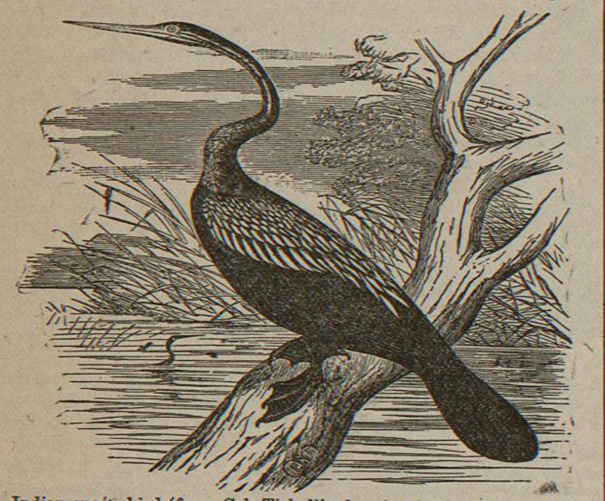
Valvata is common in fresh waters throughout Britain; the gill when the animal is expanded is protruded beyond the mantle-chamber. The *Paludinidæ* are common in the northern hemisphere. *Paludina* and *Bithynia* are both British genera. In *Paludina* the whorls of the spiral are very prominent; the genus is viviparous. *Bithynia* is smaller and the shell smoother.

Neritina has a very small spire, the terminal portion of the shell containing nearly the whole animal.

For the morphology and classification of snails, see MOLLUSCA, vol. xvi. p. 648 *sq.* A history of the British forms is given in Gwyn Jeffreys's *British Conchology*, 1862, and by Forbes and Hanley in *British Mollusca*. For speciegraphical details, see Woodward's *Manual of the Mollusca*, 1875, and Bronn's *Thierreich* (Weichthiere). For *Fasciola hepatica*, see Thomas, *Quart. Journ. Mic. Sci.*, 1882.

SNAKE-BIRD, to use the name commonly given to it by the English in North America, because of its "long slender head and neck," which, its body being submerged as it swims, "appear like a snake rising erect out of the water" (Bartram's MS., quoted by Ord in Wilson's *Am. Ornithology*, ix. p. 81), the "Darter" of many authors, and the *Plotus anhinga*[1] of ornithology, is the type of a small but very well-marked Family of Birds, *Plotidæ*, belonging to the group *Steganopodes* (the *Dysporomorphæ* of Prof. Huxley), and consisting of but a single genus and three or four species. They bear a general resemblance both outwardly and in habits to Cormorants (see vol. vi. p. 407), but are much more slender in form and have both neck and tail much elongated. The bill also, instead of being tipped with a maxillary hook, has its edges beset with serratures directed backwards, and is sharply pointed,—in this respect, as well as in the attenuated neck, likening the Snake-birds to the Herons (see vol. xi. p. 760); but the latter do not generally transfix their prey as do the former.

The male of the American species, which ranges from Illinois to the south of Brazil, is in full breeding-plumage a very beautiful bird, with crimson irides, the bare skin round the eyes apple-green



Indian snake-bird (from Col. Tickell's drawing in the library of the Zoological Society).

and that of the chin orange, the head, neck, and most part of the body clothed in black glossed with green; but down each side of the neck runs a row of long hair-like white feathers, tinged with pale lilac. The much elongated scapulars and the small upper wing-coverts bear each a median white mark, which on the former is a stripe pointed at either end, and on the latter a broad ovate patch.[2] The larger wing-coverts are dull white, but the quill-feathers of the wings and tail are black, the last broadly tipped with brownish-red, passing into greyish-white, and forming a conspicuous band when the tail is spread in form of a fan, as it often is under water.[3] The hen differs much in appearance from the cock, having the head, neck, and breast of a more or less deep buff, bounded beneath by a narrow chestnut band; but otherwise her plumage is like that of her mate, only not so bright in colour. The habits of this species have been repeatedly described by American writers, and those of its congeners, to be immediately mentioned, seem to be essentially the same. The Snake-bird frequents the larger rivers or back-waters connected with them, where it may be seen resting motionless on some neighbouring tree, generally choosing a dead branch, or on a "snag" projecting from the bottom, whence it plunges beneath the surface, in pursuit of its fishy prey, to emerge, in the manner before related, showing little more than its slender head and neck. Its speed and skill under water are almost beyond exaggeration, and it exhibits these qualities even in captivity, taking—apparently without effort—fish after fish that may be introduced into its tank, however rapidly they may swim and twist, and only returning to its perch when its voracious appetite is for the moment appeased or its supply of food temporarily exhausted. Then, after adjusting its plumage with a few rapid passes of its bill, and often expanding its wings, as though, Cormorant-fashion, to dry them, it abandons itself to the pleasurable and passive process of digestion, reawaking to activity at the call of hunger. Yet at liberty it will indulge in long flights, and those of the male at the breeding-season are ostentatiously performed in the presence of his mate, around whom he plays in irregular zigzag courses. The nest is variously placed, but almost always in trees or bushes overhanging the water's edge, and is a large structure of sticks, roots, and moss, in which are laid four eggs with the white chalky shell that is so characteristic of most Steganopodous birds. Not unfrequently several or even many nests are built close together, and the locality that suits the Snake-bird suits also many of the Herons, so that these, its distant relatives, are often also its near neighbours.[4] The African Snake-bird, *P. congensis* (or *levaillanti* of some authors), inhabits the greater part of that continent from Natal northwards; but, though met with on the White Nile, it is not known to have occurred in Egypt, a fact the more remarkable seeing that Canon Tristram found it breeding in considerable numbers on the Lake of Antioch, to which it is a summer visitor, and it can hardly reach its home without passing over the intervening country. The male bird is easily distinguishable from the American species by its rufous coronal patch, its buff throat and its chestnut greater wing-coverts. A third species, *P. melanogaster*, ranges from Madagascar to India, Ceylon, Borneo, Java, and China. This so closely resembles the last-mentioned that the differences between them cannot be briefly expressed. The Australian region also has its Snake-bird, which is by some regarded as forming a fourth species, *P. novæ-hollandiæ*; but others unite it to that last-mentioned, which is perhaps somewhat variable, and it would seem (*P. Z. S.*, 1877, p. 349) that examples from New Guinea differ somewhat from those inhabiting Australia itself.

The anatomy of the genus *Plotus* has been dealt with more fully than that of most forms. Beside the excellent description of the American bird's alimentary canal furnished to Audubon by Macgillivray, other important points in its structure have been well set forth by Garrod and Forbes in the Zoological *Proceedings* (1876, pp. 335-345, pls. xxvi.-xxviii.; 1878, pp. 679-681; and 1882, pp. 208-212), showing among other things that there is an appreciable anatomical difference between the species of the New World and of the Old; while the osteology of *P. melanogaster* has been admirably described and illustrated by Prof. Milne-Edwards in M. Grandidier's great *Oiseaux de Madagascar* (pp. 691-695, pls. 284, 285). In all the species the neck affords a feature which seems to be unique. The first seven of the cervical vertebræ form a continuous curve with its concavity forward, but the eighth articulates with the seventh nearly at a right angle and, when the bird is at rest, lies horizontally. The nint is directed downwards almost as abruptly, and those which succeed present a gentle forward convexity. The muscles moving this curious framework are as curiously specialized, and the result of the whole piece of mechanism is to enable the bird to spear with facility its fishy prey. (A. N.)

[1] "Anhinga," according to Marcgrave, who first described this bird (*Hist. Rer. Nat. Brasiliæ*, p. 218), was the name it bore among the natives.

[2] These feathers are very characteristic of each species of the genus, and in India, says Jerdon, are among the Khasias a badge of royalty.

[3] This peculiarity, first pointed out to the writer by Mr. Bartlett, who observed it in birds in the Zoological Society's possession, doubtless suggested the name of "Water-Turkey" by which in some places *Plotus anhinga* is said to be known.

[4] The curious but apparently well-attested fact of the occurrence in England, near Poole, in June 1851, of a male bird of this species (*Zoologist*, pp. 3601, 3654) has been overlooked by several writers who profess to mention all cases of a similar character

SNAKE-ROOT. In most countries where snakes abound some root or herb is used by the natives as an antidote for the bites of venomous species, and many herbs have consequently received the name of snake-root. Botanically speaking, the name properly belongs to *Ophiorrhiza Mungos*, L., a plant of the Cinchona family, used in the East Indies for the purpose above indicated. In medicine, however, the roots of *Aristolochia Serpentaria*, L., *Polygala Senega*, L., or *Cimicifuga racemosa*, Elliott, are alike understood by this name, being distinguished respectively as the Virginian, Seneka, and Black Snake-roots. The first is now employed as an aromatic antiseptic tonic in typhoid fever, the second as a stimulant expectorant in bronchitis, and the third as a sedative in rheumatic or inflammatory affections, especially in muscular rheumatism and lumbago. The root of *Aristolochia reticulata*, Nutt., which is known in the United States as Red River or Texan Snake-root, is the kind most frequently met with in the United Kingdom as Serpentary or Virginian Snake-root. (See GUACO.)

The roots or rhizome of *Liatris spicata*, Willd., *Eryngium aquaticum*, L., and *Eupatorium altissimum*, L., have all been used in North America for snake-bites, the first two being known as Button Snake-root and the last as White Snake-root. The rhizome of *Asarum canadense*, L., passes under the name of Canadian Snake-root. All of these contain acrid or aromatic principles which, when a warm decoction of the drug is taken, exercise a powerfully diaphoretic or, in some cases, diuretic action, to which any benefit that may be derived from their use must be attributed.

SNAKES constitute an order (*Ophidia*) in the class of Reptiles which is characterized by an exceedingly elongate body, cylindrical or sub-cylindrical, and terminating in a tapering tail. The integuments are folded into flat imbricate scales, which are rarely tubercular or granular. The spinal column consists of a very great number of vertebræ, with which the numerous ribs are movably articulated. Limbs are entirely absent, or only rudiments of the posterior occur more or less hidden below the skin; there is no sternum. The bones of the palate and jaws are movable; the mandibles are united in front by an elastic ligament and are very distensible. Generally both jaws and the palate are toothed, the teeth being thin and needle-like. There are no eyelids, no ear-opening. The vent is a transverse slit.

Great as is the difference in appearance between a typical snake and a typical lizard, the two orders of Ophidians and Lacertilians are nearly allied; the former is probably merely a specialized descendant of the latter or of the pythonomorphous reptiles, or perhaps of both. Moreover, the living Lacertilians include forms which approach the Ophidians by having a greatly increased number of vertebræ, a much advanced degradation of the scapular and pelvic arches and limbs, a simple dentition, and the absence of eyelids and external ear-opening. And on the other hand we find Ophidians with a greatly diminished flexibility of the vertebral column, with closely adherent, smooth and polished scales, with a narrow mouth—totally unlike the enormous gape of the typical snakes—and even without that longitudinal fold in the median line of the chin which is so characteristic of the order (*Typhlopidæ*). Thus of the Ophidian characters as given above only that taken from the loose connexion of the bones of the skull remains as a sharp line of separation between snakes and lizards. The mandibulary symphysis is not by suture but by an elastic band; the intermaxillary, palatine, and pterygoid bones are so loosely attached to the cranium that they can be easily pressed outwards and forwards, and the maxillary and mandibulary of one side can be moved in those directions independently of their fellows opposite. The intermaxillary is small, generally toothless, and coalesces with the nasals and vomer into a single movable bone; finally, the suspensory is much elongate and movable at both ends. This arrangement ensures an extraordinary degree of mobility and elasticity of all parts of the gape, which, however, varies in the different families of the order For the other characteristic points of their structure and for their distribution, see REPTILES.

The number of known species of snakes has been given as 1500 by some authorities and as 1800 by others. The limits of their distribution seem to be the 70th parallel N. lat. in Europe, the 54th in British Columbia, and the 40th parallel S. lat. in the southern hemisphere. The number of species and of individuals in a species is small in the temperate zones, but increases as the tropics are approached. In the tropical zone they are abundant, especially where a well-watered soil nourishes a rich vegetation, with glades open to the sun, and where a variety of small animals serve as an abundant and easily obtained prey. It is in the tropics also that the largest (boas, pythons) and the most specialized kinds occur (tree snakes, sea snakes, the large poisonous snakes). On the other hand, every variety of soil is tenanted by some kind of snakes: they form a contingent in every desert fauna. In accordance with this general distribution snakes show a great amount of differentiation with regard to their mode of life and general organization; and from the appearance alone of a snake a safe conclusion can be drawn as to its habits. The following categories may be distinguished.

(1) Burrowing snakes, which live under ground and but rarely appear on the surface. They have a cylindrical rigid body, covered with generally smooth and polished scales; a short strong tail; a short rounded or pointed head with narrow mouth; teeth few in number; small or rudimentary eye; no abdominal scutes or only narrow ones. They feed chiefly on invertebrate animals, and none are poisonous. (2) Ground snakes, living chiefly on the ground, and rarely ascending bushes or entering water. Their body is cylindrical, flexible in every part, covered with smooth or keeled scales, and provided with broad ventral and subcaudal scutes. All the various parts of their body and head are well proportioned; the non-poisonous kinds of ground snakes are in fact the typical and least specialized snakes, and more numerous than any of the other kinds. They feed chiefly on terrestrial vertebrates. The majority are non-poisonous; but the majority of poisonous snakes must be referred to this category. (3) Tree snakes, which are able to climb bushes or trees with facility or pass even the greater part of their existence on trees. Their body is rarely cylindrical, generally compressed and slender; their broad ventral scutes are often carinate on the sides. Those kinds which have a less elongate and cylindrical body possess a distinctly prehensile tail. The eye is generally large. Their coloration consists often of bright hues, and sometimes resembles that of their surroundings. They feed on animals which likewise lead an arboreal life, rarely on eggs. Poisonous as well as innocuous snakes are represented in this category. (4) Freshwater snakes, living in or frequenting fresh waters; they are excellent swimmers and divers. The nostrils are placed on the top of the snout and can be closed whilst the animal is under water. Their body is cylindrical, moderately long, provided with narrow ventral scutes; the tail tapering; head flat, rather short; and the eyes of small size. They feed on fish, frogs, and other aquatic animals, and are innocuous and viviparous. (5) Sea snakes are distinguished by the compressed, rudder-shaped tail, supported by erect neural and hæmal spines. They never leave the sea (with the exception of one genus) and are unable to move on land. They feed on fishes, are viviparous and poisonous.

The majority of snakes are active during the day, their energy increasing with the increasing temperature of the air; whilst some delight in the moist sweltering heat of dense tropical vegetation, others expose themselves to the fiercest rays of the midday sun. Not a few, however, lead a nocturnal life, and many of them have, accordingly, their pupil contracted into a vertical or more rarely a horizontal slit. Those which inhabit temperate latitudes hibernate. Snakes are the most stationary of all vertebrates; as long as a locality affords them a sufficiency of food and some shelter to which they can readily retreat, they have no inducement to change it. Their dispersal, therefore, must have been extremely slow and gradual. Although able to move with extreme rapidity, they cannot maintain it for any length of time. Their organs of locomotion are the ribs, the number of which is very great, nearly corresponding to that of the vertebræ of the trunk. They can adapt their motions to every variation of the ground over which they move, yet all varieties of snake locomotion are founded on the following simple process. When a part of the body has found some projection of

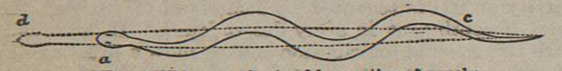


FIG. 1.—Diagram of natural locomotion of a snake.

the ground which affords it a point of support, the ribs are drawn more closely together, on alternate sides, thereby producing alternate bends of the body. The hinder portion of the body being drawn after, some part of it (*c*) finds another support on the rough ground or a projection; and, the anterior bends being stretched in a straight line, the front part of the body is propelled (from *a* to *d*) in consequence. During this peculiar locomotion the numerous broad shields of the belly are of great advantage, as by means of their free edges the snake is enabled to catch and use as points of support the slightest projections of the ground. A pair of ribs corresponds to each of these ventral shields. Snakes are not able to move over a perfectly smooth surface. Thus it is evident that they move by dragging their body over the ground, or over some

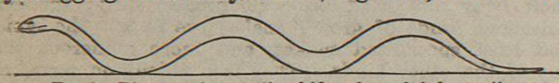


FIG. 2.—Diagram of conventional idea of a snake's locomotion.

other firm base, such as the branch of a tree; hence the conventional representation of the progress of a snake, in which its undulating body is figured as resting by a series of lower bends on the ground whilst the alternate bends are raised above it, is an impossible attitude. Also the notion that snakes when attacking are able to jump off the ground is quite erroneous; when they strike an object, they dart the fore part of their body, which was retracted in several bends, forwards in a straight line. And sometimes very active snakes, like the cobra, advance simultaneously with the remainder of the body, which, however, glides in the ordinary fashion over the ground; but no snake is able to impart such an impetus to the whole of its body as to lose its contact with the ground. Some snakes can raise the anterior part of their body and even move in this attitude, but it is only about the anterior fourth or third of the total length which can be thus erected.

With very few exceptions, the integuments form imbricate scale-like folds arranged with the greatest regularity; they are small and pluriserial on the upper parts of the body and tail, large and uniserial on the abdomen, and generally biserial on the lower side of the tail. The folds can be stretched out, so that the skin is capable of a great degree of distension. The scales are sometimes rounded behind, but generally rhombic in shape and more or less elongate; they may be quite smooth or provided with a longitudinal ridge or *keel* in the middle line. The integuments of the head are divided into non-imbricate shields or plates, symmetrically arranged, but not corresponding in size or shape with the underlying cranial bones or having any relation to them. The form and number of the scales and scutes, and the shape and arrangement of the head-shields, are of great value in distinguishing the genera and species, and it will therefore be useful to explain in the accompanying woodcut (fig. 3) the terms by which these parts are designated. The skin does not form eyelids; but the epidermis passes over the eye, forming transparent disk, concave like the glass of a watch, behind which the eye moves. It is the first part which is cast off when the snake sheds its skin; this is done several times in the year, and the epidermis comes off in a single piece.

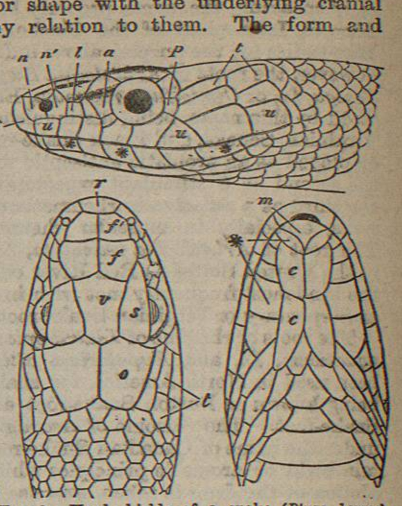


FIG. 3.—Head-shields of a snake (*Ptyas korros*). *r*, Rostral; *f*, posterior frontal; *f'*, anterior frontal; *v*, vertical; *s*, supraciliary or supraocular; *o*, occipital; *n*, *n'*, nasals; *l*, loreal; *a*, anterior ocular or orbital, or præorbital or anteocular; *p*, postoculars; *u*, *u*, upper labials; *t*, *t*, temporals; *m*, mental; *, *, lower labials; *c*, *c*, chin-shields.

Tongue. The tongue in snakes is narrow, almost worm-like, generally of a black colour and forked; that is, it terminates in front in two extremely fine filaments. It is often exserted with a rapid motion, sometimes with the object of feeling some object, sometimes under the influence of anger or fear.

Snakes possess teeth in the maxillaries, mandibles, palatine, and pterygoid bones, sometimes also in the intermaxillary; they may be absent in one or the other of the bones mentioned. In the innocuous snakes the teeth are simple and uniform in structure, thin, sharp like needles, and bent backwards; their function consists merely in seizing and holding the prey. In some all the teeth are nearly of the same size; others possess in front of the jaws (Lycodonts) or behind in the maxillaries (Diacrasterians) a tooth more or less conspicuously larger than the rest; whilst others again are distinguished by this larger posterior tooth being grooved along its outer face. The snakes with this grooved kind of tooth have been named *Opisthoglyphi*, and also *Suspecti*, because some herpetologists were of opinion that the function of the groove of the tooth was to facilitate the introduction of poisonous saliva into a wound. The venomous nature of these snakes, however, has never been proved, and persons are frequently bitten by them without any evil consequences. Nevertheless as the depth of the groove, the length of the tooth, and the development of the salivary glands in its vicinity vary greatly, it is quite possible that the function and the physiological effect of this apparatus are not the same in all Opisthoglyphs. In the true poisonous snakes the maxillary dentition has undergone a special modification. The so-called Colubrine Venomous snakes, which retain in a great measure an external resemblance to the innocuous snakes, have the maxillary bone not at all, or but little, shortened, armed in front with a fixed, erect fang, and provided with a deep groove or closed

canal for the conveyance of the poison, the fluid being secreted by a special poison-gland. One or more small ordinary teeth may be placed at some distance behind this poison-fang. In the other venomous snakes (Viperines and Crotalines) the maxillary bone is very short, and is armed with a single very long curved fang with a canal and aperture at each end. Although firmly anchylosed to the bone, the tooth, which when at rest is laid backwards, is erectile,—the bone itself being mobile and rotated round its transverse axis by muscles. One or more reserve teeth, in various stages of development, lie between the folds of the gum and are ready to take the place of the one in function whenever it is lost by accident, or shed, which seems to happen at regular intervals. The gland which secretes the poison is described under REPTILES (vol. xx. p. 457).

Food. All snakes are carnivorous, and as a rule take living prey only; a few feed habitually or occasionally on eggs. Many swallow their victim alive; others first kill it by smothering it between the coils of their body (constriction). The effects of a bite by a poisonous snake upon a small mammal or bird are almost instantaneous, preventing its escape; and the snake swallows its victim at its leisure, sometimes hours after it has been killed. The prey is always swallowed entire, and, as its girth generally much exceeds that of the snake, the progress of deglutition is very laborious and slow. Opening their jaws to their fullest extent, they seize the animal generally by the head, and pushing alternately the right and left sides of the jaws forward, they press the body through their elastic gullet into the stomach, its outlines being visible for some time through the distended walls of the abdomen. Digestion is quick and much accelerated by the quantity of saliva which is secreted during the progress of deglutition, and in venomous snakes probably also by the chemical action of the poison. The primary function of the poison-apparatus in the economy of snakes is without doubt to serve as the means of procuring their food. But, like the weapons of other carnivorous animals, it has assumed the secondary function of an organ of defence. Only very few poisonous snakes (like *Ophiophagus elaps*) are known to resent the approach of man so much as to follow him on his retreat and to attack him. Others, as if conscious of their fearful power of inflicting injury, are much less inclined to avoid collision with man than innocuous kinds, and are excited by the slightest provocation to use that power in self-defence. They have thus become one of the greatest scourges to mankind, and Sir J. Fayrer[1] has demonstrated that in India alone annually some 20,000 human beings perish from snake-bites. Therefore it will not be out of place to add here a few words on snake-poison and on the best means (ineffectual though they be in numerous cases) of counteracting its deleterious effects.

Action of snake-poison. Chemistry has not yet succeeded in separating the active principle of snake-poison or in distinguishing between the secretions of different kinds of poisonous snakes; in fact it seems to be identical in all, and probably not different from the poison of scorpions and many *Hymenoptera*. The physiological effects of all these poisons on warm-blooded Vertebrates are identical, and vary only in degree, the smallest quantities of the poison producing a local irritation, whilst in serious cases the whole mass of the blood is poisoned in the course of some seconds or minutes, producing paralysis of the nerve-centres. That there is some difference, however, in the action of the poisons upon the blood has been shown by Fayrer, who found that the poison of Viperine snakes invariably destroys its coagulability, whilst nothing of the kind is observed in animals which perished from the bite of a Colubrine Venomous snake. The same observer has also experimentally demonstrated that the blood of a poisoned warm-blooded animal assumes poisonous properties, and, when injected, kills like the poison itself, although the bodies of the animals may be eaten by man with impunity. On the other hand, he has proved that the opinion generally adopted since Redi's time, viz., that snake-poison is efficacious only through direct injection into the blood, is fallacious and that it is readily absorbed through mucous and serous membranes, producing the same effects, though in a milder degree.

The degree of danger arising from a snake-bite to man depends in the first place on the quantity of poison injected: a large vigorous snake which has not bitten for some time is more to be feared than one of small size or one which is weakly or has exhausted its stock of poison by previous bites. The bite of some of the smaller Australian Diemenias and *Hoplocephali* is followed by no worse consequences than those arising from the sting of a wasp or a hornet, while immediately fatal cases are on record of persons bitten by the cobra or the large South-American Crotalines. In the second place it depends on the strength of the individual bitten: a man of strong physical constitution and energetic mental disposition is better able to survive the immediate effects of the bite than a child or a person wanting in courage. Thirdly, it depends on the position and depth of the bite: the bite may be merely a superficial scratch, or may penetrate into tissue having few blood-vessels, and thus be almost harmless; or it may be deep in vascular tissue or even penetrate a vein, producing immediate and fatal effects. It must be mentioned also that Fayrer is distinctly of opinion that the poison of some kinds is more powerful than that of others. The mere shock produced by the bite of a snake upon a nervous person may be sufficiently severe to be followed by symptoms of collapse, although no actual poisoning of the blood has taken place, or although the bite was that of an innocuous snake. It is said that persons have actually died under such circumstances from mere fright. The local appearances in the neighbourhood of a poisoned wound, which soon after the bite is much swollen and discoloured and very painful, readily prove its character; but this can be often ascertained also immediately after the bite by the inspection of the wound,—the teeth, which are so differently arranged in poisonous and non-poisonous snakes, leaving a different pattern on the skin. As a non-poisonous snake has four rows of teeth in the upper jaw, the pattern of its bite will more or less resemble fig. 4, whilst a poisonous snake leaves two rows of more distinctly marked punctured wounds in the place of the two outer series in the non-poisonous (see fig. 5). Of course, there may be modifications of these patterns, as, for instance, when one fang only hits or penetrates the part aimed at, or when the direction of the stroke is slanting, producing merely a scratch.

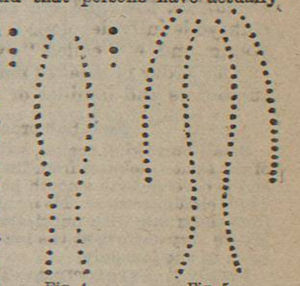


Fig. 4 Fig. 5.

FIG. 4.—Diagram of toothmarks of an innocuous snake.
FIG. 5.—Diagram of toothmarks of a poisonous snake (cobra).

Unfortunately no antidote is known capable of counteracting or neutralizing the action of snake-poison. Some years ago injections of ammonia or liquor potassæ were recommended, but there is the obvious objection that hardly in one out of a thousand cases of snake-bite would either the appliances or the operator be at hand. Fayrer's experiments, however, have distinctly disproved the efficacy of this remedial measure. Equally useless is permanganate of potassium; it is indeed true that a solution of this compound destroys the properties of snake-poison when mixed with it; and therefore such of the poison as remains in the wound will be neutralized by the external application or injection of the permanganate, but the remedy is entirely without effect after the poison has passed into the circulation. Treatment is therefore limited to endeavours to prevent by mechanical means the poison from entering the circulation, or by chemical agencies to destroy or remove as much of it as possible that remains in the wound, and to save the patient from the subsequent mental and physical depression by the free use of stimulants. Whatever is or can be done must be done immediately, as a few seconds suffice to carry the poison into the whole vascular system, and the slightest delay diminishes the chances of the patient's recovery. Courageous persons badly bitten in a finger or toe are known to have saved their lives by the immediate amputation of the wounded member. To the mode of treatment summarized by Günther[2] but little can be added. (1) If the wound is on some part of the extremities, one or more ligatures should be made as tightly as possible at a short distance above the wound, to stop circulation; this is most effectually done by inserting a stick under the ligature and twisting it to the uttermost. The ligatures are left until means are taken to destroy the virus in the wound and other remedial measures are resorted to, or until the swelling necessitates their removal. (2) The punctured wounds should be enlarged by deep incisions, to cause a free efflux of the poisoned blood, or should be cut out entirely. (3) The wound should be sucked either by the patient

[1] *The Thanatophidia of India*, fol., London, 1872.

[2] *Reptiles of British India*, London, 1864, 4to.

or some other person whose mouth is free from any solution of continuity. Cupping-glasses, where they can be applied, answer the same purpose, but not with the same effect. (4) By cauterization with a red-hot iron, a live coal, nitrate of silver or carbolic or mineral acid, or by injections of permanganate of potassium, the poison which remains in the wound can be destroyed or neutralized. Ammonia applied to the wound as a wash and rubbed into the neighbouring parts is likewise undeniably of great benefit, especially in less serious cases, since it alleviates the pain and reduces the swelling. (5) Internally, stimulants are to be taken freely; they do not act as specifics against the virus, but are given to excite the action of the heart, the contractions of which become feeble and irregular, to counteract the physical and mental depression, and to prevent a complete collapse. Brandy, whisky, and ammonia in any of its officinal forms should be taken in large doses and at short intervals. The so-called "snake-stones" can have no other effect than, at the best, to act as local absorbents, and can be of use only in the very slightest cases.

Snakes are oviparous; they deposit from ten to eighty eggs of an ellipsoid shape, covered with a soft leathery shell, in places where they are exposed to and hatched by moist heat. The parents pay no further attention to them, except the pythons, which incubate their eggs by coiling their body over them, and fiercely defend them. In some families, as many freshwater snakes, the sea snakes, *Viperidæ*, and *Crotalidæ*, the eggs are retained in the oviduct until the embryo is fully developed. These snakes bring forth living young, and are called "ovo-viviparous."

The order of snakes may be divided into the following sub-orders and families or groups.

First Sub-order.—**Hopoterodontes.**

Small burrowing snakes, with a cylindrical body, which is nearly of the same thickness from its anterior to its posterior extremity, and is covered with smooth polished scales of the same size in its whole circumference. No mental groove. Head small, not distinct from the trunk, with imbricate scale-like scutes. Eye rudimentary. Mouth very narrow, at the lower side of the head, armed with small teeth in one jaw only.

Family 1. TYPHLOPIDÆ.—Teeth in the upper jaw only.

Genera: *Typhlina*, *Onychocephalus*, *Typhlops* (see figs. 6, 7).

Family 2. STENOSTOMATIDÆ.—Teeth in the lower jaw only.

Genera: *Stenostoma*, *Siagnodon*.

Second Sub-order.—**Ophidii Colubriformes.**

Innocuous snakes. Teeth in both jaws, none of the anterior being grooved or perforated. Scales more or less differentiated. A mental groove is generally present. Eye developed.

Family 1. TORTRICIDÆ.—Body cylindrical, with a rounded head not distinct from the neck; tail very short. Rudiments of hind limbs hidden in a small groove on each side of the vent. Scales rounded, polished, those of the ventral series but little enlarged; only one pair of frontals; six upper labials. Eye small. Mouth of moderate width; teeth few in number, sub-equal in size.

Genera: *Ilysia* (tropical America); *Cylindrophis* (India).

Family 2. XENOPELTIDÆ.—Body cylindrical, with a rounded head not distinct from the neck; tail short. No rudimentary hind limbs. Scales rounded, polished; ventral shields well differentiated; two pairs of frontals; occiput covered with five shields. Eye small. Mouth of moderate width; teeth numerous, sub-equal.

One genus, from the Indian region: *Xenopeltis*.

Family 3. UROPELTIDÆ (Rough Tails).—Body cylindrical, with a short head not distinct from the neck; tail very short, truncated or scarcely tapering, frequently terminating in a rough naked disk or covered with keeled scales. Scales rounded and polished, those of the ventral series being always somewhat larger than the rest; only one pair of frontals; four upper labials. Eye very small. Mouth of moderate width; teeth few in number, small, sub-equal, none on the palate. Mental groove generally absent. Small burrowing Indian snakes.

Genera: *Rhinophis*, *Uropeltis*, *Silybura*, *Plectrurus*, *Melanophidium*.

Family 4. CALAMARIIDÆ.—Small snakes, with a rather rigid body; the short head not distinct from the neck; tail more or less short. Scales in from thirteen to seventeen series; ventral shields well developed, generally less than 200 in number; the normal number of head-shields always reduced by two or more of them being confluent. Cleft of the mouth of moderate width; nostril lateral; palatine teeth present.

African genera: *Homalosoma*, *Calamelaps*, *Prosymna*, *Opisthotropis*, *Xenocalamus*, *Amblyodipsas*, *Elapops*, *Urobelus*, *Uriechis*. Europeo-Asiatic genera: *Rhynchocalamus*, *Psilosoma*. Indian genera: *Calamaria*, *Macrocalamus*, *Typhlogeophis*, *Xylophis*, *Oxycalamus*, *Brachyorrhos*, *Elapoides*, *Rhinosimus*, *Aspidura*, *Haplocercus*, *Achalinus* (Japan). North-American genera: *Carphophis*, *Conocephalus*, *Streptophorus*, *Contia*. Tropical American genera: *Homalocranium*, *Arrhyton*, *Rhegnops*, *Colobognathus*, *Geophidium*, *Catostoma*, *Stenognathus*, *Leptocalamus*, *Chersodromus*, *Elapomorphus*, *Cercocalamus*, *Microdromus*, *Stenorhina*, *Rhinostoma*, *Rhynchonyx*. Genus with wide distribution: *Geophis*.

Family 5. OLIGODONTIDÆ.—Body rather rigid, covered with smooth rounded scales; head short, not distinct from neck, and nearly always with symmetrical arrow-shaped markings above. Ventral scutes broad; rostral shield large, more or less produced backwards. Maxillary teeth few in number, the hindmost enlarged, not grooved. Indian.

Genera: *Oligodon*, *Simotes*.

Family 6. COLUBRIDÆ.—This family comprises the majority of the non-venomous snakes and the least specialized forms. Their body of moderate length compared to its circumference, flexible in every part; the head, trunk, and tail—in fact all parts—well proportioned; nostril lateral; teeth numerous in the jaws and on the palate, but without fangs in front or in the middle of the maxillary. Double row of sub-caudals. This family may be divided in accordance with the general habitus or mode of life into several groups, which, however, are connected by numerous intermediate forms.

The group of (i.) Ground Colubrides, *Coronellina*, consists of small forms, generally of brilliant coloration, and comprises the following genera:—

Genera with wide distribution: *Ablabes*, *Cyclophis*, *Tachymenis*, *Coronella*, *Liophis*. African: *Psammophylax*, *Ditypophis*. Indian: *Megablabes*, *Nymphophidium*, *Odontomus*. Tropical American: *Erythrolamprus*, *Pliocercus*, *Hypsirhynchus*.

The group of (ii.) True Colubrides, *Colubrina*, are land snakes, which swim well when driven into the water, or climb when in search of food; they are of moderate or rather large size.

Genera with wide distribution: *Coluber*, *Elaphis*, *Ptyas*, *Zamenis*. African genera: *Xenurophis*, *Herpetæthiops*, *Scaphiophis*. Indian genera: *Compsosoma*, *Xenelaphis*, *Cynophis*, *Lielaphis*, *Lytorhynchus*. Europeo-Asiatic: *Rhinechis*. North-American: *Pituophis*. South-American: *Spilotes*. Australian: *Zamenophis*.

The group of (iii.) Bush Colubrides, *Dryadina*, leads up to the true Tree snakes, its members having a more or less elongate and compressed body, frequently of green colour; they are more numerous in the New than in the Old World, and belong to the following

Genera: *Dromicus*, *Herpetodryas*, *Herpetoreas*, *Philodryas*, *Diplotropis*, *Zaocys*, *Dryocalamus*.

Finally, the group of (iv.) Freshwater Colubrides, *Natricina*, are generally neither elongate nor compressed, and possess frequently keeled scales. They freely enter water in pursuit of their prey,—chiefly frogs and fishes.

Genera with wide distribution: *Tropidonotus*, *Heterodon*. African: *Grayia*, *Neusterophis*, *Limnophis*, *Hydræthiops*, *Macrophis*. Indian: *Xenochrophis*, *Prymnomiodon*, *Atretium*. North-American: *Ischnognathus*. South-American: *Xenodon*, *Tomodon*.

Family 7. HOMALOPSIDÆ (Freshwater Snakes).—Body of moderate length, cylindrical or slightly compressed; head rather thick, broad, not very distinct from neck; tail strong, of moderate length. Ventral scutes rather narrow; double row of sub-caudals. Eye small. Nostrils on the upper surface of the head, small, provided with a valve; nasal shields enlarged at the expense of the anterior frontals, which are frequently confluent into a single shield. The other head shields may deviate from the usual arrangement.

Indian genera: *Fordonia*, *Cantoria*, *Cerberus*, *Hypsirhina*, *Ferania*, *Homalopsis*, *Hipistes*, *Herpeton* (see fig. 8), *Gerrarda*, *Tachyplotus*. American genera: *Calopisma*, *Helicops*, *Hydrops*, *Tachynectes*, *Hydromorphus*.

Family 8. PSAMMOPHIDÆ (Desert Snakes).—Loreal region very concave. Scales smooth; double row of sub-caudals. Cleft of the mouth wide; nostril lateral. Eye of moderate size. Shields of the head normal; posterior frontals rounded or angular behind; vertical narrow; supraciliaries prominent. Loreal present. One of the four or five anterior maxillary teeth longer than the others, and the last grooved. Old World.

Genera: *Psammophis*, *Cœlopeltis*, *Taphrometopon*, *Rhagerrhis*, *Psammodynastes*, *Mimophis*.

Family 9. RHACHIODONTIDÆ (Egg-Eaters).—Body of moderate dimensions; head short, deep. Eyes small, pupil round. Scales strongly keeled, in twenty-three or twenty-five series. Maxillary teeth very small and few in number; the lower spinous processes of the posterior cervical vertebræ penetrate the œsophagus and act as supplementary teeth. African.

One genus: *Dasypeltis* (see fig. 9).

Family 10. DENDROPHIDÆ (Tree Snakes).—Body and tail much compressed or very slender and elongate; head generally elongate and distinct from the very slender neck; snout rather long, obtuse or rounded in front. Cleft of the mouth wide. Eye of moderate size or large, with round pupil. Shields of the head normal; scales generally narrow and much imbricate; ventral scutes keeled laterally; double row of sub-caudals. No large fang either in front or in the middle of the upper jaw.

African genera: *Bucephalus*, *Hapsidophrys*, *Rhamnophis*, *Philothamnus*, *Ithycyphus*. Indian and Australian genera: *Gonyosoma*, *Phyllophis*, *Dendrophis*, *Chrysopelea*. Tropical American: *Ahætulla*.

Family 11. DRYOPHIDÆ (Whip Snakes).—Body and tail excessively slender and elongate; head very narrow and long with tapering snout, which sometimes is produced into a longer or shorter appendage. Mouth very wide. Eye of moderate size, generally with a horizontal pupil. Scales very narrow, much imbricate; double row of sub-caudals. Posterior maxillary teeth grooved.

Genera: *Tropidococcyx*, *Cladophis*, *Dryophis*, *Tragops*, *Passerita* (see fig. 10), *Langaha*.

Family 12. DIPSADIDÆ.—Body much compressed, elongate or of moderate length; head short, broad behind, with short rounded snout distinct from neck. Eye large, generally with vertical pupil. Cleft of the mouth wide. Scales of the vertebral series frequently enlarged. Dentition strong, frequently with enlarged anterior and posterior maxillary teeth.

Genera: *Chamætortus*, *Leptodira*, *Tropidodipsas*, *Hemidipsas*, *Thamnodynastes*, *Dipsas*, *Dipsadoboa*, *Rhinobothryum*, *Pythonodipsas*.

Family 13. SCYTALIDÆ.—Head, trunk, and tail of moderate dimensions. Eye of moderate size, with elliptical pupil. Scales smooth, in seventeen or nineteen rows; anal entire; single or double row of sub-caudals. Posterior maxillary teeth grooved, anterior ones equal in length.

Genera: *Scytale*, *Oxyrhopus*, *Hologerrhum*, *Pseudoxyrhopus*, *Rhinosimus*.

Family 14. LYCODONTIDÆ. Body of moderate length or rather elongate; snout generally depressed, flat, and elongate. Eye rather small, often with vertical pupil. Upper head-shields regular, with the posterior frontals enlarged. Maxillary with a fang in front, but without posterior grooved tooth.

African genera: *Boodon*, *Holuropholis*, *Alopecion*, *Lycophidium*, *Bothrophthalmus*, *Bothrolycus*, *Lycodryas*, *Hormonotus*, *Simocephalus*, *Lamprophis*. Indian genera: *Lycodon*, *Dinodon*, *Tetragonosoma*, *Leptorhytaon*, *Ophites*, *Cercaspis*, *Ulupe*.

Family 15. AMBLYCEPHALIDÆ (Blunt Heads).—Body compressed, slender, and of moderate length; head short, thick, very distinct from neck; nostril in a single shield. Eye with vertical pupil. Cleft of the mouth narrow and not very extensible. Scales smooth or faintly keeled, those of the vertebral series generally enlarged. Maxillary dentition feeble, no grooved tooth.

Indian genera: *Dipsadomorus*, *Amblycephalus*, *Pareas*, *Asthenodipsas*, *Elachistodon*. South-American genera: *Leptognathus*, *Opisthophis*.

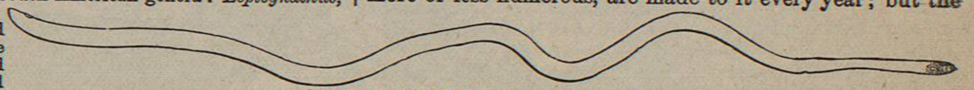


FIG. 6.—*Typhlops bothriorhyncus*. from India.

Family 16. ERYCIDÆ (Sand Snakes).—Body of moderate length, cylindrical, covered with small short scales; tail very short, with a single series of sub-caudals. Eye small, with vertical pupil. None of the labials are pitted. Anterior teeth longest. Adult individuals of some of the species with rudiments of hind limbs.

Genera: *Eryx*, *Cursoria*, *Gongylophis*, *Bolyeria*, *Erebophis*, *Lichanura*, *Calabaria*, *Wenona*, *Charina*.

Family 17. BOIDÆ.—Body and tail of moderate length or elongate; tail prehensile; snout rounded in front. Eye with vertical pupil. Scales in numerous series; single or double row of sub-caudals. In some of the genera the upper and lower labials are pitted. Teeth strong, unequal in size, none grooved; no intermaxillary teeth. Rudiments of hind limbs are generally present.

Genera: *Boa* (see fig. 11), *Pelophilus*, *Xiphosoma*, *Corallus*, *Epicrates*, *Chilabothrius*, *Enygrus*, *Leptoboa*, *Ungalia*, *Trachyboa*.

Family 18. PYTHONIDÆ (Rock Snakes).—Distinguished from the preceding family by the presence of intermaxillary teeth.

Genera: *Python* (see fig. 12), *Morelia*, *Chondropython*, *Liasis*, *Aspidiotes*, *Nardoa*, *Loxocemus*.

Family 19. ACROCHORDIDÆ (Wart Snakes).—Body of moderate length, covered with small, non-imbricate, tubercular or spiny scales; tail rather short, prehensile. Head covered with scales like the body; nostrils close together, at the top of the snout. Eye small. Teeth short, strong, sub-equal in size. Aquatic. Viviparous. India.

Genera: *Acrochordus*, *Chersydrus*.

Family 20. XENODERMIDÆ.—Distinguished from the preceding family by possessing broad ventral and sub-caudal scutes.

One genus: *Xenodermus* (Java). ? *Nothopsis* (Central America).

Third Sub-order.—**Ophidii Colubriformes Venenosi.**

Venomous Colubrine snakes. An erect grooved or perforated tooth in front of the maxillary which is not capable of rotation in its transverse axis. Scales differentiated. A mental groove.

Family 1. ELAPIDÆ.—Tail conical, tapering. Head with shield: loreal absent. Venom-fang grooved; maxillary long, with short teeth behind the fang.

Genus with wide distribution: *Naja* (see fig. 13). Indian genera: *Callophis*, *Megærophis*, *Hemibungarus*, *Xenurelaps*, *Bungarus*, *Ophiophagus*. African genera: *Pœcilophis*, *Elapsoidea*, *Cyrtophis*. South-American genus: *Elaps* (see fig. 14). Australian genera: *Vermicella*, *Brachysoma*, *Neelaps*, *Brachyurophis*, *Rhinelaps*, *Diemenia*, *Cacophis*, *Hoplocephalus*, *Tropidechis*, *Pseudechis*, *Pseudonaja*, *Pseudohaje*, *Ogmodon*.

Family 2. ATRACTASPIDIDÆ.—Body cylindrical, of moderate proportions; tail short. Head short, not distinct from neck. Mouth narrow. Maxillary short, with perforated poison-fang, without other teeth behind. Africa.

Genus: *Atractaspis*.

Family 3. CAUSIDÆ.—Body of moderate proportions, tail moderate or rather short. Head distinct from neck. Mouth wide. Maxillary short, with perforated poison-fang, without other teeth behind

African genera: *Sepedon*, *Causus*. South-American: *Dinodipsas*.

Family 4. DINOPHIDÆ (Venomous Tree Snakes).—Body and tail much elongate; head distinct from neck. Mouth wide. A perforated poison-fang, without other teeth behind. Africa.

Genus: *Dinophis* (*Dendraspis*).

Family 5. HYDROPHIDÆ (Sea Snakes).—Body generally compressed, and without broad ventral scutes; tail compressed, rudder-shaped. Nostrils directed upwards. Poison-fangs small, grooved. Viviparous.

Genera: *Platurus*, *Aipysurus*, *Disteira*, *Acalyptus*, *Hydrophis*, *Enhydrina*, *Pelagophis*, *Pelamis* (see fig. 15).

Fourth Sub-order.—**Ophidii Viperiformes.**

Viperine snakes. Maxillary very short, capable of rotation in its transverse axis, and armed with a single long tooth, which is perforated. Viviparous.

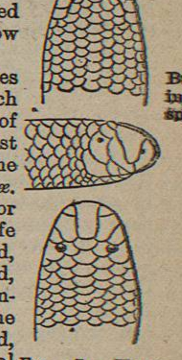
Family 1. VIPERIDÆ (Vipers).—Loreal region flat, without pit.

Old World genera: *Vipera*, *Cerastes*, *Daboia*, *Echis* (see fig. 17), *Atheris*. Australian: *Acanthophis*.

Family 2. CROTALIDÆ (Pit Vipers, Rattlesnakes).—Loreal region with a pit.

Old World genera: *Halys*, *Hypnale*, *Trimeresurus* (see fig. 18), *Calloselasma*, *Peltopelor*. New World genera: *Cenchris*, *Bothrops*, *Bothriopsis*, *Bothriechis* (*Rhinocerophis*), *Atropos*, *Trigonocephalus*, *Lachesis*, *Crotalophorus*, *Crotalus* (see fig. 16).

This list, from which many genera or sub-genera that are not well defined have been excluded, will give an idea of the great variety of forms by which the Ophidian type is represented at the present period. Additions, more or less numerous, are made to it every year; but the discoveries of late years have not revealed any new important modifications of structure, but rather have undermined the distinctions hitherto made between genera, groups, and families, so that it would appear as if we were acquainted with all the principal forms of snakes now living.



Burrowing snakes

FIG. 7.—Three views of head of *Typhlops braminus* (India), magnified.

We have now to add some notes on snakes to which special interest is attached, or which are most frequently brought to the notice of the observer or reader. The snakes most remote from the true Ophidian type are the members of the first family, *Typhlopidæ*. They are a small degraded form, adapted for burrowing and leading a subterranean life like worms. Their body is cylindrical, rigid, covered with smooth, short, highly polished, and closely fitting scales, without broad ventral scutes; tail very short; head joined to the trunk without neck-like constriction behind, and short, rounded, or with an acute rostral shield,—the principal instrument for burrowing in loose soil or mould. Their eye is quite rudimentary and can only give them a general perception of light. Their mouth is narrow, small, armed with but a few teeth in one of the jaws, and not distensible, allowing them only to feed on very small