsal view; *b*, Ventral view; *c*, Lateral view.
a, frontal; *b*, supraciliary; *c*, posterior nasal; *d*, anterior nasal; *e*, parietal; *f*, rostral; *g*, upper labials; *h*, nasal; *i*, præorbital; *k*, loreal; *l*, post-orbital; *m*, temporal; *o*, chin; *p*, lower labials; *q*, mental; *r*, cervical; *s*, cervical scales; *t*, ventrals.

CHAPTER III.

THE VIPER.

Sub-order 3, VIPERINA; or, OPHIDIA VIPERIFORMES. Family *Viperidæ*. Genus, *Pelias*. Species, *berus*.

THIS being the only reptile included in these pages that I can scarcely recommend as a pet, and having never harboured it among my own reptilian families, there is not much to tell about it. Its venomous qualities have not gained for it many ardent friends and admirers; we will therefore discuss it and dismiss it for the more attractive members of the class.

The sub-order VIPERINA is divided into the two families *Viperidæ* and *Crotalidæ*. It will assist the memory to observe that while so many of the natural Divisions, Classes, and Orders end with the letter *a*, the Families invariably terminate in *idæ*.

The *Crotalidæ* family are not represented in England, but they may be briefly described as most of them having rattles at the termination of the tail, as the rattlesnakes of America, and all of them having a peculiar hollow or "pit" in the face on each side of the nostrils, called by a French ophiologist *doubles narines*, but the use of which is at present only conjectural.

Some of the *Crotalidæ* in America have only incipient rattles like this (fig. 11), others have no rattles at all, but in all other respects they agree with the true rattlesnakes.

Fig. 11.

The general features of a viper are a broad, angular head, distinct from the body, which is thick and heavy in comparison with the colubrine snakes, a short tail tapering suddenly to a point, and rough or carniated scales (from *carina*, a keel), having a sort of mid-rib like a leaf or a feather. The head, with but few exceptions, is covered with scales, not plates. The English viper has a few plates, viz., one over each eye, and a small pair in front, sometimes another pair, or a central one; but in the matter of scales members of the same family differ. At the Zoological Gardens you may sometimes see several English vipers in one cage, and observe the variation in head-plates, though the plates are never so large and distinct as in the colubrine snakes.

But the chief characteristic of the viper is its poison tooth. "The perfection of mechanism culminates in the viperine fang," writes Dr. Edward Nicholson, a distinguished ophiologist. And by mechanism he refers to its mobility, the action of it. Among the various wonders which we discover in the structure of a snake and its control over parts of its frame that are stationary in other creatures, the power in the viper to raise and fold back its fangs is perhaps the greatest. Vipers, it will be remembered, have only one tooth, the fang, in each upper jaw, and this when at rest lies back along the gum (as in *a*, fig. 12), and when in use is "erected," that is, brought down ready to inflict the bite (as in *b*), and the action is instantaneous, rapid as is that of the viper in striking its victim. The fang is curved, pointed as a fine needle, and "hollow," commonly so called. Strictly speaking, a snake's fang is a long finely pointed tooth, flattened out and rolled over to form a groove, as seen in the magnified examples (fig. 13). In the viper the "join"—as we will call it—is so complete as to be scarcely perceptible, in other snakes the fold is more or less evident, forming a channel down which the venom flows. In the larger example, *a*, the groove is more open than in *b*. At the base the venom enters from a gland at its root. Close to the point in a viper's fang is a very tiny slit, and through this slit the venom is forced out again into the wound by the action of "striking," as the rapid bite is called. All is swift as a flash; but the noxious power of the venom is so great that in that moment of time enough has passed through the tiny slit into the flesh of the bitten creature to cause its death. The viper then draws back its head, and waits till the victim ceases to struggle, when it again approaches stealthily, cautiously surveys the prey, and if quite dead grasps it conveniently, and proceeds to swallow it. I have seen some vipers never letting go their hold after striking, but swallowing the prey at once. Usually they are extremely cautious, and this from fear, being absurdly cowardly.

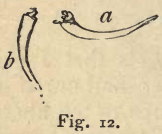


Fig. 12.

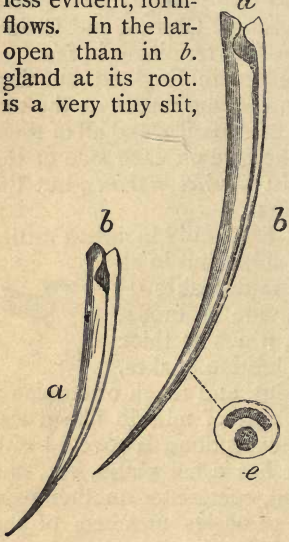


Fig. 13.—Two fangs magnified, showing the slit or join more or less complete. *e* is a section. From Fayrer's Thanatophidia.

It used to be supposed that the

mere action of opening the mouth causes a viper's fangs to descend, and that the closing of the mouth sends them back again. But the voluntary action or control of the fangs is now fully understood, as also their independent action. In watching a viper feed you may see sometimes one fang, or the other, or both in use, as it moves its jaws over the prey, well extending them so as to free the long fang from the flesh it has penetrated. Also when a viper yawns (this yawning affords many a useful lesson) you may often see first one fang and then another brought down and folded back again, proving their independent action.

The fangs being long, delicate, and loosely hinged, are easily broken off. They also come out if worn or strained, when a new pair is ready to replace them. A cluster of reserve fangs of all sizes lies in the sheath which protects the pair in use when at rest, and are developed as fast as they are required, each in turn becoming fixed and functional. It is customary to speak of the viper's *fangs* being "brought down or depressed," but in reality it is the very short jaw which rotates, the fang being firmly fixed in it, and owing to the easily separable right and left jaw, united only by a ligament, as already described, it is the two jaws, the right and left, which act independently, bearing the fang with them as they move or rotate. Imagine a pen-knife half opened and held with the blade downwards; that would represent the fang "erected;" then hold the handle perpendicularly, and the blade would assume a horizontal position, as shown in fig 12, which would represent the fang at rest; only that the knife handle is much too long to convey an idea of the mere wedge of bone which forms the viper's upper jaw.

The venom of *Pelias berus* is far less virulent than that of the larger vipers, or even one of its own size in the hotter countries. But in an unusually warm season deaths have been known to occur through its bite; or when the bitten person has been of feeble health, or if the wound has not been treated in time, and the venom has worked into the system. There must be no delay: a handkerchief, or a leathern strap or cord, should be bound very tightly round the limb *above the wound*, that is, nearer to the body, to check the circulation. Oil or ammonia should be rubbed into the wound, or any soft fat that can be obtained at the nearest cottage; the oil or fat clogging the blood, and arresting the rapid mingling of the venom with it. The old-fashioned remedy was to cut the viper open and bind that upon the wound, as there is usually a good deal of fat in its body; but there were fewer habitations at hand in those days. To suck the wound hard and thoroughly and at once is also an excellent plan if the lips and

gums are sound; of course freeing the mouth frequently of the saliva. With good courage and prompt remedies the bite of *Pelias berus* generally causes only some temporary inconvenience. It is as well to be cautious, however, in handling it, and it is important to be prepared to recognise a viper, and not mistake it for a harmless snake. And this is not difficult. Both the other English snakes are smoother and more shiny, particularly the coronella, which is nearest to it in size and colour. The head is flatter and broader than either of the others, wider behind, and excepting the few plates near and above the eyes it is covered with fine scales. It is more slender than vipers generally, and about two and a half feet long, seldom much longer when grown. It has a short blunt tail. By its colours it is most easily recognised, being generally of a dark brownish tint, with a very distinct zig-zag black mark all down its back. On its head a dark mark diverges like a V, and is generally bordered by a much lighter colour, which renders this V pattern very distinct. The dull coat of carinated scales and the short tail also assist recognition. Vipers vary much in colour, from very dark brown and nearly black to reddish tints, and almost "white;" that is, of a very pale and faded tint. The "red" viper is of a pale brick-dust, or dirty pink tint, with grey or nearly white beneath; but in them all the black line down the back is discernible.

Vipers are not found in Ireland, and all experiments to establish them there have failed; but in Scotland they are frequently seen, also in Wales. *Pelias berus* is also found nearly all over Europe, excepting in the extreme north. It is as common in England to call it "adder" as viper, the former word, like "snake," having been introduced by the Anglo-Saxons, and implying a crawling, creeping, low-lying creature, and formerly applied to other reptiles as well. *Nedre*, *nœdre*, a *nedre* gradually becoming an *eddre*, and then, dropping the article and the *n*, was corrupted into adder. The word *viper*, from the Latin *vipera*, a contraction of *vivus*, alive, and *pario*, to bring forth, signifies that it produces its young alive; so here again, as in *snake* and *serpent*, the one name was introduced by the Romans, and the other by the Saxons.

Vipers have the reputation of giving refuge to their young brood by receiving them into their throat and their capacious œsophagus in sudden danger, and presently releasing them again. Many well-authenticated instances of this have been recorded, and by observers of undoubted intelligence and integrity. On the contrary, some scientific men are slow to credit the fact, and think that the snake was probably making a meal of her progeny when they were seen to enter her mouth. But the prey of snakes do

not run helter-skelter, a dozen at a time, down the throat of an enemy; nor do snakes, when feeding, gulp down a number of snakelings at once, but one at a time, and by the action of the jaws moving gradually over the prey. The limited space in these pages will not permit of more on this subject than to state that both among reptiles and fishes are well-known examples of similar parental guardianship, which might be cited; and that in my larger work on "Snakes" a whole chapter is devoted to the question of this maternal refuge.

CHAPTER IV.

THE RING SNAKE.

Sub-order 1, OPHIDIA COLUBRIFORMES. Family, *Colubridæ*. Group, *Natricidæ*. Genus, *Tropidonotus*. Species, *natrix*.

THIS is the largest of the three British snakes, and is usually between three and four feet long, occasionally attaining five feet or even more. Excepting the little lizard, *Zootica vivipara*, it is the commonest of our reptiles, and in various localities is known as the "green snake," the "hedge snake," "water snake," "grass snake," the "ring snake," etc. Compared with the viper it may be called "green," or greenish, but it is rather of an olive-grey, dotted with black down the back, and with a series of confluent spots or short wavy lines on its sides. The abdominal shields are smooth and of a pale yellow, or a greenish-white, mottled with black. The "ring" is a well-defined mark or pair of marks, generally of a golden colour, at the back of the head or 'neck," and rendered still more vivid by the contiguous deep black triangular spots behind them. These marks are more properly a collar than a "ring," as is evident from its specific *torquata*, as called by some naturalists. Its generic name *Tropidonotus* is from the keeled scales on the back (τράπις, τρόπιδας, a keel; νωτος, back, keel-backed), not quite so prominently carinated as in the viper, or to destroy the comparatively smooth surface, yet with the distinct mid-rib or keel. The head is ovate, somewhat depressed, covered with large plates, and distinct from the neck; the body is long, slender, and tapering gradually from the largest part to the tail, which is about one quarter the length, and with a double row of *scutæ* beneath (fig. 14). Its present specific name *natrix* (in Latin, a water snake) indicates its aquatic propensities. Though not strictly one of the water snakes, which live entirely in rivers and streams, it is never far from water, swims with ease, and has been seen a considerable distance from land.

Its favourite food is frogs, which it catches with ease, being, like all the colubrines, a swiftly gliding, active snake. It will also eat young birds or field mice, and for lack of frogs will sometimes take a toad for supper, but not by preference.

The ring snake has fewer synonyms than most of its relatives, and all apply well to its characteristics. Thus it is the *Coluber natrix* of one herpetologist, the *Natrix torquata* of another, while a third considers the collar a generic distinction, and calls it *Torquata natrix;* and by the latest ophiologists the keeled scales mark the genus, and it becomes *Tropidonotus natrix*.

As a pet it is the most popular of our English snakes. Accounts of its behaviour in captivity, its tameness, its attachment to those who feed and caress it, its coming to drink what water or milk is placed in a saucer near it, with numerous anecdotes of its docility and intelligence, abound in natural history books. But, to its prejudice, it has the character of being very offensive. When tamed and accustomed to its keepers this ceases to be the case. It is provided with glands near the anus, and in self-protection,

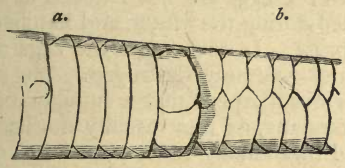


Fig. 14.—*a*, Ventral scales. *b*, Sub-caudal scales.

when alarmed or excited, emits a very offensive odour, not other wise, or so many friends would not have written in its favour.

Those who for the first time see it feed are filled with wonder at the process, and with good reason. The frog is so much bigger than the head of the snake that holds it, that to swallow it undivided seems an impossibility. But now we witness the adaptation of those loosely articulated jaws to suit the emergency. If the snake has been pursuing the frog the latter is probably caught by a hind leg, and is making violent efforts to escape. But, without loosening its hold, the snake, by alternate movements of the jaws,—first the right then the left, like two hands hauling a rope,—contrives to work the frog round till the head is in its mouth, and then you see the jaws stretch apart, and the head widening out of all shape while froggy gradually disappears. Those rows of slanting teeth, described in Chapter II., retain a firm hold, while the jaws alternately advance over the prey, which soon ceases to resist; though the victim will renew the kicking when several

inches down the throat, where, indeed, owing to the expanding ribs and the elastic covering of scales, there is more room to kick than in the jaws and throat of the snake. Suffocation, however, soon terminates the struggles, and the process has not lasted many minutes. Sometimes if a frog is very large and unmanageable, and the process of swallowing it is prolonged, you may see the snake's glottis advanced, this entrance to the trachea opening to admit air, and closing again to exclude injurious particles of dust or what not. A study of much interest is this, as also to watch the snake's head and jaws getting into shape again after the enormous expansion.

The ring snake is oviparous, and lays a string of eggs, from fifteen to twenty-five, about the size of pigeons' eggs. The shells are of a leathery texture, whitish, and usually deposited in moist and decaying vegetation, or a manure heap, where the artificial warmth will assist their development. They are hatched in about eight weeks on an average, but influenced by the season and temperature. In a cool summer the hatching is retarded. Occasions have been known when the eggs are not hatched at all the same year, but have remained during the winter, and hatched by the returning warmth of the spring. In such cases the eggs are more liable to be discovered and wantonly destroyed. We occasionally see it recorded in provincial papers that a number of snakes that had hibernated in company, as they usually do, had been unearthed by labourers, and that among them were large quantities of eggs. These would have been hatched as soon as the sun gained sufficient power; and in the meantime the eggs themselves were undergoing a kind of hibernation, in as much as vitality in them, and their consequent development, had been arrested. The young snakes are at first nearly black, with the exception of the collar, which gleams conspicuously by the contrast. After casting their first cuticle, which is generally within a week, they begin to eat; when very young frogs must be found for them. With each change of coat they assume a brighter tint, and they change frequently during the early period of rapid growth, soon assuming their natural colours, and showing their golden ring and their round bright eyes to much advantage. This "ring," however, varies much in shade or in intensity. Where several of the snakes are together you will see the collar of some nearly white, in some very pale, in others bright yellow, or absent entirely. It is as often of a creamy-white as a gold colour, but always set off by the deep black behind it.

For a cage for your tame snakes you cannot do better than adopt the plan of glass cages like those at the Zoological Gardens,

with the lid of perforated zinc at the top. Let there be plenty of sand or gravel on the floor of it, some moss, which should be frequently renewed, and a good large pan of water, which should be filled afresh every day. In addition to these little comforts, and to enable your pets to take exercise, a small growing shrub in a pot will encourage them to climb, and to enable you to watch their movements and their various gymnastics.

CHAPTER V.

THE SMOOTH SNAKE.

Sub-order 1, OPHIDIA COLUBRIFORMES. Family, *Colubridæ*. Genus, *Coronella*. Species, *austriaca*.

THIS little snake, though very common on the Continent, was not admitted among the English fauna until about thirty years ago. It was, I think, first found near Dumfries, and after many doubts about it received the name of *Coluber Dumfriesensis*. It was then taken to be a variety of viper, or the young of some other snake. It was next found in Hampshire and in Dorsetshire, and the question arose "Had it been introduced into England, or was it truly a native?" and if the latter, which was its true locality? Mr. M. C. Cooke, in his book of *Our Reptiles*, gives a very interesting account of its history and of the various specimens caught, and the careful investigation of every report concerning it before it was confidently decided to include it among English snakes. By degrees its claim to be a native was established. It was identified with the *Coronella austriaca* of the Continent; but it entered the lists here as *Coronella lævis*, the specific referring to its smooth, uncarinated scales. It is very common on the Continent, where it is also known as *Coluber lævis* and *Coluber ferruginous*, the latter from its colour. It belongs to a very large group, including many genera, and represented in nearly every country of the globe. It is a slender little snake, seldom exceeding two feet in length, and is easily distinguished from both the viper and the ring snake. In colour it is a sort of rusty, reddish-brown, with black, but not very conspicuous spots. Its head is rather long and narrow, and covered with plates or shields, and the body scales are short, and of a rhomboid shape on the back, somewhat larger on the sides, with the ventral scutæ broad as usual. It has a shortish muzzle, and the maxillary teeth longer posteriorly than in front, but no fangs. *Coronella lævis* is said to be spiteful, and to try to bite when caught, but it has no venom, and the bite can be no worse than

the pressure of a row of pins. Grasp a snake close behind the head so that it cannot turn to inflict a bite; but to catch it press a stick across its back to arrest its escape and to fetter its movements, and then you can take it up by the neck.

C. lævis produces its young alive, so far as has been observed of it in captivity, but some of its foreign relatives lay eggs. Its natural food is lizards, which are plentiful in the same localities where the snake itself is found, namely, on heaths and commons, particularly those in Hampshire and near Poole and Bournemouth. Like other snakes in a hungry fit, if its favourite food is not at hand, it will take what it can get of a convenient size. It is said to partake of a grasshopper now and then, and possibly would not in that case wait to discriminate between a slender saurian and a green arthropod. No doubt young slow-worms are a seasonable dainty, their form and size suiting *Coronella's* small mouth and swallowing capacities admirably. Occasions are, albeit, on record when the little snake has brought itself into difficulties through a lack of discrimination. A gentleman had a *C. lævis* and a slow-worm in the same cage, *Anguis fragilis*, a very large one, being very nearly as big as its companion. For a time they lived together on excellent terms, *Anguis* being served with worms and *Coronella* with small lizards. There came a time, however, when lizards ran short. It was, if I remember rightly, during the winter, and the snake had no food for a long while, nor did it seem to require any. But one fine morning the gentleman came down to witness a great scuffling in the cage. *Coronella* had the head of the slow-worm in its mouth, the two struggling together, *Anguis* lashing itself about in desperate style. For a time the battle went on with doubtful results, for though *Coronella* retained its hold, the vigorous gyrations of the captive considerably retarded proceedings; but by degrees the little jaws advanced as if they had watched their opportunity; and the persevering *Coronella*, after three hours of very hard work, succeeded in swallowing the last inch of its unoffending companion. There are many stories of ill-judged snakes taking inconveniently bulky prey, and even injuring themselves by so doing. As a rule, however, their adjustable jaws and ribs and their expansive skin accommodate themselves to the occasion, and then a long repose ensues. Many days or even weeks may elapse before the snake is inclined to partake of another meal.

Though I have spoken of this little snake as *Coronella lævis*, because it has become popularly known by that name, M. Boulenger considers it is best entitled to preserve its original name of *C. austriaca*, "as the oldest and that most generally in

use" among scientific ophiologists: and the one, therefore, by which it will ultimately appear in scientific works. It is "smooth" certainly, in comparison with the viper, and in not having carinated scales, but many other snakes are equally so; and as it was first described by Laurenti, the specific *austriaca*, given by him, will probably remain as its permanent name.

CHAPTER VI.

THE AMPHIBIANS.

Amphi, double; *Bios*, life; a double life. That is the meaning of amphibious, a term formerly applied to those animals, reptiles, and even some birds that are as much at home in water as on land, resorting to each in turn at their pleasure; as, for example, crocodiles, otters, seals, turtles, etc., in addition to frogs and newts. The true amphibians are, however, only those creatures whose organism fits them to live and to breathe both in water and on land; not like the above animals, breathing atmospheric air only; but like fish at first, breathing by means of gills, independent of the upper air; and then, in their mature state, by means of lungs. They also possess the remarkable faculty of cutaneous respiration, that is, a power in the skin to effect changes in the blood usually performed by the lungs, which in these creatures are inefficient. Like fishes, they are born or hatched from an egg deposited in the water. Like fishes, their locomotion at first is by swimming, by means of their long fin-like tail; their circulation and other functions are like those of fishes; but withal, they undergo a metamorphosis. Their gills are gradually absorbed and lungs are developed: in frogs and toads the tail is absorbed and limbs are developed; and other organs are gradually growing or being perfected, until they are ready to begin their new life on land. Their metamorphosis is not like that of insects which undergo a period of torpidity in the chrysalis state, and then emerge into the perfect imago; but it is a transformation which may be actually watched, as the growth of eyes, mouth, and other organs are produced or developed from the yolk of the egg.

The Amphibians, though represented in Britain by frogs, toads, and newts only, include a large group presenting great diversity of form in other parts of the world. They are *caudata*, with a tail, *ecaudata*, without a tail; *apoda*, without feet; frogs and newts with four perfect limbs, *vermiform*, or *ophiomorpha*, with a worm-like, or snake-like exterior, together with some extinct

orders, all go to form the class BATRACHIA. Frogs and toads vary but little in their appearance, and notwithstanding there are some hundreds of species in various parts of the world, all are easily recognisable. Not so the newts or salamanders, among which are bodies long and slender, short and stout, with two feet or four, furnished variously with two, three, or four toes each. One pair is sometimes so diminutive and close to the head that *as feet* they can be of very little use, while another pair may be close to the base of the tail. Some are so large as to attain four or five feet in length, while others are measured by inches only. Some retain their gills through life, others are furnished with lungs as well as gills, or, as in our British species, the gills remain only during the aquatic existence. Several interesting examples are generally to be seen in the Reptilium of the Zoological Gardens. There is the "Gigantic Salamander" of Japan, whose relationship to the frog you will at once perceive in the form of its head and jaws. There is also the American *Amphiuma*, a large, thick-bodied amphibian, with a pair of almost invisible feet, no bigger than the claws of a mouse, while the animal itself is above a yard in length. And there are the pretty little Mexican Axolotls with their large, feathery, permanent gills, which they wave to and fro like fans. Besides which are newts and other members of the group.

The Amphibians are mostly aquatic during life. Even those which in the adult state take to the land, prefer moist and marshy localities where water is within reach, but always fresh water; never in the sea are they seen. Indeed it is said that salt, even in small quantities, acts so injuriously on their delicate skin as to kill them. Their skin is soft and moist, and what is called *naked*, being destitute of scales, shields, or such protection as is found in crocodiles and tortoises.

As was stated in Chapter I., the Batrachians, in common with reptiles, birds, and fishes, are all produced from an egg; but while birds and reptiles possess so many structural resemblances as to be grouped together under the title *Sauropsida* (lizard-like), the Amphibians approach the fishes in so many respects as to be grouped with them as *Ichthyopsida* (resembling fish). In their first or embryo condition they are fish without fins; in their second life or adult state they are more like reptiles. The change is, as we shall see, a most interesting and wonderful one.

CHAPTER VII.

THE COMMON FROG.

Class, AMPHIBIA. Order, *Ecaudata.* Family, *Ranidæ.* Genus, *Rana.* Species, *temporaria.*

OUR common frog is a very important little animal. Not only has it been of immense service to science, and especially to medical science, by the numbers of experiments practised upon it, thus affording information of vast utility to the human race (in which case only are such experiments justifiable), but, as will be remembered, in leading to the discovery of galvanism. The frog is, besides, the highest of the Amphibians; that is, in its anatomical structure it approaches more nearly to the higher vertebrates than any other of its class. By the tables given in the Introduction it was seen that in each successive sub-kingdom there is a gradual advance—what we may call an *improvement* of organism—and additions to organs. Beginning with the mere cell, by degrees a mouth, limbs, eyes, heart, brain, external coverings, and so on are developed or perfected, until the back-boned animals are reached; and in these the progressive stages are still observable, so that the terms "higher" or "lower" in development are understood to mean their place in this graduated scale. In some of the intermediate forms—called the lowest vertebrates—the backbone is never perfected, but remains a mere cartilage, never hardening into bone: in these cases the *noto-chord* (see p. 45) is largely or entirely persistent, as in the *Tunicates*, alluded to in the Introduction; an intermediate group offering an example of this advance from the lower to the higher creatures. They have intruded themselves among our English reptiles for reasons there given. But even since this Introduction was written those researches of which I spoke have resulted in the discovery of a third eye in fishes as well as lizards; and "a rudimentary trace of it in all other groups of vertebrates including the *Amphibia*." Professor J. Beard, of the University of Freiburg, has, among others, been investigating these "Parietal" eyes in fishes, etc. He says, "Something that admitted of comparison could be

found in the *larval Ascidians*, or Tunicates. But unfortunately the Tunicates are such very degenerate vertebrates that very little can be got from them for the elucidation of the problem."

Of that "little" they can be made to suit our purpose by comparing the metamorphosis which they undergo with that of the frog, and thus afford us an example of that "higher" and "lower" development, and also some idea of the part which an embryo plays in this.

Both they and the frog begin life—that is, a free, independent life—as a tadpole. In the egg they really do begin life, and we will begin our examination of frogs' eggs from the time they are laid. This is in the spring, when you may see a jelly-like mass down among the weeds in a pond, and which on examination you

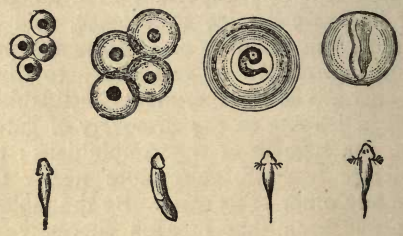


Fig. 15.—Frogs' eggs and early tadpoles: natural size.

find to be composed of numerous globular bodies all clinging together, and in the centre of each a small, dark, round body, which is the yolk of the egg; while the glutinous envelope is the "white" of the egg. They are laid in a long string, but owing to the glairy envelope which soon swells in the water to about a quarter of an inch in diameter, the whole takes the form of an irregular transparent clump full of dark specks. It is the latter which, after a few hours, undergo a rapid change that can be observed under the microscope. You will see each one of them dividing up into a great number of sections or cells, as if acted upon by some chemical agent. This is called *segmentation*, and is what every egg—whether fish, reptile, or fowl, the ovum of every vertebrate animal, in fact—undergoes. This cleavage, or yolk subdivision, however, does not always present the same appearance in the eggs of various creatures, though always it is the first stage of hatching. The segmentation may be "equal" or "unequal." Sometimes it proceeds more rapidly in one portion of the egg than another. But, as a rule, the cleavage duplicates itself; first in halves, then quarters, then 8, 16, 32, etc., sections, producing at last a granu-

lated appearance, or what is called a "mulberry mass." In the frog's egg we have an example of unequal segmentation, although symmetrical; presenting the idea of a beautiful sphere, and reminding us rather of our early lessons on the globe, than anything we should expect to find in the egg of an animal.

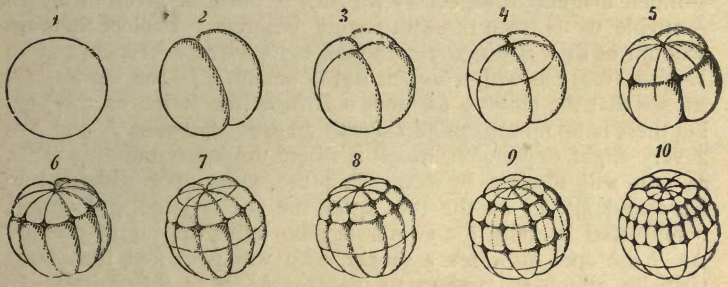


Fig. 16.—Eggs of frog, highly magnified. From Claus.

Still more so when we hear of its "poles, axes, equator," etc. One portion of the contents, lighter than the rest, always turns uppermost, producing an "upper" pole, the opposite being the "lower pole" of the egg. The first cleavage (fig. 2) divides the egg into halves, the next (fig. 3) at right angles, forms four divisions and an "axis" between the poles. Then, as you perceive in fig. 4, an "equatorial" division, but nearer the upper than the lower pole, and is followed by longitudinal divisions, after which the yolk soon breaks up into numerous smaller cells, as seen in the above examples.

One of the first indications of advance in the animal scale is the presence of the *noto-chord*, the forerunner of the vertebral column, or backbone, which is incipiently begun in the egg just so soon as the segmentation process is completed. Then there appears in the yolk what is called the "primitive groove, a delicate longitudinal line, the sides of which rise up and arch over, forming a canal, the lining of which becomes the spinal chord; while beneath it a gelatinous rod develops into a *noto-chord* (*chorda dorsalis*). Hence ultimately the backbone.

Now in the Tunicates, as Claus explains to us, there is an embryonic development, which up to a certain point presents a great resemblance to that of the lower vertebrates. First, the egg segmentation, subsequently a structure like a chorda

Fig. 17.—Tunicate Tadpole.

dorsalis, a "neural tube," a heart, respiratory organs, and so forth, "analogous to those of Vertebrates," until quite a respectable little tadpole is developed (fig. 17, last page).

In the frog's egg something of this kind may be watched from day to day. The germ begins in the upper part. The illustrations —much magnified, especially the earlier ones, as given in fig. 18 —enable us to trace the still further progress. I select them on account of their distinctness, though tadpoles of a French, not an English frog, but with a similar development. In the earliest (*a*) we see that the embryo assumes a form before it leaves the egg, but there is no mouth, and no sign of an eye. Between *N* and *S* is a very slight depression, which is where the future mouth will be, as you will observe by comparing the same spot with that in fig. *b* and fig. *c*. In the two latter the tail is large and strong, compressed laterally for swimming; no limbs appear at present. At *S* the spot indicates a sucker, with which at first the young tadpoles attach themselves to plants. At *N* is the nostril. In fig. *c*, at *Hz*, the depression has developed into a bird-like

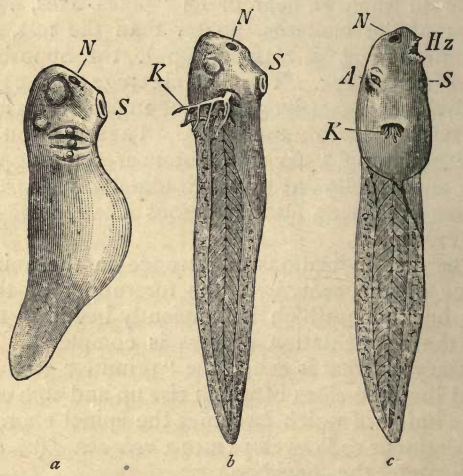


Fig. 18.—*a*, Before it leaves the egg.

"beak," or horny nippers, not the least like a frog's mouth, but adapted to the little creature's wants, enabling it to nip the soft water-plants which at this stage form its food, with doubtless the minute forms of life attached thereto. Cope, the American naturalist, tell us that the tadpoles of some frogs in the United

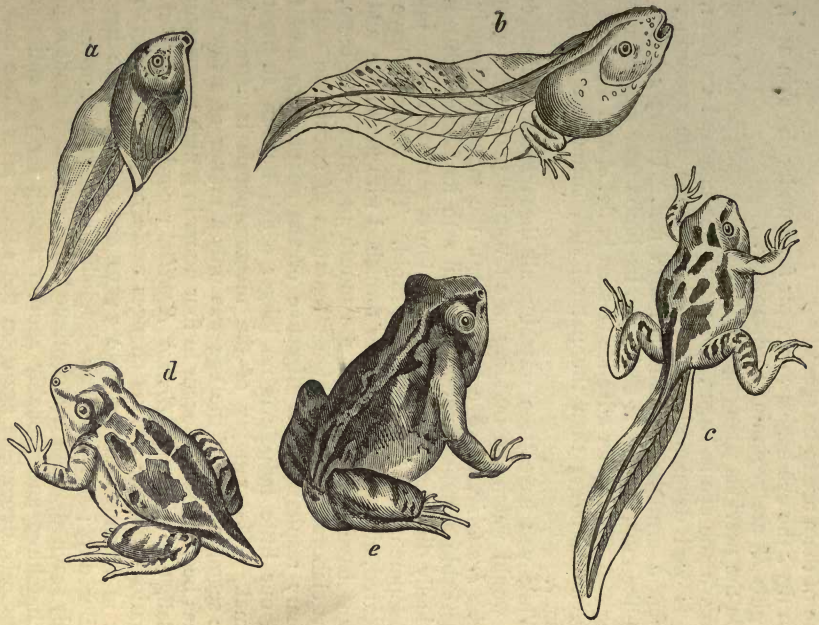


Fig. 19.—More advanced Tadpoles of Frogs.

States are excellent preparateurs of skeletons, "eating such flesh of small dead animals as they can masticate with their feeble horny jaws." They have furnished the most delicate specimens in perfect preservation (as was long ago demonstrated by the late Professor Baird, of the National Museum at Washington, where some of them are to be seen).

In fig. *c* the eye begins to appear from under the skin at *A*, and the gills *K*, are beginning to disappear.

On the previous page (fig. 19) we perceive considerable progress. In fig. *a* the eye is larger, the mouth has changed its form, the tail is well developed, and the hind limbs are sprouting, and in fig. *b* are already furnished with feet. Figure *c* has a true frog-like look, its tail is shrinking, its limbs now assist its swimming. A still further advance is seen in fig. *d*, and a perfect little frog, much larger than the natural size, sitting on the ground in fig. *e*.

While you have been watching all these external changes, as you would watch the budding of a favourite plant—the sprouting of the *branchiæ*, the eye taking form, the mouth undergoing so remarkable a transformation, the tail with its ribbon-like margins gradually disappearing and the four limbs perfected—the interior development has been not less rapid. The *branchiæ* have disappeared, and the chest is now furnished with lungs, the auditory organs have been matured, the mouth provided with teeth, the heart elaborated for the higher functions of circulation and pulmonary respiration, the digestive organs adapted for new food, and our little tadpole is no longer a fish but an air-breathing animal. The rapidity of the metamorphosis is extraordinary. The segmentation of the egg was only a matter of a few hours. It has been known to occur in four hours in a high temperature.

Bell, the author of *British Reptiles*, records very careful observations of these various changes made by Rusconi, who found that in a temperature of from 73° to 80° tadpoles were hatched in four days; but as in an English spring that temperature is rarely reached, much less continued, Bell reckoned about a month for hatching, and probably another month for the entire metamorphosis, dependent again on the season after a late and cold spring. Some spawn deposited about the 12th March I kept in a temperature averaging 50°; that is, at night below 50°, and in the day-time above. The bowl was placed in a window where the morning sun on one or two occasions for an hour or two brought the temperature to 70°. But the weather was, for the most part, chilly and sunless, and during five weeks there was only a very slightly perceptible change in the eggs. Under a

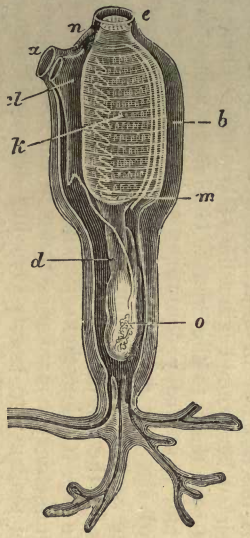


Fig. 20.—*a*, incurrent aperture; *b*, mantle; *d*, *o*, stomach and intestines; *e*, excurrent aperture; *c l*, excurrent chamber; *k*, gills.

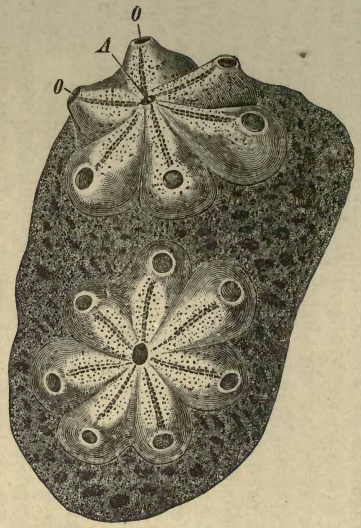


Fig. 21.—Other fixed Tunicates. *1*.

lens I could detect the form of the embryo, curled up, but no movements. During that time the eggs had all become detached and solitary with but little of the glair about them; this latter, which nourishes the egg, having been absorbed. They remained at the bottom of the bowl. When they rise to the surface it may be taken as an indication of their being worthless, as their lightness is due to the gases of decomposition. One must conclude, therefore, that eggs hatched in four days, as above alluded to, was exceedingly and unusually rapid, and by no means to be expected even in our warmest English springs. Spawn, ordinarily deposited, is in bulk sufficient to fill a large hen's egg, and the eggs must amount to hundreds. Frogs in captivity and in a warm temperature spawn earlier than in the ponds, and would naturally hatch earlier; but on one occasion—it was the beginning of July—I had some little frogs, whose tails had only just disappeared. In an early and warm season they would have become land animals much sooner.

And now a last glance at the Tunicate tadpole, which we left with a splendid tail to serve it as a swimming organ in the ocean waves. There are several orders of *Tunicates*, and though the tadpoles may not be precisely the same in all, they are mostly endowed with the organs already enumerated, and an "auditory vesicle," an "eye-spot of complicated lens-like structure," and actually a brain. Like the frog tadpoles, they also have "suckers," or arm-like projections sprouting from the upper part, with which to anchor themselves to seaweeds or rocks. Would one suppose that such promising little tadpoles could degenerate into plant-like creatures such as those in figs. 2 and 20?

This is the sad tale of what biologists call their degradation. With their suckers they begin a life of laziness. Those arm-like tentacles root them to the spot. No longer using their well-formed tail, it gradually diminishes and finally disappears; the notochord also, the eye and other partially developed organs share the general retrogression, and the Tunicates remain mere molluscs for the rest of their lives, with a mouth, a stomach, and very little else. Curious that some kinds should arrange themselves in so symmetrical a manner as those in fig. 21, proving nature's universal tendency to beauty even in "degraded" forms. It is as well to add that their mouth O is provided with *cilia*, whose constant motion draws in the sea water; they retain for food the minute animals that swarm in it, and eject the liquid again from the centre orifice, A. Should the cilia draw in anything that is distasteful, or should any injurious substance approach the mouth, it is at once detected and squirted away to a distance.

The water is sometimes squirted with considerable force five or six inches. Hence their name "Sea-squirts." They are not infrequent along our coasts. In these Ascidians we have a remarkable exception to the rule that *larvæ* develop into higher organisms. They compel biologists to seek elsewhere for the origin and subsequent decadence of the median eye.

The frog, on the contrary, continues to improve in organisation until it reaches maturity in its third summer. Its respiratory and other organs are all perfected, also its bony skeleton, at first mere cartilage. Parts of the skull become hardened, or are replaced by bony pieces. In the illustration of *Rana esculenta* (p. 59) this may be seen; it differs in no respect from *R. temporaria.*

The chief characteristics of the genus *Rana* are teeth in the upper jaw and on the palate (the latter are called vomerine teeth from the supposed resemblance of the bone in which they are fixed to a plough, *vomer*), pupil of the eye horizontal, fingers free, toes webbed, hind legs very long and formed for leaping, tongue notched and free behind, skin smooth, moist, extremely sensitive and an organ of respiration. Frogs, therefore, have a double respiration, swallowing air by means of what Mivart calls "an effective throat air-pump," and breathing through their skin as well. Experiments have proved that the skin answers all the purposes of lungs. A bladder tied so tightly over the head of a frog as to entirely exclude air does not incommode it. Placed in water in this condition, and kept there for a time, the water is found to contain carbonic acid given off through the skin, just as we give off carbonic acid from our lungs in each expiration. On account of this sensitive skin and the active perspiration by which it is kept moist, frogs in the vivarium must not be exposed to the sun glare in hot weather. Unmindful of the importance of shade, I once left the glass bowl in which my very young frogs resided close to a window exposed to the full glare of a July sun. All had seemed apparently well that morning, but on looking at them in the afternoon one was dead. It could, like the rest, have sought shelter under or behind the minerals or green sprays with which their home was furnished, but this little frog was much given to climbing up the side of the bowl and clinging there, and I have no doubt it had been struck by the intensely hot sun of that day.

The bony structure and muscles of a frog are extremely like our own, only modified to suit its requirements. In the skeleton, (fig. 22) you see how admirably the powerful hind limbs are adapted for leaping. It is common to say of a frog, as of a grasshopper,

"it hops." The French word *sauterelle* is the more correct term for the latter; by the combined action of the legs both it and the frog perform a perfect leap, and no less nimble than the "grasshopper" is the frog. The extra joint in the leg might be called a heel, but is truly formed by the very elongated ankle bones. These bones, flat on the ground, must assist the leaping, but are also used as an elbow. We speak of persons "elbowing their way" through a crowd. The frog "elbows" its way with this posterior joint, not through a crowd certainly, but to back itself into some safe retreat, as I shall presently explain. The foot of a frog is, as Mivart shows us, "a very marvel of complexity," with an elaborate system of muscles. The toes are extremely long, and this muscular system furnishes to the little animal its power of locomotion, both on land and in water. A frog has no ribs, though those bony processes from the eight joints of the spine resemble ribs, and are as long as the true ribs of newts. While the frog has a shorter spine than any other vertebrate animal it has a breast-bone, *sternum*, and is the first example in the rising scale in which the *sternum* appears.

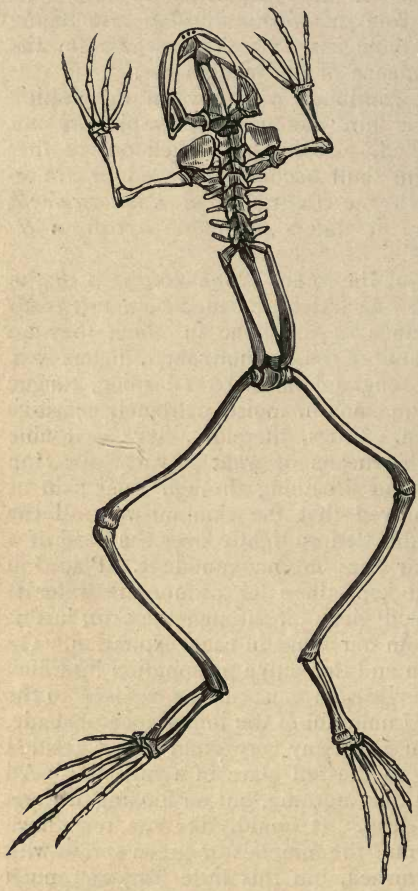


Fig. 22.—Skeleton of a frog.

We may now clothe our frog with muscles and skin, and observe its habits. As to colour, olive may be said to predominate; but

with a brownish, reddish, or yellowish tinge, according to its surroundings; because a frog changes its colour. There are, however, some distinctive marks which are always apparent. The long black spot behind the eye, rendered still more conspicuous by the light line immediately under it gives character to the head. The thighs are striped, the belly is much lighter and spotted, otherwise we can scarcely affirm that a frog is brown, or green, or yellow. When just emerging from the mud it is so dark that the black spot is scarcely seen, and when among grass or plants the tint is greenish. These changes were always observable in my little Batrachian family, and they were very frequent. One little frog that liked to keep above and in the light was of a golden tint, and the others that preferred hiding were much darker; and though all changed their tints, each was, under all circumstances, sufficiently distinct for me to recognise it. The change of colour is protective. Not that we may suppose that a frog deliberately resolves to turn brown or black on dark ground, or green when in the grass, but that there is something in the colour of contiguous objects which does act upon the skin is very certain. Claus tells us that "the colourings of its skin are due to pigment cells in the cutis, and that the changes of colour are caused by changes in the form of the cells."

It is evident, therefore, that an external influence, and not a voluntary operation, acts on the cells; though the terms "imitation" and "mimicry" have been used in describing changes of colour in some insects and birds. The skin of a frog is also richly supplied with nerves, and is to be regarded as the seat of the tactile sense. A larger and older frog, in its second summer, gave me frequent opportunities of remarking its extreme sensitiveness, starting at any sudden or jarring sound, as a nervous person starts at a gun going off, or a door slamming. This frog, known as "Froggin" (while the very young ones were "Froggies"), had the run (or jump) of a glazed off-shoot to our house, called in the house-agent's advertisement "Conservatory." In this little fabrication, however, in company with a toad, Froggin seemed well satisfied. He had his favourite corners from which he surveyed the world, one most frequently chosen being a damp nook almost under a water-tap. There was a fissure between the bricks in that corner into which he backed himself, and as he grew bigger edged himself sideways into it, with much perseverance, but with little apparent comfort, until he outgrew it beyond any further squeezing, but did not even then desert the corner. Drippings from the tap and even a good sprinkling he seemed to regard as a refreshing summer shower; but if a rush

of water descended suddenly, then Froggin in one leap was far away. He was as sensitive as a snake to vibrations through the ground, such as anything being dragged, or let down suddenly. His especial delight during the summer was to luxuriate under some moss in a pan of water. Here he would remain all day, with only his two little specks of nostrils on the tip of his snout visible, and so indistinct were they that often one could only discover him by seeking him.

That frog did not reciprocate the exigencies of science, or the spirit of inquiry which led to his rather too frequent molestation. The forcible examination of his fingers, toes, tongue, etc., seemed to frustrate the taming process. Unmolested for a few days, and with the remembrance of a yesterday's feast, he wore a very different expression to that with which he greeted his recent tormentor; yet if he were in his usual corner on the morning visit he did not attempt to escape; and if he were not there, familiar sounds—and he recognised my voice—would invite him from some nocturnal retreat, when he gradually made for his corner, faced about, backed himself as far as practicable into the crevice, and thence watched proceedings. Notwithstanding this sign of confidence, his varying expression was unmistakable. Haunted by yesterday's dental examination, he scowled up from under his eyelids, and suspiciously watched an approaching hand. At other times he would look up brightly, as also did the Froggies, as if to say, "Well, what have you got for us?" The changes of expression were unmistakable and yet perplexing, as one does not look for emotional sentiments in frog physiognomy. But Claus threw light on this phenomenon also. "In Batrachians there is a retractor muscle, by means of which the large bulb of the eye can be drawn back." Further observation, therefore, may show us that a sense of fear or displeasure causes this retraction of the eye-ball, and that varied expressions may really be witnessed in the face of a frog, and the appearance of "scowling" was one result. I observed the same in the small frogs, and also in the toad; but the latter is of a more imperturbable temper, less excitable, and the expression of its eye is habitually contemplative and unresentful. Both have large prominent eyes capable of a wide range of vision, and by the movement of the pupil can take side-long glances without turning their heads. Indeed they never do turn their heads, having no neck,—no cervical vertebræ,—but the motion up and down of the head is frequent. The eye is not buried in an *orbit*, as our own, but is only framed by the bone, as may be seen by the large round spaces in the skeletons (p. 59), and also that of the salamander (p. 71). If you look into

the mouth of a frog, toad, or newt you will see the actual eye-ball naked, and occupying considerable space on each side of the roof. The eyes are furnished with three lids, one of the lower lids being a semi-transparent, nictitating membrane.

After any effort in swallowing—as, for example, some unusually large or rough food—you will see this membrane drawn over the eye. All the Batrachians that I have watched under such circumstances, viz., frogs, toads, and newts, hold up their heads, half close their eyes with the lids working in apparent discomfort; but probably from the fact of their eye-balls being exposed in the mouth, large-sized or rough prey does somewhat discomfort them.

The action of the eyelids in both frog and toad was particularly manifest when, under forcible detention, first one and then the other, wrapped tightly in a thick cloth, was having the interior of its mouth examined. To hurt them as little as possible, I took a fine silver bodkin with which to force open their mouths. The little animals use extraordinary force in closing their jaws at such times. Froggin got his arms out and tried to push it away; the toad was too tightly swathed; but when at last the mouth was got open and held open with the bodkin, as a bit, the piteous, lachrymose expression of their eyes, especially the toad's, was so martyr-like as to be even laughable. All the three eyelids were alternately working. The operation over, and the patients at liberty, both took some time to recover the outrage and to reclose their mouth, holding up their heads and blinking their eyes helplessly and piteously, till at last each cautiously retreated to a cherished hiding-place. It was curious to note the ingenuity those two would display in finding a fresh hiding-place when their temper was too much tried; but within narrow limits the secret retreat was soon discovered. Froggin, fond of climbing, and having the advantage of the toad in being able to take a high leap, had wider choice, and would in brighter moods be found perched on the handle of the watering-pot, or a basket, on the edge of the pots and flower-boxes, or on ledges. He seemed to take each by turn, always, however, true to his corner in peaceable times. What efforts he made towards self-maintenance are very doubtful. I never saw him take any food not placed close to him, though frogs are supposed, and expected to be very useful in reducing garden pests. Near the outside door was a little well or pit of unpaved floor, about sixteen inches square, intended for drainage, but filled with earth and rubbish, a very store-house of batrachian food. In this moist earth Froggin, when the toad was not in possession, occasionally buried himself, always working himself backwards and downwards with

those posterior "elbows," until only his head, or even the nostrils were visible, and very difficult to distinguish. Here he would remain sometimes for several days; not to catch slugs and wood-lice, and declining what were offered; and as he afterwards reappeared in brilliant colouring, I fancy these seasons of retirement were previous to a change of garment. His manner of doffing his coat I was never fortunate enough to witness, and can therefore say nothing about it, but his manner of taking food calls for a word or two. It is usually affirmed that frogs catch their food by means of their tongue, as toads and chameleons do, but this was a very exceptional proceeding with my frogs. The little ones, without a single exception, jumped after and caught their food; and Froggin, with a trifle less energy, picked up his prey in the same manner.

Only twice, and then as a sort of emergency, if a fly or a spider were escaping, did I ever see the tongue used as a prehensile organ; and as no one fed him but myself, and he seemed to depend on me for all he ate, I had ample opportunity of watching him. The toad, on the contrary, used only his tongue, and surprised me at the distance he threw it out, quite two inches. In form both tongues are alike; pink, clean, and notched, and with that obnoxious bodkin both could be extended their own length; less than one inch, the tongue of the toad must, therefore, be extensile to be thrown out so far. But the eccentricities of Bufo must be reserved for their place. Another noticeable item in Froggin's feeding was that he did not always take good aim when springing at anything, sometimes making several dashes before he caught it, sometimes giving it up altogether.

An especial dainty—a spider, for instance—he leaped up to catch on the wall, often jumping high to do so. Nothing in the way of insects came amiss, and the most energetic dashes were made at green caterpillars. One large fat caterpillar was almost too much for him, but he got it down; and then followed the usual demonstration of uplifted head and blinking eyelids. Only moving creatures attract them or are aimed at. If a slug or worm remain still they cease to regard it, then the slightest movement re-arouses attention, and with head bent down they study it, until convinced that it is indeed something alive, when with a quick dash it is gone.

Should they get anything unpleasant into their mouths, as a too-gritty worm, they eject it, and then sit with their mouth open and their tongue out for some minutes, looking very foolish, and using their fingers also to brush their lips. On one occasion a little frog was trying to snatch its lesser brother's worm, when

with a pair of pincers, devoted entirely to Batrachian uses, I gently pushed away the aggressor, the pincers barely touching its snout. Instantly it leaped all over the cage, dashing at its snout with its hand as if to push away something hurtful. It seemed really distressed, not possibly by any wound, but there must have been some sort of shock to its sensitive skin. So I gave Froggie a bath, holding it head downwards to wash away the injury, and the dip and a subsequent swim had the desired effect. To see a frog swim is to take a first-class lesson. The regularity with which they strike out, and the space gained at each stroke, would rival the most adept human swimmer.

One word about climbing. Their first home was a deep glass jar with so narrow a mouth that I thought a cover unnecessary. Froggies, however, got out. Then I placed a green spray over the top which must baffle the most skilful leaper, and still they got out. After a time they were found climbing at various heights, clinging like flies to the sides of the jar. By means of suctorial discs on their fingers and toes they manage this; with much perseverance ascending the smooth glass. Up walls and rough surfaces it is easier; but those who have pet frogs must be on their guard to secure them. A zinc lid was at last provided. Afterwards they lived in a large glass bowl, and they got so accustomed to their home that they did not attempt to escape when the lid was removed; not even when the bowl was placed on its side on the floor, which I often did at night for them to get out and forage for food. Only one or two more enterprising took advantage of the privilege, and these grew much faster than those who remained at home fasting all night.

In catching prey it is not a recognition of kind that guides the Batrachian, but an instinct to seize upon a moving object. They pounce upon some small thing, a leaf or twig that may be moving, while a real dainty if quiescent remains unnoticed. On one occasion a very thin stream of water was trickling slowly towards Froggin, who watched it coming, and made a dash at it, thinking it was a worm, and then turned away disconcerted. It is said that the first living thing a tadpole swallows is a fellow-creature smaller than itself. They swarm in all sizes, luckily supplying food for a wide circle of larger creatures, and yet they abound. Frogs are abundant throughout England and Scotland, and have been introduced into Ireland. They are in themselves perfectly harmless, while of vast use in consuming for food the pests of vegetation; and at the same time being a food staple for many birds, fishes, and larger reptiles.

CHAPTER VIII.

THE EDIBLE FROG.

Family, *Ranidæ*. Genus, *Rana*. Species, *esculenta*.

RANA ESCULENTA was not originally a native of the British Isles, but has been introduced, and is now frequent in the marshy localities of the eastern counties, and is occasionally elsewhere established. As it is customary to include it among the British fauna, a few words may be said about it.

Regarding its development and mode of life, what has been related of *R. temporaria* would in most respects describe *Esculenta*,

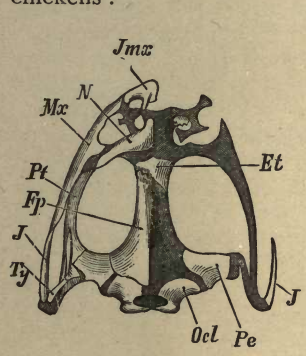
Fig. 23.—The Edible Frog.

excepting that the latter is more thoroughly aquatic, not keeping entirely to the water, but being less on land than *temporaria*. It has been called the "green frog," and is *Rana viridis* of some herpetologists, but with no better reason than that which has procured the name of "green snake" to *Coluber natrix*, viz., being of a more greenish tint than the other frog, yet not the true green of the tree frog *Hyla*. It is a trifle longer and narrower than *temporaria* and with handsomer markings, and conspicuous whitish or pale yellow lines down the back, rendering it easily distinguishable.

Boulenger's synopsis of the species is,—Fingers blunt, of moderate length, the first extending a little beyond the second; toes entirely webbed; tympanum distinct, two-thirds the size of the eye; a glandular lateral fold narrower than the upper eyelid; vomeric teeth; the upper parts more or less spotted or marbled with black, or a very dark brown; the hinder sides of the thighs also marbled.

The male of *R. esculenta* has a curious inflatable pouch on each side of its head, which is very conspicuous in the breeding season. These prominences, which impart a very grotesque appearance to the frog, are called *vocal sacs*, and give power to the voice, more power than is quite agreeable in places where *Esculenta* congregates; its croak is voted a nuisance by those who dwell within hearing.

The edible frog of England is somewhat less than its French relatives, which furnish a favourite dish at table. One in America is larger than either. The legs only are eaten, being as big as those of a young chicken, and indeed might be mistaken for such. On the prairies, near Chicago, is a very large frog which is brought to market. At an hotel there I once partook of a fricassee of frogs' legs, asking no questions when the dish was handed to me, but which, on eating, I found to be rather insipid, and remarked to a friend, "What a pity to kill such very young chickens!"



a

Fig. 24.—Upper or exterior surface.

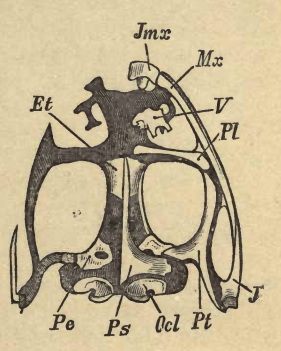


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Fig. 25.—Lower or interior surface.

EXPLANATION OF BONES OF FROG'S SKULL.

(*Membrane bones of one side removed in each case.*)

Ocl, exoccipital; *Pe*, Petrosal (prootic); *Et*, girdle-bone or sphen-ethmoid; *Ty*, tympanic; *Fp*, fronto-parietal; *J*, quadrato-jugal; *Mx*, maxillary; *Jmx*, præmaxillary; *N*, nasal; *Ps*, parasphenoid (from the wedge shape); *Pt*, pterygoid; *Pl*, palatine; *V*, vomer.

By these illustrations of the skull (alluded to on p. 51) the changes which occur during the growth of a frog from the tadpole to maturity may be studied, as also the names of the bones. The darker parts are those where the cartilage has become hardened, or is replaced by bony pieces; one is viewed from the top of the head, and the other from the interior of the mouth.

CHAPTER IX.

THE COMMON TOAD.

Order, ECAUDATA. Family, *Bufonidæ*. Genus, *Bufo*. Species, *vulgaris*.

THE chief generic and specific characteristics of *Bufo vulgaris* are, according to Boulenger, toes at least half webbed; no tarsal fold; sub-articular tubercles of toes double; fingers free, the first scarcely extending beyond the second; sternum either cartilaginous or with a semi-ossified style; no maxillary teeth; tympanum smaller than the eye, and not very distinct; the male without a vocal sac; upper parts warty.

In form and appearance the toad is not unlike the frog; but those who have once compared the two will easily recognise individual peculiarities. The toad is of a stouter build, with shorter legs, and is less active in its movements. Indeed, the mode of progression in each at once distinguishes them. We rarely see a frog move otherwise than by a leap, excepting in climbing, as backing itself into a corner, or working itself into the ground, can hardly be called progression; whereas a toad "crawls," creeps, or steps, one foot at a time, and takes a long while to consider which foot to move next, and where. "Sluggish" is the term applied to it; yet its actions give an idea of deliberation, rather. Under very great stimulus it ventures on a "hop," but scarcely to clear the ground, while four inches is the extent of its leap, accomplished with a jaunty semblance of activity that is simply ludicrous. Its skin is warty, and, as a rule, dry; of a light brown or ashy colour, the warts or spots much darker. It also has a faint shaded stripe down its back, but, like the frog, changes its colour, and that readily. Its form is not elegant, truly, especially when it puffs itself out, as it does when alarmed or disturbed, and that to a great extent. At such times it crouches close to the ground, and remains motionless. Under any very sudden annoyance it stands up erect from the ground on its four legs, as high as their length permits. My toad thus exhibited

itself the day after it came into my possession, suddenly rising on its legs and puffing itself enormously, a most ridiculous spectacle, more like a puff-ball, or a toadstool than a toad. It was, I think, because I was going to take it up, or because, being as yet a stranger, my presence and attentions were unwelcome. At the same time it exuded the cutaneous secretion which is its sole protection, and which is like a sudden and violent sweating, proving a thoroughly effective barrier under which to entrench itself. One could only watch it at a respectful distance. It presently subsided into its usual position, and made cautious steps for a hiding-place. Only on that occasion did I ever see it rise on its legs, quadruped fashion; and only for the first few days was there any perspiring moisture on its head or body if I attempted to touch it. Afterwards, with but one exception presently to be related, it was always dry and clean. This exudation is owing to glandular secretions, glands being generally present in the integument. There are two large ones behind the eyes, *parotid* glands, which abundantly emit this acrid, viscous fluid, also along the sides and on the posterior extremities; the entire body, however, becomes suddenly moistened with this acrid secretion, which is extremely unpleasant to other animals, and though not actually venomous, is, to a certain extent, irritating, particularly to the stomach. Birds have been known to die after swallowing toads; even snakes will not eat them by choice, though at the Reptilium, when other food runs short, they will, if very hungry, accept a toad.

It is this sudden sweating, so to speak, of an unpleasant secretion, which has gained for the toad the reputation of being "venomous," and brought upon it universal disgust and opprobrium. Even among the intelligent, it is viewed with prejudice. But its only means of protection lying in this, and in its capability of concealing itself, and its life being really of important use in its vast consumption of creatures injurious to vegetation, this self-protecting habit should be regarded as one of those great economic principles in the beneficent ordering of things by which the balance of nature is maintained.

Toads begin life in all respects like the frog; once leaving the water becoming altogether land animals. When fully matured they return to the water during the breeding season, and only then. The eggs are laid in a long chain, and the tadpoles are a trifle smaller and darker than frogs.

Many accounts of toads being easily tamed are recorded; of their taking food from the hand, or catching a fly on the window pane while held, and so forth. Alas! all my efforts at taming to that extent have been unsuccessful. Probably my "Toadums"

could not reconcile capricious kindnesses with the overhauling of his tongue and toes, the bodkin gagging his mouth, and the close imprisonment meanwhile. Yet, like Froggin, when there came a temporary respite from these inflictions, he made some progress towards friendliness. It was expedient during the summer to give him occasional liberty, to support himself by his own exertions. And this for several reasons. The tiny frogs and also some small newts that escaped from their glass globes in the conservatory could not always be found again; their numbers were fast diminishing, when, finding that the toad could swallow a slug much larger than the newts and a beetle much bigger than the frogs, I suspected that his tongue was the agent in their disappearance. The few square yards of enclosed space called "garden" in London swarmed with small molluscs, worms, and crustaceæ, good for toads but not for plants, and it seemed that Toadums might as well help himself to these dainties. At the far corner was a little "rockery," furnishing precisely the crevices and hiding places in which he in troublous times could circumvent me, but where, under happier auspices, he climbed and foraged, growing rapidly, a proof of his ability to maintain himself. His favourite retreat was one particular recess, a miniature cavern under a projecting stone, where from within, eight or ten inches from daylight, he could command approaches. Comically enough, whenever he saw me near, he came to the entrance of this retreat, and sat, like a sentinel at the door of his tent, waiting. His vocabulary consisted of about three distinct sounds. One, a subdued croak, "cgwha," seemed pleasurable; louder was remonstrative; and a third, consisting of about five gutturals in one unspellable ejaculation, was resistant. My usual greeting was to pat and stroke his head, which he held down submissively, simply remarking "cgwha." The finger removed he looked up, but seeing it still there down went his head again; but whether the patting was agreeable, or that he merely submitted, was never clear to me. With Froggin the attention was similarly accepted, only he more quickly and inquiringly raised his head, as if to ask, "Is that all?" Toadums' next move from his grotto was to make for one particular corner, where, from behind a fern, he faced about, observant. One day, a child who had witnessed the above routine, threw stones on the sly at Toadums in his corner. Presently I saw a little heap of stones and gravel, but the toad was gone; and after a long search was found hidden in a new retreat, under another block of stone, which only by being lifted led to his discovery.

Such an object was poor Toadums! He was literally streaming

with exudation, while one eye was completely hidden by a large bladder, which, being covered with dust, had a most remarkable appearance. Probably the child had thrown earth as well as stones, and his coat being dusty the perspiration was almost mud; and the dust in his eyes, lifted by the abundant exudation, formed this curious bladder nearly as big as his head. He was puffed to the extremest size, and a more deplorable object can scarcely be imagined. To touch him was impossible, so I replaced the stone and there left him. The next day his trouble was over; he came to the mouth of his cave reattired in a pretty light brown coat, with dark chocolate spots; very bright eyes; happy once more. If he ate the discarded garment, as toads are supposed to do, he must have the digestion of an ostrich. I was never lucky enough to witness the process of discarding the coat, but it has been often described by eye-witnesses; the splitting down the back and the drawing out of arms and legs, etc. Toadums renewed his very often, as was easily seen, because when out of doors and foraging among dead leaves, which were more black than any other colour, he soon got sooty and dingy, till, as if disgusted with himself, he remained closely hidden for a few days, and then reappeared beautifully bright and clean, white vest and all complete. It was a curious fact that he invariably reattired when brought in from the garden. As if conscious of the fitness of things, and the incongruity of a grubby garment in the society of clean little frogs, orange-vested newts, glass globes, plants, and gay colours, he was sure to appear well dressed at his earliest convenience. He knew the door very well after once being permitted to go out that way, and when it was shut would go to it, try to crawl up, and there wait. He displayed perseverance and even persistency, at variance with "sluggishness" in surmounting an obstacle, also in climbing; standing on the very tips of his toes like a ballet dancer, and reaching up as far as he could stretch his arms. If only one finger could be got upon a ledge, or an edge, or wherever he wished to mount, he then drew himself up without difficulty; standing on the toes of one foot while the other was raised to the level of the fingers, and by degrees making sure of his hold. It was very grotesque, he on one leg, with the three others stretched upwards.

But on one occasion he performed a gymnastic feat well worth recording. During some heavy rains, when the outer door had not been opened, Toadums was missing. Afterwards he was found in his cavern, but how he got out was a mystery. He was, however, permitted to remain out of doors. One morning, a week or two afterwards, there he was back again, cosily nested

in the corner pit, where, as usual, he had made a form, only his head and bright eyes being visible above the mould. "Cwaugh," he said, when I asked him how he came there; but too comfortable to stir, otherwise than to bend down his head at the accustomed greeting. He seemed to be growing quite friendly, and to accept of these familiarities; but one day, when he was perambulating the place, and I stooped down to pat him, he submitted for a time, then suddenly, as with a purpose, turned completely round and made for the pit, as if he had said, "I've had enough of this." Never before had he moved with such celerity and decision; and when he reached the corner, instead of facing about as usual, he looked straight up the wall, not stopping to deliberate, but, to my amazement, having made sure of the spot, beginning to climb. The two walls, at right angles, had no prominences to lay hold of; but no chimney-sweep in the ante-broom days could have proceeded more systematically, arms and legs, elbows and knees, pressed alternately against the two sides, and thus sustaining his heavy body as up he went, a difficult feat and a wonderful performance. Fourteen or more inches of ascent he made without once slipping, and with evident acquaintance with the place. Reaching a part where a branch of vine let through from outside had left a very slight chink, he, without pause, turned sideways, and began to edge himself through, the whole transaction exhibiting purpose, memory, and the result of experience. This, then, was his private exit and entrance, but how he had discovered the chink was a marvel. Only sideways and by hard squeezing could he get through, but the achievement was that of an expert. Probably he had made use of it for nocturnal expeditions, for his method of proceeding on this occasion was with foreknowledge and facility. Outside he simply tumbled headlong on to the flower-border; and to get back he had two feet of wall to surmount, a feat one did not happen to witness. That the chink in the wall was wide enough to admit the toad or within his reach never occurred to one, or that he could have climbed up the bare wall to explore it. Being just over his usual lair, the draught of air must have made him conscious of an exit; that is the only solution to the mystery. Boulenger describes the toes of *Bufo vulgaris* as having double sub-articular tubercles, and these no doubt assist in clinging; but the pressure of knees and elbows against the wall was very evident, and doubtless the principal means of ascent. On the approach of the winter the chink was stopped up, when he would sit and stare up at it, conscious of something different, but never attempting to climb any more.

On the tongue of this toad no signs could be detected of the viscous, mucous secretion described by Bell and others. The tongue appeared to be perfectly clean, like the frog's. It is possible, however, that such secretion is stimulated by the sight of food; just as the mouth of a snake "waters," so to speak, with that abundant secretion from its salivary glands which lubricates and renders food more easily swallowed. So a modification of the secretion may imbue the tongue of a toad. It seems not impossible, too, that the slightly bifid tip of the tongue may render it in a slight degree prehensile. The ejection of the tongue is so rapid that you cannot detect any action. A flash, a little "click," and the insect has vanished. One day I chanced to secure a very large cockroach, too big, I thought, for Toadums, but I turned it at liberty nevertheless near enough for him to see it, and with a little stick directed its progress towards him, closely watching results. Within a few inches he began to watch it with bent head, but without otherwise moving. When fully two inches distant suddenly the tongue was thrown out, the click was heard, and coleoptera had disappeared. Then Mr. Toadums resumed his meditations as if nothing had happened. The business-like expression of the eyes is very curious on such occasions, as when a tempting creature is being studied. It is as if the toad were temporarily aroused from a reverie with summoned attention, that he obeyed that summons, got through his business, and dismissed it for the more important cogitations. Thus sedately he invariably took what was placed near enough, and always at a distance of at least two inches. His method of catching food for himself out of doors demanded, one would suppose, some additional effort.

CHAPTER X.

THE NATTER-JACK.

Bufo calamita.

In colour the Natter-Jack is of a more uniform tint, its spots being less conspicuous than those of *B. vulgaris*. It is yellowish-brown, shaded with olive, with a distinct yellow, or cream-coloured line down the back. But I observe that all these creatures vary so much in tint, that one cannot positively affirm that a frog or a toad is precisely of this or that hue. The bright line and the mode of progression in the Natter-Jack render it, however, unmistakable. It neither hops nor crawls, but walks nimbly, and in warm weather, under excitement, runs with a smooth and easy motion, very like that of a mouse, only not too quickly but that you can follow the action of its limbs.

Bufo calamita used to be frequent on the heaths and commons in the vicinity of London; but with the spread of population it has, like the wild flowers, almost disappeared. In the fen and marshy counties, and in some parts of Scotland, it is still common, and occasionally in Ireland. Its name *Calamita* (from *calami*, reeds) indicates its favourite localities.

It appears to be able to adapt itself to variations of climate and soil more readily than either the common toad or the frog. Sir William Jardine found some in a marsh so near to Solway Frith that the water was almost brackish; while Bell assures us that in his own garden near Poole they were more frequent than the common toad, and that he saw them sometimes in the hottest and dryest situations, exposed to the full rays of the summer's sun. Mr. W. R. Tate records that he also found them in sunny places. We do not hear so much about the Natter-Jack as a pet. Tate, however, kept some that he succeeded in taming sufficiently to take food from his hand; they catch it on their tongues in the same manner as other toads. He gives them the character of being more sociable than *B. vulgaris*, always going in pairs. Also more intelligent, at any rate less deliberate, as they do not

stop to consider their footsteps, but if surprised "immediately conceal themselves." They "dig" deep holes to lie in, excavating, no doubt, as other toads, with the hind limbs, and yet they repose frequently in shallow water with only their noses exposed to the air, which I never saw my toad do. Tate considers that they display superior sense in ceasing to croak when disturbed, but the same instinct which leads to concealment would also induce silence.

The tadpoles of the Natter-Jack are smaller than those of *Vulgaris*, and the metamorphosis is more rapid, lasting only six or seven weeks; but in a cold season this, no doubt, would be prolonged, as we find to be the case throughout the class. The generic characters are of course the same as *Vulgaris*. The specific features are—"Hind limbs short; toes webbed at the base; no maxillary teeth; crown without bony ridges; snout short and blunt; first finger not extending beyond the second; the male with a vocal sac; tympanum small, and not very distinct."

B. calamita has the same kind of skin as *Vulgaris*, the warts being even more prominent, but the skin appears to me to be more moist, like the frog's, and not normally dry, as in the common toad. Its eyes are also prominent, said to be even more so than in *Vulgaris*. You may, however, observe an individual in which they are not nearly so prominent, perhaps due to a retractor muscle, as in the frog, but of this I cannot speak with certainty. It is very certain, however, that when closed, the eyes of both are only very slightly prominent, being almost level with the surrounding parts; and this retraction of the eyeballs during hibernation is a noteworthy protection to them. The same method of breathing as in the rest of the Batrachians may be observed; a sort of throbbing or continuous pulsation in the throat caused by swallowing air. In the very small nostrils at the end of the snout, in both toads, you may discern action likewise. The nostrils are furnished with a valve to open and close at will; and under alarm or excitement this tiny valve acts with a rapid nervous motion, opening and closing like an eyelid blinking; only the valve is below and c'oses upwards, like the nictitating membrane of the eye. The effect is very remarkable. When disturbed during hibernation—though at the moment the breathing may be hardly perceptible—the throbbing of the throat and the action of the nostrils begin almost immediately; while the creature extends its limbs in a helpless manner, and then you see the eyelids working, the nictitating membrane being the last to recede and expose the eyeball, which by degrees assumes its usual prominence.

The derivation of the word *natter*, from the German, appears to be the same as adder, a corruption of the Saxon *nædre*, signifying a crawling creature, with the gradual substitution of the *t* for the *d*. The expression of face in the Natter-Jack is gentle, as in *Vulgaris;* the eyes have the same sort of reflective or contemplative, as well as intelligent look. Those who without prejudice care to study the physiognomy of these two toads cannot deny to them this expression, seldom reproduced or done justice to in illustrations. So meditative is the aspect of the common toad when still, that I could never escape a feeling that an apology was due when disturbing mine. And after such interruption, the manner in which they—both *Vulgaris* and Natter-Jack—quietly and unresentfully resume their meditations, commands the sort of respect due to a philosophic character. More and more have I wondered, since studying toadism, that the name is popularly significant of meanness and generally contemptible qualities. Of all the various "reptiles" which for many years have been my pets and study, poor "Toadums" has, by reason of the popularly despised "meekness" and gentleness, appealed most strongly to tender compassion and consideration, except, alas! when his inexorable mistress, in the interests of "The Young Collector," has ignored his struggles and his dolorous eyelids. My slighter acquaintance with the Natter-Jack gives reason to accredit it with similar family traits.

CHAPTER XI.

THE NEWTS.

Class, BATRACHIA. Order, *Caudate*, or *Urodela*. Family, *Salamandridæ*. Genus, *Molge*.

FORMERLY the British newts were commonly known by the classical name *Triton*, probably from their aquatic habits. The smooth newt was *Lissotriton*. A still more common and colloquial name is Eft, or Evet, from the Saxon *efete*. Evet, with the article an, has evidently been corrupted or abbreviated into newt, the *v* becoming *w*, as is so often seen to be the case in our language; thus an evet (pronounced quickly eft), a nevt, a newt.

Molge, the modern generic name adopted by Boulenger and other herpetologists, is from the Greek word Μολγης, signifying slow, which may refer to their movements on land, or more appropriately to their development, as they are three years in arriving at maturity.

Bell gave at least four species of newt as belonging to Britain; but since the publication of Bell's popular work, "The British Reptiles," the newts have been receiving more attention from naturalists, and the British species are now reduced to three. The changes in appearance which they undergo at different seasons of the year, their alternate aquatic and terrestrial habits, and their slow development, caused some confusion in identifying the species, and probably a multiplication of them. M. C. Cooke, in his work "Our Reptiles," which was written sixteen years later than Bell's, explained away several of these misconceptions.

In form the newts are sufficiently like the lizards to have been called "Water Lizards," or "Marsh Lizards," *Lacerta palustris* of some herpetologists. Many excellent dictionaries even now give the definition "a lizard" to the word eft or newt, but lexicographers are not always naturalists, and they copy the older works a good deal. The relationship of newts to the frog is easily recognised in the broad head and rounded muzzle, the prominent eyes, and smooth, naked skin. Though so small, their resem-

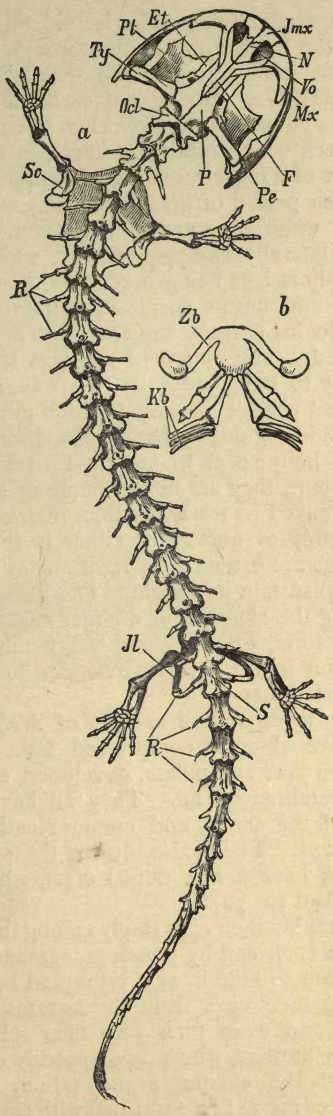

Fig. 26. Skeleton of Newt; from Claus.

Fig. *a*.

Ocl. exoccipital bone.

P. parietal.

F. frontal.

Ty. tympanic.

Pe. petrosal.

Mx. maxillary.

Jmx. Inter-maxillary.

N. nasal.

Vo. vomer.

Et. girdle-bone.

Pt. pterygoid.

Sc. pectoral girdle.

Jl. Pelvic girdle.

S. sacral vertebra.

R. ribs.

Fig. *b*.

Zb. hyoid arches.

Kb. branchial arches.

blance to the Salamander is evident, explaining their family name. Like the frogs, they breathe through their skin as well as by lungs; and the same action of the throat in breathing or swallowing air is observable. Giving out carbonic acid through the skin, they require constant attention when in captivity, and a frequent change of water, which otherwise becomes vitiated, in the same way that the air of a close room full of people becomes vitiated.

Their period of greatest activity is in April, May, and a part of June, when they are in the water. They are provided with a long, laterally compressed tail, which is their swimming organ, their short legs being used only to guide their movements in the water, and not as agents in swimming. And though more of an aquatic habit than the frogs, their feet are not so permanently webbed. The action of the legs is so easy and rapid that they appear to hang loose, so to speak, as if unhinged, though every slightest change in their position guides the animal in swimming, as a rudder guides a boat. Sometimes they are folded back close to the body so as to present no resistance in the water, then, in an instant, they are at one angle or another, or prone again, more as if swayed by the water than their owner. Then, when the newt is floating or quiescent, either in the water or upon the surface, the legs are extended at right angles to the body, so as the better to help sustain its weight. The illustration (fig. 26), though representing the skeleton of a larger Salamander, affords a correct idea of the form, with its elongated, flexible vertebral column, its short ribs and legs, the latter extended in the position natural to them when stationary.

The three British species of *Molge* are alike in having a soft, sensitive skin, a compressed tail, four fingers and five toes, toothed jaws and palate, developed eyelids, and the third nictitating membranous lid. They all have very small nostrils at the end of the snout, and communicating with the mouth, close to the front. The males, during the spring, which is the breeding season, have a fine dorsal crest, which afterwards disappears as described (p. 76).

Newts lay their eggs singly among the pond weeds, and are said to secure each egg by pressing together with their legs the parts of the plant to hide it, as if prompted by an intelligent sense of protecting their eggs from the swarms of little frog and toad tadpoles, and even their own near relatives, small fish, and other hungry hunters, who would speedily devour them. The egg goes through the unequal segmentation, and when hatched the little tadpoles are at first furnished with suckers, somewhat more stalked than those of the frog, and with which to attach themselves to a

plant until their swimming tail and other organs are sufficiently developed to enable them to enter upon their active life. Their respiration is at first aquatic, by means of gills, which are larger and more feathery than those of the frog.

As the growth of the young tadpoles progresses, you may watch the limbs sprouting and the tail gradually acquiring size and strength to serve them through life. Unlike the frog, the anterior limbs

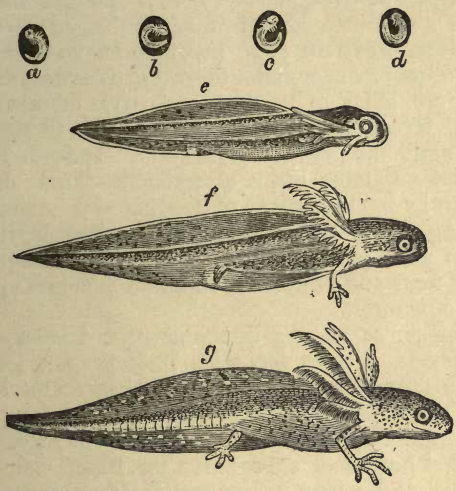

Fig. 27.—Eggs and Tadpoles of Newts (enlarged).
a, *b*, *c*, *d*, eggs in various stages; *e*, *f*, *g*, tadpoles showing the sprouting of limbs and branchiæ.

are the first to sprout, and the legs afterwards. As the lungs become developed the gills gradually disappear, and the young tadpoles become air-breathing animals. During this metamorphosis the body of the tiny creature is sufficiently transparent for you, with a powerful lens, to watch the internal development, which is a study of immense interest. Even what food they take and the process of digestion can be observed through their delicate skin, and you will find them exceedingly voracious little feeders, and also cannibals, unless plentifully supplied with other dainties. To catch young tadpoles with a muslin net, like a butterfly net, is not at all difficult; but to feed them and keep them in health when you have caught them is by no means easy, as they can take only such very small prey. If you venture on the care of them at all I should recommend a large receptacle,—a bath, for

instance,—and that you bring water and a plentiful supply from the pond, of whatever is in your net, including even weeds, and turn all into the receptacle; when in all probability food supplies will come in the form of still smaller aquatic creatures, which must be sacrificed to the needs of the larger ones, as in their native pond. By-and-by very small worms can be found for them, and the larger they become the easier it will be to feed them. The young collector who lives in the country, and has ample accommodation for a vivarium, cannot do better than to have it entirely filled with water from the pond in which he finds the tadpoles, whether of newts or frogs, and with it the delicate weeds, among which there are likely to be eggs and larvæ of other creatures, insects, etc. Weeds are an important addition to the aquarium, as they maintain the purity of the water. Indeed, the balance of animal and vegetable life is essential for the health of both, and there can be no better way of feeding very young Batrachia than to bring a supply of pond weeds. The pretty, graceful Potamogeton adds greatly to the interest of your aquarium too, and the tiny frogs and newts love to climb and rest upon it, thus adding to the picture.

Intelligence is not lacking in the newts. Almost sooner than the frogs they learned to recognise their keeper, looking up if under the water, or turning their heads when out of it. Hunger was, I fear, the chief prompter of this watchfulness, their fasting being sometimes too rigid, owing to the difficulty of finding worms or what not small enough for the lesser members of the *Molge* family, and partly because the larger newts would be first to seize upon whatever was offered. As summer approaches they mostly forsake the water, and lead a very inactive life. It is necessary then to reduce the quantity of water in your aquarium, and arrange some fragments of rock, spa, or what not, so that the newts can be on dry land when it suits them. Floating on the water in my glass globe was a broad, flat piece of cork, covered with fine moss and minute vegetation, and upon this my captive newts would rest for hours or even days together. One male, *M. cristata*, by the beginning of June made frantic efforts to get out of the water; dashing and leaping against the sides of the glass; but not for a long while did he get upon this little island of his own accord; yet when placed there would remain perfectly contented. I have observed them in the same position hour after hour on this floating island, one perhaps lying across another, or in some attitude not to be forgotten, and, I have reason to believe, remaining thus the entire day. And very graceful were their attitudes, very pretty they looked upon the little emerald

isle, one large warty newt especially, so glossy black, like a marble table ornament. If food were placed there they would sometimes rouse themselves to seize it, but if not quick the worm would wriggle off, when the newts made no effort to pursue it, and if pushed off into the water themselves displayed no lack of activity in trying to get out again. Hot weather stimulates their faculties. Very soon they recognised the fact that when the zinc cover was removed from the globe food supplies were arriving, something to cause them to turn their heads; and if by a touch the island turned round and they upon it, their heads remained directed towards that quarter, imparting very graceful curves to the half-raised body.

Newts, in common with other reptiles, moult during the summer. It has been affirmed by Bell and some other naturalists that the skin comes off in shreds. This sometimes is the case, but may be taken as the exception and not the rule. Observation of the two British species, *M. cristata* and *M. vulgaris*, and also of some *Pleurodele* newts, justifies the belief that, like most reptiles, the sloughing begins at the mouth, the cuticle slipping—or being shoved—off to the tail. You may see a newt pushing and rubbing its jaws against anything with which it comes in contact until the slough is separated round the lips, when by continual friction it is pushed back. First one arm and then another is next drawn out, sometimes reversed, sometimes not, the newt pushing down the slough, occasionally expediting the process with its feet; then the legs are withdrawn, and the tail slides easily out from the rest, which unless the newt eats it up directly, as it often does, floats, a cloudy film, in the water. Its texture is almost too attenuated to be termed a skin; it is a shapeless, almost invisible web, and, when taken out of the water, collapses into nothingness almost indistinguishable on the stick or brush, or whatever you use to raise it. But if, when it is floating, you very gently stir the water near it, it may partially expand, so that a hand, or a leg, or the tail part may be distinguished, and enable you to ascertain whether it is entire or not. By this means I was able to observe that a slough cast by a warty newt in May had a crest about as high as that of the upper newt in the frontispiece; and that another, cast by the same newt about a month later, had barely any crest at all, agreeing exactly with the gradual disappearance of the crest on that particular newt. Often the little animals tear away their sloughs with their mouths, or scratch it off with their feet, twisting themselves about so frantically that one wonders any part should remain entire. No doubt the loose skin irritates them, as they occasionally tear off a bit and eat it, as if in irrita-

tion, and then tear off more, till entirely free. Occasionally you may see only small remnants of these filmy garments hanging among the water-weeds, so that one cannot affirm that invariably the slough is cast in one way or another. One of my newts cast its coat three times during the summer, another twice, and in another bowl containing three individuals, I found only two sloughs; but then more might have cast and eaten that did not fall under my observation.

Molge cristata.

This species, commonly known as the "great water newt," is large only by comparison with the other British species, which are much smaller, as it rarely attains six inches in length. It is also called the "warty newt," from the excrescences on its skin, similar to those of the toad, and secreting humours, only in a less degree; but, from having always a moist skin, not to be observed as in the toad. My newts were in my hands very frequently, but I never discovered anything in the slightest degree unpleasant in them. They have large prominent eyeballs, which, like those of the frogs and toads, are seen within the mouth. The teeth are very fine, and those on the palate can be felt with the finger. This is the *Triton cristatus* of Bell and Cooke, and it has a long list of synonyms besides. It is the newt on the bank in the frontispiece, and below it, in the water, is a female of the same species, and without a crest. Both are about the natural size. In colour this newt varies slightly, but is generally very dark above. Those in my possession are so black that the warts are only discernible as inequalities, but the breast and belly are of a bright orange with black spots. Especially handsome are the males during the spring, when, decked out in their frills and fringes, they "a wooing go." At this season a fine dorsal crest, sometimes half an inch high, appears. It begins on the head, between the eyes, increasing in width towards the middle of the back, decreasing towards the tail, and again conspicuous on the latter. It is deeply notched and very ornamental. Besides this decoration the tail has now a broad, silvery white stripe on each side, the whole length of it; and as at this time of the year the newt takes entirely to the water, and is actively swimming about, the white band flashes in the light with an effect as if the long, streaming tail were split, or forked, like a pennon. A slighter undenticulated crest borders the tail below also, causing it to appear much wider than at other times. The head of the male is broader than that of the female, and the colours are much more vivid.

The tail is eloquent in the newt as in most other creatures, occasionally flapping rapidly, and in fear or anger curling laterally. I could always estimate the degree of fear or of anger in my newts by the curving of their tail. When suddenly disturbed it was curled up almost tightly, and close to the body. At other times it was slightly curved, and so on. It is, to a certain extent, prehensile also; and when the newt is taken out of the water the tail is clasped round the finger as a safeguard to the owner on finding itself in an unusual and perhaps dangerous position.

The warty newts displayed the same climbing tendencies as the smooth newts, somehow managing to get out of the glass globe even when only half full of water, until I covered it with a perforated zinc lid. Some got away entirely, which was more practicable to them than to the toad, as the slight space under the door would easily admit their slender body; or, climbing easily, they might have got through the chink in the wall. Frequently they buried themselves in the mould, and I would turn them up after many days, when quite given up for lost; or I might discover one calmly exploring on the floor of the conservatory. While accrediting them with graceful movements, truth compels one to limit these to the water, or when reposing; their slow, wriggling motion on *terra firma* being anything but graceful. Their very feeble limbs are not adapted for fleetness of motion on land.

Molge vulgaris.

These little newts are more common than the warty newt, and are found in almost every pond, some in my possession coming from near London. They are very much smaller than *cristata*, much lighter and more variable in colour. Greyish, sandy, very light brown, or pale olive individuals may be seen, with darker spots; and pale orange, with black spots beneath; but, as in the other species, the female is the less brightly coloured, and both are in their brightest in spring. While the specific *cristata* has been assigned to the warty newt, the commoner kind is really best entitled to the distinction, its crest in spring being very high and conspicuous, festooned, and continuous from the head to the tip of the tail, which, like the other, is laterally compressed. The lower one to the right, swimming upwards, in the frontispiece, represents the little eft natural size. The female has also a crest, but low and straight-edged, not conspicuous, as in the male. The handsome crests of my suburban newts disappeared with singular rapidity, whether from captivity, or the loss of their mates, I cannot say. Some male specimens brought me

in May were decorated with very high crests, which in two or three days were much diminished, and in another week were barely discernible. As in the larger species, the crest is adopted for the courting season, and departs with it.

The skin of this little newt is entirely free from warts, hence its name "smooth newt." Boulenger's synopsis of the species is—the head longer than broad, and with three distinct longitudinal grooves upon it, also a dark median streak; the snout elongate, and the body rounded. The fingers and toes of the female are shorter than those of the male, which are lobate; also with two small carpal and tarsal tubercles. These are the little newts that climb the glass so skilfully, no doubt aided in clinging by those tubercles. The globe they inhabited was what we may call very high-shouldered, with a narrow mouth; so that before they could get out, they were almost topsy-turvey, like a fly on the ceiling, and most perseveringly did they manage this gravitation, going in a zigzag fashion to break the ascent, like a horse dragging a weight up a hill. Often you might perceive that it was not easy to get foothold; and often they fell back and down, but, nothing daunted, began again. Several escaped entirely, or fell a prey to Toadums, but sometimes were found, submitting to be caught without resistance, apparently glad to get home again. In their natural state they wander an immense distance from water. Mr. F. Waterhouse informed me that he found some in his garden at Putney, and they must have travelled a long way, and climbed over a wall at the end of their journey. I arranged a little sort of rockwork, well out of the water, and with only pools of the latter in the globe, so that during the summer they could take their choice; and for the most part they preferred to be high and dry. Very small worms they ate most readily or small slugs; but, like the frogs, they take no notice of what is offered them unless it moves, and then do not use much exertion to secure it. One little newt fared so badly from its own slowness and timidity that it became a mere skeleton, painful to behold. Very rarely could one entice it to eat, and as early as September it showed a disposition to hibernate, though still keeping out of the water. It even survived some very severe frost, and now, at the last moment of writing (February 1888), is still alive, though its tiny bones can all be counted. One very small frog in the same globe, thin for similar reasons, succumbed to the frost, two larger frogs (though the same age and brood) have kept under the rocks, and are alive and strong. The surviving warty newt has also kept above ground, and none have displayed any inclination to bury themselves in the "mud" at the bottom of the globe. On two occa-

sions the water in the globe was frozen hard, the frogs and the larger newt being under the ice, but the tiny skeleton eft remained above. Though literally frozen up, none can be said to have actually hibernated, their eyes being always open, and when the ice was broken the frogs dashed about as vigorously as in summer.

Molge palmata.

The male palmated newt may be easily recognised among others in the water by having its toes fully webbed, like a duck's foot; and by a curious little filament, something like a tentacle, growing out of the tip of its tail. One should rather say the *end* of its tail, which is blunt, as if that portion were cut off, and this filament substituted the lost tip. In the female there is only a very slight indication of the same thing, her tail being more pointed, like the other newts. *Palmata* is the smallest of the three, and smooth-skinned, the female somewhat resembling the smooth newt.

As it is in the spring, when all the Batrachia take to the water again, that the newts are generally sought for and caught, a description of *Palmata* at that season will best assist in identifying him, this newt having peculiar aquatic adornments. His crest is lower and straight, without the handsome festooning of the others. His tail has an upper and lower crest, not very deep, so that he lacks the fine appearance of *Vulgaris*. His body at this season has a quadrangular appearance, by reason of a sort of keel formed by a cutaneous fold bordering each side of it. The body of the female is roundish; she has a low crest or vertebral ridge, but less conspicuous than in her mate, and also a fin or crest of pale orange colour on the lower part of her tail. It is interesting to note how these newts develop extra appendages when they for a time renew their aquatic life, and which afterwards disappear during their terrestrial existence; the crests, the webs between the toes, and in this species the tail filament, all disappear at the end of the season. It is an intelligent instinct also that causes them to take to the water during the breeding season, as if they were conscious of the necessity of that element for the young which are to be hatched and to spend their tadpole existence in it.

The other characteristics of *Molge palmata* are that it has vomerine teeth, and a distinct gula fold, that is, a slight doubling over of the skin of the throat. In colour the upper parts are a sort of olive-brown with small spots of a darker hue. The head has longitudinal dark streaks upon it, and the dorsal crest of the

male and also its feet are almost black; the belly, as in the other species, is orange. The tail on the lower part is greyish with dark spots. The female is altogether of a paler hue than the male, but her tail is handsomely spotted.

Palmata is found in various parts of Britain, from the Isle of Wight to the north of Scotland, and quite near to the sea, which is remarkable, considering the extreme sensitiveness of the Batrachian skin to salt.

Molge palmata has not been one of the members of my Batrachian family, therefore I regret having none of its individual habits and performances to recount.

CHAPTER XII.

THE SAURIANS.

Class, REPTILIA. Order, *Lacertilia.*

BELONGING to the same class as the snakes, the lizards might properly have followed them in order; but there is so much in frog development to throw light on that of other forms, that I ventured to deviate from the usual routine by introducing the *Batrachians* between the two groups of reptiles. In point of size, too, the snakes exceed the frogs; and our little zootica, being almost the least of reptiles, will complete the list of our thirteen British species.

Lizards are allied to snakes by many close gradations. The slow-worm, in form a snake, but a limbless lizard, is one example of this. The integument of lizards is much more varied than in snakes. In some it is composed of strong hard shields, in others it is spiny, warty, or like a polished cuirass; but in our three native lizards it is of fine scales, more approaching the ophidian cuticle than in many of the larger saurians. The anatomy, too, and movements of many are snake-like, even where there are four limbs; but which scarcely raise the body from the ground, and are of little use in locomotion, or are rather assisted by the undulations of the body. Others have well-developed feet or claws, furnished with five toes each, and often strong hard nails, with which they scratch and dig into the earth, either in search of food or to hide themselves. You may see lizards in captivity constantly scratching the earth or sand, or any dry surface; or persevering, hour after hour, at the glass sides of their cages; which does not say much for their intelligence in not learning by experience that many weeks of such labour produces no effect upon the glass. Most lizards are good climbers, especially the small and agile species which inhabit rocks, walls, and trees. Other saurian characteristics are that they have movable eyelids, non-extensible jaws and mouth—which compels them to limit the size of their prey—and movable ribs. A *sternum* is always

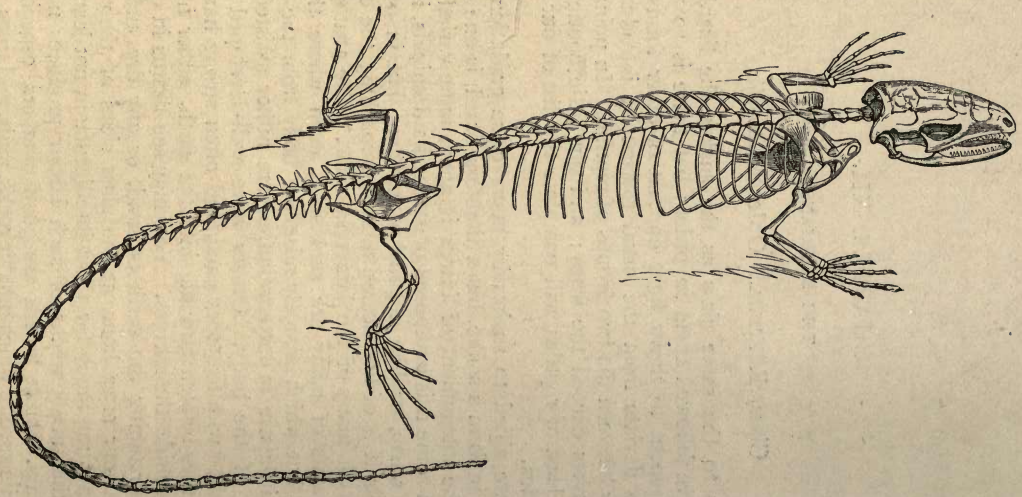

Fig. 28.—Skeleton of Lizard.

present, even should there be no limbs, as in *Anguis fragilis;* and there is generally a vestige of a pelvis, but more thoroughly developed where there are legs to support. Most lizards are exceedingly active, darting about with a swiftness that almost baffles the eye, while to detect motion in the legs is impossible. Even those thick-set species, which in confinement appear so sluggish, scarcely moving from day to day, are, in their native tropics, almost as nimble as the slender ones. The skeleton of a lizard (fig. 28), with its long and flexible spine, movable ribs, and slender limbs, all indicate activity and nimbleness.

Lizards are said to be able to reproduce their limbs if lost or maimed. So far as my own observation goes, I doubt if the bony structure is ever perfectly renewed, but only an imperfect cartilaginous claw or tail-tip. It is possible that by very slow degrees the cartilage may become ossified; but the same reptile should be kept alive and well, and be carefully watched for a long period, before the fact can be established. So here is an opportunity for our young collector to make and record observations that may be of real scientific value; viz., to see how long he can preserve the life of his pets, and to note down accurately how long the lizards take to repair their limbs or their tail, when one is nipped off by accident, or by a fellow-captive. A viviparous lizard, brought to me from Hampstead Heath in May 1885, had an uneven, as if injured, tail, which soon seemed about to break in several places. In just one month it was nearly severed within an inch of the body, and next day was off. Five weeks afterwards sloughing took place, and then, within the contracted scales of the stump, appeared the first indication of a new tail. In three more weeks (August 16th) the new point was a quarter of an inch long, looking exactly like the lead of a freshly cut pencil showing beyond the cedar, but quite smooth, soft, and pliant, and with no appearance of scales. The autumn being sunless and chilly the lizard ceased to feed, and, being feeble from the first, dwindled and died before the winter set in, and before the tail had made much progress. During four months it had attained only half an inch in length, having no indication of scales, and being still lead-coloured and smooth. In another lizard, a healthy *Agilis*, a portion of whose tail was nipped off by a companion in mistake for a worm, the renewal was much more rapid. In about the same time the new point was one inch long, and was beginning to show indications of a scaly surface. Several more months elapsed before the perfect scales appeared, though the point had ceased to grow, and was still soft and pliant. Therefore, should the bony skeleton be restored, it would be only after

a long interval; but in captivity reptiles seldom live long enough to permit of accurate observations. A slow-worm ("Blackie," p 458 of "Snakes") which I caught on "The Common" at Bournemouth, had barely half the usual length of tail. Several inches of it must have got broken off, leaving a very blunt point which had become perfectly healed and rounded, but presented no signs of growing any longer. Nor did I see any change in it during the four months that it survived. There is still much to be studied and observed in reptile life, and I trust some of my readers may feel induced to afford these interesting pets a place in their vivarium.

CHAPTER XIII.

ANGUIS FRAGILIS.

Class, Reptilia. Order, *Lacertilia.* Family, *Anguidæ.*
Genus, *Anguis.* Species, *fragilis.*

This little reptile obtains its family name from its snake-like form, without any trace of limbs externally, and there are a great many of the group in various parts of the world. It has no broad, ventral *scutæ* as in snakes, its scales being alike all round; neither has it any palate teeth, but the jaws are toothed. The scales are close set, of a roundish form, and very smooth; in length it averages twelve to fourteen or fifteen inches. Its colour, though almost uniform, varies in each individual, with the exception of several rows of very small darker spots down the sides of the body, and a faint dark line down the back; but these markings are too feeble to interfere with the predominating colour, which is mostly of a silvery, brownish-grey, or olive tint, darker or lighter. The one mentioned in the last chapter was so black that no markings were distinguishable; in the lighter ones they are plainer, and so on. There was a so-called "white" slow-worm at the Zoological Gardens a few years ago: but, like the "white" viper, it was of a pale, dingy, pinkish hue; and as its eyes were also pink, one may call it an albino, with a general deficiency of the colouring pigment in its skin. In the male the tail is quite as long, often longer than the body, and in the female the body exceeds the tail in length; so that it is not difficult to distinguish the sexes. But when the tail is very much shorter than the body, it has probably lost an inch or so. It is very common to say that the slow-worm breaks *in "halves;"* a figure of speech arising from the fact of its having a long tail, as it is only this latter that breaks, never the body, of course. It is a most gentle, timid little creature, fear causing it to contract its muscles to such an extent that it becomes brittle, and requires the most careful handling. You will feel it tightening itself round your fingers, which it does for safety, and from fear of falling when in a strange situation;

and if at such times you endeavour forcibly to unwind it, the chances are a portion of its tail, which is in a measure prehensile, will break off. When accustomed to be held it does not contract itself so persistently, but twines in and about the fingers, some-

Fig. 29.—*Anguis fragilis* in a knot. From life by the author.

times getting itself into a very pretty knot, out of which it glides when placed on the table, in an extremely interesting manner (fig. 29).

The ribs of *Anguis fragilis* are very numerous and very fine. By means of these it appears to glide, as snakes do; but you can detect no action in them; and the quiet sliding, gliding progression of the little creature is very wonderful. Silent, and with no effort, scarcely causing movement in a blade of grass or a spray of moss as it penetrates below that with which its cage is furnished. Its habits are to burrow, and the moment it is released from your hand down it goes into its mossy floor. Worms are, I think, its favourite food, but it takes flies, caterpillars, slugs, and many small things; and, like the Batrachians, will seize them only when they move, as if it did not recognise them when motionless. It drinks freely, and must always have a pan of clean water in its home. It is very curious and interesting to watch it throw out its bifid tongue to drink, to lap really, which it will do a great number of times in succession, with its neck raised and curved, and its pretty head bent down in a very graceful fashion. The head of *Anguis* is covered with plates in symmetrical arrangement, each pair, or single median scale, having its own name, as in snakes and other lizards. Though without limbs externally, *A. fragilis* has vestiges of sternum, shoulder bones, and pelvis, as if its remote ancestors were in possession of limbs, but which had become obsolete from disuse; and indeed, these limbless lizards are never at a loss, the easy effortless progression of *A. fragilis* being one of the most marvellous in reptile physiology. And its perseverance in climbing and in getting to the top of its cage surpasses even that of the toad. My slow-worms inhabited a bell-shaped bowl a few inches higher—or deeper—than their own length. In order to reach the edge of this, they raised themselves against the

side, often falling and beginning again until on the merest tip of their tail they rested. Not "tip-toe" they stood, but as nearly like it as possible. Even then a good deal of time and patience were requisite before they could stretch themselves sufficiently to get their head upon the edge (because they might sink on the sand and moss), but this accomplished they would draw themselves up and over, and so down on the other side. Space forbids any lengthened history of my many tame slow-worms, but as pets they are most cordially recommended. Clean, quiet, gentle, harmless, and easily managed, they will be found most interesting and—yes, I may truthfully say, *intelligent* too, as they evidently profited by experience in climbing and in mastering the covering of net made sure by an elastic band. That they are not "blind" their pretty bright eyes declare. The reputation of blindness probably arose from their being found with closed eyes when hibernating in company with snakes, whose open eyes would present a contrast. Nor are they "deaf," as I took great pains to ascertain by various experiments, until "Lizzie" (the slow-worm who was longest under tuition) learned to recognise certain sounds made to attract her attention, and the peculiar intonation of voice used to her only; and these from across the room were persisted in until she looked round. Other experiments, and much more about the slow-worms have been recorded elsewhere, and perhaps read by some of our young collectors; and the limits of this little book demand that one must hasten on to the great herpetological event of the year 1886, viz., the discovery of the third eye in lizards.

Through this the poor despised "slow-worm," "blind worm," "deaf adder," with all its misnomers, has become a very distinguished little reptile; for in it was the discovery first made. We must not here attempt more than a glance at this remarkable organ which is now found to exist in various stages of development in many vertebrate animals. It affords another illustration of the principle of progressive development described in Chapter VII. Eyes, like other organs, had their beginnings. As we saw an incipient backbone in the Tunicate tadpole, and an "eye-spot of complicated, lens-like structure," a half-ossified sternum and skull in some of the Batrachians, and so forth, so there are incipient eyes, single eyes, improved eyes, and perfect eyes in the various sub-kingdoms. Some enable the animal merely to distinguish light from darkness, yet these are an advance on no eyes at all, as in the lowest forms.

This "median eye," so called from its central position, is also called a "parietal eye," being connected with the parietal bone

of the skull; "and a pineal eye" from its connection with the pineal gland situated in the brain; and the strange part about it is that while a pair of perfect eyes have been subsequently developed and are in use, this buried organ seems never to have advanced beyond those found in the invertebrate groups, presenting, as Von Henri de Graaf at first described it, "the important example of the two kinds of eyes being present in the same animal." In *Anguis fragilis* the organ is too deeply embedded to be affected even by light; but in the New Zealand lizard, *Hatteria*, or *Sphenodon punctatus*, de Graaf found a well-marked nerve connected with the brain. The very interesting subject has been enthusiastically taken up by many biologists, and the results of their labours introduce wonders almost daily. In England Professor Baldwin Spencer, late of the Oxford University Museum, who has been examining all the lizards alive or dead that can be got at, and also fossil remains, shows us that in some lizards the eye is so near the surface that its functional power is even possible; and from America we hear of one, the "common pine-tree lizard," in which the organ is so well developed that "it may possibly still serve to warn its owner of the advent of daylight."

In *Anguis fragilis* Prof. J. Beard (see p. 43) finds the parietal eye to vary in size and distinctness, though so deeply embedded as to preclude the idea of its being affected with light. In some lizards at the Zoological Gardens you may detect the spot where this eye exists, though without a powerful magnifier nothing more than the external scale, often transparent, can be seen. In our two little British lizards, forming the subject of the following chapter, we will presume on the existence of this median eye. What has been said of other kinds suffices for the scope of this work.

CHAPTER XIV.

THE LIZARDS.

Order, LACERTILIA. Family, *Lacertidæ*. Genus, *Lacerta*. Species, *agilis*.

THUS far, with the exception of the viper, the members of my reptilian family have been represented as such amiable individuals that my readers may suspect me of undue partiality; a charge which they will retract on their own personal acquaintance with the subjects in question. Bell records a case of the slow-worm turning to bite any one who touched it, and even clinging with its teeth. Well, but for the way in which slow-worms snap at their food when feeding, one might have almost doubted their capability of biting. It is true that mine underwent no dental examination; nor were they subject to any rougher handling than might be bestowed on other such brittle ware; to retreat and to burrow was the only impulse they betrayed. But now, truth compels me to affirm that the male *Lacerta agilis* at once displayed an aggressive viciousness of temper that would be deplorable were it not ridiculous. He not only turned to bite whenever approached, but held on to the finger so persistently as to be carried about the house on exhibition thus pendent. His feeble little jaws could, of course, inflict no injury; therefore, his spiteful efforts to grip the harder whenever touched, as he thus hung, were simply laughable, reminding one of the fly on the bull's horn, only lacking the fly's polite apologies. If he happened to grip a fleshy part of the hand you might afterwards almost count the number of his teeth, from the two little rows of indentations, like a V. The skin was never penetrated. To do him justice this temper lasted only a few days; and very soon he was the tamest of the family, which, at that time, consisted of himself and two ladies *agilis*, and five of *L. zootica*. In colour he was of a fine peacock green, darker above, and of a lighter and beautiful tint beneath; his throat almost white, but with that greenish iridescence. Four examples of these male *Lacertas* from

the Bournemouth Commons, which at various times have been members of the family, were all of this decided green, lighter or darker, and with the markings showing variously; and all of a beautiful creamy green beneath, with the white throat. The head was darker and duller, but the head scales did not always come off at the regular sloughing, and towards winter the colours were less vivid. I think the fact of the male *agilis* being often green, and of a stouter form than the female, may have given rise to the impression that the true *L. viridis* is found in England. And very probably it may sometimes be met with, as an escaped pet; but it is certainly not indigenous; though it possibly may become more acclimated in the southern counties. Comparing the two closely a wide difference is seen to exist between them.

Not only in colour and markings, but in length of tail, *L. agilis* varies, the latter circumstance being probably due to an accident, as the tail easily breaks. The head of the male is larger and broader than that of the female, and his shape is altogether less elegant.

The diversity in the form of the scales is remarkable in these lizards as compared with those of the slow-worm. Large plates cover the head; a few border the chin and jaws beneath, the intermediate space to the neck being covered with extremely fine scales; then, forming a distinct collar, is a row of scalloped-shaped scales; and from these to the tail are small scales on the back, and large ventral *scutæ* beneath. On the tail quite another arrangement appears in successive whorls, finer and finer to the tapering tip. The whorled scales on the tail are common to many lizards.

In the cast-off cuticle all these variations are very distinct; on the limbs also the scales vary, those above being finer than the under ones, and those on fingers and toes extremely fine, the whole coming off like a tiny and perfect glove. Though the body of the cuticle was generally cast entire with sleeves, etc., the tail in all three of my *L. agilis* seemed to possess an independent mode of sloughing. Having carefully preserved the cast-off raiment of the whole family, with dates and particulars of each sloughing, I am able to record a few particulars, chiefly concerning the green one, who had a new coat—to his tail only—in May, the first change since his arrival in April; and not until 30th of June he cast the rest of his garment, in remnants. In forty-two days, namely, on August 11th, he had an entire new coat, tail and all; only the head shields came off irregularly; and during the 6th and 7th of September he again cast the cuticle, and in a very singular fashion. Though the lizards, like other reptiles, might be seen

rubbing their jaws and head, and crawling in and out among the moss, indicating that sloughing was about to occur, the operation was less regular in these than in *A. fragilis*, or the newts. On this occasion the cuticle of "Greenie's" eyelids first peeled, sticking out like ears all day, which did not seem to concern him at all. Next his collar grew ragged, and his jaws, in which untidy state he ate a large fly and a caterpillar. Next day he went about in ragged gloves, and lastly, when his coat was nearly off, he enjoyed his usual amusement of trying to scratch a hole through the glass, apparently indifferent to the fact that for some hours he was dragging about his bound-down legs and tail round which clung the remains of his old coat. Sloughing did not appear to interfere with his diet or occupations in any way. These little lizards often use only the fore legs, the others dragging inactively. The largest *agilis*, a very handsome female, also changed three times during the summer, viz., on July 16th, August 4th, and partially towards the end of October, at which time she was too feeble to move about, and the process was of several weeks' duration, a few scales at a time. In August she had got away, and was lost for three days, when she was found on the balcony of a house several doors off. She had fallen out of the window, and was brought home in an exhausted condition, the nights having been cold. She ceased to feed from that time, and gradually declined, dying in November. The third *Agilis*, the one who had lost her tail (p. 83), changed only twice during the summer. July 20th, while she was on a few weeks' visit to the Zoological Gardens, and again in about six weeks irregularly. The July sloughing I did not witness, but in September, though faint indications of scales appeared on the inch of new tail, no cuticle of that part was cast, the slough ending abruptly and looking as if it had been cut off at the stump.

L. agilis, commonly known as the sand lizard, is about seven inches long when grown. Its markings—the three rows of spots with white centres—down its back render it easily distinguishable even when young, from the smaller lizard whose colours are less bright. It is found on sandy heaths, and is very frequently met with in Hampshire and Dorsetshire.

The female scratches a hole in the sand as a nest for her eggs, and lays a dozen or more, which have a thin, coriaceous envelope. She is not generally accredited with much maternal affection, but those who have watched her attentively consider injustice is done her in this respect. I have reason to think that all three of the English lizards possess rather strong maternal instincts. Regarding *Lacerta viridis*, also, Mr. Jenner Weir told me of one in

his possession who displayed not only vigilance and care for her eggs, but considerable wiliness in secreting them. The spot where she had laid them being discovered, she being there, hastily retreated, but presently returned and scratched the peat over them till hidden by a little mound; then continued day after day to visit the spot and bask on the mound; but as if conscious of being watched, would never do anything to betray the place while any one was near.

The Common Lizard (*Lacerta vivipara*).

It is generally conceded that the specific name *Agilis*, given to the sand lizard, is a rather unfair inference that it is the more active of the two. Nimble it undoubtedly is; but in alertness, swiftness, and agility, the little *Vivipara* can scarcely find a rival. Supple as if they were boneless, if you do succeed in catching one, to retain it in your hand without risk of injury is almost impossible. Secure, as one thinks, in the tightly closed hand, it finds escape where least expected. If its head be thumbwards, it will turn in some marvellous fashion and make instantaneous exit at the fourth finger, or between the fingers, however close together. As well try to manage and restrain a stream of quicksilver. And the *Viviparas* are more shy of being touched than the sand lizards, which will remain in the hand in seeming enjoyment as long as you please to keep them there. One of my five *Viviparas*, more elusive than the rest, and much disliking to be handled, would watch me through the glass, and if she saw me coming would disappear among the moss, when to find her was impossible, unless spray by spray were taken out; so swiftly did she flit among it, without disturbing a feather. Sometimes you might discern one bright eye on the look out for the enemy; eye and owner vanishing utterly at a hand ever so cautiously approaching. I half suspected sometimes as much frolic as fear in this game of hide-and-seek. Her bird-like look and her manner of eyeing one with her head on one side gained for her the name of "Birdie." Many physiological features in both lizards, especially in the smaller species, disclose their relationship to birds.

It is unnecessary to describe the various sloughings in detail, as for the most part they occurred in the same manner as in *agilis*, the head shields and tail cuticle seldom coming off with the body part, which was generally entire, and beginning at the straight collar. In two of the viviparous lizards that died in July the sloughing had begun, but they had not strength to work off the old cuticle, having ceased to feed for some weeks. Birdie changed four times during the summer; the first change, June 24-26,

producing a surprising transformation in the little creature. The old garment of the previous year was so dingy as to show barely any colour or pattern, when suddenly she appeared in pale delicate sage-green, with stripes as dense as black velvet, the throat creamy-white, and the belly of a very pale buff colour; the whole of a satiny softness, and shaded like a delicate shell. These colours were retained during the summer, only becoming a trifle duller and darker. Her second change was in twenty-four days, July 20th; the third in nineteen days, August 8th, and again in thirteen days, August 21st. August was very warm that year (1881), and the bell glass in which they lived stood in a sunny window during the hottest part of the day, which possibly induced the frequent sloughings. The markings in *Vivipara* are less conspicuous than in *Agilis*, having no white on the upper surface. There is a thin, jagged black line down the middle of the back, and a broad irregular stripe on each side of it, with a few faint spots in the intervening spaces; the under colours being very light in the female, and of a warm yellowish or crimson tint in the male. In character the scales are nearly similar to those of *Agilis*; but in form *Vivipara* is more slender and graceful, with a smaller, flatter head, and more pointed snout.

Zootica, the generic name by which it has been generally known, and its specific *Vivipara*, have the same signification, viz., producing live young, which constitutes the principal difference between the two species. As being more frequent, the smaller one is known as the "common lizard," and is found as far north as Scotland, and even in Ireland. It is accredited with the same maternal instinct as the viper in affording refuge to its young in its own œsophagus in times of danger. Several well-authenticated instances of this are recorded, and it is desirable that renewed observations may tend to throw more light on the occurrence.

These little lizards require a frequent change of diet, or as much variety as can be procured, because, in their natural state, they catch any insects, caterpillars, etc., that may be in season. In the early part of summer flies were taken eagerly; but flies, when caught, require to have their activity somewhat restricted, and worms are often of an inconvenient size; so there are some rather painful drawbacks in keeping carnivorous pets. After a time all, including *Anguis fragilis*, would eat no more flies. Some instinct must have guided them in this; and it occurred to me that while flies were depositing eggs they might be obnoxious, or even dangerous to the lizards as food; but this is only supposititious on my part. Caterpillars, if the smooth kind, were pounced upon quickly. Centipedes none of the family would eat; and if

inadvertently one was swallowed it was quickly reproduced. Spiders all caught eagerly; but it is by no means easy to furnish a variety of food to fastidious lizards. The worms retreated below, and got unhealthy in the moist sand, and the lizards would take only fresh food. Meal worms and other unpleasant bait purchased at the fishing-tackle shops offered a change for a time, but soon satiated. Pets, of whatever kinds, demand frequent and systematic attention, without which captivity is great cruelty. But persons who have access to gardens, or who live out of town and can afford ample space for these interesting little animals, will find their care of them amply repaid. There is still so much to observe and to verify about reptiles; for, as will have been seen in the perusal of these pages, much difference of opinion has prevailed and still prevails, regarding size, colour, habits, food, intelligence, and many physiological functions.

And as regards intelligence, the lizards rank much higher than the Batrachians, especially the newts. Their manner of watching, and of hiding, even of biting, as an instinct of self-preservation, and afterwards ceasing to do this, as if having gained experience, indicates something nearer to reason than frogs and salamanders ever display. To hurry-skurry away and hide is the only impulse of the latter, who on no provocation attempt to bite. Nor must it be forgotten that the little *L. vivipara* bit and hung on to my finger with its tiny jaws as persistently as its larger relative, until it ceased to be alarmed at humanity generally.

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