SNAKES

CURIOSITIES & WONDERS OF SERPENT LIFE

CATHERINE · C · HOPLEY.

EW

Arthur Loveridge.

Kilternan.
Llandaff.

SNAKES:

CURIOSITIES AND WONDERS OF SERPENT LIFE.

Morrison & Gibb, Edinburgh,
Printers to Her Majesty's Stationery Office.

Hamadryad,
Ophiophagus bungarus.

Echis carinata.

Cobra,
Naja tripudians.

Reticulated Python,
Python reticulatus.

Amphisbæna.

Rat Snake,
Ptyas mucosus.

SOME OPHIDIANS AT HOME.

INDIA.

SNAKES:

CURIOSITIES AND WONDERS OF SERPENT LIFE.

BY

CATHERINE C. HOPLEY,

AUTHOR OF 'SKETCHES OF THE OPHIDIANS,' 'LIFE IN THE SOUTH,' 'RAMBLES AND ADVENTURES IN THE WILDS OF THE WEST,' ETC. ETC.

'These lithe and elegant Beings.'—RYMER JONES.
'Can out-swim the Fish and out-climb the Monkey.'—OWEN.

GRIFFITH AND FARRAN,

SUCCESSORS TO NEWBERY AND HARRIS,

WEST CORNER OF ST. PAUL'S CHURCHYARD, LONDON.

E. P. DUTTON & CO., NEW YORK.

1882.

TO MY

MUCH HONOURED AND ESTEEMED FRIEND,

Professor Richard Owen, F.R.S.,

WHO HAS GRACIOUSLY ENCOURAGED THE STUDIES

OUT OF WHICH IT CAME;

AND WHOSE CORDIAL SYMPATHY AND REGARD,

WITH FRANKEST RECOGNITION OF HIS

DEEP DEVOTION TO HIS ART,

GAVE ONE OF ITS FEW GREAT PLEASURES TO THE

SHORT LIFE OF

A DEAR BROTHER OF MINE,

THIS BOOK

IS HUMBLY DEDICATED,

WITH GRATEFUL RECOLLECTIONS OF THE PAST.

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INTRODUCTION.

TO the many friends who have repeatedly asked me, 'What *could* induce you to take up such a *horrid* subject as snakes?' a few words of explanation must be offered. Some words of apology are also due that I, a learner myself, should aspire to instruct others. I cannot do better, therefore, than tell the history of this book from its birth, and in so doing cancel both obligations. The little history will be a sort of *OPHIDIANA*, or gossip about snakes; and in this I only follow the example of most herpetologists, who, when writing exclusively on these reptiles, preface their work with some outline of the history of ophiology, and generally with an excuse for introducing the unwelcome subject at all. There is still reason to lament that traditional prejudice invests everything in the shape of a serpent with repulsive qualities, and that these prejudices are being only very slowly swept away by the besom of science.

Serpents are intimately associated with our religious beliefs. Not that we *worship* them! Far otherwise. Many excellent and orthodox persons associate with a serpent all the sin and misery which ever existed on our globe, and are persuaded that the sooner everything in the shape of one is exterminated the better.

On the other hand, those who can look at a snake with unprejudiced eyes and study its habits, find continual reason to wonder at and admire the extraordinary features which exhibit themselves in its organization. Owing to their retiring habits, many of them nocturnal, and partly in consequence of preconceived errors, less is understood about them than almost any other natural group of animals; therefore—as the reader will discover—a student, when left to himself, has to wade through ages of writers in order to find out what to believe regarding them. Scientific ophiologists are still engaged in settling mooted questions concerning them. But apart from science there is a glamour of poetry, romance, and mystery about snakes, and not without reason. There has been a great deal of what we may call 'Drawing-room Natural History' of late years—charmingly sensational and romantic; attractive also in illustrations and colouring, but not always intended as reliable guides for students.

All travellers are not naturalists; and though they may contribute valuable information in one branch of science, it is possible they may mislead in another; and from the very popularity of their books, such errors are rapidly disseminated. I aspire to a place on drawing-room tables for my book also, but let me assure my readers that my aim has been to assist by diligent search to establish truthfulness. Whatever of romance or sensation attaches to it, is due to the marvellous powers of the creatures who fill its pages, and whose true nature I have laboured to comprehend.

Schlegel and Dumeril are two authorities on serpents much quoted by English writers, and both give us a list of all the naturalists of repute who have done service to herpetology, up to the date of their works. As many of these are introduced in the body of my work, let us glance at the progress of ophiology since the date of these two distinguished authors. In zoology as much as in any branch of science progressiveness is observable; and in zoology the advance of ophiology has of late years been remarkable. In 1843, when Schlegel's *Essai sur la Physionomie des Serpents*, 1837, was translated into English by Dr. Thos. Stewart Traill, of the University of Edinburgh, he mentioned as a reason for curtailing the original (and not adding the atlas containing 421 figures, with charts and tables), that the low state of ophiology in this country did not invite a larger work, and 'deters booksellers from undertaking such costly illustrations;' but he hoped to be useful to science by cultivating a branch of zoology hitherto neglected. Ten years prior to that date, viz. 1833, the monthly scientific magazine *The Zoologist* was started; in introducing which the Editor, Mr. Ed. Newman, wrote: 'To begin, the attempt to combine scientific truths with readable English has been considered by my friends one of surpassing rashness;' that he had 'many solicitations to desist from so hopeless a task,' and many 'supplications to introduce a few Latin descriptions to give it a scientific character,' science being then confined to the scientific alone. Nevertheless the *Zoologist* has survived half a century, and under able editorship has taken its stand as a popular as well as scientific journal. Formerly you might have hunted the pages of such magazines year after year without finding mention of an 'odious snake;' but within the last decade, not only this but other periodicals have frequently opened their pages to ophiology, and a considerable removal of prejudice is noticeable.

Mr. Newman felt encouraged by the success attending the publication of White's *Selborne*, that being one of the first works to induce a practical study of nature. Yet, until the appearance of Bell's *British Reptiles* in 1849, our present subject occupied but very stinted space in literature. Indeed, we must admit that as a nation we English have *followed*, not *taken*, the lead as naturalists. So long ago as 1709, Lawson in his *History of Carolina* lamented the 'misfortune that most of our Travellers who go to this vast Continent are of the meaner Sort, and generally of very slender Education ; hired laborers and merchants to trade among the Indians in remote parts.' . . . 'The French outstrip us in nice Observations,' he said. 'First by their numerous Clergy ; their Missionaries being obedient to their Superiors.' Secondly by gentlemen accompanying these religious missions, sent out to explore and make discoveries and to keep strict journals, which duly were handed over to science. And what Lawson remarked of the American colonies was extended to wherever the French, Portuguese, and Italians established religious communities. We find our bookshelves ever enriched by foreign naturalists.

In Germany, also, ophiology was far in advance of us. Lenz, Helmann, Effeldt, and many others pursued the study practically; and produced some valuable results in their printed works, which unfortunately are too little known in England. Doubtless because we in England have so few native reptiles, there is less inducement to concern ourselves about them. Not so in America, where herpetology soon found many enthusiasts; and the researches of Holbrooke, Emmons, De Kay, and Weir Mitchel were published within a few years of each other. Dr. Cantor in India, and Dr. Andrew Smith in South Africa, Drs. Gray and Günther and P. H. Gosse in England, all enriched ophiological literature previous to 1850, to say nothing of the valuable additions to the science dispersed among the *Reports* and *Transactions* of the various scientific Societies. After the appearance of Dr. Günther's important work, *The Reptiles of British India,* in 1864, published under the auspices of the Ray Society, another fresh impetus was observable, and we had Krefft's *Snakes of Australia,* 1869; *Indian Snakes,* by Dr. E. Nicholson, 1870; culminating in *The Thanatophidia of India,* by Sir Joseph, then Dr. Fayrer, F.R.S., C.S.I., etc., Surgeon-Major of the Bengal Army, in 1872, which brings me to the commencement of my own studies.

A few years ago, I knew nothing whatever about snakes; and to them, though deriving my chief pleasures from an inherited love of all things in nature, a faint interest *at a respectful distance,* was all I accorded. In Virginia and Florida, where a country life and a gorgeous flora enticed my steps into wild and secluded districts, we not unfrequently saw them; and one or two 'narrow escapes' seasoned the pages of my notebook. When in such rambles we caught sight of one, we flew at our utmost speed, encountering the far greater danger of treading on a venomous one in our precipitous flight, than in shunning the probably innocent one from which we were fleeing.

My first startling adventure in Virginia was more ridiculous than dangerous. We were about to cross a little rivulet that ran rippling through a wood, in which there were many such to ford. Often fallen boughs or drifting logs, dragged into the shallow parts by the negroes, served as stepping-stones. These becoming blackened in the water, and partially covered with tangled drift-weed, were so familiar a sight that, without pausing to observe, I was making a spring, when my companion caught hold of my dress, crying out, 'Don't step on them! They will bite you!' The supposed shining and tangled boughs were two large black snakes commonly known as 'Racers,' enjoying a bath; but until I had hastily regained the top of the bank, alarmed at the excitement of my young friend, I did not discover the nature of our intended stepping-stones. The snakes were not venomous, but very 'spiteful,' and might have resented the interruption by sharp bites. In moving, they probably would have caused me to fall upon them and into the water, when they might have attacked me with unpleasant results. Now, however, my chief vexation was that they got away so quickly, I could learn nothing about them.

Another 'escape' was on an intensely hot day, when in early morning we had started for a botanical ramble. Our way lay along a sloping bit of pasture land, bounded on the east and higher ground by a dense wood, which afforded shelter from the sun. Beguiled on and on, among the lovely copses of exquisite flowering shrubs and a wealth of floral treasures which carpeted the turfy slopes, we were unconscious of time.

Though only in the merry month of May, blackberries of enormous size and delicious flavour, trailing on long briars yards and yards over the mossy grass, invited us to break our fast; and, all unmindful of the breakfast-hour, we feasted and rested.

Suddenly we found ourselves no longer shaded by the wood to the east of us, for the sun had mounted high; and at the first touch of his scorching rays as we rose to our feet, we glanced at each other in dismay, for we had open ground to cross in getting home. My Virginia companion said that it would be better to ford the streams in the wood, than risk sunstroke by crossing a cornfield, our nearest way home.

This we decided to do, and having surmounted all obstacles, were almost within earshot of the house, when Ella, with a shriek, started and ran back, exclaiming, 'A moccasin!'

'What? where?' I eagerly inquired, trying to follow the direction of her eye.

'Oh, Miss Hopley, come back! Quick! Come away! Water moccasins are worse than rattlesnakes, for they dart at you!'

Sufficiently alarming, certainly; yet I wanted to *see* the terrible object, and ascertain how far off it was, and at length discovered the head and neck of a snake erect.

About a foot of it was visible, and might have been taken for a slight stem or stick standing perpendicularly out of the swampy herbage bordering the narrow path. The fixed eyes and darting 'sting'—which I then thought the tongue to be—seemed to endorse the character my young friend had given it. Yet I lingered, 'fascinated,' no doubt, by its gaze, the fascination in my case partaking of curiosity chiefly. The reptile remained so rigid that I was inclined to venture nearer; nor did I welcome the idea of having to retrace our steps and risk the open field under that Virginia sun. But Ella would not hear of passing the deadly snake. There were others, she was sure, in that swampy part.

Well, we reached home at last, more dead than alive, having discarded our treasured specimens and substituted sprays of enormous leaves with which to shield our heads from the sun. And I have ever reflected, that of the two dangers—snakes and sunstroke—we risked the greater in traversing that cornfield at such an hour.

Besides that 'deadly moccasin' and frequent 'black snakes,' there were 'whip snakes,' 'milk snakes,' and many others which the negroes would bring home as trophies of their courageous slaughter; but by no scientific names were they known there. Except this name *moccasin* or *mokeson*, which probably conveyed some especial meaning to the aborigines, few of the Indian vernaculars have been preserved in the United States, as we find them in other parts of America, which latter are treated of in chapters xxii. and xxiii. of this work; but common English names prevail.

After a time I proposed to write a book about snakes, starting with the stereotyped ideas that they all 'stung' in some incomprehensible way; that the larger kinds crushed up horses and cattle like wisps of straw; and that all, having viciously taken the life of the victim, proceeded with epicurean gusto to lick it all over and smear it with saliva, that it might glide down their throat like an oyster! There are those who to this day believe the same.

My proposed book was, however, simply to recount some adventures among the snakes which were encountered in our American rambles. It was intended for the amusement of juvenile readers, and to supplement the little work about my pet birds,[1] which had met with so kind and encouraging a reception.

But in order to merely recount an adventure with a snake, some knowledge of the reptile is essential. One must, at least, be sure of the correct name of the 'horrid thing' which lifted its 'menacing head' a few feet in front of us; such local names as 'black snake' and 'moccasin snake' affording no satisfactory information.

Nor were hasty references to books much more satisfactory. Mr. P. H. Gosse had been over the same ground, gathering many interesting items of natural history; but in his *Letters from Alabama* I could not decide on my moccasin snake. From this and his other works, and then from the authors quoted by him, I discovered only that there were many 'black snakes,' some deadly, others harmless. The same with the 'moccasin' snake, which was now of this colour, now of that. While one writer expatiates on the beauty of

[1] *Aunt Jenny's American Pets.* By Catherine C. Hopley. London, 1872.

the 'emerald snake,' a 'living gem, which the dark damsels of southern climes wind round their necks and arms,' another describes snakes of emerald green which are dreaded and avoided. One traveller tells of a 'coral snake' whose bite is fatal within an hour; while elsewhere a 'coral snake' is petted and handled. Equally perplexing were the 'carpet snakes,' 'whip snakes,' 'Jararacas,' and 'brown snakes.'

Nor were names the only puzzle to unravel; for in almost every other particular writers on snakes are at variance.

Those 'moccasin snakes' in Virginia were venomous, I was sure, having known of accidents from their bite. Hoping to become enlightened as to their true name and character, I repaired to the Zoological Gardens to ascertain if they were known there. Yes; there were several together in one cage, labelled 'Moccasins' (*Tropidonotus fasciatus*) 'from America;' but to identify them with the one in Virginia, of which I had seen only a short portion from a distance, was impossible. To add to the perplexity, Holland the keeper assured me these were 'quite harmless.'

'But are you *sure* these are harmless snakes? They are poisonous in America.'

'Well, miss, they have bitten my finger often enough for me to know,' returned Holland.

'Then there must be *two* kinds of moccasin snakes,' I argued, 'for the others are *extremely* venomous;' and I related my Virginia experiences, and that I had known of a horse bitten by one that had died in an hour or so, fearfully swollen.

'They have never hurt me,' persisted Holland.

Subsequently I discovered that in the United States this name *moccasin* is a common vernacular, first and chiefly applied to a really dangerous viper, *Ancistrodon pugnax* or *piscivorus*, the one, most likely, that we saw in the wood; and secondly, to a number of harmless snakes which are *supposed* to be dangerous, and of which those at the Gardens, *Tropidonotus fasciatus*, are among the latter. Thus at the very outset the puzzles began.

Nevertheless, after some research I learnt enough of snake nature to feel safe in proceeding with my book of *Adventures*, and in presenting it to a publisher.

'As a gift-book no one would look at it, and as an educational work there would be no demand for it,' was its encouraging reception.

This was about ten years ago; and so far from inducing me to relinquish the subject, I began to aspire to become a means of assisting to overcome these prejudices. For the space of two years the anticipated 'sequel' to my *American Pets* went the round of the London publishers of juvenile works, and to several in Scotland. It was read by many of them, who professed to have been unexpectedly and 'extremely interested' in it—'*but*'—none could be persuaded to 'entertain so repulsive a subject.' One member of a publishing house distinguished for the high standard of its literature, positively admitted among his insurmountable objections, that when a child his mother had never permitted him to look through a certain favourite volume late in the day, 'for fear the pictures of snakes in it should prevent his sleeping!'

An editor of a magazine told me he should lose his subscribers if he put snakes in its pages; and another made excuse that his children would not look at the magazine with a snake in it.

Perhaps this is not so surprising when we reflect that until within a late date snakes in children's books, if represented at all, are depicted as if with full intent of creating horror. They are represented with enormously extended jaws, and—by comparison with the surrounding trees or bushes — of several hundred feet in length; sometimes extending up a bank or over a hedge into the next field, or winding round a rock or a gnarled trunk, that must be—if the landscape have any pretensions to perspective—a long way off. Slender little tree snakes of two or three feet long are represented winding round and round thick stems and branches strong enough to support you. Into the chasm of a mouth from which an enormous instrument (intended for a tongue) is protruding, a deer the size of a squirrel (by comparison), or a squirrel the size of a mouse, is on the point of running meekly to its doom.

No wonder children 'skip' the few pages devoted to snakes in their natural history books, and grow up full of ignorance and prejudices regarding them. In no class of literature are original and conscientious illustrations more required than to replace some of those which reappear again and again, and have passed down from encyclopædias into popular works, conveying the same erroneous impressions to each unthinking reader.

The strongly - expressed opinions of publishers convinced me that the prejudices of adults must first be overcome before children could be persuaded to look at a snake as they would look at a bird or a fish, or to enter the Reptile House at the Zoological Gardens without the premeditated 'Aughs!' and 'Ughs!' and shudders.

During the two years that witnessed the MS. of *Aunt Jenny's Adventures* lying in first one and then another publishing house, an especial occurrence acted as a great stimulant, and induced an almost obstinate persistence in my apparently hopeless studies.

This was the sensation caused by the daily papers in reporting the case of 'Cockburn *versus* Mann;' and the 'SNAKES IN CHANCERY.' To the horror and dismay of the 'general public,' Mr. Mann, of Chelsea, was represented as 'keeping for his amusement *all manner of venomous serpents;*' or, as another paper put it, 'Mr. Mann had a peculiar penchant for keeping as domestic pets a large number of venomous snakes.' (I copy verbatim from the papers of that date.) That these 'water vipers and puff adders' were 'apt to stray in search of freedom;' or, 'being accustomed to take their walks abroad,' had 'strayed into the neighbours' gardens, to the terror of maid-servants and children;' and were 'now roaming up and down Cheyne Walk,' and 'turning the College groves into a garden of Eden.' So an action was brought against Mr. Mann: for the neighbours decided that 'there was no better remedy for a stray cobra than a suit in Chancery.' 'Everybody' during July 1872 was reading those delightfully sensational articles, and asking, '*Have* you heard about Mr. Mann's cobras?'

Mr. Frank Buckland was brave enough to venture into the dangerous precincts of Cheyne Walk, and even into the house of Mr. Mann, to test the virtues and vices of both the 'pets' and their possessors. He finally tranquillized the public mind by publishing accounts of his visit, affirming that not *one* of the snakes was venomous, but, on the contrary, were charmingly interesting and as tame as kittens. The testimony of so popular an authority served not only to allay local terrors, but to modify the sentence that might otherwise have been passed on the ophiophilist, who was merely cautioned by the honourable judge to keep his pets within due bounds.

After this, Mr. and Mrs. Mann and their domesticated ophidians held daily receptions. I was invited to see them, and in company with a clerical friend repaired to Chelsea. It was the first family party of snakes I had ever joined, and I must confess to considerable fluctuations of courage as we knocked at the door. Nor could one quite divest oneself of apprehension lest the boa-constrictors to which we were introduced should suddenly make a spring and constrict us into a pulp. But they didn't. On the contrary, towards ourselves they were disappointingly undemonstrative, and only evinced their consciousness of the presence of strangers by entwining themselves about the members of the family, as if soliciting their protection. They were very jealous of each other, Mr. Mann said; jealous also of other company, as if unwilling to lose their share of attention. There were half-a-dozen or more snakes—viz., several boas, of whom 'Cleo,' or Cleopatra, has become historical; two or three lacertine snakes from North Africa; and a common English snake. The smaller ones were regaled on frogs for our special edification. At that time I had never been to the Reptilium at the Zoological Gardens on feeding days, and when Mr. Mann permitted a frog to hop about the table, and we saw the ring snake glide swiftly towards it and catch it in its mouth, we could not comprehend what was to happen next. 'What *will* he do with it?' we both exclaimed. We had not long to wait. Somehow or other the frog, caught by its hind leg, got turned round till its head was in the snake's mouth and the hind legs were sprawling and kicking, but in vain. Then head-foremost it vanished by degrees into the jaws of the snake; while the head of the latter, 'poor thing,' seemed dislocated out of all shape! It was a wonderful but painful sight; for how the snake's head stretched in that amazing manner, and how the frog was drawn into the mouth, was past our comprehension.

An equally wonderful but far more attractive sight was Mrs. Mann, a graceful and charming little lady in black velvet, with Cleo coiling around her in Laocoon-like curves. The rich colouring of the beautifully-marked reptile entwining the slender form of the woman, the picturesque and caressing actions of Cleo, and the responsive repose of Mrs. Mann as the snake was now round her waist, now undulating around and over her head and neck, was altogether a sight never to be forgotten. Two sweet little children were equally familiar with the other boas, that seemed quite to know who were their friends and playfellows, for the children handled them and patted and talked to them as we talk to pet birds and cats.

Such were the 'vipers, cobras, and puff adders' that had figured in the daily papers.

After this, the reptile house at the Zoological Gardens became a new attraction. From there to the bookshelves and back again to the Gardens, my little book of adventures was discarded for a more ambitious work; but still was confronted by disaffected publishers, whom even the Chelsea snakes failed to convince of public interest.

Friends protested—and still demand—even while I write —'How *can* you give your mind to such odious, loathsome, slimy creatures?' and I boldly reply, 'In the hope of inducing you to believe that they are *not* odious and loathsome, and especially not "slimy," but in the majority graceful, useful, beautiful, *wonderful!*' And I invite them to accompany me to the Zoological Gardens, and endeavour there to contemplate a reptile as they look at the other denizens of the Gardens, simply as a member of the wide family of the brute creation, appointed by the Great All-wise to live and feed and enjoy existence as much as the rest, and that have to accomplish the purpose for which they were created equally with the feathered families which we admire and—devour!

And as whatever may be original or novel in this book has been obtained at the Zoological Gardens, I now invite my readers to accompany me in imagination to the Ophidarium, where we may learn how that little ring snake was able to swallow his prodigious mouthful without separating it limb from limb, as a carnivorous mammal would divide the lamb it has killed.

'But'—you exclaim in horror—'we do not wish to contemplate so painful, so repulsive a spectacle! How *could* you, how *can* you, stand coolly there and see that poor frog tortured and swallowed alive?'

Dear, tender-hearted reader, I did not, I *could* not, unmoved, contemplate this sight at first; nor for a very long while could I bring myself to watch a living creature being drawn into that living trap. Nor could we—you and I—feel aught but horror in visiting a slaughter-house and watching a poor calf slowly die. Nor could we, for pleasure merely, look coolly on at a painful surgical operation. Yet we know that such things must be. The life of the snake is as important as that of the frog. If we are to talk about cruelty, this book of natural history, and of intended—let me say, of hoped-for—usefulness, would become one of political economy instead. We might discuss the sport of the angler, the huntsman; the affairs of the War Office; of railroad managers and of road-makers; the matters of the Society for the Prevention of Cruelty to Animals; followed by an examination into the questions that have been ventilated in so-called 'benevolent organs;' and how some of them employ writers who in every tenth line betray their ignorance of the creatures they attempt to describe. Not even theology could be dispensed with in this work; for, since the time when Adam was told to have 'dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth,' the question of 'cruelty' has never been satisfactorily solved. Morally and broadly, let us understand it to mean *unnecessary* torture—pain and suffering that can be *avoided*, and which offers a very wide scope indeed. In the animal world, 'every creature is destined to be the food of some other creature;' and by these economies only is the balance of nature maintained. Happily we are spared the too vivid realization of the destruction of life ceaselessly going on throughout creation; the myriads of insects destroyed each moment by birds, the sufferings inflicted by the feline families and by birds of prey, the countless shoals of the smaller fish devoured—swallowed *alive* too!—by larger ones, or caught (and not too tenderly) for our own use. These things we dismiss from our minds, and accept as inevitable. We do not ventilate them in daily journals. Nor do we take our children to the slaughter-house or the surgery for their entertainment; or repair thither ourselves for the sake of minutely discussing afterwards the sufferings we have witnessed. You will, I hope, discover that the pain inflicted by the constrictor or the viper is not, after all, so acute as it is by some imagined to be. The venomous bite of the latter causes almost immediate insensibility; the frog which the ring snake ate probably died of suffocation, which also produces insensibility; the constriction of the boa—in its natural condition—produces also a speedy death. Besides, as Dr. Andrew Wilson, in a paper on this subject, has explained to us, the sufferings of a frog or a rat are not like *our* sufferings. Their brain and nerves are of a lower order.[1]

Permit me, therefore, in the outset, to dismiss from these pages the question of cruelty as not being a branch of zoology; and as we cannot prevent snakes from eating frogs, or the vipers from catching field mice (nor need we wish to do so, or the small quarry would soon become too many for us), let us examine the curious construction of a snake's head and jaw-bones that enables it to accomplish the task so easily.

With reference to the rapid development of science, it has

[1] 'Snakes and their Food,' *Modern Thought*, Jan. 1881, in reply to a paper in *Time* of the previous September.

been said that a scientific work is old as soon as the printer's ink is dry. Up to the moment of sending my concluding pages to press, I realize this; and remarkably so in the growing interest in the Ophidia. Writings on this subject are becoming so frequent that, while correcting proofs, I am tempted to add footnotes enough almost for another volume.

Several circumstances have combined to enrich ophiological literature within a few years; one which, in 1872, I quite think established a sort of new era in this branch of zoology, was the appearance of Dr. Fayrer's magnificent work, *The Thanatophidia of India*. Mr. Bullen, then the Superintendent of the Reading-Room at the British Museum, knowing that the subject was engaging my attention, informed me of the arrival of this book, and, with his ever kind thought for students, ordered it into the room for my express use; and I think I may affirm, that I was the very first 'reader' who had the privilege of inspecting the work, and, I hope, of helping to make it popular. For as day after day those huge folio leaves stood open, with the conspicuous and lifelike illustrations almost moving before your eyes, readers would linger and gaze, acquaintances would stop to inquire and inspect; some with a shudder would ask 'how on earth I could endure the sight of such fearful creatures?' while a few would manifest sufficient interest and intelligence to be indulged with a full display, and to whom I eagerly aired my convictions of the tremendous errors afloat concerning the snake tribe.

'Beyond the pale of science but little is known of Ophiology,' were Fayrer's words. Two years previously to this, in 1870, Dr. Edward Nicholson wrote his book, *Indian Snakes*, 'in the hope of dispelling the lamentable ignorance regarding some of the *most beautiful and harmless* of God's creatures.'

This enthusiasm is gradually spreading, and we now not unfrequently hear of domesticated snakes in English homes; both from friends who keep them, and from the correspondence of the *Field*, *Land and Water*, and similar papers, in whose columns inquiries for information are often made regarding ophidian pets. Lord Lilford, one of the kindest patrons of the London Reptilium, has, I believe, for many years been a practical ophiologist. There is one little favourite snake that figures in these pages of which his lordship gave an excellent character from personal acquaintance, 'the beautiful species *Elaphis-quater-radiatus*, as being the most naturally tame of all the colubrines, never hissing or trying to bite though frequently handled.' A noble lady not long since carried a pet snake to the Gardens. It was twined round her arm, where it remained quiet and content, though to the alarm of some monkeys who caught sight of it. Some members of our Royal Family, with the enlightened intelligence which displays itself in them all, have more than once paid visits to the Reptile House at the Zoological Gardens, where the keeper has enjoyed the high honour of taking snakes out of their cages to place in royal hands. The good-will and interest towards the inmates of the Ophidarium are likewise displayed by some country gentlemen in presents of game, in the form of ring snakes for the Ophiophagus and frogs for the lesser fry. Lord Arthur Russell, Lord Lilford, and other distinguished personages set excellent examples of this kind. All of which proofs of prejudices overcome are features in the history of ophiology, and especially in the last decade.

Then, in glancing at recent literature, a great change is discernible, more particularly so during the last two years, since the popular contributions of Dr. Arthur Stradling, a corresponding member of the Zoological Society, have imparted a novel interest to this branch of zoology. To this gentleman my own most grateful acknowledgments are due, as will be evident to the reader, not only for the zest imparted by his correspondence from Brazil, but for some important specimens presented to me by him, which have enabled me to describe them minutely from personal observations, as well as to add some original illustrations from them. Though my work and my studies were far advanced, previous to his valued acquaintance, yet I have been able to enrich my pages from his experience, and have added footnotes from his published writings.

Already, however, some few dispassionate students of nature among editors were promoters of herpetology, and I must here express my acknowledgments to the talented daughters of the lamented Mrs. Alfred Gatty (and editresses of that *facile princeps* among juvenile periodicals, *Aunt Judy's Magazine*), for having been the first to encourage and accept from my pen a snake in their pages, and subsequently several papers on ophidian manners and habits for their magazine.

In preparing 'Sketches of the Ophidians' for the *Dublin University Magazine*, December 1875, and January and February 1876 (in all, about forty closely-written pages), I, by request of the editor, included a paper on the venom and the various remedies, though, reluctant to intrude within the arena of professional science, a sort of summing up of evidence was all that I attempted. Having been thus required to glean some crude ideas from technical writings (which necessitated glossaries and dictionaries to be ever at hand), I again add a chapter on the 'Venoms' to my present work. Left entirely to my own independent conclusions, if I have ventured to think in opposition to some popular writers, and have even presumed to offer some suggestions of my own, I trust I may be treated with clemency.

With regard to the terrible death-rate from snake-bite in India, it does, however, appear to me that journalists who hold up their hands in horror, and write strong articles on this subject, lose sight of the religious and social condition of the low-caste Hindûs, who are the chief sufferers, and whose superstition is so fatal to them. *Snake-worship* is the root of the evil! *Education* must lower the death-rate. During the visit of H.R.H. the Prince of Wales to India, the entire programme was on one occasion interrupted because some Hindû children, to whom a feast was to be given, could not eat in the presence of Christians, whose 'shadow would have polluted their food,' or some obstacle of this nature. Similar difficulties arise when they are snake-bitten; their creed prohibits their having recourse to approved remedies. 'Snake-charmers' and native quacks are sent for instead, and often when cures are possible the fatalists submit to death.

To Professor Owen, who six years ago permitted me the honour of dedicating this contemplated work to him, and to others who were then led to expect its early appearance, I may be allowed to offer an excuse for tardiness. Like the creatures which fill its pages, I succumb to the chills of winter, and depend on the suns of summer for renewed vigour and activity. At one time impaired health, and the enforced suspension of literary pursuits under the threatened loss of the use of my right hand, were grievous interruptions.

Filial duties and domestic bereavements caused another two years' delay. Banished to the seaside, and the pen prohibited during the winter of 1874–75, I had almost despaired of turning my studies to account, when a new impulse arrived in the shape of a note from the editor of *Chambers's Journal*, begging to know if my 'work on the Ophidia was out, and by whom published'? My 'work on the Ophidia'? Could that mean my poor, despised little book that had been long ago submitted among others to those Edinburgh publishers? *My work on the Ophidia!* I began to get better from that day; and from that date, March 1875, I have had the inexpressible pleasure and privilege of including among my kindest and most sympathetic ophiological friends, the Editor of that popular journal. On the Ophidia, he entrusted me with work in various directions, encouraged by which I again returned to town, and to the Zoological Gardens.

If I am so fortunate as to afford instruction or entertainment in the following pages, my readers will join me in congratulating ourselves on the possession of so large and valuable a zoological collection as that in the Regent's Park, without which this book could not have been attempted. And I may embrace this opportunity of expressing my sincere thanks to the President and Council of the Zoological Society for the privileges and facilities afforded me at their Gardens, where not only the Reptilium but the annual series of zoological lectures there, given by the first biologists of the day, have been of inexpressible use to me.

I would also express my thanks to Professor Flower, Hunterian Professor at the Royal College of Surgeons, London, for his invariable courtesy in facilitating my examination of the ophiological specimens in the museum of that College, to which my honoured father (himself a member) attributed all the love of the study of natural history which from our earliest recollections were encouraged in his children. My thanks are also due to Dr. Günther of the British Museum for similar facilities there. Indeed, the words of encouragement given me, no less than six years ago, by the distinguished heads of the zoological department of our great national collection, sustained my courage in opposition to all counter influences *outside* the British Museum. When first contemplating and presenting some outline of this work to Dr. Günther, he honoured me by expressing his opinion that such a book was 'much needed;' that it would be 'extremely useful and interesting.' He was even so kind as to promise to state this opinion in writing to any publisher who might consult him on the subject. I here claim the pleasure of thanking my present publishers for dispensing with the necessity of troubling Dr. Günther, and for entrusting me with the preparation of this book, which, before a chapter of it was completed, they engaged to publish. Deficient as I feel it to be, it is at length launched on the doubtful waters of public criticism.

If any scientific eyes honour it with a glance, they will with clemency remember that, with no scientific knowledge whatever to start with, I have had to grope my way unaided, plodding over technicalities which in themselves were studies; and if, as no doubt is the case, any misapprehension of such technicalities has here and there crept in and misinterpreted the true meaning, I anxiously trust that the truth has not been altogether obliterated by such obscurities.

In conclusion, let me not omit a grateful tribute to the invariable kindness of the heads of the Reading-Room at the British Museum; and for their assistance in obtaining books of which I might never have known. The kindness of Mr. Garnett extended even beyond the Reading-Room; for while I was invalided at the seaside, and could only read, *not write*, he translated and forwarded to me some important pages from Lenz, a German ophiologist. To him, therefore, the thanks of the reader are also due.

In the choice of illustrations my aim has been rather to exemplify a few leading features than to attract by brilliantly-figured examples. Some of the woodcuts are borrowed from Günther's and Fayrer's works; others I have drawn faithfully from natural specimens; but in them all I am indebted to the kind and patient work of Mr. A. T. Elwes in reproducing my own imperfect attempts. And as it was impossible to draw a snake *in action* from life, or to witness a second time the precise coils or movements which had at first struck me as remarkable, the composition of some of these subjects was by no means an easy one. Our united efforts have been to represent the natural actions as far as possible, and this I hope may commend them to the reader.

There are few English persons who have not relatives in India, Australia, America, and Africa, and from whom they are continually hearing of escapes or accidents from snakes. Many letters from these friends beyond the seas find place in the columns of the daily journals. Whether, therefore, naturalists or not, a very large class of the intelligent public claims an anxious interest in the Serpent race, and to all of whom my OPHIDIANA or snake gossip is hopefully addressed.

CATHERINE C. HOPLEY.

LONDON, *October* 1882.

SNAKES:

CURIOSITIES AND WONDERS OF SERPENT LIFE.

CHAPTER I.

SEEING A SNAKE FEED.

IN any person who for the first time witnesses a snake with prey just captured, the predominant feeling must be one of surprise at the seemingly unmanageable size of the animal it has seized; and he probably exclaims to himself, or to his companion, as we did on the occasion described in the introduction, 'What will he do with it?' Let us again take our common ring snake, *Coluber natrix*, that ate a frog for our edification; only, in the present instance, instead of seeing a tame snake in a private residence at Chelsea, we will suppose ourselves to be watching one on the banks of a stream in fine summer weather. A slight movement in the grass causes us to turn our eyes towards the spot, and we are just in time to see the quick dash, and the next instant a recalcitrant frog held aloft in the jaws of a snake that with elevated head glides up the bank. Coluber's head is no bigger than a filbert, and the frog is nearly full grown, its body inflated to twice its original size, and its legs, of impracticable length and angles, kicking remonstrantly.

'How in the world is the snake going to manage it?' again you exclaim, and your amazement is not exceptional. It is what has been witnessed and heard weekly in London when the public were admitted to the Reptilium on feeding days, and it is what the reader will recall in his own case when first informed that a snake was going to swallow that monstrous mouthful undivided.

In the present instance, the injury to froggie's feelings thus far partakes more of moral than of physical pain, for the grasp of the snake is not violent, and he finds that the more he struggles the more he injures himself. Yet he kicks and struggles on, at thus being forcibly detained against his will. In the mouth of the snake he is as proportionately large as the shoulder of mutton in the jaws of the dog that has just stolen it from the butcher's shop. How do the canines manage unwieldy food? The dog can tackle the joint of meat, big though it be, because he has limbs to aid him, and he was prepared for emergencies before he stole it. He knew of a certain deserted yard up a passage close by, and of some lumber stacked there; he watched his opportunity, and is off to his hiding-place; and once hidden behind the lumber, he settles down quietly with his ill-gotten dinner firmly held between his fore-paws, while, with eyes and ears on the alert, he gnaws away.

The snake, no doubt, knows of a hole in the bank, or in a hollow tree, in which he can hide if alarmed; but he cannot set his frog down for one instant, nor can he relax his jaws in the slightest degree, or his dinner hops away, and he has to pursue it, or wait for another frog, when the same thing may happen again. He has only his teeth to trust to, and these have all the work of paws and claws, and nails and talons, to accomplish, while yet, not for one instant, must they relinquish their hold.

'Besides!—how much too big that frog is for Coluber's small mouth!' And we continue to gaze in wonderment, filled with amazement that brings us to the book-shelves, to endeavour to comprehend the phenomenon. Not, however, until we have seen the end of that frog on the banks of the stream, where the reader is supposed to be waiting.

First, let me explain that in the manner of feeding, snakes may be divided into three classes, viz. those that kill their prey by constriction or by smothering it in the coils of their body; those that kill by poison; and some smaller kinds, which, like the ring snake, eat it alive—the latter a quick process, which may also be said to be death by suffocation. Our little Coluber is in a spot where we can watch it easily; so we keep rigidly still, and soon perceive that though the snake just now had hold of froggie's side, he now has the head in his mouth. How can this be? and how has he managed to shift it thus, almost imperceptibly, while seeming to hold it still? Now the head begins to disappear, and the snake's jaws stretch in a most distorted fashion, as if dislocated; its head expands out of all original shape, while slowly, slowly, the frog is drawn in as if by suction. Now its legs are passive; they no longer kick right and left, but lie parallel, as by degrees they also vanish, and only the four feet remain in sight. These presently have been sucked in, and the skin of the snake is stretched like a knitted stocking over the lump which tells us just how far down Coluber's neck the frog has reached. Gradually the lump gets farther and farther down, but is less evident as it reaches the larger part of the body. The snake remains still for a few moments till his jaws are comfortably in place again; then he yawns once or twice, and finally retires for his siesta, and we to the bookshelves.

'Snakes work their prey down through the collapsed pharynx,' says Günther. That is, the muscles of the throat seize upon what is presented to them, and do their part, as in other animals. Only, in most other animals there is the *action* of swallowing, one mouthful at a time; whereas in serpents the action is continuous, the throat going on with the work begun by the teeth, which in a snake is only grasping and working the food in with a motion so gradual as to simulate suction. The reason why the head and jaws have been so enormously stretched and distorted, is because all the bones are, in common language, *loose;* that is, they are not consolidated like the head-bones of higher animals, but united by ligaments so elastic as to enable them to separate in the way we have seen. This extends to the jaws, and even to the palate, which is also armed with teeth, two rows extending backwards. The lower jaw or mandible being extremely long, the elastic ligament by which the pair of bones is connected in front, forming the chin, enables them to separate widely and move independently. This is the case in a lesser degree with the palate bones, and the upper jaw-bones, all six being furnished with long, fine, recurved, close-set teeth, adapted for *grasping* and *holding*, but not for dividing or for mastication in any way.

For, as we have seen, if a snake were to open its mouth one moment for the purpose of what we call *biting*, the prey would escape. In addition to a very unusual length, the lower jaw is joined to the skull by an extra bone,—one which is not found in mammals, but only, I think, in birds,—a long 'tympanic' bone, which forms an elbow, and permits of that wide expansion of the throat necessary for the passage of such large undivided prey.

The illustration of the skeleton of a cobra, on p. 33, will enable the student to distinguish the principal head-bones. There is so much similarity of construction throughout the whole ophidian families that a cobra is chosen here, because the unusually long anterior ribs which form the hood can be observed, and the expansion of which is described elsewhere. The longer teeth in the upper jaw are here fangs; the inclination of the other rows of teeth and the bones sufficiently illustrate those of the non-venomous kinds generally, such as the little ring snake that has just swallowed his frog. A few of the larger constricting snakes possess an additional bone—an intermaxillary in front between the upper jaws, very small, yet sometimes furnished with two or four teeth, thus facilitating the expansion of the jaws as well as the retention of the food.

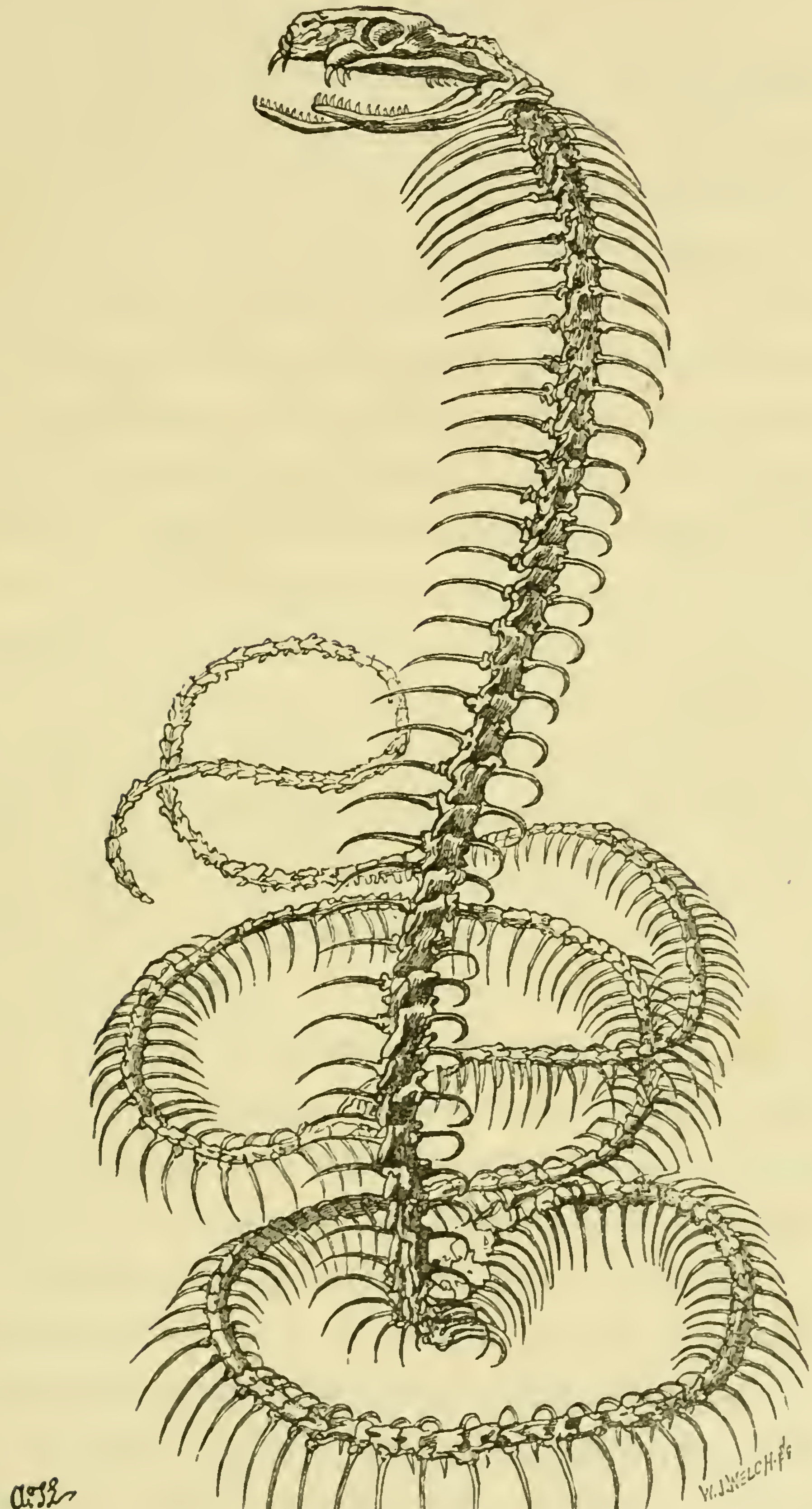
It is this adaptive development of head-bones that enabled *Coluber natrix* to turn his frog round to a more convenient position, and then draw it into his mouth so gradually that we scarcely comprehended how it disappeared. The six rows of small teeth form six jaws so to speak, each one of which advanced a very little, while the other five were engaged in holding firmly. In those largest pythons which have the little bone in front between the two upper jaw-bones (intermaxillary) we may say there are *seven* jaws. As those gigantic snakes have to deal with proportionately large and strong prey, they are thus enabled to retain and manage it.

In the graphic language of Professor Owen let me recapitulate.

The mouth can be opened laterally or transversely, as in insects, as well as vertically, as in other vertebrates. The six jaws are four above and two below, each of which can be protruded or retracted independently of the others. 'The prey having been caught and held, one jaw is then unfixed by the teeth of that jaw being withdrawn and pushed forward, when they are again unfixed farther back upon the prey; another jaw is then unfixed, protruded, and re-attached, and so with the rest in succession. This movement of protraction, being almost the only one of which they are susceptible, while stretched apart to the utmost by the bulk of the animal encompassed by them : and thus by their successive movements, the prey is slowly introduced into the gullet.'[1]

This working of the jaws would be almost imperceptible excepting to a very close observer. In the lower jaw-bones the independent action can be more readily perceived

[1] *Odontography.* By Richard Owen. London.



Skeleton of a Cobra (from Owen's *Anatomy of the Vertebrates*).

and is often very grotesque, one side of the mouth opening while the other is closed, conveying the idea of the reptile making grimaces at you; but the gradual disappearance of the prey so much more bulky than the snake itself is quite incomprehensible until we are acquainted with the remarkable phenomena of the six rows of teeth acting independently. Thus, in turning the frog round to adjust it to a more convenient position, the jaws acted like hands in moving, dragging, or shifting some cumbrous article, say a carpet or a plank, when the left hand follows the movement of the right hand until the plank or carpet is worked round or forward in the required direction.

The form and arrangement of the fine claw-shaped teeth assist the process. They are too close together, and the pressure is too slight to inflict a wound; they merely retain what they hold, and it is in vain for the prey to struggle against them, or it might get some ugly scratches as they all incline backwards. In chapter xix. illustrations of teeth, life-size, show their forms and direction; here it only need be added regarding them, that the above description refers chiefly to the non-venomous snakes.

The palate being covered with that armoury of teeth, the snake must have but a slight sense of taste, which is to its advantage, we should say; for having no assistant in the shape of beak or limbs to divide its prey, hair, fur, feathers, dust—all must be swallowed with the meal, completely disguising whatever flesh they cover, so that we should suppose the process of feeding could be productive of very little enjoyment to the reptile. Perhaps out of this state of things has developed their habit of eating so seldom, but when they do take the trouble of feeding, of doing it thoroughly, so that their meal lasts them a long while.

Deglutition is greatly facilitated by an abundant supply of saliva, which lubricates that uncomfortable coating of feathers or fur; but 'lubrication' is understood to refer merely to the natural secretions of the mouth, in which the tongue performs no part at all.

The salivary apparatus of snakes is peculiar to them, and very complicated. Even the nasal and lachrymal glands pour their superfluous secretions through small canals into the mouth.[1] These active and abundant glands are excited by hunger or the sight of food, just as in mammals; and for the more common expression of the mouth 'watering' that of 'lubrication' is here used, because over the rough-coated prey these salivary secretions act as a great aid in deglutition. The erroneous impressions that have obtained on this subject are touched upon in describing the tongue (chap. vi.).

A circumstance happened at the London Zoological Gardens a few years ago, which, although familiar to many, may be referred to as bearing on two of the above features—namely, the dull sense of taste in a snake, and the abundant supply of mucous secretions. It was in the case of a large boa which swallowed her blanket. She was about to change her skin, and, as usual on such occasions, was partially blind, as also indifferent to food. The rabbits given to her dodged her grasp, and her appreciation of flavours was not sufficient to enable her to discriminate between blanket and rabbit fur; so, seizing a portion of

[1] *Essai sur la Physionomie des Serpents.* Par Herman Schlegel. Paris, 1837.

the rug, she with natural instinct constricted this, and proceeded to swallow it. She was, however, made to disgorge it afterwards, when it was scarcely recognisable from the thick and abundant coating of mucous in which it was enveloped. Mr. F. Buckland described its appearance as that of a 'long flannel sausage.'

These highly-developed salivary glands are beneficent provisions in the economy of the serpent race. The reptile cannot, as we said, tear flesh from bones, and discard the latter; nor separate the food from the enveloping feathers or fur; nor reject whatever unsavoury portions other animals might detach and leave uneaten. All must be swallowed by a snake, and all digested; and its digestion, sufficiently powerful, is aided by the excessive flow of saliva, or the insalivation of such food.

It is not difficult to make snakes disgorge their food. They often do so on their own account, when, after swallowing some bulky meal, they are alarmed or pursued, and escape is less easy with that load to carry. The illustration exhibiting the numerous ribs, which are all loosely articulated with the spinal column, enables us to comprehend the capacity for bulk, and the ease with which these fine ribs would expand to accommodate a body even broader than the snake itself. We comprehend, also, why it is that a creature swallowed alive need not be injured or wounded by the mere fact of being swallowed, but would die of suffocation after all. A frog has been known to turn round and escape from the body of the snake, if the latter indulge in a prolonged yawn; and yawning almost always does follow as soon as the prey is swallowed, because the snake has for the time breathed less regularly, and now requires to take in a fresh supply of air. In this act you see the two jaws extended to an enormous degree, almost, indeed, to form one straight line perpendicularly. In such condition the teeth are well out of the way, and the adjustable ribs, expansile covering, and loose head bones render them not insurmountable obstacles to an escape when the prey is uninjured.

One sometimes hears of the egg-stealing snakes, cobras, etc., when surprised and pursued, first relieving themselves of their plunder before they attempt to escape. Often it may be observed, when two snakes are in a cage together, and both get hold of the same frog or rat, that they each advance upon it till their heads meet, when either the stronger or the larger snake will gain the day, and finish his frog, and then proceed to swallow his friend; or else one will relinquish his hold, when, even in those few minutes, the half-swallowed prey will be completely disguised in the mucous saliva which has already enveloped it.

Some snakes, though not quarrelsome at other times, for some reason inexplicable to the looker-on, persistently set their heart on the same bird or frog, though many are presented for their choice. In a pair of *Tropidonoti* at the Gardens this occurs almost every week; and in such instances the keeper keeps a sharp watch over them; for as neither snake will relinquish its capture, the one that begins first comes in contact with the head of his comrade, who will assuredly be swallowed too, were not a little moral, or rather physical coercion in the shape of a good shaking administered. Sometimes both get their ears boxed, figuratively;

yet the discipline has no more than a passing effect, and next week the same thing happens again.

Not many months ago a very valuable snake was thus rescued literally from the jaws of death. A South American rat snake (*Geoptyas collaris*) began to eat a rabbit that was put in the cage for a python, which also began to eat it. *Collaris* would not let it go, and so the python continued to advance upon it until he came to his comrade, and proceeded with this prolonged repast. *Collaris* is a rather large snake of some eight or ten feet long. When nearly the whole of him had vanished, the keeper—who, of course, had been occupied at each cage in turn—fortunately discovered about a foot of tail fast disappearing in the mouth of the python, the whole of *Collaris*, excepting this caudal portion, having been swallowed. Just in time to rescue the victim, the keeper, by his experienced manipulation, made the python open his mouth, while the assistant helped to pull at *Collaris*. At last they pulled back all the seven feet of snake, which sustained no further injury than a slight scratch or two against the python's teeth; but he seemed none the worse, and was no sooner free than he seized a rat, constricted and ate it with a celerity which seemed to say he would make sure of a meal this time.

On the following Friday the very same thing was about to occur again. *Collaris* had begun to swallow the python's rabbit, the latter having prior hold; but the keeper was on the watch, and administered a little practical reproof which made the rat snake loosen his hold. Matters were further complicated on this occasion by the python throwing some coils around his intended feast, so that to get a purchase and manage these two constrictors was less easy than on the previous occasion, though then the snake had been swallowed. In the same cage were also two other pythons, quite strong enough to strangle a person had they taken a fancy to hug him round the neck. Both were aroused and displeased at the commotion, and ready to 'fly' at the men, who, on the whole, had an exciting time with the four constrictors, all from eight to twelve feet long.

Cannibalism is very common in snakes, particularly among the *Elapidæ*, which have small and narrow heads, and can therefore more conveniently swallow a fellow-creature than a bird or a quadruped. The keeper told me that often a box arrives at the Gardens labelled 'Ten cobras,' or 'twelve,' as may be; when, on opening the box, the number falls short; suggesting that cannibalism has diminished the company. It is a curious fact, however, that snakes, as a rule, seize prey whose bulk far exceeds their own, even when a more manageable kind could be easily caught. It is as if they were aware of the accommodating nature of their multifold ribs; as a snake longer than themselves must be doubled up in their stomach, and those broader than themselves must, one would imagine, be a most uncomfortable meal to dispose of. Yet this is common. Mr. H. W. Bates found in a jarraraca an amphisbœna larger than itself, and in another snake a lizard whose bulk exceeded its own. My Brazilian correspondent, Dr. Arthur Stradling, wrote me of a similar circumstance. He received a little *Elaps lemniscatus* in Maceio, which presented a singularly bloated appearance. It no doubt felt itself in a condition not favourable to rapid escape; or captivity impaired its digestion, for 'the next morning it disgorged an amphisbœna or small serpent (it was half digested) actually longer than itself, and weighing half as much again.'

Prodigious meals engender drowsiness, and thus the Ophidia habitually repose a long while after taking food.

This habit of gorging enormous prey being one of the most striking of ophidian characteristics, it has been introduced thus early in my work, as affording opportunity for a general glance at the anatomical structure. In the next chapter we will enumerate a few other peculiar features, ere proceeding to examine in detail some of the most important organs.

CHAPTER II.

SNAKES OF FICTION AND OF FACT.

IN a celebrated lecture on 'Snakes,' given by Mr. Ruskin at the London Institution in March 1880, he introduced his subject with the three considerations: 'What has been thought about them?' 'What is truly known about them?'—extremely little, as he suggested;—and, 'What is wisely asked about them, and what is desirable to know?'

The three questions exactly agree with the object of my work, this chapter especially; and I will invite my readers to seek in their own minds the answer to the first question, which will also furnish a solution to the second, and, I trust, incite some interest in the third.

The learned lecturer carried us through the realms of fancy, to conjure up all the grotesque creatures which, under the name of 'serpents,' have figured in heraldry and mythology. By these, and by the light of the poets of old, and in later times through the naturalists of the sixteenth and seventeenth centuries, we learn what a 'serpent' was to them, and what it included. In remote antiquity it was an embodiment of the hideous and the terrible; and in spite of Aristotle (a comparatively recent authority), dragons and such-like chimærical creatures have pervaded the mind both of the erudite and the ignorant, in association with serpents, till within three hundred years, and are not even yet altogether discarded.

Nor am I inclined to believe that the terror-inspiring representations of classic days are so unreal as might be supposed. Palæontology is continually bringing to light new evidences of the presence of man on the earth in ages far remote; and we do not know for certain what strange forms of animal life were his contemporaries, or when the faculty of speech was so far developed in him as to enable him to learn about his predecessors, which were still more terrible. We do know that fossils of mammoth creatures, passing strange, are coeval with fossil human remains, and to those early types of humanity a knowledge of still stranger creatures of reptilian forms may have been handed down from mouth to mouth; for there is generally a germ of truth at the root of a myth. Fossil remains tell us of the gigantic forms of ancient reptiles, or compound reptile-fish or reptile-birds, and quadrupeds which have gradually diminished in size or become altogether extinct as our own period has been approached.

Said Professor Huxley, at the British Association in 1878, 'Within the last twenty years we have an astonishing accumulation of evidence of the existence of man in ages antecedent to those of which we have any historical record. Beyond all question, man, and what is more to the purpose, intelligent man, existed at a time when the whole physical conformation of the country was totally different from that which now characterizes it.'

Did these intelligent beings know anything of the *Dinotherium* (dreadful beast), or the *Dinornis* (dreadful bird), or any other of those fearful forms which have furnished historic ages with a dragon?

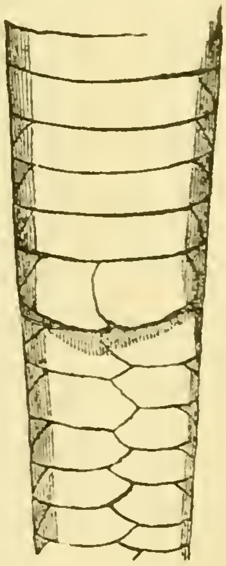
Coming down to our own era, and the time when travel and education first induced the observation and study of animals with a view to learn their habits, and to arrange them under some system of classification, we begin to see the perplexities that presented themselves to naturalists, especially with regard to egg-producing creatures. To Topsell, a writer of the seventeenth century, every creeping or crawling thing was 'a Serpente,' and many insects were included in his category. To Lawson, on the contrary, every egg-producing creature, if not a bird, was an 'Insect.' In his *History of Carolina*, 1709, he describes, under 'Insects of Carolina,' all the snakes he saw, also the alligators, lizards, etc., and thus continues: 'The Reptiles or smaller Insects are too numerous to relate here, the Country affording innumerable quantities thereof; as the Flying Stags with Horns, Beetles, Butterflies, Grasshoppers, Locusts, and several hundred of uncouth Shapes.' Having thus gone through the 'Insects,' except the 'Eel-snake' (which turns out to be a 'Loach' or *leech*), he gets puzzled over a 'Tortois, vulgarly called Turtle, which I have ranked among the Insects, because they lay Eggs, and I did not know well where to put them.' And Lawson was not alone in not knowing 'where to put' a countless number of other creatures that go to form the endless links in the long chain of living organisms; even plants, which, to use Darwin's words, 'with animals, though most remote in the scale of nature, are bound together by a web of complex relations.' You may place the dove at one end of the chain and the crocodile at the other, without one broken link. The earliest bird which palæontology has revealed had teeth in its bill, claws on the end of its wings, and a long tail with feathers growing out of it, like a pinnate leaf.

We see those strange forms reproduced in the gardens of the Crystal Palace. Lizards with the head of a bird and other combinations, the Pterosauria or winged-lizards, Ichthyosauria or fish-lizards, of which some representative types still exist in the African *Lepidosiren* and the Mexican *Axolotl*, which have puzzled modern physiologists as much as the Carolina tortoise puzzled Lawson; for whether to call them reptiles or fishes was long a disputed question. Dr. Carpenter, in his *Zoology*, reckons fifty-eight of such links among reptiles; as, for instance, the transition from turtles to crocodiles, from tortoises to lizards, in which latter we find the legs growing shorter, till they are gone altogether in the blindworms and amphisbænas. These again branch off to the cecilias, and the cecilias to worms on one side, and to frogs on the other, having the form of a snake, but the skin of the batrachian. There are the Ophiosaurians, snake-lizards, and Saurophidians, lizard-snakes; there are lizard-like frogs and frog-like lizards; some of them beginning life with gills, and becoming air-breathers afterwards, others of saurian aspect retaining their gills through life; and from these, again, is the transition between reptiles and fishes. There are diminutive snakes of worm-like aspect, and gigantic worms which might be mistaken for snakes; and among modern naturalists, that is to say within one hundred years, worms have been classed with reptiles when none such enormous species as those lately found in Africa were dreamed of.

There is in no branch of zoology so much confusion as in herpetology; and if the reader will, with a sweep of the imagination, embrace the innumerable forms that come under the class *Reptilia*, their various coverings, and their close gradations, he will not wonder at this. Let us glance at a few of the systems adopted by Linnæus and others of his time, who, we must remember, had to combat not only inherited ideas of 'creeping things,' but the difficulties presented by badly stuffed or bottled specimens; the latter often having been so long in alcohol that their colours had flown, or their covering changed in texture. The Atlantic was not crossed in a week in those days; and three months, instead of three weeks, barely sufficed to reach India, to say nothing of inland journeys when you got there. If foreign specimens came home after the manipulations of a taxidermist, he had done his very best to render them as hideous as tradition painted them. Sometimes a wooden head on a stuffed body; teeth that might furnish the jaws of the largest felines, and a tongue to match; while with external cleansings, scrapings, and polishings, it were hard to discover what manner of skin had originally clothed the creature.

Carefully chosen was Aristotle's name for reptiles, 'the terrestrial, oviparous, sanguineous animals;' for those which we are considering, breathe by lungs, and are therefore red-blooded. Cuvier divided the egg-producing animals into oviparous quadrupeds (lizards, turtles, crocodiles, and frogs); bipeds, the birds; insects and serpents. Linnæus—who, by the way, preceded Cuvier—called all reptiles 'amphibious animals,' of which serpents were the second order, those 'without limbs.' He also divided them into orders, genera, and species; but in the Ophidia was guided too much by the scales, which has caused confusion ever since, as both poisonous and harmless snakes often present similar characters in this respect.

If the reader will turn to the illustration of scales (p. 193), he will see an example of the large scutæ or ventral plates that are possessed by the majority of the true Ophidia. The burrowing snakes, most of them small and allied to lizards in their structure, are protected by a cuirass of hard, close-set, polished scales, *alike all round;* or else with a thick, smooth skin arranged in rings. Some very poisonous serpents, notably the sea-snakes, have also the scales alike all round, because they do not require the hold which those large ventral scales afford to land serpents in progression; but it will at once be seen that on so slight a resemblance it would be unsuitable to arrange such widely-differing families in the same group. The majority of snakes have the scales under the tail different from those under the body; and a very large number, both of venomous and innocuous snakes, have broad ventral scales, as far as the termination of the body, and then a double row where the tail commences. The accompanying illustration is sufficient to convey



a general idea of the arrangement of the scales before and after the anus.

Linnæus called all serpents with these two rows of subcaudal scales, *Colubers*, including under this name many both large and small, land and water, poisonous and harmless snakes. In respect for the great talent and vast work accomplished by this eminent naturalist, as well as his then paramount and diffusive knowledge, his systems prevailed for a very long while. Cuvier, after Linnæus, became also a great authority for a time. He recognised distinctions in the fangs of venomous snakes, and would reform some previous errors regarding scales. '*Boa* comprenaient autrefois tous les serpens venimeux ou non, dont le dessous du corps et de la queue est garni de bandes d'une seul pièce.'[1] It was equally unsuitable to mingle those with the double rows, as it put a viper and a coluber together. Cuvier also made closer distinctions between the lizard-like snakes and the true Ophidia, '*serpens proprement dit.*' The words *herpetology* (from the Greek), and *serpents* (from the Latin *sérpo*), formerly embraced a much larger variety; the former may include *all* reptiles, while the more recently adopted one of *ophiology* comprises snakes only. And the history of the word tells of the history of the distinctions gradually adopted as above described, as the true snakes or serpents, without external limbs, were separated from the rest.

The various names for a snake—Anguis, Serpens, Coluber, etc.—having been made generic distinctions by some of the older naturalists, cause considerable puzzle to the student,

[1] *Règne Animal*, p. 108. Paris.

who finds these words applied alike to many varying species in as many books, because a writer has often taken one author for his guide, instead of comparing a number. Many modern writers on ophiology give us a list of synonymes, which in time are found to unravel the above perplexities, but which are at first more puzzling than not, because a single snake is presented to you under so many different names. This will be apparent in the course of this work, wherein much that is merely suggestive in the present chapter will be treated more fully under various headings, without, I trust, offering a too wearisome repetition. Indeed, the whole study of the Ophidia presents so many exceptions that recapitulations may be acceptable rather than otherwise. An interlacing of subjects has not here been avoided so much as contrived, in the hope of presenting the whole more clearly to the mind of the student.

Ruskin favoured his audience with printed lists of the 'names of the snake tribe in the great languages.' And these I gladly reproduce for the benefit of my readers.

'Names of the Snake Tribe in the Great Languages.'

1. Ophis (Greek), 'the seeing' (creature, understood). Meaning especially one that sees all round it.

2. Dracon (Greek), Drachen (German), 'the beholding.' Meaning one that looks well into a thing, or person.

3. Anguis (Latin), 'the strangling.'

4. Serpens (Latin), 'the winding.'

5. Coluber (Latin), Couleuvre (French), 'the coiling.'

6. Adder (Saxon), 'the grovelling.'

7. Snake (Saxon), Schlange (German), 'the crawling' (with sense of dragging, and of smoothness).

The first, and *Ophidion*, a small serpent, *Ophiodes*, etc., have given the name *Ophiology* to the science; the second was also a 'serpente' in days of yore. The third, *Anguis*, is now applied to some of the smooth, burrowing snakes; and the rest speak for themselves.

Before quite taking leave of obsolete teachings, a few lines from two very distinguished authors of the seventeenth century must be quoted, the influence of both having no doubt gone a great way towards diffusing beliefs. Lord Bacon—in his book, *Of the Proficience and Aduancement of Learning, Diuine and Humane.* To the King. 1605—writes, 'It is not possible to join Serpentine Wisdom with the Columbine Innocency, except men know exactly all the conditions of the Serpent; his Baseness and going upon his Belly, his Volubility and Lubricity, his Envy and Sting; for without this, Virtue lyeth unfenced.'

What quality is to be understood by 'Volubility,' the reader must decide. Of the other five offences, all except that of crawling are simply imaginary. By 'Lubricity,' a supposed sliminess may be intended, or the old fable of 'licking' the prey; and the only reasonable interpretation of the 'Sting' is that the old Saxon word *styng* did imply a wound punctured or pierced with any fine, sharp instrument; and the venomous tooth is not so very unlike an insect's sting after all.

The next is from *Pepys' Diary*, vol. i. p. 322.—Feb. 4th, 1661 :—'Mr. Templer, an ingenious Man, discoursing of the Nature of Serpents, told us that some in the waste Places of Lincolnshire do grow to a Great Bigness, and do feed upon Larkes which they take thus :—They observe when the Larke is soared to the Highest, and do crawl till they come to be just underneath them, and there they place themselves with their mouth uppermost ; and there, as it is conceived, they do eject Poyson upon the Bird ; for the Bird do suddenly come down again in its course of a Circle, and falls directly into the Mouth of the Snake.'

This story, founded on fact, is related by a beholder who, to use the words of Dr. Andrew Wilson when discoursing on 'Zoological Myths,' made 'an unscientific use of his imagination.' Our largest English snake has no poison to 'eject, as it was conceived.' Quite possible that it might have looked up towards the singing lark, and with the swiftness of the bird in its descent, glided towards the spot, ready to pounce upon it. The absurdity of poison being ejected upwards through a needle-like fang,—had the snake possessed such an instrument,—and to such a height, is evident.

Having reduced a very large circle of anomalous reptiles, till the Ophidia only are in possession of the enclosure, let me endeavour to dispose of these according to the present accepted methods—not of classification, or this volume would be mere lists of names. In 1858, when Dr. Günther arranged and classified the collection in the British Museum, there were 3100 colubrine snakes (those with no viperine features) ; and when you think of these three thousand odd having, on an average, a dozen names each (the reason for which is deferred till the later chapters), my readers will cheerfully dispense with much in the way of classes and orders, especially as the present methods are reckoned very defective, and there is a loud cry for a new classification of the *Reptilia*. Already the reader can surmise some of the difficulties, and they will be more evident as we proceed.

The whole order of Ophidia may be divided into the venomous and the non-venomous, or into other two divisions, viz. those which approach the Saurians, having scales alike all round, vestiges of shoulder bones and hind limbs, and with ribs nearly encircling the body; and those which have the broad ventral plates, no rudimentary limbs, and a tongue far more extensible than the previous group.

It will not, I trust, be out of place to introduce a table as presented to us at some of the 'Davis Lectures' at the London Zoological Gardens; for I think I am safe in saying this arrangement is adopted by nearly all our living authorities. To go back to the days of our childhood and the game of 'Animal, Vegetable, or Mineral?'—the original three kingdoms of Nature,—the first heads our table: ANIMAL KINGDOM. Next comes the sub-kingdom, comprising five divisions, namely mammals, birds, reptiles, frogs, and fishes, each of which is divided into class, order, family, genus, species, with sometimes a sub-class or a sub-order. Professor St. George Mivart divides the whole of the reptiles into—(1) *Chelonia*, the tortoises; (2) *Ophidia*, the snakes; (3) *Crocodilia*, or *Loricata*, the crocodiles; (4) *Sauria*, the lizards. *Batrachia*, the frogs, he separates, because they begin life as a fish. Originally there were nine orders of reptiles; then for a long while we were taught that there were four,—Chelonians, Ophidians, Saurians, and Batrachians. Every one of the above so merges into the others that many herpetologists differ in drawing the lines between them.

If we were asked to define our little friend, the ring snake, that ate a frog while we were studying his anatomy, we would say that he belongs to the—

1. Animal Kingdom.
2. Sub-Kingdom, *Vertebrata.*
3. Class, *Reptilia.*
4. Order, *Ophidia.*
5. Family, *Tropidonotus.*
6. Genus, *Coluber.*
7. Species, *Natrix.*

He is most frequently known as *Coluber natrix*, though as both words mean simply a snake, the name is inadequate. In fact, our common English snake has been rather neglected in the way of titles, the only generic name which is at all descriptive being *Tropidonotus*, so called from the keel which characterizes the scales. So he is *Tropidonotus natrix*, and *Natrix tropidonotus*, and *Natrix torquata* of the different authors, the last-named specific presumably given on account of the collar which he wears, and which being often yellow, has gained for him the name of 'ring snake.' *Coluber natrix*, having so few synonymes, they are all given, in illustration of what has been already said of the perplexity of names assigned by different naturalists. And, by the way, this 'ring' or 'collar' is not an invariable mark. Sometimes the yellow is wanting altogether, and only a white collar is displayed. At the time of writing[1] there is one of these snakes at the Zoological Gardens with not the least tint of yellow on its neck; and I have before me in alcohol a very young and beautiful little specimen in which the white collar is very bright and large, and set off with deep black behind it, but there is not an approach to yellow or to a ring, the throat being pure white. His Latin specific is therefore more appropriate than his English one, the collar being always there, but not always the ring.

Dr. Günther divides the whole of the Ophidia into five groups, and in briefly describing these I shall hope to conduct my readers towards a consideration of those remarkable features which will be discussed under their various heads, and which will exhibit the class as unique in their marvellous organization and physical powers.

The five groups are—

1. Burrowing Snakes.
2. Ground Snakes.
3. Tree Snakes.
4. Fresh-Water Snakes.
5. Sea Snakes.

(1) The *Burrowing Snakes* live chiefly underground, some of them working their way down like the worms; and to fit them for this life they are characterized by having short stiff bodies covered with hard, firm, close scales, to form an

[1] January 1882.

armour. Most of them have short and rather curious tails, as described in chap. xi.; but many that burrow and hide in the ground live a good deal on the surface as well. Our little native slow-worm (*Anguis fragilis*) is allied to these. Their heads are small and narrow, their muzzle smooth and strong to help them to work their way. Their jaws do not stretch apart, nor does their head get out of shape in eating, the bones being all more consolidated; and their food being chiefly insects, slugs, worms, etc., they seize upon these, and hold them, and then with quick snaps get them down their throats. Many of them have rudiments of a sternum, and pelvic bones—*vestiges*, perhaps, is a more correct term, as we shall find by and by, for their saurian ancestors had perfect limbs. The group is large, perfectly harmless, and has representatives in most countries where a snake or a lizard is to be found. None are of great size.

(2) The *Ground Snakes* include by far the greatest number and diversity, and though passing their time chiefly on the surface like our 'ring snake,' can both climb trees and enjoy the water. Some of the most venomous as well as the harmless and gentle kinds, and some of the largest as well as the smallest, live habitually on the ground. To fit them for progression, they have the broad ventral scales described on p. 46, wide dilatable jaws like *Coluber natrix*, and scales of various patterns and colourings. Vipers, the cobras, the coronellas, the boas, moccasins, 'carpet snakes,' and other familiar names belong to this large group.

(3) *Tree Snakes* include both venomous and innocent genera. They are none of them large, many of them of a brilliant green, and some of them exquisitely beautiful.

Slender and active, the harmless kinds skim among the branches, which scarcely bend beneath their weight. Many of them have small and peculiarly arranged ventral shields, not requiring to hold on in progression; many also have long prehensile tails, which wind and cling while the little acrobats swing to and fro, or hang down to take a young bird or an egg out of the nest. The poisonous kinds of tree snakes abound in India, have a thick body, broad head, and a dull, sluggish habit, but still are handsome as to colour, and mostly green. They hide in the trunks of trees, or in the hollow forks of the branches, and rarely venture upon the ground. Some, however, live only in bushy foliage lower down, while other arboreal species frequent the highest branches, where, moving with amazing celerity, they are as much at home as the feathered inhabitants.

(4) *Fresh-Water Snakes* are especially adapted for an aquatic existence, and have their nostrils on the top of the snout, to enable them to breathe easily when in the water. Some of them can hold on to weeds or other things by their tails. They swim and dive, and are as active as eels. None are very large, and all are harmless. But a good many of the second group that are poisonous, spend so much of their time in the water that they are known as 'water vipers,' 'water moccasins,' etc., though not truly water snakes.

(5) *Sea Snakes.*—All highly venomous. These, as also the fresh-water snakes, are treated fully in chapters xiii. and xiv. The five divisions assist the student towards grasping an idea of the principal groups, but the whole five pass into each other by intermediate forms and imperceptible degrees.

Some other general characteristics of the Ophidia are that all are carnivorous, catching their prey alive; all are oviparous; and in organization and intelligence they rank between birds and fishes,—higher than fishes in having lungs, and lower than birds, which are warm-blooded animals. Their heart is so formed as to send only a portion of blood to the lungs on each contraction of it; their temperature, therefore, is that of the surrounding atmosphere (see p. 142). Their normal condition, particularly that of the venomous species, is one of lethargic repose and indolence, with a disposition to retreat and hide, rather than to obtrude themselves. On this account, and also because so many of them are nocturnal in their habits, less has been truly known of serpents than of most other creatures, prejudice having added to a prevailing indifference regarding them. The duration of their lives is uncertain, or whether they have a stated period of growth. Some naturalists think they grow all their lives; but this must not be taken literally, or that if a small snake happened to escape dangers, and live a very long while, it would acquire the dimensions of a python. Some think that formerly the constrictors did attain more formidable proportions than those of the present day.

Snakes have small brains, slight intelligence, and slow sensations, amounting almost to insensibility to pain. They can live a long while without their brains and without their heart; while the latter, if taken from the body, will continue its pulsations for a considerable time. Also if the head be severed, the body will for a certain time continue to move, coil, and even spring, and the head will try to bite, and the tongue dart out as in life.

Persons who dislike snakes continually ask, 'What is the use of them?' That they are not without a use will, I hope, appear in the course of this work, were it necessary to preach that *all* things have their use. But in one habit that offended Lord Bacon, viz. of 'going on their belly,' lies one of their greatest uses, because that, together with their internal conformation and external covering, enables them to penetrate where no larger carnivorous animal could venture, into dense and noisome morasses, bogs, jungles, swamps, amid the tangled vegetation of the tropics, where swarms of the lesser reptiles, on which so many of them feed, would otherwise outbalance the harmony of nature, die, and produce pestilences. Wondrously and exquisitely constructed for their habitat, they are able to exist where the higher animals could not; and while they help to clear those inaccessible places of the lesser vermin, they themselves supply food for a number of the smaller mammalia, which, with many carnivorous birds, devour vast numbers of young snakes. The hedgehog, weasel, ichneumon, rat, peccary, badger, hog, goat, and an immense number of birds keep snakes within due limits, while the latter perform their part among the grain-devouring and herbivorous lesser creatures. Thus beautifully is the balance of nature maintained.

Dr. Kirtland, an eminent naturalist of Ohio, who lived at a time when that State was being very rapidly settled, namely, during the early and middle part of the present century, observed a great increase of certain snakes as game birds which fed on them decreased. The latter were, of course, in request for the market, and the snakes, the 'black snake' particularly, having fewer enemies to consume him, flourished accordingly. It would be worth while to ascertain whether the farmer in Ohio had reason to rejoice over this redundancy of rat and vermin consumers. At the present time, when so much of the land is under cultivation, snakes have decreased again through human agency.

CHAPTER III.

OPHIDIAN TASTE FOR BIRDS' EGGS.

CAN we correctly say that snakes have a 'taste' for eggs? What flavour can there be in an egg-shell, and what pleasure or gratification can a snake derive from swallowing a hard, round, tasteless, apparently odourless, and inconvenient mass like a large egg?

That snakes do devour eggs and swallow them whole, though the fact is often questioned in zoological journals, is well known in countries where snakes abound. Therefore, we are led to consider by what extraordinary insight or perception a snake discovers that this uncompromising solid contains suitable food? Avoiding, as snakes do as a rule, all dead or even motionless food, it is the more surprising that eggs should prove an exception. And not merely the small and soft-shelled eggs of little birds, that can be got easily into the mouth and swallowed, but the eggs of poultry and the larger birds, which must in the first place be difficult to grasp, and in the second place to which the jaws so wonderfully adjust themselves that the egg passes down entire into the stomach.

Many snakes which do not habitually live in trees, will climb them in search of birds' eggs; and many others, not so agile in climbing, consume vast numbers of eggs from the nests of birds which build upon the ground. In countries where snakes are numerous and population sparse, their depredations in the poultry-yards of secluded residences are of common occurrence. And it is a noteworthy fact that the crawling culprits possess an excellent memory for the localities of hens' nests, so that when once the eggs have been missing, and the snake's tracks discovered, the farm-hands well know that the offence will be repeated, and watch for the thief, to whom no mercy is shown. But between their virtues as mousers and their vices as egg-thieves, an American farmer does sometimes hesitate in destroying certain non-venomous snakes, and may occasionally feel disposed to save his crops, to the sacrifice of his wife's poultry-yard.

A gentleman, long a resident in India, informed me that a cobra once got through a chink into his hen-house, and ate so many eggs from under a sitting hen, that it could not effect its exit through the same chink, and so remained half in and half out, where the next morning it was discovered in a very surfeited condition. It was immediately killed and cut open, when, as the eggs were found to be unbroken and still warm, the experiment was tried of replacing them under the mother, who in due time hatched the brood none the worse for this singular 'departure' in their process of incubation.

In another poultry-yard a cobra was found coiled in a hen's nest, from which all the eggs were gone but two. In this case, also, the snake had swallowed more than it could conveniently manage, but either alarm, capture, or greediness so impaired its digestion that all the eggs were ejected entire!

A similar incident was recorded in the *Field* newspaper, in May 1867, the editor introducing the narrator as one of undoubted intelligence and veracity.

His gardener informed him that a cobra had attacked a guinea-fowl's nest in the compound. He took his gun and repaired immediately to the spot, where he saw the cobra making off, followed by a host of screaming fowls. The gentleman shot the culprit through the head, and then observed a tumour-like swelling, as of an egg recently swallowed. The gardener cut the reptile open, and took out the egg safe and sound. The gentleman marked the egg, and set it with fourteen others under a guinea-fowl. In due time the young chick was hatched; and this he also marked, in order to observe whether it would grow up a healthy bird, which it did.

Several other well-authenticated instances of this nature might be related; but those who have friends or relatives in India are no doubt sufficiently familiar with such stories to dispense with them here.

Aware of a cobra's penchant for eggs, the snake-catchers, or those who pack them for transportation to Europe, sometimes place a supply in the cages, as convenient food for the snakes during the voyage. The keeper of the Ophidarium[1] at the London Zoological Gardens frequently

[1] I have ventured to coin this word for the cages and buildings likely to be required in parks and gardens for pet snakes, so notably growing in popularity.

finds hens' eggs unbroken on opening a case containing the newly-arrived cobras. How many eggs were originally in the box, and how many had been eaten and digested, or reproduced during the voyage, it would be interesting to ascertain if possible.

Snakes are fastidious feeders and long fasters during confinement. Those cobras may have fasted during the whole journey, or they may have swallowed and disgorged the eggs through terror, like their friends at home. Two things are clear, viz. that the eggs were deposited in the cage as a favourite delicacy, and that a hen's egg is not a too cumbrous morsel for even the small-headed cobra to manage.

A gentleman, accustomed to snakes, on hearing of this, regarded the eggs found intact in the box as a proof against their egg-eating propensities, and pointed to the Ophiophagus which, for lack of his ordinary food one winter, had in vain been tempted with both pigeons' and hens' eggs. 'He won't eat them, he won't notice them,' was the keeper's testimony; but, then, other snakes often decline food, even their habitual and favourite food, when in confinement; and so far as the Indian snakes are concerned, their egg-eating habits are confirmed by many writers, including Sir Joseph Fayrer, who affirms that 'they will eat and swallow the eggs whole.' 'Snakes are all carnivorous, existing on animals and birds' eggs,' he again remarks.[1] 'Cobras rob hen-roosts, and swallow the eggs whole.'[2]

And does not the very fact of the eggs being placed in the cages by the natives for their food during a journey,

[1] *Thanatophidia of India*, 1st ed. 1872. [2] *Ib.* 2d ed. p. 6. 1874.

show that these latter knew what would be most likely to tempt them?

The Indian vernacular of the Ophiophagus is *Sunkerchor*, which means, as Fayrer tells us, 'a breaker of shells.' I have taken some pains to ascertain a more definite reason for this name being assigned to the Ophiophagus, or snake-eater, but without success. Is it because he is an *exception* to the rule of eggs being swallowed *whole*, he having for his size a particularly small mouth and swallow; and that he, like his relatives the cobras, being unwilling to relinquish the dainty, manages them clumsily, and breaks the shells? There must be some reason for his being known as the 'shell-breaker.'

Being a tree snake, it may be that 'Sunkerchor,' the shell-breaker, attempts the smaller birds' eggs, which are too tender to be swallowed without fracture.

The cobra-worshipping Hindûs on their festivals place eggs for their gods, that they also may partake of the feast.

But examples of egg-eating snakes are not confined to India. America, the Cape colonies, and all snake countries are prolific of them.

Mr. P. H. Gosse in Jamaica killed a yellow boa (*Chilobothrus inornatus*), inside of which he found seven unbroken hen's eggs. It had been caught in a rat trap.

Catesby, the early American naturalist, in describing the corn-coloured snake, says 'it is harmless except as a robber of hens' roosts.' Lawson, the still earlier traveller, in his quaint description of the 'Racer,' or 'black snake' (*Coluber constrictor*), says:—'He is an excellent Egg Merchant, for he does not suck the Eggs, but swallows them whole. He will often swallow all the Eggs from under a Hen that sits, and coil himself under the Hen in the nest, where sometimes the Housewife finds him.' Lawson, also, describes the 'Egg and Chicken Snake' (a doubtful vernacular), 'so called because it is frequent about the Hen-Yard, and eats Eggs and Chickens.' The early American settlers guarded their poultry-yards against snakes as vigilantly as against rats, foxes, and other such predators. As for the 'black snake,' though non-venomous, all rearers of poultry visit him with vengeance.

Often in our rambles through the woods in Virginia we saw these snakes, and the swiftness with which they would vanish through the grass like a flash of steel, proved how well they merited their name of 'Racer.' These are the 'black snakes' *par excellence*, in distinction to the black water-viper and several other kinds which have more or less black about them. Sometimes they lay basking in our path, probably after a meal, when they become sleepy and inactive. On one such occasion I had an excellent opportunity of examining one of them, and of measuring it. It was exactly six feet long, and in the largest part as thick as a man's arm. Its scales were beautifully bright, like an armour of steel, the white throat and pale under tints completing the resemblance of polished metal. It was sleeping on a soft carpet of moss and grass which bordered our sandy path, and which showed the Racer to great advantage. My young companion, a Virginian boy to whom no sport came amiss, espied it with delight, and ran to pick up a stout stick. Knowing that it was harmless, and so excellent a mouser, I pleaded for its life; for in truth the nocturnal visitors in the shape of rats at our country dwelling were so noisy and numerous, that I regarded the Racer as a friend rather to be encouraged and domesticated than ruthlessly slain. Its couch now, in its spring green and freshness, was enamelled with the star-like partridge-berry (*Mitchella repens*), dotted here and there with twin coral berries that had lingered through the winter; the bright-leaved, white-flowered winter green (*Chimaphila maculata*); the Bluets (*Oldenlandia purpurea*), and other exquisite little flowers too lovely to be crushed and tainted; while a sunbeam glancing through the trees, and showing up the polished scales of the unconscious Racer, all seemed eloquent with mercy.

It was the first time I had been close enough to touch so large a snake; and the whole scene is vividly before me now. Culprit though it might be, it was splendid and beautiful; and I entreated Johnny to wait and wake it up, so that we might watch its actions.

'All very fine!' cried the boy, not yet in his teens, 'and fourteen more eggs gone from the hen-house last night!'

So he pounced upon a fallen bough, which he rapidly trimmed to suit his purpose, then with one sharp blow across the poor thing's back, disabled it. I think the snake was quite killed by the blows the boy subsequently dealt, for I do not remember that it moved at all.

'*Now* you can look at it as much as you please,' said the juvenile sportsman as he straightened the reptile out to its full length. Then I examined and measured it, and found it was more than two lengths of my long-handled parasol. Black creatures with two hands and two legs were far more likely to be the egg-stealers than that poor Racer far off in the woods.

This 'black snake' climbs trees with ease, and hangs from a branch to reach a nest below him. 'He is the nimblest creature living,' says an old writer on Virginia, for he not only has the credit of stealing hens' eggs, but he 'even swallows the eggs of small birds, without breaking them,' which again is a proof of the remarkable control these creatures possess of regulating the pressure of their powerful jaws.

Many of the African snakes climb trees, and also suspend themselves from a branch while reaching into a bird's nest lower down for the eggs it may contain. Both Livingstone and Dr. Andrew Smith [1] make particular mention of some of the egg-eating snakes of South Africa, the latter in his general description of ophidians stating that 'many, perhaps all snakes, devour eggs when they have an opportunity. A few feed entirely on eggs,' notably some of the small tree snakes, to which the name *Oligodon* (few teeth) has been given, this family having no teeth on the palate, like all other snakes. Their food, therefore, cannot be of a nature to require a very strong grasp, though we have no authority for stating that the *Oligodons* feed exclusively on eggs.

There is, however, one of the family with a dentition so remarkable that it has been considered a distinct type, and Dr. Andrew Smith, who was the first to observe its habits, gave it the generic name of *Anodon* (toothless), the jaws being merely roughened with the rudiments of teeth. This little snake, of about two feet in length, is exclusively an egg-feeder. 'Its business,' says Professor Owen in his *Odontography*, 'is to restrain the undue increase of small

[1] *Zoology of South Africa*, by Dr. A. Smith. 1849.

birds by devouring their eggs.' Its remarkable organization is favourable for the passage of these thin-shelled eggs unbroken until far back in the throat or gullet, when the egg comes in contact with certain 'gular teeth,' which then break the shell without any loss of the contents to the feeder. These gular teeth are a curious modification of some of the spinal processes, presenting a singular anomaly in the presence of points of enamel on the extremity of some of them.

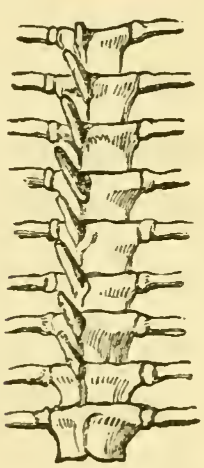
Professor Owen has very fully described this remarkable development,[1] and as his works have been the text-books of many later physiologists, his words may here be quoted, even at the risk of repetition.

'In the rough tree snake, *Deirodon scaber*, with 256 vertebræ, a hypapophysis—from ὑπὸ (Latin, *sub*), an offshoot from beneath—projects from the 32 anterior ones, which are directed backwards in the first ten, and incline forwards in the last ten, where they are unusually long, and tipped with a layer of hard cement (dentine). These perforate the dorsal parietes of the œsophagus, and serve as teeth.

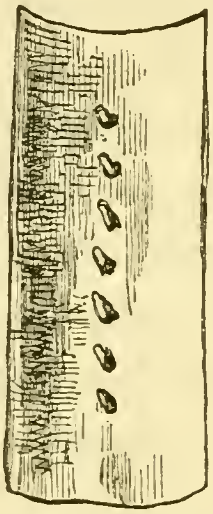
'Those who are acquainted with the habits and food of this species have shown how admirably this apparent defect —viz. the lack of teeth—is adapted to its well-being. Now, if the teeth had existed of the ordinary form and proportions in the maxillary and palatal regions, the egg must have been broken as soon as it was seized, and much of the nutritious contents would have escaped from the lipless mouth; but owing to the almost edentulous state of the jaws, the egg glides along the expanded mouth unbroken,

[1] *Odontography*, by Richard Owen, 1840, and *Anatomy of the Vertebrates*, 1866.

and not until it has reached the gullet, and the closed mouth prevents the escape of any of the nutritious matter, is it exposed to the instruments adapted to its perforation. These instruments consist of the inferior spinous processes,' etc., already described. 'They may be readily seen even in very small subjects, in the interior of that tube in which their points are directed backwards. The shell being sawed open longitudinally by these vertebral teeth, the egg is crushed by the contractions of the gullet, and is carried to the stomach, where the shell is no doubt soon dissolved by the acid gastric juice.'



Portion of spine of the Deirodon, from Andrew Smith's *Zoology of South Africa.*



Gular teeth penetrating into the gullet, *ib.*

Portion of spine from a skeleton at the museum of the R. C. S., natural size.

The two from Smith's *Zoology* must be much magnified; the third, from the skeleton, being the true size, excepting that the ribs are broken short off, some entirely so. The minute processes extend two or more inches.

As the learned professor has described the *Deirodon* (neck-toothed) both under the head of teeth, and also of vertebrated animals, the two accounts are blended, but given *verbatim* as far as possible.

The colour of the *Deirodon* is of a brightish or yellowish brown, very minutely spotted with white. Such few true teeth as some individuals may possess are extremely small and conical, discovered only towards the angle of the mouth.

Dr. Andrew Smith first examined a specimen in 1829, when he found that the gular teeth commence exactly $2\frac{1}{4}$ inches behind the apex of the lower jaw, and penetrate the œsophagal canal through small holes in its tunics, and that each point is armed with enamel. He had observed that the living specimens which he had in captivity always, when feeding, retained the egg stationary about two inches from their head, and while there, used great efforts to crush it. Dissecting a specimen in order to investigate this strange action, he discovered the gular teeth just where the egg had stopped, and which, he felt satisfied, had assisted in fixing it there, and also in breaking the shell when subjected to the muscular action of the surrounding parts. The gular teeth are developed in very young *Deirodons.*

Dr. Smith saw that the broken shell was ejected, while the fluid contents were conveyed onwards; but this may have been an exceptional case, because by a snake in health egg-shells are easily digested. Probably those snakes watched by Dr. A. Smith being captives, and presumably not altogether as happy and healthy as in their sylvan homes, found the shells too much for them, and so ejected them; as the cobras above described disgorged the stolen eggs. This habit of disgorging food appears to be sometimes voluntary.

Snakes have been known to pass the egg through their body entire, but this also must be owing to an abnormal state of health or of habit, as the strong juices of the stomach, which can convert even bones and horn to nutriment, ordinarily dissolve an egg-shell.

Throughout nature we find that, whatever the habits of the creature may be, its structure and capacities are adapted to it. Every need is, as it were, anticipated in the process of development; and wherever, as in this harmless little tree snake, we find a departure from general rules, it is because some especial requirements are met, and in order that the creature may be the better prepared for the struggle for existence. In the present example we find a marvellous adaptation of spine bones to dental purposes; how many ages it has taken to develop them we cannot conjecture. All we know is that these spinal projections are just the sort of teeth that the egg-swallower requires, and that its natural teeth are gradually becoming obsolete from disuse.

A writer who was quoted at some length in the *Zoologist* for 1875, and in several other contemporary journals, stated that some snakes 'suck out the contents of hen's eggs by making a hole at the end.' [1]

We are not told with what instrument these evidently scientific serpents punctured the shell. Some skill is required, as schoolboys give us to understand, to prick an egg-shell without breaking it; and even when the hole *is* bored, additional care is required to suck out the contents. How a snake could first grasp firmly, and then puncture a fowl's egg, is incomprehensible; how the sucking process is achieved

[1] *Natural History Notes from South Africa*, by R. B. and J. D. S. Woodward. Lond. 1874.

is still more so. We can understand that a snake which discovered a broken egg might seem to lap some of the contents, because, as we shall by and by show, the tongue habitually investigates, and is immediately in requisition under all circumstances. But to lap up an egg would be a very slow process for so slender an instrument. One is reminded of the dinner which Sir Reynard invited his friend the Stork to partake with him.

While still marvelling over these South African egg-suckers, I watched some lizards with a broken egg in their cage. Their tongues were long, thin, blade-like, and bifid, much better adapted for the purpose of lapping than that of a snake, yet stupidly slow and inefficient was this ribbon-like tongue. The lizards threw it out, spatula-fashion, into the midst of the pool of egg which was spreading itself over the floor, and caught whatever of the fluid adhered to it. Had the lizards possessed lips adapted for such a purpose, and, in addition, intelligence enough to 'suck,' they might have drawn some of the cohesive mass into their throats, but they only obeyed their instinctive habit of lapping. Snakes would do the same. Their habit is to moisten the tongue in lapping; and I fear we must not place too much credence in the exceptional intelligence of that South African egg-sucker, but rather regret the loose account which conveys so erroneous an impression. I watched those lizards for many minutes, and decided that the egg would be dried up long before it could be consumed by lizard-lapping.

The tongue of a snake is undoubtedly an important and highly-developed organ. That its sensitiveness assists the smell, we have reason to believe, and possibly it possesses other faculties of which we are at present ignorant. In the case of an unbroken egg, for instance, the tongue has told the snake that there is something good inside it; and instinct immediately leads the reptile to get the awkward mouthful between its jaws, which expand just so far as to retain it safely, yet just so lightly that not one of those rows of long, sharp teeth shall penetrate the shell or fracture it in the slightest degree. How delicate must be the adjustment whereby those six jaws, all bristling with fine, needle-like teeth, grasp and yet not break the delicate shell! for, after all, an egg *is* a fragile substance in proportion to the size of the feeder and its muscular power.

Snakes have been known to get choked in attempting to swallow an egg, as they have also come to grief with other impediments, such as horns of cattle; but this we must attribute to their not being able to estimate their own swallowing capacities, or to some other untoward event.

The Messrs. Woodward's scientific snake would not have crept into these pages had it not previously figured in the *Zoologist*, and thence copied in other prints, thereby misleading many readers. It also proved a subject worth discussing by thinking persons, and was alluded to very particularly by an ophiological friend and publisher in a letter to myself, which may be here usefully quoted. My friend, who has long stimulated me by his kind encouragement of my work, and by the assistance of his experience and judgment, was pleased to express much interest in a little paper on the *Deirodon*, which I had written for *Aunt Judy's*

[1] See *Aunt Judy's Magazine*, Aug. 1874, London,—'The Deirodon, or neck-toothed snake.'

Magazine, he having read it shortly before the appearance of the Messrs. Woodward's statement in the *Zoologist*, April 1875 :—

'In this month's *Zoologist*,' wrote my friend, 'a writer says that a certain snake makes havoc of the hen-house, by boring a hole in the egg and sucking its contents! Can this be true? To a letter of mine to Mr. Newman (the then editor of the *Zoologist*), on the subject, he replies, "With regard to snakes eating eggs, it has been repeated so often that I cannot help fearing Mr. Woodward may have *imbibed the notion from American sources.* It is so common in the United States to find snakes in holes in the bottoms of trees made by woodpeckers, that it seems almost impossible to resist the conviction that they enter these holes to get the birds themselves, or their young, or their eggs. It must be regretted that those witnesses who come into court with such evidence are not, generally speaking, the kind of close observers in whose dicta we can place implicit reliance." This,' continues my correspondent, 'Mr. Newman writes after I had suggested that some families of snakes have triturating powers (learned from *Aunt Judy*) in the throat, independent altogether of palatal teeth. The subject seems to be as much steeped in the unknown, as are the ways of the beautiful creatures themselves.'

This from a well-known and highly-popular publisher, a man of education, culture, and scientific attainments, though snakes hitherto had not been his specialty, any more than that of the late editor of the *Zoologist.* The latter, however, admitting his doubts on the subject of ophidian egg-feeders, would have done well to have added a note to that effect to the account given by Mr. Woodward, which, simply from its appearance in a scientific journal, might be received as authority.

A few more well-known proofs of ophidian taste for eggs may conclude this chapter. Of our own green or ring snake (*Coluber natrix*), Mr. Bell says, 'It feeds upon young birds, *eggs*, and mice, but prefers frogs.' In Balfour's *India*, on the subject of cobra-worship, mention is made of the snakes getting into larders for *eggs* and milk, and being protected as the good genius of the house on such occasions.

But the Hindû custom of placing eggs for snakes at their serpent festivals must be too familiar to most of my readers to need further comment.

CHAPTER IV.

DO SNAKES DRINK?

PERHAPS in no other branch of natural history has such a degree of interest been awakened during the last decade, and such an advance made as in ophiology. The result of a spirit of inquiry thus set afloat is that information is being continually elicited from travellers and observers. Those who now entertain predilections for this branch of science, will many of them admit that whatever interest they feel in the subject has been of a comparatively recent date; that since they have at all studied snake nature, they have repeatedly had to combat with preconceived notions. Again and again they have been 'surprised to learn that so-and-so'—some now established fact, perhaps—is the case, when they had '*always* thought'—probably something quite the contrary.

This has been frequently verified in my own experience in my correspondence with really scholarly men, who have generously admitted as much. Not a few, during my ten years' study of the Ophidia, have traced their interest in snakes to my own enthusiasm. Preconceived errors are not to be wondered at when we consider that, apart from scientific works, so much that has been related of serpents has been mingled with prejudice, fable, and tradition, clouding our intelligence at the very outset. Nor need we hesitate in admitting our misconceptions, when we find scientific men themselves devoting page after page to a mooted question, and after all, sometimes venturing to sum up a given subject with a modest doubt only. (Would that the less scientific writers were equally cautious in their statements!) Whether snakes drink, and *what* they drink, have been among these debated questions.

Those who possess a love for natural history are, of course, acquainted with the works of the eminent naturalist, Dr. Thomas Bell, on our native fauna; and those who admit their interest in the much-maligned snakes have included in their studies his *British Reptiles*.[1] In one portion of that work, where science is so charmingly blended with personal observations, we are carried on to the heaths and commons to watch our pretty little agile lizards skim across the grass, and flit away with legs too fleet for us to follow them.

We linger on the banks of a stream where a ring snake lies in wait for a frog; and then we are conducted into Mr. Bell's study, where the same harmless creature, now tamed, is nestling in his sleeve, or lapping milk from his hand.

Most of my readers also, whether naturalists or not, are familiar with some of the numerous works on India, its creeds, customs, and superstitions, where mention is so frequently made of cobra-worship, and of the natives setting saucers of milk near its hole to conciliate and pro-

[1] *British Reptiles*, by Thomas Bell, F.L.S., etc. 1849.

pitiate the serpent. Familiar to us all, too, is the picture of a little child with a bowl of milk on its lap, and a snake receiving a tap with the spoon to check the too greedy intrusion of its head into the bowl, but into which, according to the story, it had been accustomed and permitted to dip its tongue. Some persons place that story in Wales; others, and with better reason, trace it to New England. The child and its surroundings, the size of the snake, all justify this latter belief, and that the intruder is the notorious milk-stealer so common in the United States, the 'black snake,' or Racer (introduced p. 64).

In the face of these well-known facts, it may seem strange to propose the question, 'Do snakes ever drink?' and still stranger to affirm that this was lately a disputed point among some of our scientific writers. 'On s'ignore,' says Schlegel, 'si les serpents boivent, et s'il est juste d'opiner pour la negative; toutefois on n'a jamais aperçu des fluides dans ceux dont on a examiné l'estomac.' [1]

Schlegel, when he wrote, had not the benefit of Mr. Bell's experience, and as a foreigner, probably he had not read Jesse's *Gleanings* nor White's *Selborne;* nor, as a scientific student, had he time to bestow on promiscuous works on India, which, by the way, were not so numerous then as now. But there are several well-known milk-drinking snakes in America which had been described by writers prior to Schlegel. This learned author, however, puts down the milk-loving snakes among the 'fables' and 'prejudices;' and, as we have seen, dismissed the water-drinkers with a doubt.

[1] *Physiognomie des serpents*, p. 97. Par H. Schlegel. Amsterdam, 1837.

Mr. Bell's work has enjoyed upwards of thirty years' popularity, and his milk-drinking pet has been quoted by scores of writers of both adult and juvenile books. Thomas Bell, F.L.S., F.G.S., was secretary to the Royal Society; Professor of Zoology of King's College, London; and one of the Council of the Zoological Society of London. He was also a 'corresponding member' of the learned societies of Paris and Philadelphia, and of the Boston Society of Natural History.

As a gentleman of widely recognised learning and veracity, therefore, it may be considered that Mr. Bell, and with good reason, entertained no doubt whatever as to snakes drinking, and also drinking milk. Mr. Bell, moreover, had known of the celebrated python at Paris (see chap. xxiv.), which in 1841 evinced a thirstiness that has become historical in all zoological annals. The circumstance was fully recorded by M. Valenciennes at the time; when a no less distinguished ophiologist than M. Dumeril,[1] *Professeur d'Erpétologie au Musée à Paris,* was especially appointed to the management of the reptile department there. That very distinguished ophidian lady, the python, need be referred to here only as regards the drinking question, the rest of her history coming in its place in this book. It will be remembered that she laid eggs, and to the surprise of all, coiled herself upon them to hatch them. 'Pendant tout le temps d'incubation la femelle n'a pas voulu manger' (she began to incubate on the 6th May); 'mais le 25ᵉ de mai, après vingt jours de couvaison, son gardien, Vallée, homme très soigneux et très intelligent, la voyant plus inquiète que de coutume, remeuée la tête, et lui

[1] *Annales des sciences naturelles*, 2d Series, tome xvi. Paris, 1841.

présenta de l'eau dans un petit basin ; elle y plongea le bout de son museau, et l'animal en *but* avec avidité environs de deux verres. Elle a ensuite bu quatre fois pendant le reste du temps de sa couvaison : le 4 juin, 13, 19, 26.' (Her eggs began to hatch early in July.)

The interesting invalid, ordinarily tame and gentle, had latterly displayed anger and irritability on being disturbed, pushing away the hand if touched ; but in her present state the want of water was so great that she evinced uneasiness to her guardian, and permitted him to move and turn her head, so that she could dip the end of her muzzle into the basin. The narrator argued, from this remarkable demonstration, that the incubation (in which a rise of temperature was observable) produced a sort of feverishness which caused her to decline solid food, though her thirst was so great that she almost asked for drink.

When eight of the fifteen eggs were hatched, the little pythons ate nothing until after their first moult (which happened to them all within a fortnight), but during those early days of their existence they '*drank several times*, and also bathed themselves.'

This event perhaps established the fact beyond any doubt that snakes do drink, so far as modern and scientific ophiologists had ventured to decide ; and M. Dumeril, from long observation, is able to tell us how.

Speaking of the tongue of a snake, this experienced naturalist informs us that 'cette langue fort longue sert-elle comme on l'a observée quelque-fois à faire pénétrer un peu de liquide dans la bouche, car nous avons vu nous-même des couleuvres laper ainsi l'eau, que nous avions placée auprès d'elles dans la cage, où nous les tenions renfermées pour les observer à loisir.'[1]

But, as he goes on to describe, 'quelques serpents avalent de l'eau sans se servir de la langue pour laper. Alors ils tiennent la tête enfoncée sous l'eau au-dessous du niveau, ils écartent un peu les mâchoires, et font baisser le fond de la gorge, dans laquelle l'eau descend par son propres poids.' You can then perceive the slight movements of swallowing, like a thirsty man gulping down a beverage (*à la régalade*).

What follows affords an explanation of M. Schlegel's statement that he had never discovered water in a snake which he had dissected, this learned author not having gone so thoroughly into the matter. 'Cette eau,' says M. Dumeril, 'sert à laver les intestines; car elle est rendue liquide avec les fèces, elle ne parait pas expulsée par les voies urinaires.'

M. Dumeril speaks very clearly on this point both in his introductory preface, and again in vol. vi., under the more detailed descriptions of each especial sense and organ.

Snakes rarely drink (that is, not every day, as most animals do), most of them living in dry regions or forests, where for long periods they are deprived of water. The live prey upon which they subsist supplies them with sufficient liquid. This may be known by the natural discharges, which are usually of a liquid nature. Nevertheless, a large number of serpents live close to water, and love to plunge and to swim. These truly drink,—lapping with the tongue, as above described; at other times with the

[1] *Erpétologie genéral*, par MM. Dumeril et Bibron, tome i. p. 136. Paris, 1844.

head under water, and the neck still lower, so that the water *falls into the mouth by its own weight*, and is then swallowed. But this, he repeats, does not go into the blood, or *very little* of it, *car ils rendent en grand partie*, etc., as above, its function being principally to moisten the intestines.

Lenz, a German ophiologist of still earlier date than Schlegel, went very conscientiously into the subject of whether snakes drink or not,[1] having adopted various means in order to test them. His personal experience was, however, of a more limited range.

It is worth while to bear in mind the dates of some of these writings, both that we may watch the gradual advance of ophidian knowledge, and also that we may the better appreciate the vast amount of time, care, labour, and research by which we are finally put in possession of facts of natural history.

As a comparatively modern writer, Lenz, without doubt, made very valuable contributions to the science of ophiology, and at a time when fact was only beginning to be sifted from fable. It will be seen that, though writing several years before Schlegel, he had arrived at the same conclusions.

'The numerous snakes and other animals which inhabit arid mountains, or plains destitute of water, can only quench their thirst with rain or dew. Snakes require but little water as long as they live in the open air. It is an established rule that no water is found in the maw, stomach, or entrails of snakes killed in the open air, even when

[1] *Schlangen und Schlangenfiend*, par H. O. Lenz. Gotha, 1832.

destroyed by or in a piece of water. *Snakes are never seen to go to drink in any part of the world.*'

This last clause is, as we have now seen, a too positive assertion, and one not subsequently borne out by other equally conscientious and intelligent writers. Livingstone, who was a close observer of nature, informs us that he has known some of the African snakes *come a long way to pools and rivers to drink.* Dr. Theodore Cantor, who is one of the best authorities on the Indian sea snakes, and who was a member of the Zoological Society, tells us that he has seen snakes 'both drink and also moisten the tongue; *two distinct operations,*' he explains.[1] This conviction having been stated prior to Dumeril's elaborate and much-prized work, is valuable testimony. The majority of snakes in India are partial to water, he tells us, with the exception of the arboreal species, which probably obtain sufficient moisture from the rain or dew upon the leaves; and as it is not in their nature to be on the ground, their organization doubtless renders them independent of water.

We of late so often see it said of any particular snakes in captivity that 'they neither ate nor drank at first;' or that 'they drank, though they would not eat,' that we almost wonder their bibulous propensities were ever doubted; especially as the majority of snakes are fond of water, and swim readily. We are surprised, therefore, that the second edition of Mr. Lenz' really valuable work, published so lately as 1870, should still retain the assertion that snakes have never been *seen* to drink.

[1] *Sea Snakes: Pelagic Serpents,* by Dr. Theo. E. Cantor. London, 1842. Zoological Society's *Transactions,* 1841.

Mr. Frank Buckland saw his Coronella drink frequently, though she ate nothing; and as the discovery and captivity of this interesting lady and her brood, born in London in 1862,[1] formed the subject of many papers in the scientific journals at the time, one would suppose that they would have been heard of in Germany, where the species (*C. lævis*) is well known.

'Though not to be tempted with food, they are very fond of water,' says Mr. F. Buckland.

Lenz' experiments are, however, well worth noticing, because subsequent observations have in many instances confirmed this author's conclusions.

'In confinement,' he says, 'snakes are more easily induced to lick up drops sprinkled on grass than to drink from a vessel.' Naturally so. In their native haunts they are not accustomed to pans of water or saucers of milk, but they *are* accustomed to moisten their tongues on the blades of grass or the leaves of plants which hold the drops of rain or dew. Lenz then mentions some experiments which he himself made with snakes. He placed a ring snake and an adder in an empty box, and kept them there without food for a fortnight, at the end of which period he placed them in a tub containing half an inch of water, and left them there for half an hour. He then killed them both, and on dissection found no water inside of them. This led him to the conclusion that they had not drank at all; but, in the first place, had they occupied the whole half-hour in lapping with their thread-like tongue, it may be doubted whether any appreciable quantity could be imbibed

[1] See *Field* newspaper, September and October 1862. London.

during that time; and in the second place, the sudden transition and strange situation in which they found themselves would, through fright, entirely destroy whatever inclination they might have had to appease hunger or thirst.

It will be seen that snakes are exceedingly capricious in taking food; and that when in an abnormal or strange locality they rarely feed for a long while. Mr. Lenz himself is of opinion that, had he left them longer in the water, or placed them in a dry tub where liquid could be got at, they would or might have drunk. Thus, the experiments only go to corroborate what all keepers of snakes have observed, viz. that captivity or strange surroundings render them averse to feed.

M. Lenz placed his snakes among the cows in order to test the foolish belief that obtains in some countries that snakes will 'suck' the udders; but of course, and for similar reasons, even could such an achievement be possible, the snakes attempted no such thing.

His snakes were strict members of a temperance society also, for not even wine could tempt them to drink, though this and other liquids were placed within reach to entice their taste. Not so Pliny's snakes, for he would have us believe that they show 'a great liking for wine,' whenever an opportunity presented itself for their tasting it!

But how came the idea to obtain that snakes suck cows,—a fact so frequently asserted by the older naturalists? One old writer goes so far as to state that a certain American snake 'causes cows to give forth bloody milk.' And yet, to the thinking or observing person, the origin of the belief may be easily accounted for. That snakes have partiality for milk no longer admits of a doubt; that they like warmth and shelter is an equally established fact. Therefore, they find their way into cattle-sheds, and hide in the straw or any snug corner, possibly even among the recumbent cattle; and, being there, their ever busy exploring tongues discover a savour of milk, and the snake is led by this intelligent tongue to the very fountain of their favourite drop. The irritated cow would then naturally stir or kick, and endeavour to shake off the strange intruder, who, in its turn alarmed or angered, would bite the udder, and fetch blood. This, in the dark ages of natural history, and during the period when the serpent was invested with all manner of cruel and revolting wilfulness, would suffice to give rise to the belief that has so long prevailed. The rat snake (*Ptyas mucosus*) and the *Clothonia* of India are 'said' to suck the teats of cows; so also are the 'hoop snake' and several other American species, which, with their climbing propensities, may sometimes twine themselves about the legs of cattle, and thus reach the udders, where persons have discovered them. It is just possible that the snakes may get the teat into their mouths, and advance upon it, with the intention of swallowing it, not knowing that it was only a teat, with a cow inconveniently attached to it, and not some small and more manageable prey.

Among the American milk-drinking snakes is *Coluber eximius*, known as the 'milk snake,' one of the dairy frequenters, which is said to seek milk with avidity. This snake is mentioned by De Kay,[1] Emmons,[2] and

[1] *Zoology of New York*, by J. E. De Kay. Albany, 1844.
[2] *Natural History of New York*. 5 vols. New York, 1842.

Holbrooke,[1] who all describe it as being very beautiful and 'innocent' (except in the eyes of the farmers' wives). It is of a pale, pearly white, sometimes tinged with pink, and with rich chocolate spots on its back. The Racer, of egg-stealing notoriety, is also a sad milk thief, and, like our own little ring snake, has been known to retrace its way into dairies. Such depredations were more frequent formerly when the snakes were more numerous. Of the Racer, Lawson[2] says, 'This Whipster haunts the Dairies of careless Housewives, and never misses to skim the Milk clear of the Cream.'

The same love of warmth which takes the reptiles among cattle, guides them into dwellings, particularly during the night; and in hot countries where nursing-women of the poorer classes lie exposed, snakes have been found upon their breasts, and absurd stories have been told of their sucking the teats of women. In India, Australia, and America, such stories are common.

After all, it does not seem surprising that snakes should like milk. Being carnivorous by nature, they would at once detect an animal flavour in the liquid by the agency of their sensitive tongue.

Now turning to India, we find that the love of snakes for milk is mentioned by numerous writers on the manners and customs of the Hindûs, as well as by travellers and naturalists. Balfour[3] tells us 'when a snake discovers how to get at the eggs and *milk* in a larder, no native will on any account kill it, because it is regarded as the good genius of the

[1] *North American Herpetology.* Phil., U. S., 1842.
[2] *History of Carolina*, by Jno. Lawson, 1709.
[3] Balfour's *British India;* also the *Cyclopedia of India.*

house.' And again, 'that the cobra is fed with *milk* in some of the temples where it is worshipped.'

Dr. Shortt of Madras keeps a man to attend to his cobras, and finds them thrive excellently on sour milk, which is administered once in ten or twelve days.[1] 'Snakes feed on eggs and *milk*,' says Sir J. Fayrer.

When we read similar facts mentioned incidentally, and with no especial object, we may give them credence even more than if a prejudiced writer were endeavouring to prove such or such a thing. For instance, during the visit of H.R.H. the Prince of Wales to India, the exhibition of snakes and snake-charming formed a not unimportant item in the programme, and furnished many columns of cobra performances and cobra traditions to the papers. More than one of the journalists unintentionally corroborated what Balfour and other writers tell us about the 'good luck' of having a cobra in the *chuppur* of the hut, the fearlessness with which the children regard their 'uncle,' as they call it, and their care in placing *milk* and eggs for it each evening.

But I am reminded of a singular case which came to me through a personal acquaintance from India who was present at the time.

Four officers sitting in a bungalow in India were deep in a game of whist. Suddenly one of them, turning deadly pale, made signs that no one should move or speak. In a hushed voice he exclaimed, 'Keep still, for God's sake! I feel a cobra crawling about my legs!' He knew that timidity was one of the strongest characteristics of this snake, and that if not disturbed or alarmed, it would in due

[1] See *Medical Times*, 1872, p. 730.

time depart of its own accord. All present were accustomed to the stealthy intruders, and did not, happily, lose their presence of mind. They very noiselessly bent down so as to take a survey beneath the table, when, sure enough, there was the unwelcome visitor, a full-sized cobra, twining and gliding about the legs of their hapless friend. Literally death was at his feet! A movement, a noise, even an agitated tremble might have been fatal.

Luckily one of the four was acquainted with the milk-loving habit of the cobra, and rising from his seat with quiet and cautious movements, not daring to hasten, yet dreading delay, he managed to steal from the room, while he signed the rest to remain motionless. Quickly he crept back with a saucer of milk in his hand, and still with noiseless movements set the saucer under the table as close to the terrible reptile as it was safe to venture.

That fearful strain on their nerves was happily of not long duration, for presently they were relieved by seeing the creature gradually untwine itself and go to the milk.

Never before or since did that officer leap from his seat as he did then, the moment he felt himself free from the coils of the cobra, and read in the faces of his comrades that he was saved. Short thrift, however, had Mr. Cobra, for sticks and whip-handles were freely administered, even before the saucer was reached.

The enemy got rid of, the game was resumed; and it is worth the while of those in India to bear this narrow escape in mind, and bring milk to the rescue in case of similar danger.

That snakes drink, and occasionally drink milk, is sufficiently established. Modern authorities now affirm it decidedly. Says Dr. Günther in his great work, published by the Ray Society,[1] 'All snakes drink, and *die* when deprived of water.' Dr. Edward Nicholson, another of our practical ophiologists, speaking of one of his pet snakes, a *Tropidonotus*, says 'the offer of a drink of water will at once gain its heart.' In watching snakes drinking, he has frequently counted one hundred gulps before the drinker is satisfied.[2] If *Anguis fragilis*, the common blindworm, from its snake-like form, may be cited here, I may mention one of my own, which, after being shut up in a box for safety during my absence from home for some days, drank for such a long while when first released from captivity, that I was really tired of waiting to watch her. She almost immediately went to a flower-pot saucer of water, with which she was familiar, and which I placed near her. For some time I watched the tongue thrown out and withdrawn, till I began to wonder how much longer she would remain dipping that little bifid organ. I then began to count, and she dipped it seventy-five times more, after drinking at least as long as that previously. Then she moved away, and explored among the books on the table, but soon returned to the saucer and dipped her tongue again upwards of seventy times. How much more I cannot affirm, as I could not remain any longer waiting for her, and left her still drinking. ('Lizzie,' thus named from her lizard nature, must claim a chapter to herself in this book, for she greatly distinguished herself in lacertine doings.)

[1] *Reptiles of British India*, by Dr. A. Günther, F.R.S. London, 1864.
[2] *Indian Snakes*, by E. Nicholson, Madras Army. Madras, 1870.

While puzzling over this drinking question, I find a favourite author, P. H. Gosse, affirm, 'Snakes drink by suction, not by lapping,' and that 'serpents are said to lap up fluids with their forked tongue, which, however, seems to be ill suited to such an operation.' [1]

Then one naturally turns to the encyclopedias, where we grow still more perplexed, for no two agree precisely on all points.

'The use of the tongue in serpents is not exactly known.' [2] And again, 'It is believed that serpents never drink.' [3] It is true that the compiler of the article *Reptilia* quotes Schlegel a good deal; but unfortunately that is the very point on which Schlegel speaks doubtfully. Nor do we presume to include the learned Schlegel as one of the inaccurately informed individuals, though he does discredit the milk-drinkers. Of him Dumeril thus writes, or of his work rather, which he pronounced to be 'le plus detaillé et le plus complet qui ait paru jusqu'ici (1844), et auquel nous serons sans cesse obligé d'avoir recours.' Schlegel is also quoted by Cantor, 1841; by Dr. J. E. Gray, 1849; by Dr. A. Günther, 1864; and, in fact, by most scientific ophiologists. Natural history is an ever-advancing science, more so, perhaps, than any other. Linnæus and Cuvier were great in their day, but their systems obtain no longer.

Unfortunately, a dozen book-makers and a thousand journalists seek no farther than encyclopedias when they are 'reading up' a subject; and not until too late, if at all, or after

[1] *Natural History of Reptiles*, by P. H. Gosse. 1850.

[2] *Encyclopedia Britannica*, 1859, see art. 'Reptilia,' p. 47.

[3] *Ibid.* p. 47.

long searchings and a realization of the importance of dates, do these wide spreaders of information discover the error. Compilers of articles for encyclopedias are always limited as to space, and often as to time; and life would not be long enough to wade through *Zoological Records* covering fifty years, or *Annales des sciences naturelles* which date from 1824 to the present time. Only, the compilers of articles on the *Reptilia* should surely have known of Mr. Bell's *Coluber natrix*, and of the Paris python, and of the *Amphisbæna* of the Zoological Gardens, all ophidian celebrities in their day.

The mention of the Zoological Gardens reminds me of my promise to conduct my readers thither as an agreeable change from the book-shelves. Therefore, without further wearying them with the conflicting statements of fifty writers, let us repair thither, and see what Holland, the keeper, tells us about his thirsty snakes.

First, we observe that most of the cages are furnished with a tank or a pan of water, and this not for the water-snakes only. Many of the others, also, are lying in their bath, coiled up in apparent enjoyment. Questioning the intelligent keeper, he tells us that when fresh ophidian inmates arrive, they almost invariably go to the water, and though for a time they refuse food, they *always drink.* On several occasions some have drunk so eagerly that the water has visibly sunk in the tank. These were the larger snakes, of course. He does 'not believe they would live without water.' He then tells us the story of the *Amphisbæna* over again, the snake that lived for six months on milk only, and which was chronicled in the zoological magazines of the day, and has figured in books ever since.

Mr. Mann confirmed all these facts in his own ophidian pets, and going to see these interesting individuals, we felt no doubt about it when a saucer of water was in the way.

But I do feel inclined to doubt whether the use of the tongue in 'lapping,' as it has been called, is not rather to moisten that organ than to quench the thirst. We shall see in the following chapter what it does for its owner, and we shall see the necessity for this delicate organ to be well lubricated. Both it and its sheath require to be constantly moistened; how else could it glide in and out with that wonderful activity? how in a dry and parched condition could it retain its exceeding flexibility and delicacy of perception?

Unfortunately, the position of the tanks in the cages at the London Zoological Gardens, and the stone ledge in front of them, prevent the visitors from watching the actions of the snakes in the water, either when swimming or drinking. Occasionally one of the inmates of the larger cages may be seen in a pan of water, though their motions are necessarily restricted there. One day, however, the yellow Jamaica boa, when drinking from the pan, afforded an excellent opportunity for observation. And he was a long time imbibing. There was no perceptible action of the lips, which were barely parted. The snake kept its mouth just below the level of the water, and the only action or movement seen was at the back of the head, or on each side of the neck, like a pulsation, as the water passed down in short gulps. This is the 'suction' which writers describe, a drawing in of the liquid; but the lips do not take part in the act. When, therefore, we read that snakes drink both by lapping and also by suction, we may surmise that the former is for the benefit of the tongue, the latter of the body; and a large quantity of liquid is often drawn in by this sort of suction, very distinct from 'sucking,' the reputed way of enjoying milk from the living fountain, and a process impossible to creatures that have not soft lips and a broad tongue. The Jamaica boa drew in those perceptible gulps for a long time, then raised his head, and rested awhile, and presently drank again, and this several times while we were watching. It was what Dumeril described *à la régalade*.

Mr. Sam Lockwood of New Jersey, writing in the *American Naturalist*, vol. ix. 1875, describes the pine snake drinking. 'It lays its head flat upon the water, letting the lower jaw just sink a little below the surface, when with a very uniform movement the water is drawn up into the mouth and passed into the throat. It is true drinking, like that of a horse.' One that he watched drank five minutes by the clock without taking breath. Then it paused, looked about for three minutes, and then drank again for five minutes more. 'In all, it drank a little over a gill. Previously it has been without water for four weeks.'

In size this pine snake differs not much from the Jamaica boa (*Chilobothrus inornatus*), that we watched at the Gardens, and the manner and time were very similar. True, we did not time him by a watch, nor could we tell exactly how much he drank, nor how long previously he had been without drinking; but, at a guess, he could not have been much less than five minutes without taking breath. *Anguis fragilis*, that lapped seventy times, and stopped, and lapped again, must also have been some minutes without breathing, because hers was the most leisurely lapping I ever saw.

CHAPTER V.

THE TONGUE OF A SNAKE.

PART I.—WHAT IT IS *NOT*.

GOSSIP from the Zoological Gardens to confirm what has been so often said, namely, that nine out of every ten of the visitors to the Ophidarium will point to the tongue of a snake and exclaim, 'Look at its sting!' seems too trivial and too defiantly challenging the credulity of my readers, to introduce here. Nevertheless, that it is necessary emphatically to state not only that the tongue of a snake is not its sting, but that a snake has no sting at all, you will admit the very next time you go there. You will hear not only the Monday, but the *Sunday* visitors—well dressed, and apparently well educated persons—say to each other when watching a snake, 'That's its sting!' I must be permitted, therefore, to 'gossip' a moment in confirmation.

One Friday, in April 1881, just before the time when the public were excluded at feeding hours, we were watching the movements of a pretty little harmless snake, the rapid quivering of whose tongue denoted excitement of some kind. Probably it was anticipating the frog in store for it, as this was feeding day. Its tongue was unusually active, and was exserted to its extreme length, its motions being almost invisible in their rapidity.

Two gentlemen drew near, and also stopped before this cage. One of them, a tall, dark man, looked like a foreigner; but he was talking pure English to his friend, and had been talking a good deal about the snakes, as if he were familiar with their habits. 'From the Tropics,' observed my companion, *sotto voce*, and looking as if we might hear something worth knowing from this large, loud-voiced visitor.

'See *that?*' he presently exclaimed to his friend. 'Look there!'

'That thing it keeps putting out of its mouth?'

'Yes. That's its sting. One touch of that, just one little touch, and you're a dead man. There's no cure for it!'

No less than four different parties made similar remarks in our hearing during our short visit to the reptile house that day, and these not of the common crowd either.

First, two lads who looked as if they ought to have known better. Next, a party of several persons, of whom the one more particularly addressed when his friend informed him, 'That's the sting that it jerks out so,' replied, 'Ah, but they extract it!' Thirdly, a young gentleman remarked to his lady companion, 'See how it keeps darting out its sting!' to whom she ejaculated, 'Oh, the fearful creature!' Fourthly, the tall man. And all this of poor little innocent *Tropidonotus* (our common ring snake), with not even a fang to injure you!

Like many other of the zoological myths not yet extinct, this 'stinging tongue' has its origin in mystery. Long before a deadly serpent was examined by an intelligent reasoner, and the nature of its fatal stroke comprehended, the mysterious 'dart' was seen to play; this, to the ignorant, being the only visible and possible instrument of such fatality. But that the fable should still obtain is amazing. Even some learned men of the present century, if they do not happen to have included natural history in their studies, assist in disseminating the error. Can they, however, be acquainted with classical writers? Pliny, to whom many of the old-time errors in natural history have been traced, must be acquitted as regards the poisonous tongue; for though he speaks of the 'sting' of a serpent, I do not recall that he once attributed the injury to the tongue. Aristotle, whose reputation as a naturalist ranks far higher, distinctly and frequently speaks of the *bite*, and the degrees of injury inflicted by the various kinds of serpent bites. It is possible that some classical writers may have supposed the tongue to be an instrument of death, as it is certain that some of the sacred writers did. But our inherited faith in Bible history has, until recently, checked all doubt and even inquiry. Now, however, that a new version of Holy Writ has been deemed essential, it is to be hoped that an efficient naturalist is included in the Council.

In justification of the above criticism I may be permitted to quote just one of the many unquestioning writers. The author of the *History of Egypt*, W. Holt Yates, M.R.C.P. of London, President of the Royal Medical Society of Edinburgh, Physician to the General Dispensary, etc., says in a foot-note (vol. i. p. 322), 'It is a mistake to suppose that snakes hurt only with their teeth. Some have no teeth, but only hard gums. Others only attack with their tongue —the same end is attained in either case by the insertion of the poison.'

Now were you to ask that writer, as I have several times asked persons who were under the same impression, 'What reason have you to suppose that the snake's tongue is poisonous?' he would very likely reply, 'Oh! well—it *is* venomous. I always thought so.' Then, reflectively, he might add, 'Poisonous-tongued? — "whose tongue out-venoms"—"with deadlier tongue than thine, thou serpent"' —or some such familiar words, proving that his idea was poetical, imaginative, and acquired he can scarcely explain how.

What very little he knew about snakes, then, was learned from Shakspeare—we say Shakspeare, for what other author has been read and re-read, and committed to memory, and quoted during the last three centuries like the Bard of Avon? The bard, genius though he was, and wide his field of information, was certainly *not* a naturalist. Nor did he make any pretensions to be one. He was as unconscious of the errors in natural history which he was handing down to posterity, as he was unconscious of his own enduring fame; or that he would be 'the immortal bard' three hundred years later, with every probability of ever living in the human mind as such.

His idea of the poisonous tongue of a snake was the prevalent one of his day. It was an inherited prejudice, which he had never stopped to question, any more than nine hundred and ninety-nine out of every thousand of his readers have ever stopped to question the fact of an adder's *tongue* being poisonous, Shakspeare having affirmed that it is so.

People do not read Shakspeare to learn natural history, you say. True; but his poetry, his similes, take hold of the mind, fix themselves in the memory, and take root; and an assertion, as in the case of the gentle little 'blindworm,' takes very deep root, as it seems, and thrives for three hundred years; or naturalists of the present day would not feel called upon to explain that it is neither 'blind,' nor 'deaf,' nor 'venomous.'

Still you reject the idea that Shakspeare through his immense and universal popularity is responsible for a ridiculous error. Not Shakspeare alone, then, or culpably so. But since the idea has prevailed for thousands of years, even to the present time, and since persons are more likely to quote Shakspeare on the subject than any other author, let us glance at the literature of Shakspeare's time, and endeavour to account for his fixed impression as to a serpent's tongue being poisonous. Let us also try to recall from any one of the writers of the same era, or those who wrote in English previously, any single line on the present subject that has become so engrafted on the mind, so incorporated with our education, as those, for example, above quoted. There was a host of other play-writers in Shakspeare's time, but very few naturalists.

Poetry, plays, and Protestantism characterized the literature of the period. But familiar to us *by name* as are his contemporaries, it will be as easy to find one educated person who has read the whole of their works, as it would be to find one educated person who has not read Shakspeare.

There were travels and histories written, the great maritime discoveries of the age giving birth to this new class of literature. Hakluyt's voyages were printed when Shakspeare was only twenty-five years of age, and even if he read them he would not have learned much about serpents there. Nor in Sir Walter Raleigh's histories either, which were written chiefly during his prison life, he being liberated the same year that saw the death of Shakspeare, 1616.

Many other well-known authors will occur to the reader, to say nothing of the writers of the previous eras, the great divines and scholars who wrote in Latin, and the many English ballad-writers more likely to be perused by 'the Bard.'

As for natural history, it found no place on those shelves, for as a science it did not as yet exist in England. Lord Bacon, Shakspeare's celebrated contemporary, did make some pretensions to be a naturalist; but his *Novum Organum* was written in Latin, and we are not led to believe that the poet enjoyed any very great educational and classical advantages, having had

'Small Latin and less Greek,'

according to his friend and eulogist, Ben Jonson.

And even if Shakspeare did read what was then *the Book* of the period, Lord Bacon unfortunately fell into some of the popular errors, or made very hazardous conjectures, so far as natural history was understood; and of him Dr. Carpenter says, 'So far from contributing to our knowledge of natural history, he often gave additional force to error by the weight of his authority.'

In recalling some lines from Shakspeare, the reader will find how very familiar to the mind are the serpent similes. Some of them prove that the poet was cognizant of a tooth being also a source of evil; but it is evident that he thought the tongue was so also, especially the tongue of the 'blindworm.'

For a few out of the many in which Shakspeare's plays abound, *vide Timon of Athens*, Act iv. Scene 3: 'The gilded newt and eyeless venomed worm.'

Midsummer Night's Dream, Act iii. Scene 2. When Hermia thinks that Demetrius has killed Lysander while sleeping, she scathingly ejaculates: 'O brave touch! Could not a worm, an adder do so much? An adder did it; for with deadlier tongue than thine, thou serpent, never adder stung!'

In *Cymbeline*, Act iii. Scene 2, Pisanio says: 'What false Italian, as poisonous tongued as handed, hath prevailed on thy too ready hearing?' Again, in Scene 4 of the same Act, Pisanio would not hear evil of his mistress, and cries: 'No, 'tis slander; whose edge is sharper than the sword, whose tongue outvenoms all the worms.'

Henry VI., Act ii. Scene 2, Clifford says to the King: 'Who 'scapes the lurking serpent's mortal sting!' Act iii. Scene 2: 'Their touch affrights me as a serpent's sting. . . . What! art thou like the adder waxen deaf? Be poisonous too!'

Much Ado about Nothing, Act v. Scene 1, Antonio says: 'As I dare take a serpent by the tongue.'

And in *King John*, Act ii. Scene 1, Randolph says to

King Philip, 'France, thou may'st hold a serpent by the tongue!'

Not snakes only, but toads, lizards, spiders, and other 'creeping things,' were thought venomous in Shakspeare's time.

Song in *Midsummer Night's Dream*: 'You spotted snakes, with double tongue.' Then, in appeal to the 'serpents' not to injure the Fairy Queen: 'Newts and blindworms, do no wrong.'

The nearest approach to a scientific work on natural history written in English at that time was a curious volume published in 1608, in whose folio pages may be seen most astonishing 'Serpentes,' combinations of worms and feathered fowls, saurian, ophidian, and batrachian, wonderfully adorned with horns, gills, wings, spear-shaped or forked tongues, and arrow-shaped tails. The zoological illustrations of that work give us some idea of what a snake was supposed to be. Among them is one with a human head, and another with a crown, because he is 'the King of Serpentes for his Magnitude or Greatnesse.' There is also a 'Dragon' with horns, wings, scales, claws, two rows of robust teeth, and an arrow-headed tongue. Mingled fable and fancy with some few facts, these anomalies are solemnly described as 'The Naturall Historie of Serpentes,' the said serpents including bees, wasps, 'frogges,' toads, earthworms, lizards, spiders, etc., and a 'cockatrice.'

The author, E. Topsell, addresses the 'gentle and pious Reader' on the 'publishing of this Treatise of Venomous Beasts,' and more particularly of 'Serpentes, Divine, Morall, and Naturell, their Poyson and Bitings, since the gentle and pious Reader will see how that the Historie of Serpentes begineth at the Creation.'

Thus we see that the ideal snake was a religious principle, carried out in illustrations and architectural embellishments, where 'that old serpent the devil' was depicted as a creature as terrible as imagination could conceive it ; and of course with a highly-developed tongue in the form of a dart or a spear, more or less alarming.

Fabulous tongues.

Far in advance of Topsell, and far in advance of England, were the naturalists of Southern Europe. Gesner, professor of philosophy at Zurich, published his *Historia Animalium* in 1551 ; and Aldrovanus, professor of philosophy and physic at Bologna, wrote thirteen folio volumes of natural history, four only of which were published during his lifetime, and the rest after his death, which was in 1605. These two authors, though out of date at the present day, have left their names perpetuated in plants and animals examined by them.

As one of the objects of this work is to trace the origin of some of the many errors that have obtained regarding the serpent race, and to note the gradual enlightenment observable in successive writers, it is a part of our duty to quote the Bible ; and this we do with reverence, emboldened by the fact that the present state of knowledge has demanded a new translation to satisfy the intellect of the age.

Shakspeare himself might have had the Bible devoutly in his mind when he talked of the adder's 'sting.'

Among the many commentators and exponents of Holy Writ, Cruden (A.D. 1794) says, 'Some place the venom of the serpent in its gall, others in its tongue, and others in its teeth.' David seems to place it in its tongue:—Ps. cxl. 3, 'They have sharpened their tongues like a serpent.' So also Job, xx. 16, 'The viper's tongue shall slay him.'

The sacred writers, however, quite understood that serpents did bite as well as 'sting.' Solomon made the same distinction that is observable in Shakspeare, 'biteth like a serpent, stingeth like an adder.'

In fact, the *tongue* of an adder, whether in allusion to 'the worm of the Nile,' or to our own pretty little 'deaf-adder,' seems still to bear the evil character which it has borne from time immemorial.

Superstition, prejudice, and ignorance are still rampant whenever a snake is thought of. Inherited and educated antipathies regarding them are still so strong that some persons will not even allow themselves to *un*learn their misconceptions; others by misrepresentations do their best to prevent a true comprehension of their habits from being better understood; and, again, there are those who know better, and who are even engaged in instructing others by their pen, but who fall into the habit of encouraging horror and hatred, instead of reason, truth, and a tolerance towards a creature wisely produced to fulfil its part and to perform its duties in the great balance of organized beings.

Some journalists religiously keep up the delusion about the tongue of a snake, by using a prejudicial prefix. From a pile of newspaper cuttings and other printed matter relative to snakes, I transcribe a few sentences at random, to illustrate what is meant:—'Its horrid forked tongue.' 'Its slithering tongue.' 'Its villanous poisonous tongue,' etc.

And if sensationalism seem to demand still more forcible language, as, for instance, in describing an injury or an escape, our journalist tells us of the 'forked tongue darting defiance.' 'The wicked-looking serpent tongue protruded with lightning-like swiftness.' 'To see the reptile run its devilish tongue out at you.' 'Its horrid lancinating tongue protruded,' etc. These are only a few of such sentences copied *verbatim*, but they are unfortunately too common, even with the better-informed writers.

The idea of a snake being sufficiently intelligent, reasoning, and reflective to deliberately 'run its tongue out at you,' as if conscious of its own moral power and your moral weakness, is too ludicrous. If the snake could truly inflict injury with those soft, flexible, delicate filaments,—if it could, with one rapid touch, insert poison, as the tall talker at the Zoological Gardens affirmed, the threatening quiver could only be in friendly warning. Let the poor reptile at least be thanked for that.

Our lamented friend, Frank Buckland, fell into the same error (or inadvertency, since he quite understood that the tongue could do no harm) when he wrote thus of the tongue in his *Curiosities of Natural History*:—'The tongue is generally protruded in order to intimidate the bystanders;' and, 'The tongue acts as a sort of intimidation to its aggressors;' thus giving the snake the credit of a waggish sort of intelligence, far more complimentary to the reptile than to the bystander. In imagination we behold a solemn Convention of snakes, held in ages long ago, and a resolution to this effect passed unanimously:—'Now these poor ignorant mortals think we can kill them with our soft and tender tongues. Though so tall, and powerful, and terrible to us, they look dreadfully frightened whenever we use our tongues in our own service. Therefore, whenever any of these two-legged creatures come near us, we will put out our tongues at them, and frighten them off,'—a resolution which has answered admirably well down to the present time. 'Down to the present time' is written and repeated in all seriousness.

Let me be pardoned for introducing a little more gossip here, as it is the fashion to relate what is seen and heard at the Zoological Gardens. And so much is related, and has been related, and even printed, to mislead the public, that, in the earnest hope and aspiration of assisting in correcting false impressions, I claim to repeat what was heard as well as the rest. Besides, when persons talk as loudly as if they were delivering a lecture, and apparently with the benevolent intention of instructing the public generally, one feels justified in quoting them.

Eight years ago, when first contemplating this work, and anxiously seeking to ascertain precisely what could be learned, and what was already understood about snakes, so far as the reptile house at the Zoological Gardens was a means of instruction, I made very careful notes of what I saw there, and occasionally of what I *heard* there.

In the summer of 1874 some well-dressed children, accompanied by their parents, were watching the pythons in the largest cage, when one of the little ones asked, 'Papa, what is that thing that the snake keeps putting out of its mouth?' 'Oh, that is its poisonous sting,' replied the father. The eldest girl (in her teens), with an affected shudder, cried 'Ugh!' and a boy exclaimed, 'I am glad it can't put it through the glass at *us!*'

August 3, 1877.—A gentleman, to all appearance well-bred and intelligent, told his two boys, 'That's the sting,' as they were watching the play of a snake's tongue in one of the cages. The boys looked wonderingly at the terrible instrument, and were evidently anxious to know more about it, and turned to ask their father. But he had passed on, and was then calling to them to look at something else.

July 1880.—A lady, apparently the governess of two girls of about twelve and fourteen, and of a boy of about eight, who were with her, was conscientiously endeavouring to blend instruction with amusement, and was telling them some strange and hitherto unheard-of facts about the snakes; as, for instance, that the rattlesnake was now going to 'crush a guinea-pig by winding itself round it;' for it was feeding-day, and the keeper had just put poor piggy into the cage. But the children got tired of waiting to see what did not occur; the rattlesnake was merely investigating matters by means of its useful tongue. 'Now, watch it!' cried the lady eagerly, 'and you'll see it lick the guinea-pig with its poisonous tongue.'

Neither was this feat performed by the Crotalus, and as the children got tired of waiting, and were impatient to 'see something else,' the party moved on.

But the reader will be weary of hearing what the tongue of a snake is *not*, and be desirous of knowing what it *is;* and to this purpose we will devote another chapter.

CHAPTER VI.

THE TONGUE OF A SNAKE.

PART II.—WHAT IT *IS.*

IF only by the law of compensation, another chapter must be devoted to the innocent tongue of a snake. It has been an object of hatred and aversion for untold ages, and the misrepresentation of it, and the abuse of it, would fill many chapters. Were it endowed with speech, and the words of St. James applied to it,—'the tongue is a fire, a world of iniquity,'—no stronger animosity could be displayed.

Happily, this animosity is by degrees dying away; but only by degrees, as we have seen, some writers during the last twenty years having been undergoing a sort of transition state with regard to the use of the tongue, inasmuch as, while they have arrived at the conviction that it does not 'sting,' they are not yet quite clear as to what it does do. Some few have even clung to the lubrication theory. *Popular writers*, to speak more correctly, not scientific ones. Still, it is the popular writers who most influence the casual reader. To satisfy a passing interest, we turn to these, to the books they quote, and next to encyclopedias, and not to scientific text-books, where we are beset by technicalities which are in themselves a study to be first mastered. Otherwise, from scientific works a good deal might have been learned long ago about this exceedingly wonderful organ, the tongue of a snake.

It is evident, however, that a good many of our drawing-room naturalists have not thought it necessary to first devote themselves to the scientific study of a snake's tongue before they ventured to write about it; therefore they remained only partially enlightened. To such an extent has the supposed 'lubrication' prevailed, that ophiologists of the day have not thought it too trivial to speak of and to refute. The same visitors to the Zoological Gardens who tell their friends or children to look at the snake's 'sting,' also wait to 'see the snake lick the rabbit all over before it begins to swallow it.'

Were a painter to set to work to paint a house, or a mason to whitewash the ceiling, with a camel's-hair pencil, it would not be a more tedious and impossible process than that of a snake 'licking all over with its tongue' the body of the animal it is about to devour. Illustrations, in order to be as startling as possible, and to feed the educated horror of snakes, often represent a boa or an anaconda coiled round a bull or some other equally large and rough-coated animal, which, as the writer informs us, 'it was seen to lick all over and cover with its mucus.'

Let the reader reflect a moment, and he will perceive what supply of moisture this degree of lubrication would demand. Even were the snake's whole body furnished with salivary glands, and were it provided with a broad, flat tongue to work with, what must the rate of secretion be to enable the snake to go through such a task, and to enable it to perform it in a period of time in which a spectator (supposing he had sufficient powers of endurance) could stand by and watch the process!

Snakes are, it is true, supplied very abundantly with a mucous saliva. Describing the mode of swallowing, Dr. Günther says: 'But for the quantity of saliva discharged over the body of the prey, deglutition would be slow.' Slow in comparison with the feeding of other animals it is, under any circumstances, and it would be painfully tedious, almost impossible, for the unfortunate reptile to feed at all, were its difficulties not relieved by this 'abundant supply' of saliva. But this is not saying that the tongue performs any office in systematic lubrication. It simply means that the mouth of the hungry snake 'waters' over its food, and waters far more freely than is the usual case with other animals. We ourselves know something of this stimulation of the salivary glands at the sight or smell of food when we are hungry; but snakes are beneficently provided with the salivary apparatus (described in the first chapter), and the mouth waters over its prey, as much when the tongue is in its sheath as when the tongue is engaged in its own peculiar and distinct functions. What the spectator does see is this tongue fulfilling its office of feeling, examining, exploring, investigating, ascertaining whether the prey is thoroughly dead, and the best way of setting to work on the great task of swallowing the huge, rough mass. All this work the tongue does for its owner; and we shall, as I hope, see before we have done with it, that so far from exciting our hatred and disgust, there is perhaps no other feature or organ belonging to the helpless snake so important to it, so worthy of our own observation and admiration, as this much-abused tongue.

We have an admirable opportunity for study in our visits to the Zoological Gardens, and there the lover of nature can decide for himself. Hours and hours has one watched, and I admit (in the early days of my studies) *waited*, to see this lubrication which, as the books told me, was performed by the tongue. Often and often one has heard visitors say to each other when they have seen the prey about to be devoured, 'Now we shall see, or you will see' (as the case might be) 'the snake lick it all over before he swallows it.'

An observation to this effect was once made in our hearing while I was on the point of asking the keeper if he had ever observed anything of the kind, and was telling him how often it had been so stated in print.

'Snakes never did, and never *will*, lick their prey, ma'am,' returned Holland emphatically; 'but I have seen the saliva flow, it is so plentiful.' And so have I, and so may you, patient reader, if you are sufficiently interested in the subject. You will soon become convinced that such a process as 'licking' is impossible, and you will soon decide that if the reptile did this instinctively, its tongue would have developed into something more like that of a cat, strong and rough with tiny spines, or some organ better adapted to the performance than a thin pencil or fork of tender flesh.

It is much to be regretted that a number of anecdotes which describe this 'lubrication' have been retained and quoted over and over again in books on snakes. Writers who are conscientiously instructing us, and who are even telling us 'snakes do *not* lick their prey,' quote the anecdotes which tell us that they *do*, and thus appear to favour the assumed mistake.

Space will not permit of the numerous examples which might be here introduced in proof of this. Nor is it necessary to name more than two or three of these misleading anecdotes; the reader will at once recognise them, for they appear everywhere.

First comes the M'Leod narrative, which has found favour with popular writers for no less than sixty-three years! The first edition of the *Voyage of the Alceste*, by Dr. M'Leod, the surgeon on board, was published in London in 1817, a second edition in 1818, and a third (so popular was the work) in 1819. His account of feeding the boa constrictor was not the least popular part of the little book; for in those days there were few who knew what to believe where a snake was concerned. The account of a goat being swallowed fills several pages, written in a style to exaggerate horrors, and apparently deny to the reptile any right to obey nature's laws. 'The python fixed a deadly and malignant eye on the goat:' . . . 'first operation was to dart out its forked tongue:' . . . 'continued to grasp with its fangs:' . . . 'began to prepare for swallowing:' and 'commenced by lubricating with its saliva:' . . . 'commission of this murder,' etc.

Maunder, in his *Treasury of Natural History*, quotes this, having previously stated (under the head Boa Constrictor):

'The prey is then prepared for being swallowed, which the creature accomplished by pushing the limbs into the most convenient position, and *then covering the surface with a glutinous saliva*.' Though not positively asserted that the tongue is the agent in this 'covering,' the reader naturally jumps to this conclusion. The 'Penny' and several other encyclopedias quote the M'Leod story, among them the *Encyclopedia Britannica*, ed. 1856, notwithstanding the compiler of the article 'Reptilia' affirms, 'The use of the tongue is not exactly known.' Surely this licking over an enormous mass of fur or wool, each time the reptile partakes of food, would be a very important use indeed of the tongue, did such a process take place.

Mr. Philip Henry Gosse, in his *Natural History of Reptiles*, 1860, repeats the M'Leod story; but he follows it up by also quoting a writer, Broderip, who carefully considered the subject, and who doubted the possibility of such a tongue performing this office.

Mr. Gosse is one of the most popular of our 'drawing-room' naturalists. A careful and conscientious writer, he has contributed in his various works a great deal of valuable information, and has done as much, if not more, towards inducing a taste for natural history than any other author of his day and class.

Another popular anecdote much used is that of Sir R. Ker Porter, who (*cir.* 1820–24) sent an anaconda to the United Service Museum, accompanied by an account of its seizing its prey. 'In an instant every bone is broken, and the long, fleshy tongue passes over the entire form of the lifeless beast, leaving on it a sort of glutinous saliva which greatly facilitates deglutition.' This last clause was particularly striking, and you find those three words, 'greatly facilitates deglutition,' used ever since by more writers than one can enumerate.

A third of the many well-worn anecdotes in which the 'lubrication' is conspicuous, is taken from a German journal, the *Ephemerides,* in which a combat between a boa constrictor and a buffalo is described in the approved sensational style, and this sentence occurs:—'In order to make the body slip down the throat more glibly, it (the snake) was seen to lick the whole body over, and thus cover it with its mucus.'

Perhaps these three anecdotes, copied from book to book for, say, only fifty years, have done as much to mislead regarding the second reputed use of the tongue, as Shakspeare and his predecessors did regarding the stinging theory.

Sir Robert Ker Porter published two very handsome quarto volumes (illustrated) of his *Travels in Georgia, Persia, and the East,* during the years 1817 to 1821. Such a work from a distinguished traveller in that day would soon grow into popularity; but, like Dr. M'Leod, he does not describe his snake by the cool light of science.

In a very able article, 'Boa' in the good old *Penny Cyclopedia,* dated 1835, the writer, quoted by Mr. Philip Henry Gosse, mildly criticises the lubrication theory, and gives at length an excellent paper on the subject, contributed to the *Zoological Journal* in 1826 by the distinguished naturalist, W. J. Broderip, F.L.S., etc.[1] Very courteously Mr. Broderip discusses Dr. M'Leod's description, and in giving an account of what he himself witnessed in the manner of a boa feeding, speaks of 'the secretion

[1] Author of *Zoological Researches*, and *Leaves from the Notebook of a Naturalist.*

of lubricating mucus being excessive,' and that 'the jaws dripped with the mucus which had lubricated the parts,' but not once mentioning the tongue as having any part in this function. The writer in the *Penny Cyclopedia* concludes by saying that he had himself frequently watched the snakes while feeding, and they 'never covered the victim; the tongue was thrust forth, but only,' etc. And yet so many book-makers who must have read this have copied the anecdotes without the comment, and have thus popularized the lingual lubrication!

CHAPTER VII.

THE TONGUE OF A SNAKE.

PART III.—*ITS USES.*

ONE more function in which the tongue has no part it is important first to mention. 'It is supposed to be concerned in the function of voice, that is, hissing,' says Mr. Frank Buckland in his *Curiosities of Natural History*, 1860. Now, as this is an extremely popular book, and as Mr. Buckland was a very popular writer, and much quoted and believed in from his pleasant and genial style, and his many opportunities, it is necessary to explain that the tongue is often or generally in its sheath while the snake hisses, and therefore has *no part whatever* in the 'function of voice.'

More recently still, a writer in 1876 is under the same impression. It is well known that the contributors to that excellent magazine, the *Leisure Hour*, are for the most part persons of good literary standing. However, in the matter of snakes we are all only learners.

There are in the magazine referred to, three chapters 'On Snakes,' occupying, with the illustrations, about eight pages, in which the general subject is treated.

'It is a very general belief that the sting of a poisonous snake is in its tongue,' says this writer, 'and to any one who has seen an adder ready for attack, with its body coiled, its head and neck reared aloft, and its long, narrow tongue, split for a considerable distance from the point inwards, and thus resembling a two-pronged fork, vibrating rapidly, accompanied by a hissing sound, the needle-like points of the tongue have a decidedly stinging aspect. It need hardly be said that the tongue is only responsible for the hissing.' The hissing is from the lungs (see chap. ix.), and, as may be repeated, often while the tongue is within its sheath, the opening of which is forward in the mouth.

The tongue of a snake occupies much the same place in the lower jaw as that of other animals; only being, while passive, within its sheath, which opens at the tip, the tongue can move but in one direction, namely, *forwards*.

The illustration in the *Leisure Hour* which accompanies the above writer's explanation, displays a rattlesnake with widely-extended jaws, and a tongue which, by comparison, must be from root to tip half a foot in length, and represented as coming from far back in the throat, as if no sheath existed.

The tongue of a snake not being so planted, and not by any possibility intercepting the breath, it is needless to repeat that it can never be any agent of the voice, *i.e.* 'hissing,' nor is it every snake that does hiss (see chap. ix.). Illustrations conveying an entirely erroneous impression are very much to be regretted, and unfortunately this misplacing of the snake's tongue is an extremely common error, and we recognise the familiar woodcut again and again in a number of different publications, misconceptions thus being seriously multiplied. Bad illustrations, even more than printed errors, are responsible, because more persons turn the leaves of a book to look at these, than those who read the page, and a glance either instructs or misinforms the eye.

The hissing of a snake, as we may here add, is merely an escape or expulsion of air from the lungs, more or less quick or 'loud,' as the reptile is more or less alarmed or angry. Conjecturally, one may suppose this hissing to correspond with the agitated breathing or panting of other animals, or of an excited person.

In the seventeenth century, when travellers were visiting for the first time the newly-settled colonies in America and Africa, and when the early explorers in various parts of the world were sending home stuffed specimens of animals (in the days when taxidermy, like other sciences, was in its infancy), a stuffed snake was furnished with a huge, broad, fleshy tongue, big enough to crowd its entire mouth, minus teeth and gums.[1] Whether this broad tongue was to favour the delusion of 'licking,' or whether the licking was presupposed from the look of the tongue, we cannot say, but that the stuffed specimens did encourage the delusion is clear.

Our Philosophical Society, founded about the middle of that century, and the 'Philosophical Transactions' of those days record the first arrival of tropical serpents in England, and the marvellous beliefs concerning them. From them we learn, nevertheless, that many things said to be 'new to

[1] In the 'Laidley Worm,' exhibited at the Grosvenor Gallery in 1881, the artist must have copied one of these.

science' in our own time, were not unknown two centuries ago.

Passing by a large number of writers on snakes, who, being convinced that the tongue neither 'stings' nor 'licks' nor 'aids in hissing,' and who, therefore, cursorily dismiss it with, 'the use of the tongue is not known,' let us thoroughly examine for ourselves this mysterious organ; and this we can do with the assistance of those who have devoted careful attention to the subject.

Quoting first our English authorities, Dr. J. E. Gray tells us: 'Tongue very long, retractile into a sheath at its base. Apex forked, very long, slender, and tapering.'

Says Dr. Günther: 'Tongue long, vermiform, forked; an organ of touch; frequently and rapidly exserted to examine an object. The slightest provocation brings the tongue into play.'

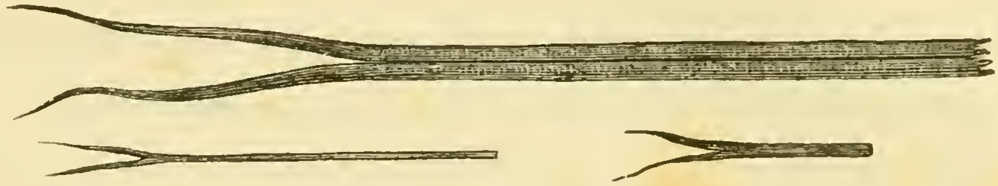
Rymer Jones, in his *Organization of the Animal Kingdom*, tells us that 'in snakes the bulk of the tongue is reduced to the utmost extent. The whole organ seems converted into a slender, bifid instrument of touch, and is covered with a delicate membrane.' Again, in Todd's *Cyclopedia of Anatomy*, the same writer says that 'the tongue of a snake seems to perform functions, the nature of which is not so obvious' (as that of some other reptiles).

Der Hœven (Clark's translation) tells us 'the tongue of a snake is an organ of feeling or tact, and much used, as the antennæ of insects.'

It will be observed that while no two of the above writers use precisely the same words, each helps us to picture the tongue more accurately, and we glean from each some new particular. The *Encyclopedia Britannica*, after telling us 'the use of the tongue is not exactly known,' adds, 'they (the snakes) are continually lancing it into the air, and may possibly in this way gather moisture from grass or herbage' (alluding to the question of 'drinking,' see chap. iv.).

Professor Owen still further defines it as a pair of muscles, or a double muscle partly connected and partly free. The reader will prefer the learned Professor's own words, notwithstanding the slight repetition.

In his *Anatomy of the Vertebrates*, p. 463, after describing the prehensile character of the tongue in some reptiles, notably the toad and the chameleon, he says: 'In serpents the tongue takes no other share in the prehension of food than by the degree in which it may assist in the art of drinking. It is very long, slender, cylindrical, protractile, consisting of a pair of muscular cylinders in close connection along the two basal thirds, but liberated from each other, and tapering each to a point at the anterior third; these are in constant vibration when the tongue is protruded, and are in great part withdrawn with the undivided body of the tongue into a sheath when the organ is retracted.' The pair of parallel muscles can be distinguished in the largest of the accompanying illustrations, viz. the tongue of a Jamaica boa of about 8 feet long. It was cut out and given me immediately after the death of the reptile, and while soft and flexible was carefully copied. The hair-like points diminish to an almost invisible fineness impossible to represent with pen or pencil. The *slender* little tongue is that of the young *Jararaca;* and the shortest is that of the African viperling. I have drawn only as much as is usually exserted when in use. The entire tongues are much longer, of a pale flesh tint, and somewhat thicker towards the root. It is observable that the organs, like their possessors, are either shorter and stouter, or longer and more slender.



Three tongues from nature (exact size).

The reader will concur with Mr. P. H. Gosse and the *Penny Cyclopedia*, that 'no instrument is less adapted for licking.'

There is yet one more of our English scientific writers who must be quoted, and who, though he wrote so far back as 1834, shows us that even then this tongue was far better understood by the French and German zoologists than ourselves. Roget, in his *Animal Physiology* (one of the Bridgewater Treatises), says: 'Hellmann has shown us that the slender, bifurcated tongue of snakes is used for the purposes of touch.'

It is to be regretted that we have no translation of this and of several other German ophiologists of whom mention is made by Roget and others. Lenz gives us to understand that in 1817 Hellmann had decided that a snake uses its tongue as an insect does its antennæ. And in watching with unprejudiced eyes the varying play of the organ, the similarity of action will at once be recognised.

After all, how little can we ever know of these organs beyond conjecture! Who shall say whether each or both may not possess a sense of which we ourselves have no true perception? Close observers are convinced that the tongue of a snake is endowed with peculiar sensibilities; and it is the more astonishing, therefore, that reason and observation have so long been blinded and enslaved by prejudice regarding it.

Some naturalists think that the sense of smell lies in antennæ. The sense of smell itself is dull in snakes; yet they have means of ascertaining what other animals learn by smell. Says Huxley, 'The great majority of the sensations we call taste are in reality complex sensations, into which smell and even touch largely enter.'[1] It is certain that the snake's tongue is in constant use for some purpose or other, though beyond what we see of its form and actions we can only speculate, or, at best, draw conclusions from observation.

Both Dumeril and Lenz give the result of their own observations. The former, however, devotes so many pages to the tongue and its functions under the various headings of 'touch,' 'nutrition,' 'the senses,' etc., that it will be necessary to curtail a good deal, particularly as this great author has been quoted by those other physiologists whose words were given above. Of the sheath into which the tongue is received he says:—'Une gaîne cylindrique, charnue; mais l'extrémité de cette langue est fourchue, ou divisée en deux pointes mobiles, vibrantes, susceptible de se mouvoir indépendamment l'une de l'autre, de s'écarter et d'être lancées, pour ainsi dire: ce que la fait regarder par le vulgaire comme une sorte de darte, auquel même quelques peintres ont donné dans leurs tableaux la forme d'un fer de flêche. Le vrai est que cette langue est molle, humide, très faible, et que l'on a

[1] *Elementary Lessons in Physiology.* London, 1875.

fait des conjectures, plutôt sur les usages auquels on l'a cru destinée, que sur l'utilité réelle dont elle peut être aux serpents dans l'acte de la deglutition ; car les serpents ne mâchent jamais leurs alimens.'[1] 'Quoiqu'on ignore le véritable usage de la langue humide et charnue que les serpents brandissent et font continuellement sortir de la bouche et vibrer dans l'air, il est facile de concevoir qu'à cause de la forme cylindrique et de son etroitesse elle ne pourrait faciliter la mastication, quand même les dents seraient propres de cet usage.'[2]

This first volume of *Erpétologie générale* treats of all reptiles inclusively; but in the sixth volume, where the *ophidia* particularly are introduced, the tongue is, with the rest of the organs, more minutely described. Some repetition necessarily occurs; but there is still a good deal that will repay perusal.

After stating that in serpents the sense of touch is dull, on account of the integument, and the absence of what may be regarded as tactile organs, and that the sense of smell is dull, the nostrils being feebly developed, Dumeril adds: 'The tongue, though fleshy, very mobile, and constantly moist, is rather an especial instrument for touch, for the action of lapping, and for other functions, than to perceive the nature of liquids;' in other words, than as an organ of *taste*. 'It is, however, very remarkable; though smooth and even above, it is furnished with little fringes or papillæ along the sides. Notwithstanding its length and narrowness, it is singularly protractile and retractile; and in its exceedingly rapid vibrations has impressed the vulgar with the idea

[1] Tome i. p. 126 of *Erpétologie générale*. [2] *Ibid.* p. 135.

that it is formed with the two spear-like points. It is clothed with a delicate skin.' [1]

Lenz made many interesting experiments. In his work he gives us the result of these, and also what some other German ophiologists had seen and done. He observed how entirely the snake trusted to its tongue in any unusual circumstances; the all-important member was then in ceaseless activity. Confined in a glass jar containing wine or any liquid that the snake did not like, the tongue was ever agitated. Crawling up the side, the tongue was in constant request to feel the glass (as may be often seen at the Zoological Gardens); and on arriving at the top, the head was turned this way and that, and then bent over the edge, as if to make certain that no further obstacle existed; the tongue not for one instant quiet, but exserted sometimes as far forward as the whole length of the head, telling to its owner all that the other senses could not discover.

Permitting it to touch his hand, he felt it like the sweep of a thread, so light and delicate. Too fine and flexible to injure any surface, the slightest touch of one or both the tips suffices for intelligence. Nay, sometimes without even touching—that is, without positive contact, but by some subtle sense, it seems to act as guide.

When the snake is excited by fear or alarm, or when in a strange place, the activity of the tongue is so great, the vibrations are so rapid, that the eye cannot follow them. It is like the play of electricity.

So far from participating in deglutition, the snake with-

[1] Tome vi. p. 100 of *Erpétologie générale.*

draws the slender instrument into its sheath, which, while feeding, is safely closed. For this highly-endowed organ is so guarded against injury, that the reptile has not only a place of safety provided, but power to close the mouth of its scabbard, lest dust or other irritating particles should enter.

We have only to reflect upon and to observe the habits of snakes to perceive the importance of their tongue to them. For the most part nocturnal, winding their way under tangled masses of vegetation, often in dark caves, holes, crevices, and obscure retreats, with their eyes so placed that they can see neither before nor under them, and with other senses only feebly developed, the tongue with its sensitive papillæ feels its way, and conveys impressions to its owner.

Cats have their whiskers to help them in the dark; moles and mice have their quick sense of smell to guide them; all nocturnal animals are gifted in some manner or another, but snakes have only their tongue.

We can now imagine the helpless condition of the reptile if deprived of the tongue! Rudolph Effeldt, of whom Lenz speaks as the 'most eminent observer of living snakes,' found that when deprived of the tongue, they would neither eat nor drink, and, of course, died after a while. But Lenz had some snakes sent him which had been deprived of their tongues, and he observed that though for a time dull and declining, they did recover, and by and by ate as usual. From which we can only conclude that snakes, like other animals, differ in their powers of endurance. Some survive mutilation and suffering, some do not.

Another error in illustrations is to represent the tongue far extended while the mouth is wide open. Snakes very rarely open their mouths and use their tongues at the same time. Indeed, excepting to gape, the snake does *not* generally open its mouth ; nor invariably keep it open while advancing on its prey, as illustrations often represent.

Nature has further provided for the safety of the tongue by leaving a small opening in the upper lip, or at the point of the muzzle, just where no teeth are in the way, so that the snake can use its tongue without exposing the sheath and mouth to injury. This 'chink in the rostral shield,' to use technical language, permits the free exit of the tongue and the independent actions of the two muscles of which it is formed, enabling the reptile to hold the two fine tips close together as one tip, while passing the tongue through the narrow chink, and to expand them afterwards.

Lenz never observed any dust or small particles adhering to the tongue ; but Mr. Arthur Nicols, the author of *Zoological Notes*, informs me that he *has* noticed little fragments of rubbish cling to the tongue and carried into the mouth. Dr. Cantor also says : 'Sea snakes make no use of the tongue while *in* the water, but considerable use of it as a feeler when out of the water.' He has noticed 'several Indian land snakes use it to bring into the mouth various small bodies, as stones, sand, twigs, which they swallow to stimulate digestion.'

This is curious and noteworthy. The power or volition which can control the sheath and close the valve can, no doubt, exclude these foreign particles ; as, while lapping, the mouth must be moistened as well as the interior of the sheath, both it and the tongue requiring frequent lubrication.

But we have now reached the confines of speculation. There is enough of real fact about this 'horrid forked tongue' to interest and astonish us. We find it guarded, aided, especially provided for, and especially constructed and endowed; especially *harmless* also. To the owner its importance ranks not second even to the eyes.

The importance of the antennæ to insects is evident to all who have ever watched the play of those active and beautifully-elaborate organs, their infinitely varying forms (often many times the length of the insect itself), their ceaseless play and independent action. Constantly waving, they lightly touch every contiguous object; investigating on all sides, they convey to insect intelligence all it requires to know regarding its environments. Like a herald or a scout, they literally 'spy out the land,' and thus become a guide and a guard to the tiny feeble creature which possesses them. Through them the owner learns all that is needful for its well-being.

Much as an insect uses these exquisitely-constructed antennæ, so does a snake its long, slender, pliant, bifurcate, and highly-sensitive tongue. Ever busy, ever vigilant, exploring while barely touching each surface within reach, yet by night and by day conveying with that slight contact all necessary information to its owner. Sent out with the speed of a flash, it telegraphs back with like quickness the result of its discoveries.

If we may assign intelligence to any single organ, we might affirm that there is more of what we consider rational intelligence in the tongue of a snake than in any other of its perceptive faculties. Probably the most important knowledge demanded by the reptile is conveyed, or, at least, confirmed by this organ.

'*Colorée*,' says Dumeril of the tongue, as botanists say of the part of a plant ordinarily green, as, for instance, a calyx; 'coloured,' but not what colour. This is precisely as we may describe the colour of a snake's tongue. My attention was first drawn to this on reading one of Dr. Arthur Stradling's communications to *Land and Water*, April 2, 1881. 'It would be interesting to know why some snakes have red tongues and others black,' he writes. 'Here beside me, in a glass case, are two little snakes, both belonging to the same genus (*Tropidonotus*)—a seven-banded (*T. leberis*), and a moccasin (*T. fasciatus*), both hailing from the United States, and both alike in their habits and choice of food; yet it is a case of *rouge et noir* with their lingual appendages.'

After reading this, I noticed the varieties of colour in all the 'forked tongues' that exhibited themselves at the Zoological Gardens. Black or very dark tongues, I think, predominate; and next to black, brownish or olive tints, resembling those of the snake itself. But not as a rule; for some very light snakes have dark tongues, and the converse. In two small green tree snakes of distinct genera, one had a pale pink or flesh-coloured tongue, and the other a black one. Some tongues are almost white, while a few are red. There seems to be as much caprice as in the colour of the human hair and eyes; and as physiologists have traced some sort of connection or relationship with complexions and constitutions in these, so ophiologists may, after a time, discover a similar relation or sympathy between the colour of a snake's tongue and its integument or eyes. At present, I have observed only so far as that two entirely black and two entirely green snakes may present four distinct colours as regards their four tongues, and that many tints of brown, black, and pink may be seen in the tongues of as many snakes.

CHAPTER VIII.

THE GLOTTIS.

ONE Friday in August 1873, while watching a large python, at the Zoological Gardens, swallowing a duck which it had just killed, I was struck by a singular something projecting or hanging from the side of the snake's mouth. It looked like a kind of tube or pipe, about one inch and a half or two inches of which were visible. The python had rather an awkward hold of the duck, having begun at the breast with the neck doubled back, the head forming some temporary impediment to the progress of the jaws upon the prey. So the strange protuberance gave one a 'sort of turn,' and a shudder. It looked as if it might be some part of the crushed bird, and then again it had the appearance of some internal arrangement; and another shudder crept over one as the idea suggested itself that the poor snake had ruptured its throat in some way. What *could* this queer thing be, hanging on one side, as you see the tongue of a horse or dog sometimes lolling sideways over its lower jaw? While intently pondering and observing this strange tube-like object, in size somewhat as big as the edge of a thimble, I saw the end of it moving of itself, an orifice contracting and closing tight, by the loose skin puckering up, so to speak. Presently it opened, and by and by again closed tight, as you see the breathing orifice of the octopus contract and expand, open and close, at regular intervals, only in the present case the intervals were not regular. This strange tube, then, had life and volition in it! What could it be?

Suddenly a certain day of one's childhood flashed into my mind, and a certain scene of home. One Michaelmas Day it was, when, having stolen surreptitiously into the kitchen to coax the cook to '*let* me see the goose!' I found her busy preparing the bird, and clambered into a chair to watch her. 'What's *that?*' I demanded, seeing part of a long, pipe-like looking thing lying there.

'Oh, that's the windpipe. That's like what *you've* got in *your* throat; and that's where the crumbs get to make you choke so,' in allusion to a recent occurrence.

I gazed with awe and interest at that very strange thing, and wondered if it really could be like anything in my own throat, and where it began and ended, and so on. And that goose's windpipe was indelibly stamped on my memory.

And now that scene came vividly back to me, for there was a windpipe sort of look about this appendage to the snake's jaw, only it did not appear to be bruised or injured in any way. Nor from the position of the duck (by this time half swallowed) could it belong to the bird. And, again, it moved with an independent motion!

And now the snake threw up its head, to free the legs of the duck from its folds where it had been held, and as you see horses toss up their heads to get the grain in the bag hung on their noses, and I saw the tube-like object still more plainly. Then, with a strange, awe-struck feeling, came a conviction that this could be nothing less than the poor snake's windpipe, and that something must be very wrong with it.

I beckoned to the keeper, and pointed to it, telling him, 'I do think that must be its windpipe. Is it hurt?'

The keeper said, 'No, the snake was not hurt. That he had often seen it like that when the snakes were feeding; and that he also thought it must be the windpipe, to enable the snake to breathe while feeding.'

Next day, with eager steps and excited curiosity, I hurried to the British Museum reading-room, thinking I had made a wonderful discovery, for I had never heard this strange phenomenon alluded to, and the keeper evidently knew very little about it.

With this great secret on my mind, I flew to the well-known shelves, to secure those books which would certainly enlighten me if information were to be had. Alas! for my wonderful discovery, though it really had been a portion of the windpipe which was thus extended from the mouth, it was what had been known long ago by those physiologists who had studied the anatomy of the ophidia, and it was as coolly described as if it were the commonest occurrence in the world for creatures to do what they pleased with their windpipe!

Says Professor Owen in his *Anatomy of the Vertebrates*, vol. i. p. 525: 'The glottis of serpents can be drawn forward and protruded from the mouth by the action of' (certain surrounding) 'muscles. In marine serpents the glottis is situated very near the fore part of the mouth, and the air can be inspired at the surface of the water without exposure of the jaws.'

The lungs of snakes, then, are supplied with air through that moveable tube, and the 'glottis,' which is the mouth or opening of what may here be called the air-tube, not to venture on scientific terms, was what I had seen 'puckered up,' as it appeared.

We may briefly remind the reader that our own throats contain two passages, one to the lungs, the other to the stomach ; and in order that the air passage may be safely guarded from the entrance of any foreign particles, there are various parts, valves, and muscles which come into play with the action of swallowing, each and all having technical names, larynx, pharynx, glottis, epiglottis, etc., which need not be here described. But in the adaptive development of those wonderful creatures, snakes, the entrance or mouth of the windpipe—which begins *in* their mouth—can not only be closed at will, but still further to protect the passage, and also to enable the reptiles to breathe during the long process of swallowing, they can absolutely bring the apparatus forward, even *beyond* their mouths ; and this was what had so surprised me on witnessing it.

The glottis, being the soft, membranous end or aperture, was what opened and closed, expanded and contracted, by that sort of puckering up and loosening again that was observable, and which here was rounded, but in the higher animals is a narrow, lip-like slit.

Some physiologists, in describing this 'air-tube' of serpents, speak of it as the *larynx*, which is what we unscientific folk would call the entrance to, or the upper portion of, the true windpipe or trachea. Others, again, affirm that they saw the 'windpipe' projecting. After all, much less has been said about it than one could wish; and what is said is somewhat conflicting, perhaps on account of the obscurity connected with this surprising adaptation of means to necessities. A thorough examination of the position of the trachea of snakes *while feeding*, and a perfect realization of its functions, could only be obtained were it possible to arrest the process of feeding by the instantaneous death of the feeder, and while every muscle of the snake's mouth remained in position. Even then, one could not be positive, as snakes are endowed with the astonishing power of carrying out their intentions, or, in common language, 'going on with their business,' even after death. That is to say, owing to the irritability of their muscles, the action which they were about to perform (as, for instance, springing at a foe) continues should the head be shot off at the moment of making the attempt. In p. 56 and chap. xxi. some remarkable elucidations of this are given.

The general appearance of a windpipe is familiar to every one. It is formed of a series of rings or hoops, partially cartilaginous in mammals; that is to say, they are incomplete behind, where their ends are united by muscle and membrane, and come in contact with the gullet; but in serpents the rings are entire, the ends of each being joined together by an elastic substance. The rings themselves are also connected with each other by elastic membranes, so that the windpipe is capable of being extended like an india-rubber tube, and of regaining its former position.

The length of it naturally varies according to the size and species of serpent; but as a rule it is always much longer comparatively than in man. In a full-sized rattlesnake, the trachea is about twenty inches long. In a boa constrictor, also, though a much larger snake, it measures about the same. In smaller snakes it is, of course, much shorter; but there is the same singular diversity in this as we find in other serpent anomalies, viz. a great variation in the length in snakes of equal size, and without any very apparent reason.

Bingley, in his *Animal Biography*, 1820, describes the appearance of a large snake (M'Leod's celebrated boa) when gorging a goat; but the account, like those of that time, is more sensational than scientific. 'His cheeks were immensely dilated, and appeared to be bursting, and his *windpipe* projected three inches beyond his jaws.'

Broderip, a few years later, 1825, more lucidly and dispassionately describes what he had observed. 'I have uniformly found that the larynx is, during the operation of swallowing, protruded sometimes as much as a quarter of an inch beyond the edge of the dilated lower jaw. I have seen, in company with others, the valves of the glottis open and shut, and the dead rabbit's fur immediately before the aperture stirred, apparently by the serpent's breath, when his jaws and throat were stiff, and stretched to excess' (*Zoological Journal*, ii. 1826). This account is quoted from the paper entitled, 'Some Account of the Mode in which the Boa Constrictor takes its Prey, and of the Adaptation of its Organization to its Habits,' by W. J. Broderip, Esq., F.L.S. The paper was written as a criticism of the M'Leod story.

I, also, on several occasions, saw the fur or feathers stirred by air when the mouth or valve opened of what we may safely call the *air-tube*, whether larynx or trachea.

Though so rarely mentioned in popular books on snakes, this surprising modification of the breathing apparatus was described by the indefatigable Dr. Edward Tyson, on his dissection of the first rattlesnake that fell into the hands of the Royal Society, 1683, and whose paper on the *Vipera caudisona*, as he named it, is quoted in chapters xvi. and xx. 'Over the tongue did lye the *larynx*, not formed with that variety of cartilages as is usual in other animals, but so as to make a rime or slit for receiving or conveying out the air. Nor was there any epiglottis for preventing other bodies from slipping in, this being sufficiently provided for by the strict closure of it.' [1]

Dr. Tyson examined only a dead specimen, and could not therefore witness the action observable in life; but his remarkable accuracy in describing the parts will be evident in comparing what he said with Dumeril, who did observe the living reptiles. The confusion which sometimes occurs in distinguishing the parts may be also explained by the less complicated structure of the tube, which in higher animals presents the nicer distinctions of the parts, glottis, epiglottis, larynx, etc.

'Il n'y a pas de véritable larynx, une petite languette

[1] *Philosophical Transactions*, vol. xiii. p. 25. 1684.

mobile qui s'ajuste, sur l'ouverture linéaire ; c'est la glotte. . . . La glotte, située au-dessous de la victime, se porte en avant, et l'acte de respiration ne se trouve point empêché. C'est que nous avons indiqué à l'article de la déglutition ; car on voit distinctement alors la glotte se fermer et se délater.'[1]

This *petite languette* became a new object of curiosity, and soon came fresh opportunities for observation, namely, when some of the larger snakes were engaged in yawning. On account of its extreme mobility, you do not always detect the form of this little point on the upper lip, which as often as not presents a rounded opening; but occasionally the little tongue—which can be nothing but an apology for an epiglottis—is very distinct, and may be compared with the moveable, pointed snout of some of the large pachyderms, or, still better, with an exactly similar formation at the end of the elephant's trunk, and which, though for a different purpose, moves similarly.

As to the *exact position* of this glottis when at rest, a word or two must be said; for a number of prepositions have been used to describe it. One writer says 'beneath' the tongue sheath, others say 'beyond,' others again 'before;' 'over,' 'above,' 'behind,' 'in front of,' have been variously used, and all depending on which way the snake is viewed; but without drawing upon half a score of prepositions to puzzle the reader, as I myself was sorely puzzled until a yawning snake was so kind as to afford me an ocular scrutiny of its lingual arrangements, we can easily comprehend where a passage to the windpipe and lungs must necessarily be, and which, it is clear, is not *under* the tongue. When a snake's

[1] *Erpétologie générale*, tome vi. p. 177 *et seq.*

head is raised, as in crawling up a wall or a tree, the glottis may be said to be 'beneath' or 'under;' but the general position of a snake being horizontal, the mouth then opened would show you the opening of the tongue sheath *nearest* to you and to the front; and beyond that, behind, over, or *upon* the tongue sheath, is another aperture, which is the glottis or entrance to the larynx and trachea or windpipe.

So there are in fact two sheaths or tubes lying one upon the other, viz. the tongue sheath, and upon this and parallel with it, the windpipe.

After becoming better acquainted with the nature of that tube which had impressed me so strangely, I lost no opportunity of making further observations, and on the following feeding day at the Gardens I saw the air-tubes of several snakes plainly. In September of that year, a new 'Horse-shoe' snake (*Zamenis hippocrepis*) arrived from Morocco. It was a small and very pretty snake, and while enjoying the privilege of a private inspection, the keeper got its mouth open for me, enabling me to see the glottis, as well as to both see and *feel* the four upper rows of its beautiful little teeth, closely placed, and as sharp as the finest pins. But the action of the air-tube was very distinct. Probably little *Zamenis* was breathing harder and nervously under the detention, but no word better describes the formation of the aperture of the perfectly rounded tube, and the movement of it, than the *petite languette*.

Subsequently, there were opportunities of observing the air-tube in two of the large African vipers, the 'River Jack' or 'Nose-horned' vipers (*Vipera rhinosceros*) occupying the same cage. Each struck a guinea-pig and held it. One of them began to eat his before it was quite dead, and had finished it before his friend had begun. In his case, the air-pipe was at the side of his distended jaws. In the other, it projected more than half an inch *beneath*, nearly in the centre.

This happened on a mild, damp day in November 1873, and after that I saw the tube in 'several snakes,' but I regret the names were not entered in my notebook at the time. In the smaller non-venomous snakes, or in the lacertines—of which there were then a large number—I do not remember to have observed it. They despatch their frog or mouse so quickly that they would scarcely need a fresh supply of air meanwhile. In the larger vipers, rattlesnakes, and constrictors, the air-tube was undoubtedly witnessed. Winter then terminated my observations, and afterwards a prolonged absence from town. Unfortunately, when observations were about to be resumed, the change of the plans at the Zoological Gardens, and the exclusion of the public, defeated my intentions, though on one occasion I did see the windpipe of little *Natrix torquata* very distinctly; and this was the smallest snake in which I had ever observed it. *Natrix* had nearly disposed of a large frog. The whole of it was in his mouth, which was widely expanded, and the air-tube was protruded sideways, not *out* of the mouth, but sufficiently forward to enable one to distinguish its form, and the action of the *petite languette*. The prey being unusually large, the snake had needed air while swallowing it.

On several occasions in snakes recently dead, and of various sizes, one has been able to notice how admirably this tube, which lies along the mouth like a soft cushion, somewhat in the form of a parrot's tongue, is supplied with space in the roof, arched to fit it, the palate teeth enclosing it on each side, while the opening, or glottis, exactly meets the nostrils, *les arrières nez*, bringing it into communication with the outer air.

In a little *Coluber*, just dead, I again had an opportunity of making observations. The membranous coating was so thin and transparent that the rings of the windpipe could be very distinctly traced from a quite forward position in the mouth, and beginning on and over the tongue sheath. The surrounding skin or membrane was also loose and abundant, so that with the point of a needle the upper part of the windpipe could be easily drawn forward *beyond* the lips. In life the little snake could thus have voluntarily protruded it as occasion required.

Another day the large reticulated python seemed to intentionally gratify my curiosity by affording me a most leisurely and excellent opportunity for observation. His head was raised, and so close to the glass that the process of swallowing could be watched conveniently. The final swallow, or successive efforts at the last were, as usual, attended with frequent yawns. The glottis, as could on these occasions be distinctly seen, was repeatedly opened and closed, and after being extended beyond the mouth, it gradually resumed its natural position. While the prey occupied the entire space between the gaping jaws, one could see the air-tube pushed forward *beneath;* but as by degrees the duck disappeared down the throat, the interior of the mouth could be better and better observed. In this large snake the membrane or skin was too thick to enable one to discern rings as in the little *Coluber;* but as the larynx is merely the upper part of the trachea, and as the glottis is the mere membranous opening to the larynx, it seems evident that the windpipe itself is also extensible, the windpipe being, indeed, the only portion of the air-tube sufficiently firm and resisting to aid the purpose of respiration under such conditions.

The exact distance which the tube is extended cannot be accurately stated. It would not be equally protruded in snakes of different sizes nor under different conditions. Broderip saw it 'as much as a quarter of an inch.' Bingley, an earlier and a less safe authority, says 'the windpipe projected *three inches* beyond his jaws.' The keeper at the Gardens thought he had sometimes seen it 'as much as two inches in the largest snakes;' and my own impression was, one inch, at least, in the python, and almost that in the large vipers.

It is undoubtedly one of those interesting features worthy of further investigation, and one is surprised that more accurate information regarding it has not appeared in our later encyclopedias and in the 'Proceedings of the Zoological Societies.'

So long ago as 1826, it was observed and confirmed by the distinguished author of *Zoological Researches,* and *Leaves from the Notebook of a Naturalist.* The author of *British Reptiles,* who conducted the *Zoological Journal* when Mr. Broderip contributed the valuable paper above quoted, added a note by special request, stating that his own 'not unfrequent observations have on every point been completely confirmatory of those above recorded' by W. J. Broderip, Esq.

A very good account of the whole is quoted in the *Penny Magazine*, 1836, and we are therein further enlightened by reading that Joseph Henry Green, Esq., F.R.S., in one of his lectures at the Royal College of Surgeons, alluded to Broderip's paper 'On the Mode in which Constrictors swallow their Prey,' and which had drawn his attention to the statement about the larynx, and led him to examine the mouth of a snake.

In process of dissection, he detected two muscles in the lower jaw, evidently intended for the purpose of bringing the larynx forward; how far forward and how much of the true windpipe was also brought forward, he did not say. But this in a dead specimen could scarcely be affirmed with certainty.

From the large size of their prey, and the jaws being stretched open and gorged to their utmost capacity, it is plain that snakes cannot breathe freely in the ordinary manner while feeding, a process sometimes of an hour or more. Owing to the construction of their lungs and their capability to contain a large volume of air, they do not require to breathe frequently; still they do occasionally take a fresh inspiration, and their needs are met by this wonderful arrangement of the breathing apparatus.

CHAPTER IX.

BREATHING AND HISSING OF SNAKES.

FOLLOWING on the subject of the last chapter comes that of respiration; and in connection with breathing is the 'voice,' so far as this class of animals can be said to possess a voice.

As already seen in the description of the glottis, serpents do not breathe in the ordinary way, with short and regular inspirations, but when they do respire, they take in a supply of air to last them for some time. Their lungs, instead of occupying one particular portion of the body corresponding with the chest of the higher animals, are less developed. One lung—or what Professor Owen calls the long pulmonary bag—of snakes extends along more than half of their body; in some species nearly to the anus. Only one lung is normal, the other is rudimentary. The circulation is so arranged that on each contraction of the heart only a part of the blood is exposed to the influence of the air and becomes oxygenated, the rest returning to the parts without having undergone the action of respiration at all. The blood is, in consequence, poor in red corpuscles, its circulation is comparatively languid, the reptile becomes easily torpid, and its temperature is influenced by the surrounding atmosphere more than by the vigour of its own functions. This is why, when not excited to activity by external warmth, reptiles can pass a long time without food. Having no fixed temperature to maintain, one important source of demand for food is withdrawn.

The air enters their lungs chiefly in a direct course from the nostrils, only by the mouth when open. If you observe the flatness of the head, and the very short space that can exist between the nose and the mouth of snakes, you will readily trace the communication between the entrance to the trachea and the outer air through the nostrils when the glottis is not closed. Professor Owen, in his *Anatomy of the Vertebrates*, vol. i. p. 528, describes this process fully. In the foregoing description I have borrowed from him, as well as from Dr. Carpenter, Todd, and others; but as there is nothing like 'seeing for oneself,' I would persuade my readers to watch a snake for a few minutes. An inspiration at intervals will be easily discerned by the expansion of the body. You will also perceive partial or slighter breathings, and the trunk dilating and expanding gently through a sort of internal respiration which is going on; every now and then comes the deeper, fuller breath.

You may perceive that sometimes one short portion of the body expands, as if the lung in that part only were at work. This is more easily seen in the larger snakes. I have watched these for a quarter of an hour or more at a time, during which period only a comparatively short portion of the body showed any signs of breathing.

Schlegel, who carefully studied this action, observed sometimes as many as thirty such partial dilatations of the trunk and lung between two full inspirations.

In the large reticulated python I once saw that about two feet of the body, viz. four to six feet from the head, dilated with occasional and irregular inspirations, and no other part. By and by slight indications of breathing were observable much lower down, many feet apart from the previous action, while during the whole time I was watching I saw not one full and entire inflation of the lungs. This was on a rather chilly September afternoon, and the python had partaken of a couple of ducks for dinner the previous day, and it was a time when inactivity is usual. In a rattlesnake, on the same day, similar partial and irregular respirations were observable, this serpent having caused four rats to disappear at his last night's supper.

Sometimes you can discern no indication whatever of breathing for a very long time. When the reptiles are not in health, when they are about to cast their skin, or when in a half-torpid condition, you may observe this.

When a snake yawns—a long and leisurely proceeding—the lungs are doubtless greatly refreshed; otherwise these reptiles do not rest with their mouths open, and the only possible access of outer air by the lips being through the chink appropriated to the service of the tongue (and which is as exactly opposite the opening of the tongue-sheath as the nostrils are opposite to the glottis), they must breathe almost entirely through the nose, *except when yawning.*

From the elongated form of the pulmonary bag, and the large volume of air which it contains, we can understand not only how a temporary suspension of respiration can be supported, but we comprehend how it is that these reptiles can remain under water for long periods, as they often do,—not because they breathe *in* the water, but because they can for a while do without breathing.

Snakes have been seen to remain perfectly quiet at the bottom of a clear stream for half an hour or more. Sometimes in this totally quiescent state one has been supposed to be dead, until, on a stone being thrown, it has darted away like a fish. None of the aquatic birds or the cetaceous mammalia can remain so long under water without coming to the surface to breathe as serpents can.

At the Zoological Gardens they remain for hours at a time in their tanks. Often you will see a head peeping out—which, unfortunately, is all we *can* see—while the bath is being enjoyed, but as often the head is also immersed, though, of course, for a shorter interval, the snake lifting it to breathe occasionally.

We can imagine also the great assistance in swimming which this long air-receptacle must be, these reptiles deriving from it the same advantage, says Professor Owen, 'as an eel from its swim-bladder.' In chap. xii. is described the almost swimming motion of the more active snakes when gliding through long grass, or effecting progress over a very smooth surface. In the water the action is similar —that is, the progression is by lateral undulations, the tail being the chief propelling power. Whether through the resisting medium of water, or beating the air, so to speak, when skimming over smooth or unresisting surfaces, this swimming motion is ever easy and graceful. In the chapter on Tails, we shall see what an important agent in progression is this limb, whether by pressure, as in the burrowing snakes, or by its oar-like or paddle-like use in rapid motion.

To recapitulate the above in a few words—first, respiration warms the blood; snakes are cold-blooded because only a portion of the blood passes through the lungs to become oxygenated, and in proportion to the diminution of the quantity of blood transmitted to the lungs, so does respiration become weaker; therefore reptiles are less dependent on breathing.

Regarding the 'voice' of serpents, so surprising are the qualities attributed to it, that one would imagine the existence of varieties of snakes of widely differing organizations, if we were to believe all we read of the sounds they produce. 'Hissing loudly,' or 'whistling,' is the rule. No ordinary writer or traveller who says a word about a snake ever heard it hiss anything but 'loudly,' a statement traceable to the same sentiment which causes persons to talk of the 'horrid forked tongue.' A benevolently-disposed snake who would warn you away with that terrible tongue would also strengthen his argument by a prolonged hiss, and the louder the better.

But let us turn to the hard, cold, unpoetical, unimaginative language of science, and see what a snake can really do in the vocal expression of its feelings.

Says Dr. Carpenter: 'In all air-breathing vertebrata the production of sound depends upon the passage of air through a certain portion of the respiratory tube, which is so constructed as to set the air in vibration. In reptiles and mammals it is at the point where the windpipe opens into the front of the pharynx, that this vibrating apparatus is situated. Few of the animals of the former class, however, can produce any other sound than a *hiss*, occasioned by the passage of air through the narrow chink by which the trachea communicates with the pharynx; but this sound, owing to the great capacity of their lungs, is often very much prolonged' (*Animal Physiology*),—prolonged, but not powerful, be it observed.

Says Professor Owen: 'The true "*chordæ vocales*" are absent in serpents, and the voice is reduced to a hissing sound, produced by the action of the expired air upon the margins of the glottis' (*Anatomy of the Vertebrates*).

Speaking of the escape of air from the lungs, Dumeril says: 'Lorsqu'il est passé plus vivement il laisse entendre une sorte de vibration, qui le plus souvent, ne consiste que dans le bruit d'un soufflement.'[1]

Sometimes, according to the position of a snake, or when the passage is well open and uninterrupted, the hiss partakes somewhat of a whistling sound, like the blowing through a quill. I observed this particularly in a 'tree boa' (*Epicratis cenchris*), which hissed at me angrily one day because I took the liberty of touching it when the keeper opened its cage to arrange its blanket. The 'hiss,' not loud, or by any means musical, differed from the ordinary blowing only as a current of air passing through a round tube would differ from the same current passing

[1] *Erpétologie générale*, tome i. p. 180.

through a narrow slit. A true 'hiss,' such as we produce with closed teeth in prolonging the sound of *s*, a serpent can never express. The nearest approach to it in the human voice is when the tongue is in the position as if we are about to say *ye* or *he*, and then prolong the breath; that is to say, breathe out while the tongue is so placed before the word is uttered.

Naturally the larger the snake the stronger the 'hiss;' the more rapid the expiration, the more powerful will be the volume of air with its attendant *soufflement.*

The sound and action, as well as degree, are easily seen in the 'puff adder' (*Clotho*, or *Vipera arietans*). When angry or alarmed, it draws in a full breath, and its body swells perceptibly; then you hear the escaping air like a prolonged sigh or blowing till the lungs are empty. This process is repeated as long as the provocation lasts.

These alternate inspirations and expirations, with their accompanying movements, the swelling and then diminishing of the trunk and the regular *soufflants*, are so precisely like those of a pair of bellows, that excepting in shape, we require no more complete comparison. The *degree* or strength of hiss is in this reptile very perceptible. When recently imported and easily excited, its violent 'puffing' corresponds with a very large pair of bellows; but in time it grows less alarmed at the appearance of the human beings who unceremoniously stare at it; and at length the puffing is very slight, ceasing altogether after the snake becomes accustomed to its surroundings. But if molested and alarmed, you then see the full play of the lungs, and the whole body alternately expanding and contracting as before.

We may almost compare this pulmonary action to the panting or full breathings of ourselves under alarm or agitation. Only, in comparison as the lung of snakes is elongated, and there is so much of it to fill with air, so is the sound prolonged, and the breathing a slower process.

There is another viper, the small Cape adder (*Vipera atropos*), a most deadly little reptile, in which a similar sound to that of the 'puff adder' may be heard. When this creature is disturbed, it draws in a long breath which expands its whole body in the same manner, and then in expelling the air, a long sort of wheeze or blowing is audible. Even in drawing the breath in, a slight sound is heard (as it also is in our native viper and some others); but instead of the prolonged hiss by which most snakes display their agitation, this little adder expresses itself in long successive blowings, like its larger relative *arietans*, only a little less regularly. In the present instance, I saw the lung inflated with an agitated undulating motion, as if the fluid air were entering in little waves. I do not state positively that this is invariably the case from having witnessed it in one specimen. This might be the normal process, or this viper's lungs and health may have been impaired. I am thus precise because it is unsafe to establish as an invariable fact in natural history what may have been seen only occasionally, a habit which has so often led to the promulgation of erroneous impressions.

The prolonged sound of the hiss in snakes is due to the size of the lung, they having a large supply of air to draw upon. Some serpents expand their bodies under excitement without any perceptible hiss: the cobra both hisses and expands, so do some others; but all these movements are, no doubt, connected with respiration in some way, just as in human beings, sighing, sobbing, panting, etc., in which the ribs take part, are only modifications of the ordinary movements of respiration, and chiefly emotional.

Very similar also to the manner of the puff adder is that of *Vipera rhinosceros*, one of the largest African poisonous serpents, known as the 'River Jack,' being fond of water. One of these was in the London collection for several years, and I observed that whenever disturbed, its body swelled considerably, while the 'hissing,' or expulsion of breath, alternated with this expansion.

Snakes, like other animals, probably differ in temper or in nervousness; for while some are noted hissers, others hiss only on great provocation, and others, again, not at all. One remarkable example of a non-hissing snake, though from no amiability of temper, is the little carpet viper of India (*Echis carinata*). Unless you were positively assured by learned authorities that this exceedingly irritable little viper never hisses, you would scarcely believe your ears, so sibilant is the sound it causes by rustling its scales together.

Sir Joseph Fayrer, in the *Thanatophidia*, describes this as a very fierce and aggressive little viper, always ready to attack and be on the defensive. It throws itself into a double coil, and its agitated motion causes the rough, carinated scales to rub against each other, and make a sound like hissing, but '*it does not hiss*.'

This rustling is very much like the sound of the crotalus rattle, and the dry scales must be raised in a sort of way, or ruffled, as an alarmed hen ruffles her feathers. 'The outer scales are prominent, and at a different angle to the rest,' says Fayrer. It generally lies coiled in a compact form, often like a 'w,' as may be seen in the frontispiece, with its head in the centre, but always towards the point of supposed danger, which in a cage is facing the spectator.

Curious and wonderful is the agitation into which this carpet snake throws itself when disturbed, every inch of it, excepting the head, in motion. The head retains its fixed position, the eyes intently keeping guard, while the body moves in every conceivable curve, like wheels within wheels, yet retaining the same outline, or occupying the same place and space, though every muscle must be in activity.

One can liken this behaviour only to what is seen in the blending of liquids of different densities. As you look down into a glass containing one fluid while drop after drop of another is falling, you perceive fresh currents and curves in every direction. Watching one of these, it has changed places with another, you lose trace of it, each drop is lost in the commingling of the whole. So it is with this wonderful little echis. It is almost impossible to follow with the eye any one portion or coil of its moving length ; but each inch changes places and mingles with the rest, like blending fluids.

Speaking of an American snake (*Pituophis melanoleucus*), in which a similar excitement is observable, Mr. Samuel Lockwood[1] likens it to a 'mystic wheel.' 'The movement consists of numberless units of individual activities,' he says, 'and all regulated by and under the perfect control of one

[1] *American Naturalist*, vol. ix.

will that is felt in every curved line.' There is some likeness to the 'thousand personal activities of a regiment of soldiers on their winding way.' He has watched the creature 'melting into movements so intricate and delicate that the lithe and limbless thing looks like gossamer incarnate.'

This Pine snake is very smooth, and in the excited actions thus graphically described, it makes no noise like the little Indian viper; but Mr. Lockwood's words are so appropriate to both snakes that the reader has only to add in imagination the rustling noise that accompanies the quivering echis.

Among other of the ophidians remarkable for their hissing is *Psamophis sibilans*, the 'hissing sand snake,' a very slender little creature. Several mentioned by the earlier naturalists as 'the hissing snake,' are evidently *Heterodons*. Catesby, Lawson, and others mention one as the 'blowing viper;' *Blauser* of the Dutch, also the 'chequered' or 'spreading-adder,' which leaves no difficulty in identifying *Heterodon platyrhinos*. An American writer indulges in a figure of speech while describing this little Coluber by saying, 'It emits a succession of hisses, "sibilant sounds," similar to letting off steam from a small steam engine.' He at the same time admits that it is 'harmless and inoffensive in spite of its threatening aspect when flattening its head.' This is the 'spread head' alluded to in chap. xxii., an unfortunate demonstration of alarm which has gained for it its venomous titles. Several of this species have from time to time been added to the collection at the Zoological Gardens, and the chief drawback to their anticipated attractions is that they so soon become tame and peaceful that you can scarcely provoke them to exhibit their reputed power. I have seen one flatten its head so slightly as to be barely noticeable, but I never heard it 'hiss.'

'Its spots become visibly brighter through rage,' wrote Carver in 1796, 'and at the same time it blows from its mouth with great force a subtle wind that is reported to be of a nauseous smell.' Chateaubriand, of course, had something to say of 'the hissing snake,' frequent in the warmer States of America. 'When approached it becomes flat, appears of different colours, and opens its mouth hissing. Great caution is necessary not to enter the atmosphere which surrounds it. It decomposes the air, which, imprudently inhaled, induces languor. The person wastes away, the lungs are affected, and in the course of four months he dies of consumption!' Of another snake this author says, 'He hisses like a mountain eagle, he bellows like a bull!'

It may be objected, 'Why occupy space by quoting such old wives' fables?' I reply, because they have already been so abundantly quoted; and to such fables are in great part due the erroneous impressions which exist to the present day. Several members of the *Heterodon* family have from time to time been in our London collection. Friends of mine have had *Heterodons* in their keeping as pets; I have often handled them, and found them gentle and inoffensive in every way. They are indeed so popularly and peculiarly interesting that they will claim a page presently, the present chapter being devoted exclusively to ophidian lungs, not human lungs, supposed to be destroyed by them!

While admitting various degrees and qualities of hissing, we may give a passing mention to Du Chaillu's snakes, all of which appear to be of the whistling, as well as of the 'springing' kind. He saw 'an enormous black shining snake, loathsome and horrid.' . . . 'Then the fellow gave a spring, and whistled in a most horrid manner.' And when he was wounded, he again 'gave a sharp whistle.' On another occasion, while a Goree man was playing with a large Naja, 'the air around seemed to be filled with the whistling sound of the creature,' and so on.

Another African snake, the 'Green Mamba,' has such very bad manners that it not only hisses, but spits and darts at you. In this instance my informant was a young lady, who had 'seen it!'

Somewhat more perplexing, because more deserving of notice, is what Livingstone tells us of a serpent called *Nega-put-sane*, or 'serpent of a kid,' which 'utters a cry by night exactly like the bleating of that animal,' and that he had 'heard one at a spot where no kid could possibly have been.'[1]

'*Il canta como un gallo*,' said Albert Seba of an astonishing snake in Hayti and St. Domingo once.

'Beyond a hissing and often a peculiar drumming noise, snakes emit no sound,' says Krefft, one of our very able authorities.[2] This experienced writer does not positively affirm that the 'drumming' is produced by the voice, and it is more likely to proceed from the beating of an agitated tail, an action which may be frequently witnessed in excited snakes.

[1] *Missionary Travels in South Africa*, by David Livingstone.
[2] *Snakes of Australia*, by Gerard Krefft.

Dr. Otto Wucherer saw this in a South American snake, *Xenodon colubrinus.* 'It has the habit of striking the ground rapidly with the tail when irritated' (*Zoo. Soc. Proc.* 1861).

So do *Spilotes variabilis*, and some others. So also does the Pine snake, whose tail ends in a horny tip, 'like a four-sided spike,' and which vibrates like a crotalus in rudiment, or strikes the ground.

Several American naturalists have contributed interesting accounts of this last species, known as the 'Bull' or 'Pine snake,' or 'Pilot snake,' the largest of the N. American Colubers. It was this species (*Pituophis melanoleucus*) whose actions Mr. Sam. Lockwood described as mystic circles, and its activity as almost equal to that of the 'Racer' (*American Naturalist*, vol. ix. 1875). But it is called the Bull snake because it 'roars like a bull.' Bartram went so far as to say like thunder! 'Said to hiss like thunder,' or 'resembling distant thunder,' is the cautious testimony of Holbrooke, who adds, 'but I never heard it, though well acquainted with it.'

Mr. Lockwood minutely described one in his possession. In reading his account we can but notice the similarity of action between this 'Bull snake' and the African vipers in 'puffing,' though regarding the nature of the sound, the writer positively affirms that 'there is nothing sibilant in this blowing, not the slightest hiss about it.' Mr. Lockwood records his experience of several that he had seen and heard, and of a fight between one and a rat. 'Now began that fearful blowing. The snake slowly fills its lungs with air, and then expels it with a bellowing sound that is really formidable.' And again, in the same volume, in reference to the former account, he says: 'As there noted, the *Pituophis*, when alarmed or enraged, slowly inflates itself with air, thus nearly doubling its normal size along its entire length, except the tail. It then slowly expels the air with its own peculiar sound.' He recalls his boyish terror on once hearing this sound, which came upon him suddenly in a field, 'like the restrained roaring of a bull.' This was in New Jersey; but the *Pituophis* family extends to the Western States, and to the Rocky Mountains, where 'Bull snakes' are frequently seen. In the reports of the United States Exploring Expeditions, mention has been made of the prairie Bull snake, and of others in Nebraska and as far west as California.

Some attain to seven feet in length; Holbrooke mentions one of nine feet, and 'as thick as your arm,' in common parlance. An angry snake of this size could, of course, blow with considerable force, and the term 'bellowing' might not unreasonably be applied to the sound; as it is also applied to the croaking of the 'bull frog' (*Rana mugiens*), the sound of which is really so like the lowing of cattle, that, on hearing one for the first time in the woods of Virginia, I looked round, quite expecting to see a young heifer in close proximity.[1] Probably, had the bovine lungs sounded at the same moment, the reptilian 'bellow' would have proved but a feeble imitation. A sound out of place, so to speak, or unanticipated, strikes upon the ear more forcibly than when expected. But if one reptile, and that a very small one, can so well imitate a bull as it is universally known the bull frog does, why

[1] *Life in the South*, vol. i. p. 260. By Catherine C. Hopley. Lond. 1862.

may not another do the same?—an argument which I venture to use notwithstanding many herpetologists accept doubtfully the possibility of a snake producing such a sound. 'Il est difficile à concevoir comment les serpents auraient la faculté de siffler, comme on pretend que peuvent le faire certaines espèces de couleuvres, et comme les poëtes se plaisent à nous les representer. Jamais nous n'avons pu entendre qu'un soufflement très sourd, provenant de l'air qui sortait avec plus ou moins de rapidité de l'interieur de leur poumon que l'on voyait s'affaisser en trouvant une issue par la glotte, à travers les trous des narines ou directement par la bouche dont la mâchoire superieure est naturellement echanchrée. Alors la bruit était seulement comparable à celui qui resulterait du passage rapide et continue de l'air dans un tube ou par un tuyau sec et etroit, comme serait celui d'une plume.'[1]

This no doubt answers to the ordinary 'hissing' of the majority of snakes; but that the sound varies under certain conditions, and in the same serpent, cannot be denied. A. R. Wallace relates an incident which may well be introduced here, as affording both a proof of the length of time snakes can sustain a sort of half suffocation, and also the expression or power of 'voice' in breathing. A young boa was caught, and in order to prevent its escape, its captors, while preparing a box in which to convey it away, tied it tightly round the neck to a thick stick, which not only fettered its movements, but appeared to early stop its respiration. It lay writhing in much discomfort, sometimes opening its mouth with a suspicious

[1] Dumeril et Bibron's *Erpétologie générale*, tome vi. p. 186.

yawn, as if trying hard to breathe. By and by, when relieved from its clog and safely consigned to a box with bars on the top, it began to make up for loss of time by breathing violently, 'the expirations sounding like high-pressure steam escaping from a locomotive. This continued for some hours, of four and a half respirations a minute,' when the breathing—in this case we may say panting—gradually subsided, and then the poor thing settled down into silence.[1]

The expression of feelings by the tail in so many snakes, producing a sibilant sound in rustling dead leaves, and in some which are supposed never to hiss, is a subject well worth the attention of scientific naturalists. It would be interesting to ascertain if any peculiarity of trachea or of glottis exist in these.

[1] *Travels in the Amazons*, p. 47. By A. R. Wallace. London, 1853.

CHAPTER X.

HIBERNATION.

THE periodical torpor known as the winter sleep of reptiles is intimately connected with respiration, and a chapter must now be devoted to this subject.

'Reptiles are obedient to the external atmosphere,' has been aptly said of them. Thus, they obey the sun; for if exposed to his rays, they warm into life and activity. They obey the frost; for when exposed to its influence, their functions grow feeble or fail altogether, and they succumb to within a verge of lifelessness. They obey all the intermediate variations of temperature during the changing year, by displaying degrees of animation and activity responsive to the degree of warmth externally which they do not possess in themselves.

Bell speaks of hibernation as 'amongst the most remarkable and interesting phenomena which occur in the history of animals.' It is not a state of suffering, like that of a warm-blooded creature that is frozen to death; but with one common impulse, reptiles all retire, and remain in an almost lifeless repose, with every function so nearly suspended, that no external signs of existence are visible. For them it is a sort of rest, and we may cease to wonder at their longevity since they live only half their lives. It is, indeed, a convenient mode of getting through life, reminding us of a theory or proposal ventilated not long since, by which convicts were to be economically provided for by submitting them to a certain freezing process, and disposing them neatly on rows of shelves until the expiration of their term of punishment; all to be done then was to dust them thoroughly—perhaps scrub them a little—and restore them to the world and life again. And they were promised to be none the worse, not even to have lost their memory or to have acquired the rheumatism. Unfortunately the wonderful process has never been made clear to anxious inquirers, or some others of us, who are *not* convicts, might gladly resort to this method of rest occasionally, and of freezing out the worries of existence.

On the principle of political economy, this would be all very well, and in the great routine of nature there is beneficence in the hibernation of creatures, whether reptiles or other animals, that are sent to sleep at the very time when food fails them. The smaller members of the class have no longer insects and molluscs; the larger ones feed chiefly on rodents and birds which have also retired or migrated, or on their lesser kinsfolk, that no longer abound where most wanted by them. Therefore, this going to sleep every winter, and doing without food when there is no food to be had, is most convenient for a considerable section of animated nature.

There is something strangely analogous in the almost total suspension of vital forces in reptiles to that which vegetation undergoes. Circulation stops, the juices become stagnant, whether in a tree or in a snake, and it is sometimes difficult to decide in either case whether life is extinct or not. But with returning warmth comes renewed vitality; the fluids, whether of the animal or the vegetable organism, are thawed by the revivifying solar rays, which set them circulating and start the pulsation; and the animal machinery, like a watch wound up, is set in working order again.

It is owing to this lack of warmth in themselves that snakes can live only in hot countries, or in cooler latitudes, during the warmer weather, and not at all in the frigid zones. In speaking of them, Dumeril says Linnæus was right in calling them cold animals in hot countries. 'Aussi la plupart des Ophidiens habitent-ils les climats chauds, et c'est en parlant d'eux que Linné a pu dire avec raison: "Frigida æstuantium animalia."'[1]

Dumeril describes their respiration as arbitrary, suspended, retarded, or accelerated at will. 'La respiration étant volontairement accélerée ou retardée, les actions chimiques et vitales qui en resultent doivent être naturellement excitées ou ralenties par cette cause.'[2] 'The electric fluid,' says Latreille, 'is one of the great agents in animating living beings; and upon reptiles it operates in conjunction with warmth in rousing them from their inactivity.'

The periodical torpor and insensibility which reptiles undergo cannot, however, be always associated with extremes of cold, nor in all cases called strictly a '*winter*' sleep;

[1] *Erpétologie générale*, tome vi. p. 184.
[2] *Ibid.* tome i. p. 180.

because it is during the hottest seasons in the tropics that they resign themselves similarly to an almost death-like repose and temporary tomb, burying themselves in the mud, which is hard-baked around and over them, almost hermetically sealed until the rainy season loosens the soil, and frees them from this literal sarcophagus. In this case the so-called 'hibernation' is the result of drought. It is moisture now which revivifies them, rain which restores their vital functions, and like the chrysalis bursting its shell and emerging a new and brilliant creature, the reptile lives anew, doffs his muddy coat, and re-appears in all his resplendent colouring.

The prairie rattlesnake (*Crotalus confluentus*) is known to undergo this species of torpor, which is, in fact, estivation. It is described as having been found in this 'stupid condition' in the dry cañons of the Rocky Mountains during the droughts of July and August. American naturalists who accompany the Exploring Expeditions affirm that this partial torpor is common to many species of snakes, and analogous to hibernation. They are 'sluggish, stupid, blind, striking wildly,' says one of the official Reports.

Snakes remain torpid on an average half the year. It is a winter sleep in colder and temperate climates, and a summer sleep in hot ones. The green garter-snake of the United States hibernates eight months out of the twelve. So do some of the Australian snakes, others being underground five months in the year, Krefft tells us. The duration of insensibility varies, of course, with the climate and season.

Snakes in menageries have been known to manifest inactivity and disinclination for food as early as September if the season be unusually cold, at other times in October; but, on the contrary, during a milder season they keep active until November, while some do not hibernate at all. Their habits there can, however, scarcely be cited as normal, since the artificial heat regularly maintained in the Ophidarium never permits the rigours of an out-door winter to affect them. Nevertheless they manifest the disposition for repose; and if it could be so arranged that the tropical snakes could be submitted to tropical heat and drought, and those of cooler countries to frosty air, as in a state of nature, we might witness both estivation and hibernation under the same roof.

A partial hibernation is observable in reptiles in captivity when, though not absolutely inactive, they decline food. For twenty-two weeks a python at the Zoological Gardens fasted during one winter; at another time, twenty weeks. The large python (*reticulatus*) fasted for one year and eleven months, covering two winters, but fed well and retained its health after this. Meanwhile, during this prolonged fast, should a gleam of sunshine penetrate the foggy atmosphere of our London winters, and shine through the glass roof upon a constrictor's coverlet, he may slowly emerge therefrom, displaying a few feet of his lazy length for an hour or so, thus verifying the words, 'obedient to the external atmosphere.' No creatures are so susceptible of the changes of temperature; and the same degree which caused them to seek a retreat will, on the return of spring, reanimate them. And warmth—in them almost another word for vitality—equally affects their appetite. In the very height of summer, should their feeding-day prove a chilly one, a much lighter drain on the larder is observable, while a warm, bright day will show a heavy poulterer's bill *in re Ophidarium.* Dr. A. Stradling, a practical ophiologist, found that the common English snakes 'thrive exceedingly by reason of their increased appetites,' when taken to the tropics. 'It is impossible to say what degree of heat a reptile will not stand and enjoy,' says this writer (*Field*, July 28, 1881). 'On the hottest days in the hottest places on earth, one surprises snakes and lizards basking in the blazing sun-glare, on sands and rocks which it would almost blister the hand to touch.' Florida is the most southern extreme of my own experience; but during a summer there one could not rest the hand on the almost burning stones and walls on which the reptiles delightedly reposed; and even in England, during a hot August, my little Bournemouth lizards were positively hot to the touch when basking in the full power of a bright noon sun. Dumeril corroborates these facts when he says some reptiles can endure a temperature higher than blood-heat. Sometimes in early spring he found a snake seeming to be asleep under a very hot wall which had been exposed to the mid-day sun, but which had been several hours in shadow. So tenaciously had the reptile retained the heat it had then absorbed, that though the air now felt cold, the snake imparted *une chaleur très notable* when he touched it. Many times, in taking up a lizard from a sunny rock in summer, it really has *brulé les doigts.*[1] The old fable about salamanders living in fire no doubt originates in the fact of reptiles loving heat as they do. Many pages might be filled with instances

[1] Dumeril et Bibron, tome vi. p. 184.

of this, and of their approaching fire to a suicidal extent.

Equally strange is the degree of cold to which they can sometimes submit, and yet recover. But we must conclude that this is when they are overcome *gradually*, not suddenly, by it, and not exposed to the outer air so that the tissues would be injured. Dr. Carpenter mentions reptiles having been kept three years in an ice-house, and recovering on being gradually restored to warmth. Too recklessly acting upon this, I deposited my pet lizards in a small, shallow box containing moss, sand, and soft rubbish, and left them outside a window to hibernate. They buried themselves as deeply as they could go,—only a few inches, alas!—but a sudden and severe frost set in, and the poor little victims were frozen stiff at the bottom of their prison-house. It was in a bleak north-eastern aspect, and the sharp frost easily striking through the wood, that slight box must have proved a very different sort of nest to what they would have chosen on their native heath,—far down, and well protected from the icy winds. In a strong, deep box, or an earthenware jar, with sufficient earth and rubbish in it, they might have survived.

In the Museum of Paris in 1875–76, sixteen rattlesnakes are said to have died of cold. The heating apparatus at the Jardin des Plantes is less effective than our own in London, where very few of the snakes have been known to suffer from lowered temperature.

Snakes are abundantly supplied with oily fat; thick layers of it line their intestines in autumn, and this is gradually absorbed during their torpor. They therefore lose weight, and awake in an enfeebled condition, only gradually recovering their normal strength after some days.

The power of endurance in serpents, and their independence of a large supply of oxygen, render them important agents in the economy of nature. In the swamps and morasses where malaria abounds, reptiles are most numerous. Many such places under canopies of pestilential vapours, swarm with insects, molluscs, worms, caterpillars, and the smaller reptiles on which snakes mostly feed. They are, therefore, the scavengers of such localities; they fulfil a great law by keeping up the balance of nature even to the extent of rendering certain countries habitable.

Those ophidian families which prefer higher lands, sandy or rocky districts, select the sunny hill-sides when the frost sets in, and hide themselves under stones or in caves where, as described in the chapter on rattlesnakes, they congregate in vast numbers. Piles and convolutions of serpents in this condition have often been discovered, and as often described. It is as if the small degree of animal warmth each one possessed were harvested for their mutual good, and to the benefit of the whole community. Nor are these assemblages at all exclusive as to kind, but are dens of discordant materials, where, as an American wrote, 'the liberal terms of admission seemed only to require the evidence of snakeship.' Lizards, too, though of widely-branching kinship, are guided by the same instinct, and sometimes share the retreat.

A few years ago, near Hayward's Heath in Sussex, some men who were levelling the ground for building, dug out of a bank at a depth of from four to five feet, upwards of one hundred slow worms and as many small lizards, all in a torpid state. It was during February.

At the end of September more recently, a farmer in Wales, who with his labourers was removing a heap of manure, came upon an extraordinary bed of snakes and slow worms, and no less than 352 were killed, together with an enormous quantity of eggs; 'thousands in clusters were destroyed.' 'Three of the snakes were of immense size, and one hundred of them nine to twelve inches long.' These latter were probably slow worms, and the three 'immense' ones ring snakes. One feels curious to know whether judgment for this act of wanton cruelty visited that farmer in a destruction of his crops next year by the mice and insects from which these harmless reptiles would have saved them!

The general reptilian instincts are the same in all climates where the temperature is similar. In Australia, as Krefft tells us, this is a grand time among schoolboys for 'snake-hunting.' They lay traps of large flat stones on open sunny ridges where the reptiles are likely to resort. Six to ten specimens of different species are often taken under one such stone. Even the venomous kinds may be easily captured and transferred to a bag in their half-dormant condition. Sometimes in lifting a stone, a dozen or more handsome and beautiful lizards are found among their ophidian cousins. The Wallaby hunters generally provide themselves with a collecting-bag, and thousands of snakes have thus been transferred to museums. So expert do the hunters become, that in eight years, the same author affirms, not one accident has occurred from a venomous species. From May to September in Australia, timid persons need be in no fear of snakes in the 'scrub.' The larger and more dangerous species retire deep into the ground, and only the young ones under stones. Warm days entice them out for an hour or two, and they retire again at night, just as is the case with those of the United States.

The ancients were aware of this hibernation of reptiles; and Pliny, who, having sometimes a foundation of fact to build upon, is all the more dangerous from his fabulous superstructure, writes, 'The viper is the only serpent that conceals itself in the earth. It can live there without taking food for a whole year. *They are not venomous when they are asleep,*' he sagely adds. Vipers can live without food for even more than a year, and so can other snakes; but this often is irrespective of hibernation, and of this more will be said presently.

A still stronger evidence of vitality or suspended animation is witnessed in the extraordinary custom of packing the poor wretched snakes in air-tight bottles, which some barbarous (the word here in both senses may be used) people adopt. A Cerastes arrived in England in a bottle, which had been hermetically closed for six weeks, and it revived. It was so crowded into the bottle as to look quite dead, but revived directly it was released, and struck a fowl, which died instantly! Sometimes a bottle or jar is literally crowded with ophidian captives, that are certainly out of harm's way so far as others are concerned, and travel in a compact compass; but it stands to reason that even when they survive this close imprisonment, they are not in a very lively condition, and the large mortality which is found in most collections may be imputed to a great extent to the unhealthy condition in which they arrive after injudicious packing. Nailed up in air-tight boxes, is a very ordinary mode of transportation, a species of cruelty which would raise a cry of horror were the captive any other than a despised 'reptile!' In connection with breathing or not breathing, and powers of endurance, *such packing* receives only a passing mention here, but is one that should be thoroughly exposed in the *Animal World* and similar papers.

One more singular example of periodical repose, but which can scarcely be called either hibernation or estivation, is seen in the sea snakes, the *Hydrophidæ* of the Eastern Ocean. Of these Dr. Cantor affirms that they are seen so soundly asleep on the surface of the water, that a ship passing among them does not awaken them. This is the more remarkable because the eyes of sea snakes are organized to endure the glare of light only when modified or subdued through water, and are easily affected when out of it, the reptiles becoming dazzled, and even blinded, by bright sunshine. So that we must suppose some peculiar insensibility of nerve in these, or a cessation of active functions during their repose analogous to the hibernation of land snakes. Another interesting inquiry suggests itself: viz. How does one ascertain that an open-eyed snake is '*asleep*'? We called that Racer (p. 64) 'asleep,' as it appeared to be quite unconscious of interruption, and did not move at our approach.

CHAPTER XI.

THE TAIL OF A SNAKE.

SETTING aside for the present the true death-dealing powers of the ophidians, viz. the fangs of the poisonous families and the constricting powers of the larger non-venomous kinds, another *supposed* medium of mischief, second only to the tongue, is the tail!

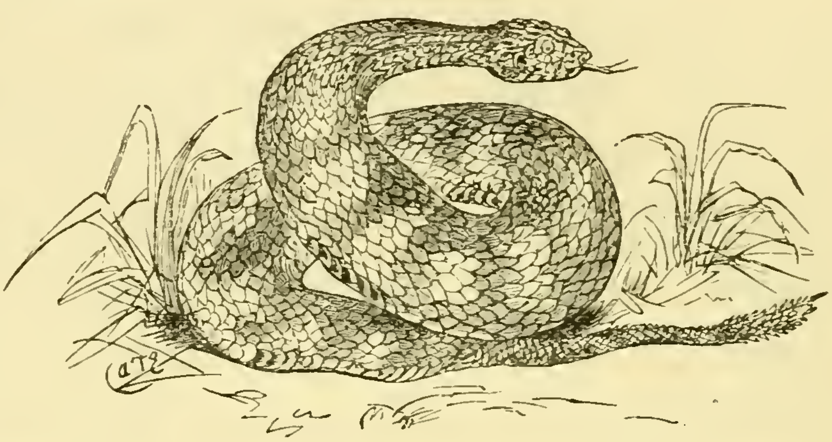
The old-time fables of the 'stinging tails' have always obtained credence, and do so still among the ignorant classes in many countries. Nor is the belief without some apparent reason, for the tail of a large number of snakes, both of the poisonous and the non-poisonous families, terminates in a horny spine more or less hard and pointed. In a few, this sharp spine is curved with an undeniably weapon-like aspect. Some of these thorn-like tips might even be capable of inflicting a slight wound were the owners conscious of this, and had they a disposition to avail themselves of it. But, as a weapon, snakes do *not* instinctively use their pointed tails; they are chiefly assistants in locomotion. As a fulcrum, and sometimes a propeller, certain species make constant and important use of them. You may observe that when in a position of danger, many snakes trust greatly to the pressure of their tails, whether pointed or not, as a balance or even a support. This pressure, which is forcible, but not aggressive, no doubt gave rise in the first instance to the belief that the snake was intentionally endeavouring to inflict a wound—a myth which, like all the other ophidian myths, is so hard to eradicate.

Sir Thomas Browne, in his *Pseudoxia*, more than two hundred years ago, mentioned this as one of the 'Vulgar Errours.' As very little was known of foreign snakes at that time, 1672, excepting through classic writers, one must suppose that our poor little native *Anguis fragilis* was included among the weapon-tailed snakes, 'that worm with venomed tongue' which does really in a remarkable manner make important though innocent use of its very blunt tail as a means of progression. He says, 'That Snakes and Vipers do sting, or transmit their Mischief by the Tail, is a common Expression, not easy to be justified. . . . The Poison lying about their Teeth and communicated by Bite in such as are destructive. And Bitings mentioned in Scripture are differentially set down from such as Mischief by Stings.'[1] 'God commanded Moses to take up the Serpent by the Tail,' Sir Thomas Browne reminds us, as if in proof that the caudal extremity was perfectly harmless. 'Nor are all Snakes of such empoisoning Qualities as common Opinion presumeth,' the author endeavours to impress upon his readers, because there are several histories of domestic snakes from 'Ophiophagous Nations and such as feed on Serpents.' Then follows an opinion equally wise and witty. 'Surely the destructive

[1] *Pseudoxia; or, Vulgar Errours*, Book iii. p. 207. By Sir Thomas Browne.

Delusion of Satan in this Shape hath much enlarged the Opinion of their Mischief. Which was not so high with the Heathens, in whom the Devil had wrought a better Opinion of this Animal, it being sacred unto the Egyptians, Greeks, and Romans, and the common symbol of Sanity.'

But, alas! many spiny-tailed snakes have sprung to light in various countries, long since Sir Thomas Browne so wisely instructed his readers; and even now, the 'death adder of Australia (*Acanthophis antarctica*) is much dreaded on account of its thorn-like tail.' Krefft's[1] description of the repulsive aspect of this snake is sufficiently terrifying, apart altogether from its looks alone, its ragged-looking head, with its loose scales, thick body, and its short, rough, unmistakeable tail, terminating in a suspicious-looking point, as if one sharp spine had taken root there, and was capable of inflicting a wound. The tail spine hardens only in age, he tells us, and 'is really not a weapon either of attack or defence.'



Death Adder (from Krefft's *Snakes of Australia*).

Another tail of evil repute belongs to the Water Viper of the United States, vernacularly known as the 'Thorn-tail' snake, *Trigonocephalus piscivorus* of American herpetologists.

John Lawson, in his *History of Carolina*, published in 1707, was one of the first to describe it. After him we hear of it

[1] *Snakes of Australia*, by Gerard Krefft.

from Catesby. The quaint descriptions of each of these early travellers are amusing; and from such accounts the progress of science is traced.

'Of the Horn Snake,' says Lawson, 'I never saw but two that I remember. They are like the Rattlesnake in Colour, but rather lighter. They hiss exactly like a Goose when anything approaches them. They strike at their Enemy with their Tail, and kill whatsoever they wound with it, which is armed at the End with a Horny Substance like a Cock's Spur. This is their Weapon. I have heard it credibly reported by those who said they were Eye-Witnesses, that a small Locust Tree, about the Thickness of a Man's Arm, being struck by one of these Snakes at Ten o'clock in the Morning, then verdant and flourishing, at Four in the Afternoon was dead, and the Leaves dead and withered.' (Probably the tree had been struck by lightning during the interval, a very frequent occurrence in those parts.) 'Doubtless, be it how it will, they are very venomous. I think the Indians do not pretend to cure their wound.'

When Lawson travelled, setting out in December 1700, as an appointed 'Surveyor-General' of the newly settled colony of North Carolina, very little was known of the natural history and productions of those parts, and he relied on the native tribes for much of his information.

His work was dedicated 'To His Excellency, William Lord Craven, Palatine; The Most Noble Henry, Duke of Beaufort; The Right Hon. John Lord Carteret; and the rest of the True and Absolute Lords, Proprietors of the Province of Carolina in America.'

'As a Debt of Gratitude the Sheets were laid at their Lord-ships' Feet, having nothing to recommend them but Truth, a Gift which every Author may be Master of if he will.'

With ever so praiseworthy an *intention* of telling 'the Truth,' Lawson did not possess the scientific knowledge to enable him to guard against error. Neither did Colonel Beverley, who wrote a *History of Virginia*, published in London in 1722, and who perpetuated the 'stinging tail.' 'There is likewise a Horn Snake, so called from a Sharp Horn it carries in its Tail, with which it assaults anything that offends it, with that Force that, as it is said, it will strike its Tail into the Butt End of a Musket, from whence it is not able to disengage itself.'

A few years later, Catesby went over the same ground as a professed naturalist, and afforded a more rational account of this 'horn snake,' to which he assigned the name of *Vipera aquatica*, 'Water viper,' or 'Water rattlesnake.' 'Not that it hath a Rattle. The Tail of this Viper is small towards the End, and terminates in a blunt, horny Point, about half an Inch long. This harmless little Thing has given a dreadful Character to its Owner, imposing a Belief on the Credulous that he is the terrible Horn Snake armed with Death at both Ends, thus attributing to him another Instrument of Death besides that he had before, though in reality of equal Truth with that of the Two-headed Amphisbæna. Yet we are told that this fatal Horn, by a Jerk of the Tail, not only mortally wounds Men and other Animals but if by Chance struck into a young Tree, whose Bark is more easily penetrated than an old one, the Tree instantly withers, and turns black and dies'[1]

[1] *The Natural History of Carolina*, by Mark Catesby. London, 1731.

Unfortunately, in mentioning the 'Horn snake,' many subsequent writers, seizing on the marvellous rather than the rational, have omitted the qualifying 'it is said to inflict a wound,' and Catesby's exposition of the absurdity; thus handing down as a fact that the tail was truly a terrible weapon!

It was probably this water viper which Chateaubriand had in his mind when, towards the end of that century, he described the 'Prickly snake, short and thick. It has a sting in its tail, the wound of which is mortal!' Chateaubriand was much quoted for a long period.

Dr. J. E. Holbrooke, in his *North American Herpetology*, published at New York in 1842, corroborates all Catesby further said regarding the fish-loving tastes of the 'Thorn-tail' snake, and which obtained for it the specific name *piscivorus*. It frequents damp and swampy places, and is never seen far from water. In the summer (during Catesby's time), great numbers might be seen lying on the low boughs of trees overhanging a river, whence they would drop into the water and pursue the fish with great swiftness. Few fish exceed its velocity in swimming. *Cenchris* or *Trigonocephalus piscivorus* is the name by which American herpetologists now recognise it. It is becoming rare where formerly it abounded, but is still found in the wilder districts of the less settled States, and in the hot weather may be seen lying motionless on the low branches, and often so like a portion of the bough as not to be observed till the sudden plunge tells that a deadly snake was close at hand. It is a cannibal besides, and other snakes are afraid of it and give it a wide berth. The horny spine (which is a mere hardening and consolidation of the terminal scales) and another feature, namely the 'pit' in its cheeks, described in chap. xxi., prove it to be allied to the rattlesnake. It is therefore included among the *Crotalidæ*, of which more hereafter.[1]

A number of the 'Pit vipers' and *Trigonocephali* are furnished with hard-pointed tails, and when they vibrate them rapidly, as many snakes do under excitement, the rustling against the dead leaves produces a sound very similar to the sibilation of the true *Crotalus* tail.

Trigonocephalus contortrix, the 'Copper-head,' is another of these. Also the renowned 'Bushmaster' of Guiana and Brazil (*Lachesis mutus*, or *Crotalus mutus*), of which latter Darwin wrote, confirming Cuvier's reasons for making it a subgenus of the rattlesnake :—'I observed a fact which appears to me very curious, as showing how every character, even though it may be independent of structure, has a tendency to vary by slow degrees. The extremity of the tail of this snake is terminated by a horny point, which is slightly enlarged, and as the animal glides along, it constantly vibrates the last inch or so ; and this part, striking against the dry grass and brushwood, produces a

Tail of *Lachesis mutus* (exact size).

[1] The vipers in the London Gardens labelled *Cenchris piscivorus* have *not* the thorny tail, nor are they fish eaters. Nor can the spectator form any idea of their swimming capacities, their dark, narrow tank barely enabling them to extend themselves full length. Herpetologists differ in assigning the above name, and in deciding which is really the 'Thorn-tail' or 'Horn snake' of Lawson and Catesby. Those at the Zoological Gardens, notwithstanding their specific name, are never regaled on fish.

rattling noise which can be distinctly heard at the distance of six feet. As often as the animal was irritated or surprised, its tail was shaken, and its vibrations were extremely rapid. This *Trigonocephalus* has, therefore, in some respects the structure of a viper with the habits of a rattlesnake.'

Dr. Günther and Sir Joseph Fayrer both mention a peculiarity of this kind in some of the Eastern representatives of the *Crotalus*, viz. the *Trimcresuri*, Indian tree snakes. The former writes: 'Some have prehensile tails, which, when not so occupied, vibrate rapidly, producing a rustling sound among the leaves.'[1] Others of the family have horny tails.

Dr. Andrew Smith, in his *Zoology of South Africa*, mentions *Vipera caudalis* especially, as having a 'tail distinctly recognised, at the termination of his very thick body, and which is not often seen.' In the vipers, however, more than others, tails are distinguishable, those of many of them being short as well as suddenly tapering to a point. The deadly Puff adder is called *Brachyura* on this account, its tail being extremely short for the size of the snake. One exceedingly dangerous kind in St. Lucia is known as the 'Rat-tailed snake.' For climbing, and as a propelling power, this slender tail can be of little service. In St. Lucia is also a 'Rat snake,' *Crebo* or *Cribo* in vernacular (*Spilotes variabilis*), one of the active non-venomous kinds which, not content with rats and mice for food, wages war on its most venomous fellow-reptiles; as the 'Racer' and the 'King snake' do against the rattlesnake of the United States. This *Crebo* is a graceful, elegant creature, and on account of

[1] *Reptiles of British India.*

its twofold virtues of mouser and 'rat-tail' catcher, is domesticated and petted in some of the islands.[1]

In many of the Colubrine snakes it is almost impossible to distinguish where the ribs cease and the tail begins, except by the anus, so very gradually does the body taper. Nor does there appear to be any certain rule about the *length* of tails, which in some snakes are even longer than their bodies, and in others not one-tenth the length.

In giving the length of a few snakes (not in feet or inches, but in the number of their vertebræ), the reader will obtain a clear idea of this variation in tails. One species of rattlesnake has 194 vertebræ, of which 168 support each a pair of ribs, leaving 24 for its tail, or one-eighth. The python has 291 vertebræ, of which the 3d to the 251st support a pair of ribs, leaving 40 for its tail, or less than one-seventh of its length.

Let me explain a seeming discrepancy of arithmetic. The spine of the boa constrictor consists of 304 vertebræ, of which 2 next the head support no ribs, and 252 support each a pair of ribs. Taking away the first two, which, having *no ribs*, may be said to form the neck of the snake, that leaves fifty joints for the tail, or about one-sixth of the entire length. Our little sums, therefore, are as follows, in reckoning the vertebræ :—

RATTLESNAKE.		BOA CONSTRICTOR.		PYTHON.	
Neck, . . .	2	Neck, . . .	2	Neck, . .	2
Supporting ribs,	168	Supporting ribs,	252	With ribs,	249
Tail, ...	24	Tail, ...	50	Tail, . .	40
Total,	194	Total,	304	Total,	291

[1] Dr. A. Stradling affirms that these two snakes do not invariably molest each

Though in form the 'neck' of a snake is often as undistinguishable as the tail—'une tête sans col, et une queue, dont l'origine se confond avec le reste du corps,' as Dumeril expresses it—there is the one invariable rule belonging to it, namely, that the first two joints of a snake's spine are ribless, and that the ribs begin at the third. Physiologists tell us a snake has no neck, and for reasons which will be explained in the next chapter; yet, by way of distinction, all speak of 'the neck' as an accepted fact.

No invariable rule as to tails can, however, be established, either as regards length, shape, or character. Firstly, the length of the tail varies from inches to feet in snakes of nearly the same size. Secondly, both venomous and harmless ones are occasionally furnished with horny tips, and both vibrate them with equal rapidity. Thirdly, snakes that have long *spineless* tails also vibrate them rapidly; as do snakes with short spineless tails; so that one cannot say that spines are confined to one genus, any more than is their use or their action. The vibration of the tail is, in fact, only 'an outlet for suppressed energy,' as Professor Shaler of the United States has lucidly put it. Excitement displays itself in the tail of a snake as much as in the tail of a dog. This may be observed at the Ophidarium, or wherever an active snake can be watched. In the rattlesnake it is, of course, more conspicuous, and always audible when agitated; but many others similarly display their feelings in their eloquent caudal terminations.

A handsome young python, of about eight feet long, at

other. He had the Rat-tail (*Fer de lance*) and two *Cribos* with others in one cage, living on peaceful terms.

the Zoological Gardens, has a tail of which the last few inches taper so suddenly that the extreme end of this reptile appears almost ludicrously trivial for so fine a possessor. One inch of this—hardly thicker than a rat's tail—you may see wriggling so rapidly that you can scarcely follow its movements, or believe that it is a part of the large quiescent body to which it is attached. In pursuit of its prey the python itself glides with slow dignity, while the trifling little terminal inch or so of tail is in a perpetual but most *un*dignified wriggle.

In the 'Racer,' already familiar to the reader, the tail is one-fourth the length of the body; in the 'milk snake' (*Coluber eximius*), introduced in chapter iv., it is one-fifth. The extensive variation in tails may be comprehended by their number of vertebræ, which in some snakes amount to 200, and in others are reduced to 5.

Of the practical uses of the snake's tail, the *natural* uses,—those above mentioned being either imaginary ones, or a mere expression of feeling,—the prehensile power is one of the greatest. 'Strictly speaking, the true prehensile tail is found only in the boa,' Schlegel, Owen, and other physiologists tell us; but that statement refers to some peculiar anatomical construction, enabling the tail to twine and grasp with extraordinary force, because nearly all snakes can manage to climb, or to raise themselves when occasion requires it, making use of their tails, as was stated at the commencement of this chapter. 'Even the clumsy, ugly death adder can climb well,' Krefft assures us, and that it can support itself against a wall with only a portion of its tail on the ground.

Many writers and observers, in describing this power or force in the snake, have given rise to the idea that snakes can *stand* on their tails. Erect themselves nearly upright they certainly do, even without extraneous support for a few moments, and *with* support for a considerable time.

Cobras can do this. A personal friend, Colonel C——, when in India, once heard a sort of muffled sound at his door, which caused him to open it suddenly, when a cobra, which had raised itself three or more feet against it, fell straight into the room. He sprang quickly aside, and ran to fetch a stick, but when he got back the cobra was gone.

But to return to their prehensile powers. Snakes which are not habitual climbers are often found in trees, suspending themselves from or supporting themselves upon the branches, as instanced in the chapter on the egg-eaters. The *Hamadryad* is also much in trees, as its name implies, and is seen hanging from the branches. This latter, and also the Indian tree snakes, *Trimeresuri*, are poisonous, and far removed from the boas with the true prehensile tail. Familiar to every one are illustrations of tropical scenery, in which the boa constrictor and the anaconda, hanging from trees, are important features. Dumeril, in general terms, says: 'Les ophidiens rampent, glissent, s'accrochent, se suspendent, gravissent en s'aidant de la totalité de leur corps, sautent, s'élancent, bondissent, nagent, et plongent,'[1] in every one of which movements the tail is an important agent. *S'accrocher* and *se suspendre* must be mainly by the agency of the tail.

[1] *Erpétologie générale*, tome i. p. 47.

Schlegel follows up his statement, 'tail strictly prehensile found only in boas,' by explaining, nevertheless, that a short tail is sufficiently vigorous to *attach* itself to any point, and support the whole body.[1] In the non-venomous tree snakes the tail is long and slender, and no squirrel or bird is more active and at home in a tree than these. They glide, swing, climb, and almost fly from branch to branch, scarcely disturbing a leaf.

Our 'excellent egg merchant,' introduced as the Racer, though a ground snake, is equally at home in a tree, and holds on by its tail with remarkable adroitness, but then the Racer or 'Pilot snake' is a true boa also. (The true 'boa' is distinguished by its dentition and formation of jaw-bones, the term 'boa,' so variously and perplexingly used by some of the older naturalists, being now restricted to certain non-venomous species which possess such anatomical structure.)

Lawson's description of this 'Racer' is graphic. 'The long black Snake frequents the Land altogether, and is the nimblest Creature living. His Bite has no more Venom than a Prick with a Pin. He is the best Mouser that can be; for he leaves not one of that Vermin alive where he comes. He also kills the Rattlesnake wherever he meets him by twisting his Head about the Neck of the Rattlesnake, and whipping him to Death with his Tail. This Whipster, for all his Agility, is so brittle that when he is pursued, and gets his Head into the Hole of a Tree, if anybody gets hold of the other End, he will twist and break himself in the Middle.'

Lawson does not appear to have understood the nature of

[1] *Essai sur la physiognomie des serpents,* par Herman Schlegel. Amsterdam, 1837.

constrictors. 'Whipping' the rattlesnake was probably only the tail lashed in anger, or used in controlling the exceedingly active movements of the captor. As for its 'breaking itself in halves,' many exaggerated stories are told by unscientific spectators of the 'brittleness' of snakes, the simple explanation being that all are alike irritated and terrified when rendered helpless by their tail being fettered, and may then struggle until they injure themselves. The common blindworm (*Anguis fragilis*) has been seen to so-call 'break itself in halves;' but this will be explained in its place (chap. xxv.).

This sensitiveness—*sensibility*, one may almost term it—in the tail of snakes has been pointed out by the late Frank Buckland, Dr. Stradling, and others of like practical experience, affording useful information in case of danger. 'If attacked by a boa constrictor, it is of no use to pull and haul, but catch hold of the tip of the tail and unwind him.' Also, 'when striking, aim at the tail. The spinal cord there being only thinly covered with bone, it is more easily wounded; and when the spine is broken, the animal is disabled.'[1]

Certain it is, that by the muscular power of the tail snakes perform wonderful feats, not only erecting themselves, and maintaining their balance for a short time, as a long pole is balanced by an acrobat on his chin or his nose; hanging by an inch or so of the tip, as an acrobat hangs for a time on one foot or one finger; raising themselves against a smooth surface, as you see the large pythons at the Gardens do against the smooth sides or glass fronts of their cages, even to the very top, but springing, 'executing leaps,' as Roget

[1] *Curiosities of Natural History*, by F. Buckland.

and others term it. For though the 'leap' is not strictly like the action of a frog or a grasshopper, or a man whose two limbs act in concert and together, the result is the same,—the reptile accomplishes a long distance with quickness, decision, and aim. Professor Owen [1] calls it a saltatory motion, 'the sudden extension of the coils of the body reacting upon the point of earth on which the tail presses, throwing the serpent forward.' Sometimes, when the creature lies closely coiled, the sudden unbending has the effect of a spiral spring; and occasionally, when the tail is brought suddenly up to the head, and the serpent springs forward again, and continues to do this in pursuit, as has often been witnessed, the effect is that of a rolling hoop, and has given rise to a belief among the ignorant that the reptile really rolls along.

One in America, known as the 'Hoop snake,' is reported to 'roll down hill,' the idea originating possibly from the optical illusion in consequence of the rapid changes of position—an effect which we see in that amusing toy, the zoetrope.

The 'black snake' of Australia, *Hoplocephalus pseudechis*, is one of the very active venomous kinds, whose motions in pursuit or escape are almost like leaps, and present the appearance of a hoop or circle. Reputed 'hoop snakes' are there also. The reptile rapidly extends itself to full length, then brings up its posterior portion in a loop, and so springs forward again, continuing to do this with amazing rapidity.

The most easy and natural convolutions of a snake are

[1] *Anatomy of the Vertebrates*, p. 260.

lateral. As closely as their body can be coiled on a given space, as close as a ribbon or a rope, they can curl themselves round sideways, that is, with the ventral scales all prone to the ground, and the vertebral column upwards; nor could they, from the construction of their spine, coil themselves similarly in a vertical position, as a hedgehog and a dormouse roll themselves up. But temporarily and partially they *can* bend themselves vertically; for you see a snake often with a part of its body raised vertically against a wall, while the rest is horizontally along the ground, and consequently one part is at right angles with the other part, and as the creature rises against the wall every joint has in turn taken this position. Also, when coiled round a branch, you do occasionally see that the curves are not invariably and unexceptionally lateral, but sometimes vertical, although not so closely so as in the more natural coils. I have very narrowly observed this, because the 'hoop'-like motion is often ridiculed; but it seems a not impossible action when a large circle is described by the body, though close coils would be less possible.[1]

A clergyman of Australia had a narrow escape from one of these 'rolling' creatures. His daughter gave me an account of the circumstance, she also, when a resident there, having been well acquainted with such scenes. Her father accidentally trod on one of those dangerous serpents, which immediately made a spring at him, but which he expertly

[1] Since the above was in type, I have on several occasions observed vertical coils in constricting snakes. Twice a python constricted an animal in *distinct vertical coils.* I drew the attention of Keeper Tyrrell to this, and we were both convinced that no lateral coils whatever were used. On another occasion, while Mr. Elwes was studying the action of *Elaphis quater-radiatus* for the illustration, p. 205, its coils were entirely vertical, *not* lateral.

eluded, and took to his heels with all speed, knowing the vicious nature of that snake. Looking back, he saw the reptile pursuing him with 'strides' or 'bounds,' stretching itself to full length, then bringing up its tail and springing forward again with terrific vigour. In its excitement it seemed almost to fly, now gaining on him, and now, as an occasional obstacle had to be avoided, giving his victim some slight advantage. For the space of three whole fields, 'paddocks,' he was thus chased, he the while using his utmost speed. His home was in the bush, and when, almost dropping with excessive fatigue and terror, he came within sight of it, one of his farm-servants saw him thus tearing along, and, guessing the cause, seized his gun, and hastened to meet the fugitive, and put an end to the chase.

Du Chaillu's snakes were almost always 'springing' at him, and very probably some of them did so. At the same time, most of his snakes had 'fangs' as well; but then, in his '*Wild Life*' he witnessed many other anomalies.

As a rule, the most active are the non-venomous kinds; yet among the venomous colubrines, the slender *elapidæ*, of which the above Australian snake is one, we find much activity.

Mr. P. H. Gosse was struck with the amazing springing power of the yellow Jamaica boa (*Chilobothrus inornatus*), and by a similar use of its tail as a propelling power.[1] It rears itself up and leaps an incredible distance, he tells us; one covered nearly twenty feet in such a spring, but that was on the incline of a hill. He noticed another suspending

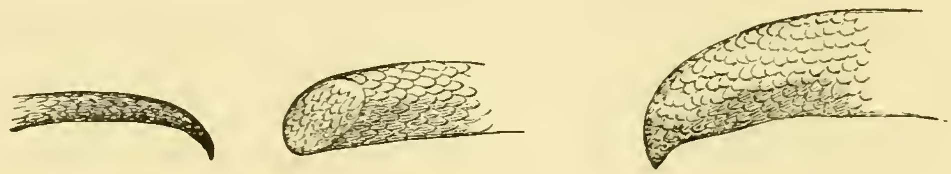
[1] *A Naturalist in Jamaica*, by P. H. Gosse.

itself from a branch, not with its tail *curled* round, but with a mere tip of it lying longitudinally, pressure alone supporting the reptile. The slightest contact suffices to maintain the hold.

There is still one more offending tail to describe. It belongs to a West Indian relative of our own little 'blind-worm,' bearing also the family name, and for more justifiable reasons, inasmuch as the eyes of the Jamaica species really are not easily distinguished. It is worm-like in aspect, and of about the same size as *Anguis fragilis*, similarly smooth and polished, and so active that it is difficult to hold it. *Typhlops lumbricalis* is its name, the first word signifying blind, and the second worm-like. It moves backwards and forwards with equal facility, and is therefore commonly called the 'two-headed snake.' The coloured people are dreadfully afraid of its short blunt tail, which they think can 'sting,' and which terminates in a minute horny nipple on a shining round plate or scale. Being a burrowing snake, this hard, protected tail is of great use as a fulcrum; but when off the ground, taken up by the hand, for instance, the little shining worm makes still further use of its tail, as its English cousin does, pressing the tip firmly against the fingers, or whatever surface is near it, to support itself, and to the terror of those who hold it, and who forthwith dash it down, though it is wholly powerless to injure.

In Australia it has some allies, whose tails are remarkably developed into this useful point. The reptiles being as round as rulers and as smooth, the difficulty of progression without this aid as a fulcrum will be evident. Below are three tails, which will suffice to exemplify their purpose and utility.

A curious modification is seen in the centre tail, belonging to *Uropeltis philippinus*, which, as the name implies, terminates in a round disk or shield. This snake is also one of the smooth cylindrical forms, 'admirably adapted to burrowing,' says Dr. Günther. Its truncated appearance is as if it were chopped clean in halves.



Tails of three burrowing snakes.

Another is the *Cylindrophis*, from its form. Several of the burrowing family are remarkable for a similarity of head and tail, obscure features, inconspicuous eyes, and very small mouth, rendering it difficult on first sight to decide which is the head and which the tail. All being feeble, inoffensive, and entirely harmless, the evil attached to them of having 'two heads' is only another proof of the prejudice and animosity displayed towards every creature in the shape of a snake, however innocent. These poor little 'blind-worms,' admirably organized to dig and burrow and find their food in deep and hidden places, have their uses. In countries where dangerous ants swarm, we might well tremble for the consequences, had not nature anticipated such evils by providing insectivorous reptiles, as well as birds and ant-eaters, to keep them in check.

We must not omit one other of the family of burrowing snakes, which from the very earliest ages has been suppositiously endowed with two heads. Its name, *Amphisbæna*, or 'double-walker' (going both ways), however, is well merited, because, like *Typhlops*, it can progress either way, forwards or backwards, with equal facility. This is the one alluded to by Catesby (p. 174). We can comprehend the advantage of the retrogressing power to these otherwise unprotected little reptiles, when they cautiously peep from their narrow burrow in the ground, and espy one of their many enemies in the shape of a much larger ophidian, or a carnivorous bird. Quick as thought, back they glide, and are safe. Living chiefly among the ants, on which they feed, their cuirass of hard, polished, close-set scales protects them from a bite or sting. Another beautiful provision of nature is, that the young ones, on being hatched, find food ready at hand—at mouth, rather—the eggs having been laid, or the young ones born, in the nest of the ants.

Of this harmless and useful reptile, Pliny seriously wrote: 'The amphisbæna has two heads; that is, it has a second one at its tail, as though one mouth were too little for the discharge of all its venom!'

Even at the present day this belief in 'two heads,' or 'two tails,' and 'death at both ends,' is not wholly eradicated, and not merely among the lower classes either.

It only remains to say that when two heads have really appeared—and there are several such cases on record—they are simply monstrosities, malformations, as found in other animals occasionally. An example of this kind may be seen at the Museum of the Royal College of Surgeons. Another was described by Frank Buckland in *Land and*

Water, April 1872. It was sent to him by his friend Dr. Bowerbank of St. Leonard's.

A curious jumble of the *Amphisbæna* and the Cobra, with its elevated and expanded neck, is found in the *Philosophical Transactions*, vol. iii. p. 863, for 1665. There had been a correspondence on the subject of two heads, and a reader was evidently sceptical, for the writer thus protests that he is telling the truth :—

'There are indeed such Serpents in these Parts (Java Naja) which have an Head on each End of their Body, called *Capra capella.* They are esteemed Sacred by these People, and fortunate to those in whose House and Lands they are found ; but pernicious to whomsoever doth them Harm.'

This credulous gentleman writes from the East, and cannot corroborate what he has been told by a personal acquaintance with even an Amphisbæna, which might really deceive a casual observer. But that the belief prevailed extensively prior to this, we find from a distinguished physician of his day, F. Hermandez, or Fernandez, who, in his work, *Animalium Mexicanum*, 1628, represents a creature that would fill one of these pages, with two heads like a ram with wattles and other ample appendages, and distinguishes it as *Amphisbæna Europæa.*


Amphisbæna Europæa.

'It is not for us to question the Ancients,' says the much too modest author, betraying a lurking misgiving as to the reality of the creature, but nevertheless doing his best to represent it as his imagination depicts it. It is here much reduced in size, but may be found on p. 797 of the above very interesting volume.

Sir Thomas Browne includes this among his 'Vulgar Errours,' and traces it to Nicander, Galen, and other classic writers, but to 'Ælian most confidently.' He discusses the creature with dispassionate intelligence, and shows us that 'poets have been more reasonable than philosophers' about it.[1] 'Again, if such a thing there were, it were not to be obtruded by the name of *Amphisbœna*, or as an animal of one denomination, with a duplicity of hearts and heads,' he argues, giving honour to the head, and therefore that the creature must be dual.

There are frequently some of the smooth, ruler-like snakes in our London Reptilium ; their very small eyes and mouth, and blunt, shapeless head, render it difficult to decide at the moment between head and tail. Any with sheep's heads we are not likely to see, and those that have had the malformation of two reptilian heads generally present something of two necks as well. The writers, however, whom we have quoted were not thinking of monstrosities, but had profound faith in a veritable *Amphisbœna Europœa*, which an artist with an unscientific imagination has handed down to posterity !

[1] *Pseudoxia*, Book iii. chap. xx. p. 155.

CHAPTER XII.

OPHIDIAN ACROBATS: CONSTRUCTION AND CONSTRICTION.

BEFORE discussing the most remarkable of all ophidian caudal appendages, the *Crotalus* rattle, and the many speculations regarding it, we will enumerate some other acrobatic achievements of which snakes are capable; as, in accounting for these, some interesting facts appertaining to their anatomical structure can be described.

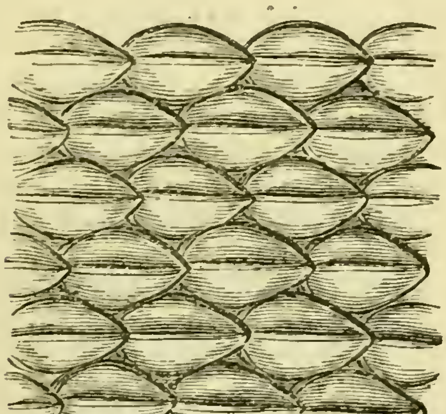
A humorous journalist has said, 'There is apparently nothing that a snake can *not* do, except swallow a porcupine.'[1] Presuming that he alludes to physical feats, he is not far from wrong. For all that, the Western pioneers of America tell us of yet one more thing that these reptiles cannot accomplish, and that is, cross over a rope of horse-hair.

[1] Since this was in type, I find that not even a porcupine is safe from a hungry snake. In vol. xliii. of the *Philosophical Transactions* (1744), p. 271, is a letter from a gentleman in India, who states that on an island near Bombay a dead snake was found with the quills of a porcupine 'sticking out of its Belly.' The snake had 'sucked it in Head foremost, while the Quills were flatted down. Afterwards they rose and ran through the Snake's Belly, and so killed it.' The pressure of the jaws had 'flatted' the quills, but not killed the animal, which, when in its expansile tomb, had, though vainly, erected its natural armour.

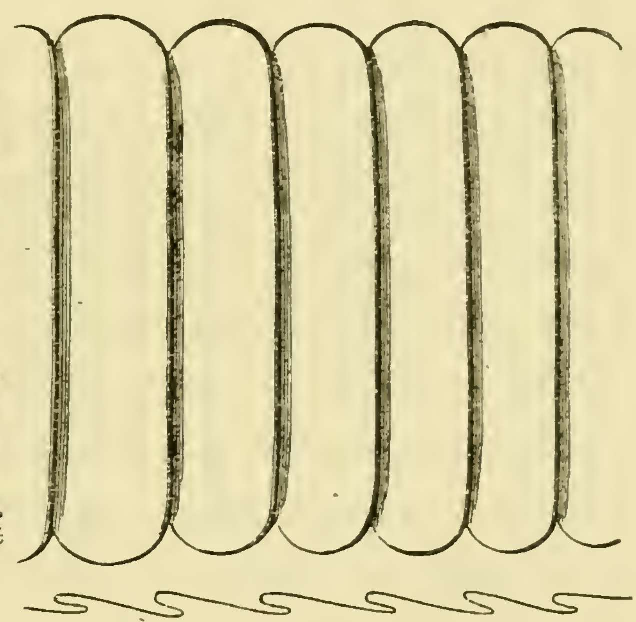
Having by accident discovered that they turn aside from this, some Western settlers, when camping out, have effectually entrenched themselves within a circle of horse-hair rope as a barrier to rattlesnakes while sleeping.

Let us try to account for this.

Many of my readers have seen the cast-off coat of a snake. Those who have not can have the pleasure of examining one or several the next time they go to the Zoological Gardens, where the obliging keeper will cheerfully exhibit them. Others at a distance may not enjoy this facility, and for these the accompanying diagrams may be a slight compensation.



Portion of slough of a rattle-snake (exact size).



Ventral scales of the same, and a section.

The whole cuticle or epidermis of a serpent is composed of these overlapping scales, of which the above illustrations are only fragments. Thus when we speak of their *scales*, we do not mean distinct and separable laminæ, like the scales of some fishes, each of which may be scraped or plucked off, and which overlie each other like the feathers of birds. The covering of a snake is one entire piece, loose-fitting, and so arranged as to lie in those scale-like folds which accommodate themselves to every movement of the body. The ventral or under scales are, in fact, a regular kilting, as may be seen by the section; and the upper ones correspond somewhat with what our lady friends call the shell or the leaf pattern in knitting work. The outer or exposed folds are stronger, thicker, and more hardened than the inner parts, just as the knitter 'throws up' her pattern with a coarser wool or larger needles, and knits the less conspicuous parts in a softer material. The naked space of thinner skin between these scales being very considerable, one can therefore easily understand how, when a snake would attempt to pass over a horse-hair rope, the sharp, prickly hairs, standing out *chevaux-de-frise* fashion, would insinuate themselves unpleasantly in those softer and more vulnerable interstices which become exposed by the sinuations of the body. Probably, if we knew it, or had an opportunity of observing, we should ascertain that snakes do not crawl over furze bushes, or thistles, or the prickly pear (*opuntia*), or any similar vegetation of tropical climates, and for the same reason. The close-scaled burrowing snakes, with their hard and strong cuirass all round them, might have nothing to fear from a furze bush; but this is mere speculation. That fine, sharp spines or prickles, and therefore a horse-hair rope, would incommode the tender intermediate epidermal folds of other snakes, we can well suppose. Had they sense enough to *leap* the obstacle, this they could easily do, after the manner of 'leaping' already described; but the 'leap' is only an instinctive action used in pursuit or escape; and it may be equally instinctive to turn aside from uncomfortable obstacles, whether prickly pears or horse-hair ropes.

Mr. Ruskin, in his highly-entertaining lecture on 'Snakes,' at the London Institution, March 1880 (a lecture which, by the way, was artistic, poetic, figurative, imaginative—'Snakes' from a Ruskin, but not a zoological, point of view), remarked 'that no scientific book tells us why the reptile *is* a "serpent," *i.e.* serpentine in its motions, and why it cannot go straight.' Now, may not the fact that snakes have acquired these ever-varying sinuations arise from their sensitiveness to the slightest, and what would be to other creatures almost impalpable, obstructions in their path?—mere inequalities which in their lazy nature it is easier, they know not why, to circumvent than to surmount; because they *can* go straight, and *do* go straight when the way is plain.

Rymer Jones, in his *Organization of the Animal Kingdom*, thinks that their sense of touch from the nature of their integument must be extremely imperfect; they being 'deprived of any limbs which can be regarded as tactile organs,' p. 753. But close observation leads one to agree rather with a much older writer, Roget, who, in his *Animal Physiology*, intimates that the peculiar conformation of serpents must be exceedingly favourable to the acquisition of correct perceptions of touch, and that these perceptions which lead to a perfect acquaintance with the tangible properties of surrounding bodies must contribute much to the sagacity of snakes;—that their whole body is a hand, conferring some of the advantages of that instrument.

That this latter faculty is strictly and marvellously the case, we shall presently see, owing to the flexibility of the spine, and its capability of grasping and twining round objects of almost any shape, and of taking, as Roget says, 'their exact measure.' For this grasping power is not confined to the constricting snakes only. In all snakes a great flexibility is abundantly provided for in the construction of 'these lithe and elegant beings,' as Rymer Jones in unprejudiced language calls them (p. 724 of the book above quoted); 'the spinal column admits the utmost pliancy of motion in any required direction.'

Though snakes have no limbs externally, 'the work of hands, feet, and fins is performed by a modification of the vertebral column.'[1] 'Except flying, there is no limit to their locomotion,' said Professor Huxley in *his* lecture on 'Snakes,' a few weeks previously to that of Ruskin, and under the same roof. To both these lectures we shall again refer, as the reader will feel sure that all coming from such sources must add value to the present writer's arguments.

As 'flying,' the swift motions of many snakes have been described by ancient writers, as, for example, the 'flying serpents' of Scripture, though these are by many supposed to be the *Dracunculi*, the earliest known of human parasites. The astonishing movements of serpents were, however, in superstitious ages ascribed to supernatural agency. Says Pliny: 'The Jaculus darts from trees, flies through the air as if it were hurled from an engine.' The 'wisest of men' admitted that the actions of serpents were beyond his comprehension; 'the way of a serpent on a rock' was 'too wonderful' for him.

[1] Owen's *Anatomy of the Vertebrates*, p. 261.

Even in intermediate ages, when travellers and naturalists began to confront fiction with fact, even in the days of Buffon and Lacepède, a serpent was regarded as a living allegory rather than a zoological reality by many intelligent, albeit unscientific persons. Of such was Chateaubriand, whose contemplation of the serpent partook of religious awe. 'Everything is mysterious, secret, astonishing in this incomprehensible reptile. His movements differ from those of all other animals. It is impossible to say where his locomotive principle lies, for he has neither fins, nor feet, nor wings; and yet he flits like a shadow, he vanishes as if by magic, he reappears, and is gone again like a light azure vapour on the gleams of a sabre in the dark. Now he curls himself into a circle, and projects a tongue of fire; now standing erect upon the extremity of his tail he moves as if by enchantment. He rolls himself into a ball, rises and falls like a spiral line, gives to his rings the undulations of a wave, twines round the branches of trees, glides under the grass of the meadow, or skims along the surface of the water,' and so forth.[1]

Excepting the 'tongue of fire,' the whole of this poetic description is so far true and unexaggerated, that Chateaubriand has not attributed to the reptile one action of which it is not capable, and which, to the untutored mind, might well seem supernatural. Roget, Schlegel, Huxley, and others tell us the same things in the language of science. To quote them all is impossible; the reader will be content with one scientific assurance of ophidian capabilities, not less poetic than Chateaubriand's.

[1] *Genius of Christianity.*

Professor Owen, in describing the bony structure of the Ophidia, and in allusion to the scriptural text—'Upon thy belly shalt thou go'—affirms that so far from the reptiles being degraded from a higher type, their whole organization demonstrates how exquisitely their parts are adapted to their necessities, and thus proceeds: 'They can outclimb the monkey, outswim the fish, outleap the jerboa, and suddenly loosing the coils of their crouching spiral, they can spring into the air and seize the bird upon its wing.'

The active snakes can always 'leap' their own length, whether upwards to seize a bird, or horizontally, and, as in the case of the Jamaica boa (described p. 186), can leap much farther from a similar impetus when the direction is *downwards.* Indeed, they can let themselves fall from a certain elevation with an additional impetus to progress, as a boy first runs in order to leap a ditch.

'With neither hands nor talons, they can out-wrestle the athlete, and crush their prey in the embrace of their ponderous, over-lapping folds. . . . Instead of licking up its food as it glides along, the serpent uplifts its crushed prey, and presents it grasped in its death-like coil, as in a hand, to its gaping mouth.'[1]

A similarly graphic account is given by Rymer Jones, p. 718 of his work,[2] that will be read with interest by those who wish to pursue the study scientifically.

In watching the larger constricting snakes while feeding, you see how *dexterously* they manage.—(One may use this word here, because those above quoted, 'as in a hand,' are

[1] *Anatomy of the Vertebrates*, vol. iii. p. 260 *et seq.*

[2] *Organization of the Animal Kingdom.*

literally, scientifically true; therefore we may suppose fingers as well as a hand, and say how dexterously the creatures bring their coils to their aid.)

They have quickly strangled and begun to eat, say an opossum or a turkey buzzard, when a part of the prey not swallowed offers some impediment to the expanded jaws; the wings or legs may be inconveniently extended, or have become wedged between some immoveable obstacles—a log, a narrow space, or under a portion of themselves. Their mouth, the only apparent grasping agent, is already occupied, and a strain sufficiently powerful, while the jaws are thus retaining the prey, would be painful to the feeder, might even drag back the food, to the injury of the engaged teeth. How does the reptile proceed in this emergency? With the lightness and deftness of enormous strength, it applies two folds of its body, two loops of its own coils, and with them drags forth, lifts up, or otherwise adjusts its prey in a more convenient position—in fact, 'presents it as in a hand' to its own mouth.

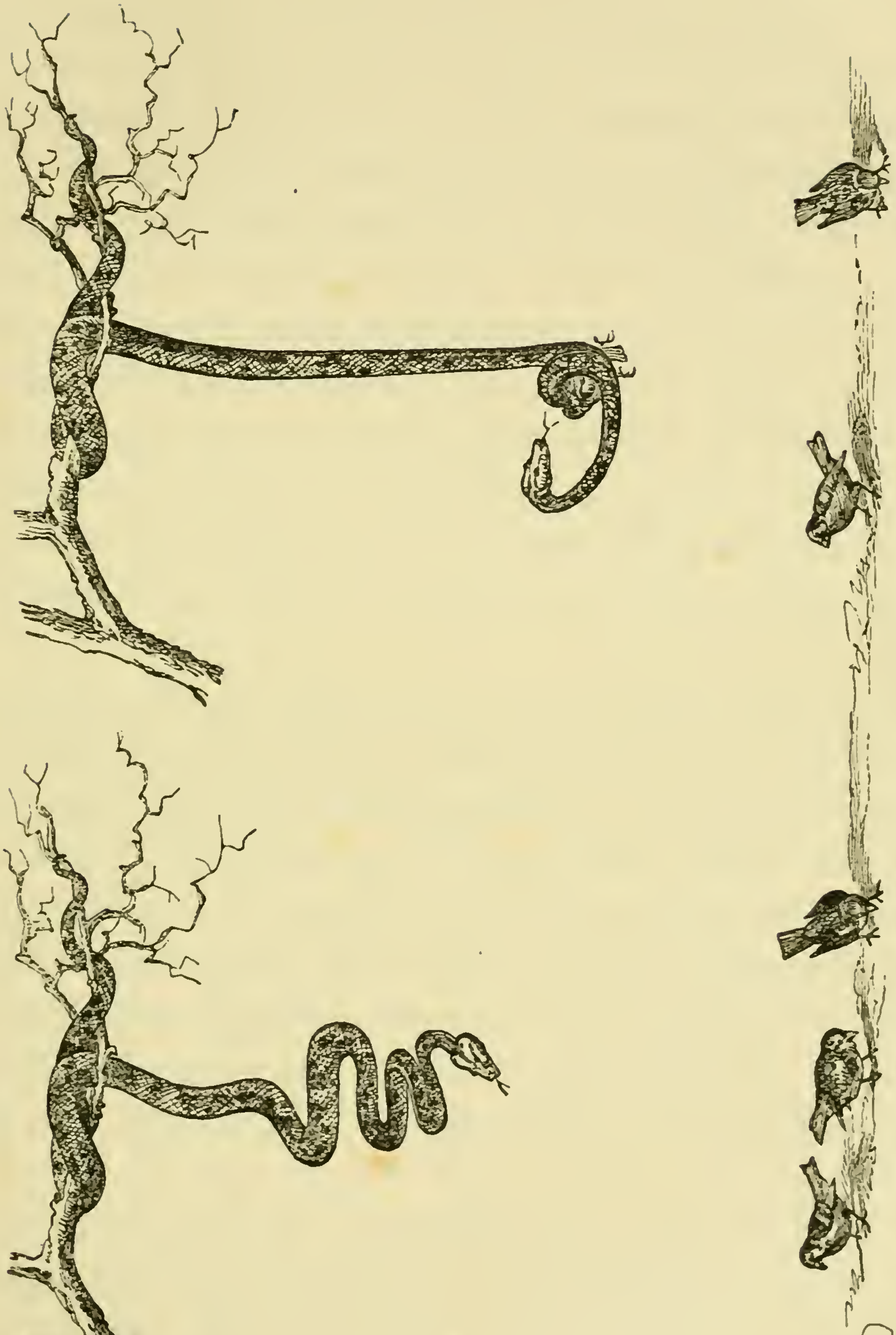
A very remarkable instance of a constricting snake thus using its coils is related by Dr. Elliott Coues, of the United States army, late surgeon and naturalist to the United States Northern Boundary Commission. He witnessed one of those frequent combats between the Racer and the Rattlesnake, in which the former—and in far less time than it takes to read one line of this page—threw two folds or coils round his adversary, one coil of the anterior portion of his own body round one part, and a second coil of the posterior portion of his own body round another part, and then, by a sudden extension of himself, tore the rattlesnake in halves. And this was done with greater ease and swiftness than we could snap a thread which we must first secure round the fingers of our two hands. As if indeed possessed of two hands, the constrictor snapped his foe in twain. This is Lawson's 'Whipster,' p. 182.

The coiling of the constricting snakes is like lightning; you cannot follow the movements. In this case death must have been instantaneous, and indeed it is doubtful whether any beast or bird of prey puts his victim to a more speedy and less torturing death than the constrictors when following their own instincts.

Repairing to the Zoological Gardens in the hope of witnessing the wonderful adaptation of coils to manual uses, after reading what Roget and Owen had affirmed, one soon had a favourable opportunity in watching a python. It was, I think, in June 1874, and the poor python had a ruptured side. In spite of which—as my zoological notes record—'it helped by the folds of its body to get the wings of the duck down flat and close, so as to swallow it more easily. With reason does Roget say, "Its whole body is a hand," for it used its loops to hold and to push and to flatten in a manner truly intelligent.'

Such was my first entry and observation. Subsequently, and indeed almost on every feeding day, the same kind of thing was to be seen at the Gardens. Many such examples are recorded in my notebook; but of these one or two later notes will suffice to illustrate the subject.

A young python was hanging from a branch, more than half its body curved as in the accompanying sketch, remaining motionless and quiescent, watching some sparrows which



'Totsey,' a python born in the Gardens, June 30, 1877, taking her supper, Sept. 24, 1880.

the keeper had just put into the cage. The birds, eyeing certain insects among the gravel, seemed all unconscious of the pair of glistening eyes looking down upon them. Suddenly a movement, a flicker, like the flash of a whip, and the snake had changed its position. Too quick for us to follow the motion, but in that flash of time it now hung like a pendulum, with a sparrow almost hidden in its coils. The snake had precisely measured its distance, reached down, and recoiled with the swiftness of an elastic spring. After a few minutes, *feeling* that its prey was dead, it prepared to swallow it, holding it encircled in a portion of its body, while the head was free to commence the usual examination. Still hanging there, it held and devoured the bird.

On another occasion, one of the larger pythons caught a guinea-pig in the same manner. This also was so quick in its movements that one scarcely knew what had happened until the snake was seen to have changed its position, some of the anterior coils had embraced a something, and a quadruped was missing. This snake also still hung while eating its meal, the whole process occupying less than ten minutes. In both these cases we saw the prehensile tail in its natural use, while the rest of the body was free for action.

One of the most remarkable cases of what we may call independent constricting powers, that is, two or more parts of the reptile being engaged at the same time, was in some very hungry, or very greedy, or very sagacious little constrictors, the 'four-rayed snakes,' *Elaphis quater-radiatus.*

They are slender for their length, which may be from three to five feet, of an inconspicuous colour, but with two black lines on each side, running the whole length of their body; hence their name, 'four-lined,' or 'four-rayed.' In the present instance, there were in the same cage three of these, also one young royal python, one small common boa, and one 'thick-necked tree boa' (*Epicratis cenchris*), all constrictors. The day was close and warm for April, and the snakes, reviving from their winter torpor, seemed particularly active and lively. Probably they had not fed much of late, and thought now was their opportunity, for the keeper no sooner threw the birds—finches, and plenty of them for all—into the cage, than there was a general scuffle. Each of the six snakes seized its bird and entwined it, then on the part of the reptiles all was comparatively still. The rest of the poor little birds, fluttering hither and thither, were, however, not disregarded, for although each snake was constricting its captive, several of them captured another bird by pressing it beneath them, and holding it down with a disengaged part of themselves. One of the four-rayed snakes felt its held-down victim struggling, and instantaneously a second coil was thrown round it. Then another caught a second bird in its mouth, for its head and neck were not occupied with the bird already held, and in order to have coils at its disposal, slipped down its first captive, or rather passed itself onwards to constrict the second, the earlier coils not changing in form in the slightest degree, any more than a ring passed down a cord would change its form. The next moment I saw one of those two hungry ones with three birds under its control. It had already begun to eat the first, a second was coiled about eight inches behind, and a good deal of the posterior portion of the reptile was still disengaged when a bird passed across its tail, and instantly that was captured. All this was done by a sense of feeling only, as the snakes did not once turn their heads. Two of these 'four-rayed' snakes were so close together, so rapid in their movements, so excited and eager for their prey, that which of them first began his bird, and which one caught the third, it is impossible to affirm confidently.

Whenever either of them was in the same position for one quiet minute, a few hurried strokes of the pencil fixed them in my notebook, and of the hasty though faithful sketches thus made, I present three to the reader on the opposite page.

April 1st, 1881.—After this date nothing more was to be seen! Henceforth visitors were to be excluded, and the reptiles were to be fed *after sunset.*

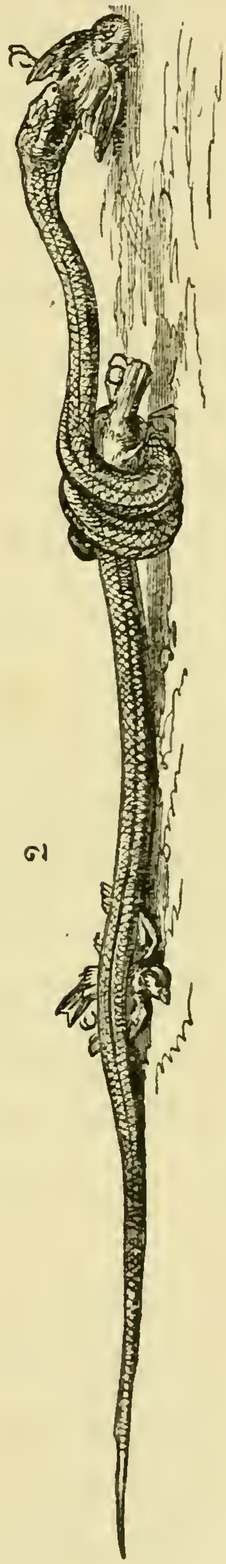
Now, however painfully and sympathetically we may regard those poor little birds so unceremoniously seized, crushed, and devoured, we can but reverently, and almost with awe, admire the astonishing facility with which these limbless, toolless reptiles provide themselves with food. With still deeper awe and reverence we shall admire when we examine their anatomical structure, and see by what marvellous development it has been adapted to their necessities.

We feel sadly for the finches, it is true; because finches are often our pets, and are sweet songsters. Were a toad or a rat thus treated, we should care less, perhaps; because there is as much repugnance towards toads and 'vermin,' as towards snakes.

1

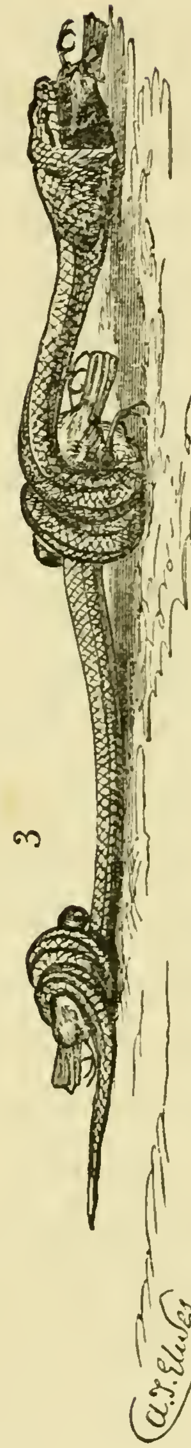
First bird caught and a second held down.

2



First bird dead, the second coiled, and a third bird caught.

3



First bird half eaten, two others in coils.
April 1st, 1881.

But if the finches did not become the prey of snakes, they would become the victims of bird-catchers and milliners; and if they escaped these wanton spoilers, they would fall victims to birds of prey, as much larger birds fall victims to our own need of food.

Reptiles also have existence and requirements, and an organization adapted to such requirements. This should be their claim upon our tolerance; and if they do not win our admiration, we cannot deny them the right to live, the right to feed according to their instincts, and to secure their natural food in their own way, which—begging the reader to pardon this feeble moralizing—we find to be a very wonderful way.

Though the term 'reptile' is applied to a whole tribe of crawling creatures, whether four-legged or limbless, that are covered with scales, horny plates, or a skin more or less hardened, imbricated, or rugose (viz. crocodiles, lizards, frogs, toads, serpents, and their congeners), snakes are more truly reptiles, being limbless, from *repo*, to creep. Hence serpents (from *serpo*, to creep, and its derivatives serpentine, serpentize, etc., from *serpens*, winding) have been separated from the rest. The true serpents, therefore, are those without feet, and which move only close to the ground, by the sinuations of their body.

We have seen that the constricting snakes use this body as a substitute for hands, literally *managing* with it; but though they are externally legless, and *apodal* (without feet), the truth is that few creatures, none perhaps, not even millipedes, are more liberally furnished with legs and feet than serpents. One curious exception to general rules is, that while other creatures have the same number of feet as legs, that is, one foot to each leg, a snake has only one foot to each pair of legs!

Many of my observant readers have already discovered for themselves where and what these numerous legs and feet are. In the early days of my ophidian studies, which then consisted chiefly of observations, I noticed the action of limbs beneath the skin of the pythons as they moved about, and more particularly when they were climbing up the glass in front of their cages, and as in the case of the glottis, I thought I had made a grand discovery; and so I had, as far as myself was concerned.

Deductions from personal observation, which in the history of many sciences have again and again been claimed as original discoveries by rival thinkers or experimentalists, no doubt *were* original on the part of each.

Probably, also, many other persons have noticed this leg-like action of the ribs, but who, not being specially interested in snakeology, have never troubled themselves to ascertain 'further particulars,' or cared whether any one else had observed this or not. But it *is* a very evident and unmistakeable action, and one quite worth studying on your next visit to the Reptilium.

Books on ophiology tell us that Sir Joseph Banks was the first to observe this limb-like action of the ribs. Sir Everard—then Mr.—Home, F.R.S, and the most distinguished anatomist of his time, was, however, the first to publish a scientific description of the fact; his account and the illustrations accompanying it having been subsequently adopted by most ophiologists.

In vol. cii. of the *Philosophical Transactions* of 1812, p.

163, is a paper which was read before the Royal Society in February of that year, by Everard Home, Esq., F.R.S. It is entitled, 'Observations to show that the Progressive Motion of Snakes is partly performed by the Ribs.'

We give his introductory words, not only because the 'discovery' was a great event in the history of ophiology, but as showing that to see and examine a foreign snake was at that time a rare if not a novel occurrence. He tells us that on a former occasion in 1804, he had described the anterior ribs of a cobra, those which form the 'hood.' At that time he was 'not in possession of the bodies of snakes,' so that he could compare their structure, but had *since* found out a good deal more about their anatomy, and then he proceeds: 'A Coluber of unusual size lately brought to London to be exhibited, was shown to Sir Joseph Banks. The animal was lively and moved along the carpet briskly; while it was doing so, Sir Joseph thought he saw the ribs come forward in succession, like the feet of a caterpillar. This remark he immediately communicated to me, and gave me an opportunity of seeing the snake and making my own observations. The fact was already established, and I could feel the ribs with my fingers as they were brought forward. I placed my hand under the snake, and the ribs were felt distinctly upon the palm as the animal passed over it. This becomes the more interesting discovery as it constitutes a new species of progressive motion, and one widely different from those already known.'

The 'unusually large Coluber' was probably a python. Had a previous opportunity presented itself to this scientific and thoughtful observer, Sir Joseph Banks might not have been the one to carry off the palm in this discovery. Home had already described the peculiarity of the cobra's anterior ribs (chap. xviii.), and, as already suggested, it is scarcely possible to watch one of those larger constrictors *without* perceiving the mode of progression. We shall see in the course of this book that snake observers have arrived at the same conclusions on several points, while wholly ignorant of what others had said or decided regarding the same.

In the previous chapter the number of vertebræ forming the spinal column of three or four snakes was given, but this number varies greatly, not only in snakes but in species. In some species there are above 400 vertebræ or joints in a snake's spine. But here is a puzzle that baffles the student. 'Every one knows,' says Schlegel, 'that their number differs' (speaking of the vertebræ), 'not only according to the species, but also in individuals, so that sometimes we find in serpents of the same species a difference of thirty or forty vertebræ more or less.' [1]

Taking this literally according to the text, one might expect to find one ring-snake in a family of ten measuring two feet, while his brother measured two yards, and a third four feet, and so on, as if each had a different number of vertebræ.

'The same species,' that is, two anacondas or two cobras! 'A mistranslation,' one naturally decided, and proceeded to consult the original. But no. The translator had faithfully and unquestioningly followed the original French; but the fact was so irreconcilable that I sought Dr. Günther's kind assistance in comprehending the passage.

[1] *Essay on the Physiology of Serpents.* Translated from the original by Thomas Stewart Trail, M.D., F.R.S.E., etc. Edin. 1843.

'Evidently an oversight. Manifestly impossible,' that learned authority at once decided. (As Schlegel stands high as a scientific ophiologist, the misprint is pointed out for the benefit of future students.)

Thus lengths, *as to the number of vertebræ*, vary in species of the same genus, but *not* in 'individuals of the same species.' And this alone is sufficiently perplexing.

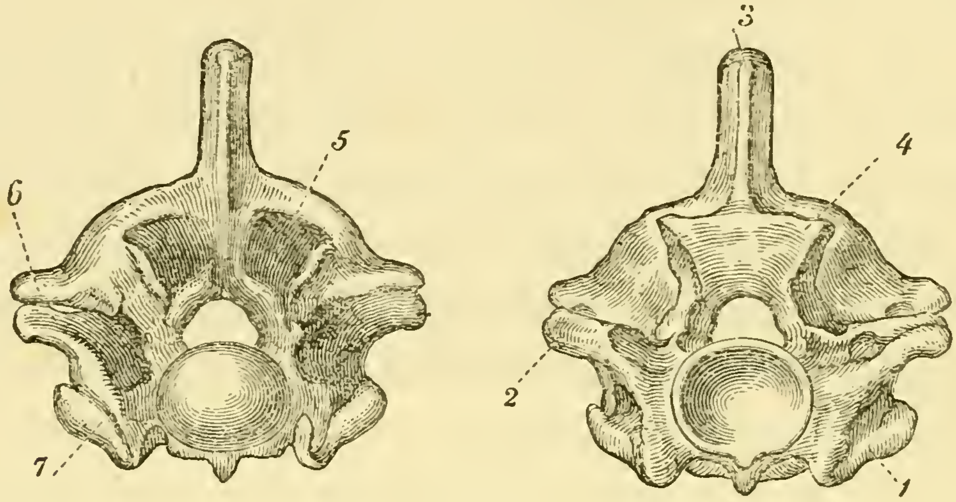
For example, we read in one work that a rattlesnake has 194 vertebræ, and in another that 'it,' viz. 'a rattle-snake,' has 207 vertebræ. Both equally correct, because two distinct species are described. Again, Dr. Carpenter, in his *Animal Physiology* (edition of 1872), gives a table of the vertebræ of various animals, in which 'a python' has 422 joints, while Owen gives 'a python' 291 joints, each learned anatomist having examined a different species. By these facts we comprehend what Schlegel intended to say.

The little constrictors caught their finches with five feet of body at their disposal. An anaconda, with five yards of body to work with, might with equal ease coil three opossums.

'The skeleton of a snake exhibits the greatest possible simplicity to which a vertebrate animal can be reduced,' says Roget. It is 'merely a lengthened spinal column.' It is 'simple' in the same way that botanists call a stem simple when it has no branches, or bracts, or leaves, to interrupt its uniformity. For this reason, having no limbs, and therefore none of those bones which in quadrupeds connect the limbs to the trunk, the spine is, in unscientific language, alike all the way down; '*un corps tout en tronc.*' And because those two first joints of the spine which have no ribs attached to them are in form precisely like the other joints, physiologists tell us that a snake has 'no neck.' By way of simplifying matters we just now called those two joints an invariable neck. But in the way of *cervical* or neck vertebræ, however, we must bear in mind that a true anatomical neck, in the eyes of science, a snake has not. Some of the four-legged reptiles have a true neck, that is, they have cervical vertebræ which differ from dorsal, lumbar, etc. vertebræ, as we ourselves and mammals in general have ; because four-legged reptiles have a breast-bone and limbs to support, and their neck varies in length. For example, a tortoise has nine cervical or neck joints, a monitor lizard six, and a salamander only one.

But so also do the necks of mammals vary very greatly *in length,* while all, without exception, are formed of seven joints, *only seven vertebræ ;* a man, a whale, a giraffe, and a mouse possess each seven cervical vertebræ, different in form from the rest of the joints of the spinal column. We might say that in appearance a whale has no neck, but its seven neck joints are flat and close as seven cards or seven pennies, while those of the giraffe are extraordinarily prolonged ; and in ourselves—well, of course, the reader will admit the perfection of symmetry in our own necks, and the seven joints, therefore, are precisely of the proper size.

While the spine of a snake is 'simple' in respect of its joints being all formed on the same plan, it is the reverse of simple in its wonderfully complex structure. Professor Huxley, in his delightful lecture, said that 'the most beautiful piece of anatomy he knew was the vertebra of a snake.' Professor Owen thus anatomically describes it : 'The vertebræ of serpents articulate with each other by eight joints, in addition to those of the cup and ball on the centrum; and interlock by parts reciprocally receiving and entering one another, like the joints called tenon and mortice in carpentry' (*Anatomy of the Vertebrates*, p. 54).



Front and back view of a vertebra.

Bearing in mind that each of these highly complicated joints supports a pair of moveable ribs, and that the ends of these ribs are connected by muscles with the large stiff scutes or scales crossing the under surface of the body (see illustrations, p. 193), which move with the ribs, one foot-like scale to each pair, we comprehend how snakes exceed millipedes in the number of their *limbs*, if not true legs, and how they excel the insect also in variety of movement. Those 'ball and socket' joints admit of free lateral flexion, and every variety of curvature—'*the utmost pliancy of motion*,' to repeat the words of Rymer Jones; and also of that surprisingly independent motion which enables the constrictors to surpass even the *Bimana* (except practised experts) in doing *several things at once*.

Thoughtful persons who can contemplate this wondrous organization with due reverence, and witness it in activity—as we admiringly observe the works of a watch in motion—will forget to censure those who supply food to this piece of animated mechanism, and even pardon a hungry little snake for so expertly securing three birds at once.

Think of 300 back-bones and 300 pairs of legs, all requiring wholesome exercise. Some snakes have 300 pairs of ribs—each pair capable of independent motion, and articulated with that complex spine; and each pair moving together, and carrying along with them a foot in the shape of a broad ventral scale. 'This scutum by its posterior edge lays hold of the ground,' says Sir Everard Home, 'and becomes a fixed point whence to set out anew.'

The hold which the ventral scales have of the ground obviously renders it easier for the reptiles to pass over a rough than a smooth surface; what are obstacles to other creatures are facilities to them. But they appear to be never at a loss. On a boarded room, or even a marble floor, they will manage progression of some sort,—many by the pressure of the tail to push themselves forward, and others with an action that can be compared only with swimming. With the same rapid, undulating motion as swimming, the active snakes skim through the grass, or over soft herbage, on which they seem to make no impression. Their swift sinuations are almost invisible to the eye. You only know that a snake *was* there, and now has vanished. The 'Rat' snake of Ceylon (*Ptyas mucosus*) (see frontispiece) and the 'Pilot' snakes of America are among the best known of these swift-flitting or gliding creatures.

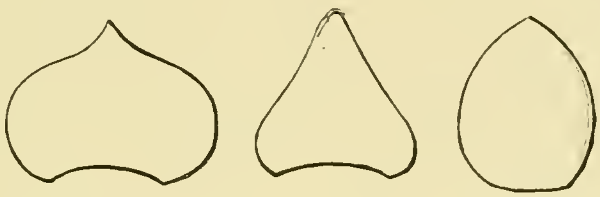
Rats are fleet little quadrupeds, but their enemies, the

Rat snakes of India, are more than their match. Sir Emerson Tennant, in his *History of Ceylon*, describes an encounter with one. *Ptyas mucosus* caught a rat, and both captor and captive were promptly covered with a glass shade to be watched. With an instinct to escape stronger than hunger, *Ptyas* relinquished his hold, and manifested uneasiness. Then the glass shade was raised a trifle, and instantly away ran the rat; but the snake was after it like a flash, caught it, and glided away swiftly, with head erect and the rat in its mouth.

At one of the Davis lectures at the Zoological Gardens, a fine Rat snake in the Society's collection was exhibited, and was permitted to be handled by a favoured few. To hold it *still* was not possible, for the creature glided through the hand, and entwined itself about one as if a dozen snakes had you in possession. It was very tame, and accustomed to be handled by the keeper, whose especial pet it was; otherwise *Ptyas* is a powerful snake, and quite capable of strangling you should it take a fancy to constrict your neck. On another occasion this same snake constricted my arm sufficiently to make my fingers swell; but that was not so much in anger as for safety, because it did not like to be fettered in its movements, or to be somewhat unceremoniously examined. A younger and less tame specimen tried to bite me, and squeezed my fingers blue by constricting them.

There is no circumventing these 'lithe and elegant beings.' They will get into your pocket, or up your sleeve; and while you think you have the head safely in your hand, the whole twelve feet of snake will have glided through, and be making its way to the book shelves, or where you least expect to see it.

When frequently handling the young constrictors, one has been able to *feel* as well as to observe the action of the ribs. As they pass through the hand, you feel them expanded, so as to present a flatter under surface. In *Ptyas* the back is remarkably keeled when crawling, a section of his body presenting the form of the middle diagram given below.



Schlegel describes the forms which the bodies of various snakes assume in swimming, climbing, clinging, etc. Sometimes they are laterally compressed, at others flattened. The three figures above are on a much reduced scale, but give an idea of the sections of three different snakes, though each snake is capable of several such changes of form. When snakes climb against the glass of their cages, you may easily discern the flattening of their bodies. In this action there seems to be a compressing power, any hold of the scutæ against a polished plane being, of course, impossible; yet without holding they seem to cling; and the ribs advance in wave-like intervals just the same, with an intermediate space at rest until in turn the wave is there and passes on, while from an anterior portion another wave approaches, and so on. Yet the *compressure* strikes one forcibly. There is also the evident support of the tail in a large python thus crawling to the very top of his cage.

Mr. Gosse observed the dilatation and flattening of the body in the climbing snakes, and that they had no more difficulty in gliding up a tree or a wall in a straight line than on the ground. In the *Anecdotes of Serpents*, revised for the Messrs. W. & R. Chambers, of Edinburgh, in 1875, from the tract by the late John Keast Lord, I also recorded my observations on this peculiarity.

Some young Jamaica boas crawled to the top of their cage as soon as they were born. I saw them the same day; *held* them, as well as it was possible to hold threads of quicksilver; *felt* them, too, for the exceedingly juvenile constrictors tied up my fingers cleverly. So did some young boa constrictors, born alive at the Gardens, June 30, 1877. They were from fifteen to twenty inches in length, and had teeth sufficiently developed to draw blood from Holland's hand, showing fight and ingratitude at the same time. They were exceedingly active, and fed on young mice, which they constricted instinctively. One of them, known as 'Totsey,' subsequently *hung* for her portrait, as on p. 201.

In vol. xx. of *Nature*, p. 528, is a very clever paper on the progression of snakes, by H. F. Hutchinson, who has evidently observed them closely. He arrives at the conclusion that they have three different modes, viz. 'on smooth plane surfaces by means of their rib-legs;' . . . 'through high grass by rapid, almost invisible, sinuous onward movement, like swimming;' in climbing straight walls or ascending smooth surfaces by creating a vacuum with the ventral scales. He reminds us that cobras, kraits, the rat snake, and other slender and active kinds are constantly found on house roofs, walls, straight smooth trees, etc., and asks how they got there. He has seen the 'abdominal scales creating a vacuum like the pedal scales of house lizards.' He put some active little snakes on the ground, where there was no hold for the scutæ, and they 'flew about in all directions.' He saw that they moved on by these quick, sinuous curves—'rapid wriggles.'

In company with my esteemed friend, Mr. Robert Chambers of Edinburgh, we made similar experiments by placing some of the smooth-scaled, active snakes on a boarded floor. Being extremely wild, they displayed their anger and skill to perfection, and literally *swam* along, scarcely touching the floor, and so swiftly that we had difficulty in pursuing and securing them again. Some very young *Tropidonoti* when disturbed flew or 'swam' about their cage in the same manner. We also saw pythons climb up a window-frame, and a corner of the room where no visible hold could be obtained; and after the example of Sir Everard Home, we allowed the reptiles to crawl over our hands, when we could feel the expansion and flattening of the body by the spreading of the ribs. I incline to agree, therefore, with the writer in *Nature*, that there is a sort of vacuum created by the ventral scales. Dr. Stradling observed that on occasions of retreat, some snakes move in such rapid and ever-varying sinuations as to baffle you completely when you attempt to lay hold of them; the part you thought to grasp is gone.[1] Such are the movements of *Pituophis* and of *Echis* (p. 151).

At the risk of being tedious, a few more words must be added on this subject of progression, because we so con-

[1] 'On the Movements of Snakes in Flight,' by Dr. Arthur Stradling, C.M.Z.S., *Nature*, Feb. 1882.

stantly see it asserted that snakes 'move with difficulty over smooth surfaces.' Their actions have not excited sufficient attention and study. Have you ever watched them moving about in their bath at the Zoological Gardens? The motions of a python once particularly struck me. The earthenware pan was smooth polished ware, and with enough water in it to render it smoother, if that be possible. The reptile was not swimming, for the thicker part of its body was not even wholly submersed. The pan was too shallow for that, and too small to permit of any portion of the python being fully extended. It moved in ever-varying coils and curves, yet with the greatest ease, its head slightly raised, so that the nostrils and mouth were out of water. It seemed to be enjoying its bath, as it actively glided, turned, and curved in that wonderful fashion which Ruskin described as 'a bit one way, a bit another, and some of him not at all.' There could be no hold for the scutæ in this case, nor could I detect any action of the ribs as in crawling over a less smooth surface. The creature seemed to move by its easy sinuations, and with no more effort than you see in the fish at an aquarium. Perfectly incomprehensible is this lax and leisurely movement in shallow water. Even the inert little slow-worm astonishes us by its physical achievements, which will be duly described in its especial chapter.

But among the most characteristically active are the small and slender tree snakes, the *Dryadidæ* and *Dendrophidæ*, mostly of a brilliant green. These and the Whip snakes are exceedingly long and slender, the tails of many of them very gradually diminishing to a fine and attenuated point. Some of them are closely allied to the lizards, and skim and dash through the foliage with a scarcely perceptible weight. These are the true acrobats, full of gracile ease and activity. Many are over four feet in length, and not much thicker than a pencil.

They are found in the hot countries of both hemispheres. The Siamese call some of them 'sunbeams,' from their combination of grace and splendour, and in Brazil some have the brilliant tints of the humming-birds. These little creatures in your hand feel like soft, fine, satin cords endowed with life.

Dr. Wucherer, writing from Brazil, enthusiastically declared that he was always delighted to find one of them in his garden. He discovered them coiled in a bird's nest, their body of two feet long occupying a space no larger than the hollow of your hand. 'In an instant they dart upwards between the branches and over the leaves, which scarcely bend beneath their weight. A moment more, and you have lost them.'[1]

Krefft, of Australia, had some of the active snakes, which were confined in an empty room, but one day could not be found. At last they were discovered upon the moulding of a door, nine feet from the floor! They must have climbed up the smooth wood-work in their own mysterious fashion.

Ere concluding this chapter, one slight exception to the extremely 'simple' spinal column must be named. This is that certain families, more nearly allied to the lizards, or most far removed from the vipers, have rudiments of pelvic bones, or those which in bipeds connect the legs with the trunk. In a few families there is even a pair of these rudiments externally, though only in the form of a spur or

[1] Letter to Sir Emerson Tennant.

claw, as seen in the boa constrictor, the pythons, and some of the blind-worms, and usually more developed in the male.

There is, however, the true skeleton of a claw beneath the skin, composed of several bones, and presenting somewhat the form of a bird's claw, hinting at the common ancestry between snakes and lizards. These spurs, though mere vestiges of limbs, must still be of some use to the large constrictors when climbing trees and hanging from the branches. They are found in the boa, python, eryx, and tortrix, four groups which approach the lizard characteristics; also in *Boa aquatica*, the anaconda.

CHAPTER XIII.

FRESH-WATER SNAKES.

THE frequent allusion to water snakes in the preceding chapters seems to render this a suitable place to describe them more in detail; and among them are of course the sea snakes, and 'The Great Sea Serpent' must not be omitted.

In many books on natural history, particularly if herpetology occupy any space, we find the subject wound up with a chapter on 'The Sea Serpent,' forming a sort of apologetic little addendum, as if the creature of questionable existence must claim no space in the heart of the volume, yet is not quite so unimportant as to be omitted altogether.

On the part of some other authors, a total and summary dismissal of the 'monster' is apt to exclude with it any reference to the smaller sea snakes, whose actual existence is therefore a fact less known than it should be; and many persons, seeing the doubt cast upon the celebrated individual whose reputed reappearance on the prorogation of Parliament has become an annual joke, conclude that all sea snakes are similarly mythical.

Admitting it to be a dubious creature, with neither name nor ancestry in ophidian annals, I must not give it precedence of the recognised water snakes; but it shall figure in the heart of my book notwithstanding.

'*Fresh-water snakes*' form the fourth, and '*Sea snakes*' the fifth of the five groups into which Dr. Günther has separated the ophidian families; but the gradations between the land and the fresh-water species, and between the latter and the salt-water snakes or the true *Hydrophidæ*, are, like all other herpetological features, extremely close. There are water-loving land snakes and land-frequenting water snakes, that is, those which are equally at home in both. In the true water species, however, we find modifications of ordinary rules which show them to be peculiarly protected and adapted for an aquatic existence.

One notable characteristic in all, both salt-water and fresh, is the position of the nostrils on the top of the snout, and in many these are protected by a valve which closes at will. As air-breathing animals they must come to the surface, but the timid, stealthy ophidian instinct which seeks to hide from observation can be indulged even in the water, with the nostrils so situated that only a very small surface of the head need be exposed. Could we examine the interior of the mouth we should doubtless find some slight variation in the position of the glottis also. In a foregoing chapter we saw that the trachea opens exactly opposite to and close behind what Dumeril calls the 'arrière-narines;' 'leur glotte qui est à deux lèvres et qui represente un larynx très simple, s'ouvre dans la bouche derrière le fourreau de la langue . . . elle s'élève pour se presenter dilatée sous les arrière-narines.'[1] The glottis of water snakes must have a still more upward direction to present itself to those air passages. Perhaps water snakes do not require to yawn so frequently as is the habit of their terrestrial relatives; and if they do, it must be a rare privilege to be able to inspect the process, as one can so frequently do with the pythons and vipers at home. Our authorities do not give us much information on this point.[2]

Their moderately long tapering tail is used as a propelling power. Exteriorly, too, water snakes have smooth non-imbricated scales, though exceptions exist in those species which frequent both land and water, as the *Tropidonoti*, a large family of which our common English ring snake is a member, and which, as their name denotes, have all keeled scales, from τρόπις, τρόπιδος, *a keel.* These, also, can elevate their ribs, and so flatten the body in the water, another assistant in swimming.

A marked exception to the smooth-scaled, water-loving snakes is the African viper, known as the 'River Jack' from its partiality to water. *Vipera rhinosceros,* from the spinous scales which have the appearance of horns on its nose, is allied to those described in the 18th chapter. Though

[1] Dumeril et Bibron, *Erpétologie générale*, tome i. p. 179.

[2] Since this has been in type, there has been brought to the Gardens an Indian 'River snake' (*Tropidonotus quincunciatus*), affording me an opportunity to observe that there is a notable modification of the glottis, as also of the nostrils. Not a true water snake, but one of the intermediate families, so do we find the nostrils somewhat higher than those of land snakes, while yet not quite on the top of the snout as in sea snakes; the glottis has a corresponding upward direction to meet them, and is a more elongated, longitudinal slit than those furnished with the *petite languette.*—June 1882.

not strictly a water snake, it much frequents it, and glides through it with ease, the more remarkable because, in common with those other 'horned vipers' of Africa, it has a short, insignificant little tail, which can be of little use as a propelling power. Altogether, it is one of the ugliest and most ferocious-looking of the whole serpent tribe, with a thick, heavy body, a dingy, rough exterior, and strongly-carinated scales. Excepting in colour, and a more horizontal inclination of its horns, it is not unlike the *V. nasicornis* of the coloured illustration, chap. xviii.

While all the *Homalopsidæ* or true fresh-water snakes are innocent, there are many other venomous kinds known as 'water serpents,' both in Africa and America. For example, the 'water viper,' or 'water moccasin,' *Cenchris piscivorus*, whose aquatic and fish-eating propensities were described in the chapter on Tails. This 'thorn-tail' viper has not, however, the nostrils of the true fresh-water snakes or *Homalopsidæ*. In Australia also are several poisonous species, known vernacularly as 'water snakes;' but strictly speaking, and on the authority of Günther, the true *Homalopsidæ* are all non-venomous.

To describe these more minutely from Günther, Krefft, and Dr. E. Nicholson, 'they have a body moderately cylindrical, a tail somewhat compressed at the root, and more or less prehensile. Many of them have a distinctly prehensile tail, by which they hold on to projecting objects;' and in times of storms and strong currents we can imagine the importance of this security to them. Their eyes, though prominent, are small, and thus less exposed to injury; and the nostrils, as already stated, are on the upper surface of the head, and provided with a valvule. Another peculiarity is that the last or back tooth of the maxillary bone is a grooved fang, a transitional tooth between an ordinary one and a fang; but there is no evidence of any poisonous saliva connected with it. Indeed, as we may repeat, Dr. Günther distinctly affirms that all the fresh-water snakes are harmless and *thoroughly aquatic*, though a few are occasionally found on the beach. They inhabit rivers and estuaries, feeding on fish, and rarely coming to land ; some of them frequent brackish waters, and even enter the sea. These latter in their organization approach the true marine serpents. One Indian example, *Hydrinus*, is semi-pelagic. They are all viviparous, producing their young in the water ; and they belong to the tropical or semi-tropical regions. In Australia they are found only in the far north ; but in America some so-called 'water snakes,' which spend most of their time in the water, frequent rivers which are frozen over in winter, during which season they probably undergo hibernation in holes near the banks.

Several of the older naturalists describe 'water snakes' in words which leave us no doubt as to the *numbers*, though of their name we cannot be so certain. Carver in 1796 mentioned some small islands near the western end of Lake Erie, so infested with snakes that it was dangerous to land upon them. It is impossible that any place can produce a greater number of all kinds of snakes, particularly the 'water snake,' than this. He says: 'The lake is covered near the banks of the islands with the large pond lily, the leaves of which lie on the surface of the water so thick as to cover it entirely for many acres together, and on each of these lay wreaths of water snakes, amounting to myriads, basking in the sun.' A sight of the last century this. I have passed over that part of Lake Erie and through the Detroit river, and remember the islands and the water-lilies and other attractive objects, but 'wreaths of water snakes' were not of these.

Lawson, too, can assure us of their habitat, but not their name, and his account is of worth chiefly to verify their swarming numbers. It is possible that some of those which he describes are now extinct or very rare. 'Of water Snakes there are four sorts. The first is of the Horn Snake's Colour, though less.' (This might be the young of the 'water moccasin,' *Cenchris*, or *Trigonoceph. piscivorus.*) 'The next is a very long Snake, differing in Colour, and will make nothing to swim over a River a League wide. They hang upon Birches and other Trees by the Water Side. I had the Fortune once to have one of them leap into my Boat as I was going up a narrow River. The Boat was full of Mats, which I was glad to take out and so get rid of him. They are reckoned poisonous. A third is much of an English Adder Colour, but always frequents the Salts, and lies under the drift Seaweed, where they are in Abundance, and are accounted mischievous when they bite. The last is of a sooty, black Colour, and frequents Ponds and Ditches. What his Qualities are, I cannot tell.'

Catesby is responsible for having called *Tropidonotus fasciatus* 'the brown water viper,' a stumbling-block to many ever since, much confusion existing between this and the true 'water viper,' the dangerous moccasin snake. Occasionally they are very dark. They are rather thick and viperish-looking as well, but are perfectly harmless.

This is the snake to which almost this book owes its origin, the specimens at the Zoological Gardens called 'Moccasins' tripping me up at the outset, as my preface sets forth. Holbrooke describes it as spending most of its time in the water, or about pond and river banks. It swims rapidly, and hundreds may be seen darting in all directions through the water. They are very common in the United States, and might have formed the 'wreathed myriads' on Lake Erie formerly. In summer they roost on the lower branches of trees, overhanging the water, like *Trigonocephalus piscivorus*, the true 'water moccasin,' or 'cotton mouth.' At the time of writing there are examples of both these at the Gardens, the harmless 'moccasin,' a rather handsome snake, and the venomous one (not there recognised as the well-known moccasin of the United States), so nearly black that we can account for its being occasionally called the 'black water viper.'

It is probably *Tropidonotus* which Parker Gilmore describes as 'water vipers.'[1] At Vincennes in Indiana, he says, 'On the side where some alder bushes grow in the water, I have seen, on a very warm and bright day, such numbers of water vipers twined round the limbs and trunks which margin the pond, that it would be almost impossible to wade a yard without being within reach of one of them. They certainly have all the appearance of being venomous; the inhabitants say, however, they are harmless. They feed principally on fish, frogs, and small birds.'

[1] *Prairie Farms and Prairie Folks*, vol. ii. pp. 83, 84.

Of American water snakes, the anaconda deserves special mention. Of it Seba says, 'Ce serpent habite plus les eaux que les rochers;' and in its having the nostrils situated on the top of the head, and in possessing some other features in common with the *Homalopsidæ*, we are justified in calling it a water serpent, notwithstanding it is a true constrictor. 'Mother of waters,' the aborigines of South America call it. It is the *Boa aquatica* of Neuwied, and *Eunectes murinus* of Wagler, the latter name being the one most frequently used by modern herpetologists. Dumeril adopts it, *l'Eunect murin*, giving the origin of the generic name, *bon nageur*, from the Greek εὖ, *bien, fort*, and νηκτής, *nageur—qui nage bien.* As to the meaning of the specific name *murinus*, there can be but little doubt, though some have attributed it to its mouse-coloured skin or spots. *Le mangeur de rats*, Bonnat called it; *le rativoro*, Lacepède. Seba, who was one of the first to describe it, says, 'Il font guerre aux rats;' and Bonnat, on his authority, says, 'Il se nourrit d'une espèce de rats.' 'Serpent d'Amerique à moucheteur de tortue,' Seba also describes it, and with 'jolies écailles magnifiquement madrées de grandes taches, semblable de celles des tortues; taches semées sans ordres, grands, petits,' etc. *Murinus*, therefore, clearly refers to its food, not its colour.

Dumeril's description is of more scientific exactness: 'Pas de fossettes aux lèvres. On peut aisément reconnaitre les Eunectes seul entre les boa, ils ont les narines percées à la face supérieure du bout du museau et directement tournées vers le ciel.' These, being extremely small, and with a power to close hermetically, declare its aquatic habits. Its eyes are prominent, and so placed that the reptile can see before it, and also below — that is, down into the waters.

On first sight it might be a matter of wonder that so large a serpent should condescend to a meal of rats and mice; but to explain this we must again go back to the early naturalists, when we discover that what Seba called *le rat d'Amerique* was a rodent quite worth constricting for dinner. Under the order *Muridæ* were included in those days a number of the larger rodents, such as the Paca, *Mus Braziliensis;* the Coypu, *Mus coypus; Myopotamus,* the Capybara; the Murine opossum, and several others, aquatic in their habits, and large enough to attract the 'Giant of the Waters.'

From the vernacular *Matatoro,* or 'Bull killer,' also a whole century of misrepresentations have arisen, the said 'bull' being really as small in proportion as the 'rats' and 'mice' were large. 'The deer swallower' is another of its local titles, showing that it is a serpent of varying tastes. Stories are told of this 'monster' killing itself in attempting to gorge large animals with enormously extended horns, animals not to be found among the Brazilian fauna; and familiar to most persons are the illustrations of anacondas of untraceable length, the posterior portion coiled round a branch fifty feet high, and the anterior coiled round a bull as big as a prize ox. These illustrations are the offspring of ignorance rather than reality, and though occasionally *Eunectes* might come to grief by attacking a somewhat unmanageable meal, yet its recognised specific, *murinus* or *murina,* points more clearly the true nature of its food, viz. rodents of at most some two feet long.

No less exaggerated than its appetite is its length. Possibly anacondas may have attained greater size formerly when there were fewer enemies than at present, if it be true, as some have affirmed, that serpents grow all their lives. Thirty feet is the utmost length on record. Wallace affirms that he has never seen one exceeding twenty feet. Those individuals at the Zoological Gardens have rarely exceeded this, and Günther gives twenty-two feet as their average length in the present day.

Of those known in South Africa as 'water snakes,' one is *Avusamans* vernacularly, a black one and common, and another, *Iffulu*, of a beautiful bright green. Mr. Woodward, whose scientific egg-sucker has been already mentioned in chap. iii., states that both these are poisonous, that he never saw the green one out of water, and that it is unsafe to bathe where they are. On referring to Dr. Andrew Smith's *Zoology of South Africa*, I am not able to identify these with certainty, and do not, therefore, give the above as scientific information.

But before concluding this part of the subject, I would add a word or two on the importance of an accurate description of the snake, as far as possible, when one is found in some unusual situation; because a snake being found in the water is no proof that it is a water snake, or even that it was there by choice. Livingstone, in his *Expedition to the Zambesi*, p. 150, describes the number of venomous creatures, such as scorpions, centipedes, etc., that were found on board, 'having been brought into the ship with wood.' 'Snakes also came sometimes with the wood, but oftener floated down the river to us, climbing easily by the chain cable. Some poisonous ones were caught in the cabin. A green one was there several weeks, hiding in the daytime.'

Often in newspapers are stories of 'sea snakes' as having appeared quite out of their geographical range. These on investigation may reasonably be traced to land snakes which have been carried out by the tidal rivers. In *Land and Water* of Jan. 5, 1878, was such a story. Again, March 31, the following year, a correspondent, 'J. J. A.,' on 'Animal Life in New Caledonia,' stated that the sea inside the reefs is sometimes covered with both dead and living creatures carried out by the violence of the currents after heavy rains. 'The flooded rivers rush with great force from the mountains,' and numbers of reptiles were among the victims of that force. He saw 'incredible numbers of snakes,' and described the common sea snakes as 'stupid, fearless things, that will not get out of your way. . . . The small sand-islands are literally alive with them.' The writer made no pretensions to be a naturalist, or to state confidently what the snakes were specifically. New Caledonia would seem to be rather beyond the range of sea snakes proper, and those 'incredible numbers' may have been only land snakes involuntarily taking a sea bath, or certain species frequenting brackish waters, like those in South Carolina described by Lawson.

About the same time an American newspaper contained an account given by Captain O. A. Pitfield, of the steamship *Mexico*, who stated that he had 'passed through a tangled mass of snakes' off the Tortuga islands, at the entrance to the Gulf of Mexico. The ship was 'more than an hour' in passing them. 'They were of all sizes, from the ordinary green water snake of two feet long, to monsters, genuine "sea serpents," of fourteen to fifteen feet in length.' I replied to both these communications at the time (*Land and Water*, April 5, 1879), inviting further information, and describing the features by which true water and true sea snakes could be easily distinguished. Nothing further appeared on the subject, and I have little doubt but that, in both cases, the 'shoals of sea snakes' were land species that had been merely carried out to sea by force of rivers. I have since been more strongly inclined to this opinion on learning from Dr. Stradling that similar transportations of snakes occur through the force of some of the South American rivers. 'Do you know the snakes which belong to the River Plate proper?' he asks me by letter. 'So many are brought down by floods from Paraguay—even the big constrictors—that it is difficult to determine from occasional specimens.'

I could not, unfortunately, refer to any books that afforded much information on this subject; for amongst the greatest literary needs experienced by an ophiologist is some complete and special work on the South American snakes, corresponding with Günther's *Reptiles of British India*, and Krefft's *Snakes of Australia*.

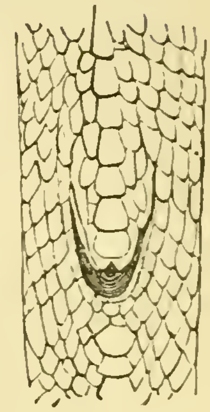
Other writers have mentioned the occurrence of boa constrictors and anacondas far out at sea occasionally, beguiling the unsophisticated into reporting a veritable 'sea serpent' to the *Times* by the first homeward-bound mail.

CHAPTER XIV.

THE PELAGIC OR SEA SNAKES.

THE modifications of ordinary forms which are seen in the fresh-water snakes are still more beautifully developed in the *Hydrophidæ,* or true marine serpents. The former, being never out of easy reach of shore, could easily find a safe harbour from violent torrents, in holes in the banks or among the strong aquatic weeds along the borders of lakes and rivers; and to be enabled to hold on to these in times of danger or of repose, they possess a prehensile power of tail. In a rough and stormy ocean, a much more powerful propeller and rudder would be necessary for the guidance of the reptile, and to afford resistance against the denser medium of sea water; therefore the tail of sea snakes is not only prehensile but strongly compressed, so as to almost form a vertical fin, answering altogether to that of a fish. This is their most conspicuous and striking feature, and one that would leave no doubt in the mind of the observer between the true marine and those fresh-water species which may by accident drift out to sea by force of current.

Another distinguishing feature is the absence of ventral scales in most of the species. In land snakes we saw how admirably adapted are the broad, ventral plates for assisting those reptiles over rough surfaces, as affording hold; but the *Hydrophidæ* requiring no such aid in a fluid, those scutæ would be useless; they are therefore, excepting in one or two species, entirely absent, or but slightly developed, and the belly is ridged instead, like the keel of a boat.



Portion of the under side of a sea snake, above and below the anus, with no distinction in tail scales.

The nostrils are small, placed horizontally on the top of the snout, as in the *Homalopsidæ*, and in most of the sea snakes they are contiguous. They are, moreover, furnished with a valve, which is under control of the will, opening to admit air, and closing to exclude water when diving. For, be it remembered, these marine reptiles breathe through their nostrils even more entirely than terrestrial snakes, the latter being better able to indulge their yawning propensities, or to occasionally respire slightly, and through parted lips and the tongue chink as well. Sea snakes, on the contrary, not requiring the continual use of their tongue to feel and explore surroundings, and not using it below water, are not provided with the little centre chink for its exsertion; but the middle plate of the upper lip, *i.e.* the 'rostral shield' (see illus. p. 238), is altogether of a different form. Indeed, the centre plates or shields in both lips are conspicuously modified, the upper one often inclining downwards in a point which fits into the lower one shaped to receive it, so that the mouth is firmly closed to keep out the water. Less required, the tongue is shorter and less developed, the tips are less hair-like, as only these, if at all, are exposed to the sea water, and a very small notch on each side of the pointed rostral shield of some permits the slight egress of these tips. When out of their natural element, the tongue is brought into more active service, for then the bewildered reptiles require its assistance, and it is then seen to be exserted as in land snakes. Their lungs extend the whole length of the body to the anus, and by retaining a large supply of air, these animals are enabled to float easily, as they do for a long while on the surface of the calm tropical seas, not only while sleeping, as mentioned in the chapter on hibernation, but in pure enjoyment, and probably in the lazy *postprandial* condition.

As has been already stated, the eyes of sea snakes are adapted to see better through the medium of water than through the brilliant atmosphere of their native latitudes. They are very small, and soon blinded by light; consequently, though among the swiftest and most gracile of serpents in their native element, the movements of the *Hydrophidæ* on land are uncertain and 'maladroit.'

Some forty years ago, Dr. Theodore Cantor, F.Z.S., devoted a good deal of time to the study of the pelagic serpents, and wrote a somewhat detailed account of them to the Zoological Society. His paper, published in the *Zoological Society Transactions*, 1842, vol. ii., was considered the most important that had as yet appeared. He, therefore, has been one of our first authorities. Subsequently we are indebted to Günther, Dr. E. Nicholson, Gerard Krefft, and Sir Joseph Fayrer for the results of their individual observations. In my foregoing descriptions I have culled from each of these, and as most modern writers on this subject merely reproduce from the works of Günther, Cantor, and Fayrer, I will keep chiefly to these in what further has to be said of sea snakes.

First, they belong to the tropical seas of the Eastern hemisphere, and are most numerous in the Indian Ocean, where they abound. The geographical range of a few is, however, somewhat extensive, viz. from Madagascar and that part of the African coast to northern Australia, the Bay of Bengal, and even to the western coasts of Panama ; while others are restricted to certain localities. All are highly venomous. They are wild and ferocious as well, and therefore peculiarly dangerous, and are the great dread of fishermen, who carefully avoid them. Accidents, nevertheless, frequently happen through their being caught in the nets, when, from their exceeding activity, it is difficult to disengage them and set them free again. When out of the water they try to bite at the nearest objects, and being dazzled by the light, strike wildly, unable to aim correctly. Cantor informs us that he has known them to turn and strike their own bodies in their rage, and that he has found difficulty in disengaging their fangs and teeth from their own flesh.

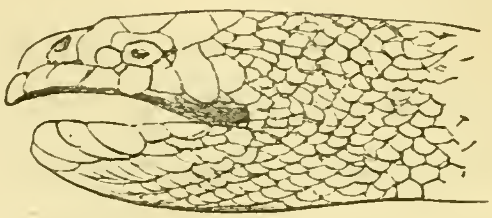
Owing to the great danger attending their capture, and also the almost impossibility of keeping them alive when out of the sea, less is accurately known of the pelagic than most other snakes. Even if placed in a large hole in the ground filled with sea water, or a capacious tank similarly supplied, they die very rapidly. Sir Joseph Fayrer in his experiments resorted to every means in order to keep them alive, but informs us that their exceeding delicacy caused their rapid death in spite of the utmost care. Dr. Vincent Richards, however, has succeeded in keeping some alive several weeks.

In length they vary from two to ten feet. Krefft says that the largest he ever saw was nine feet long. Günther states that they sometimes attain twelve feet, and sea snakes of even fourteen feet in length have been occasionally reported, though not perhaps from well authenticated sources. It is probable that, like all other reptiles, they attain their greatest proportions in the hottest regions.

Though purely oceanic, and no more found in fresh water than on dry ground, yet they come some distance up the rivers as far as brackish water. When washed on shore by the surf, they are helpless and blind, and at such times 'peaceable,' by reason of their helplessness. Occasionally they are seen coiled up asleep on the beach, where they have probably been washed by the tide, and where the next tide will no doubt release them from their uncongenial bed. Those species which have a less keeled body and the partially developed ventral scales might even manage to get back to sea independently of the tide. Even those without ventral scales contrive to wriggle along in their own fashion.

Such an occurrence is related by Mr. E. H. Pringle in the *Field* newspaper of 3d September 1881. He tracked an *Enhydrina* fifty feet along the sands, making its way back to the sea from a salt-water pool, where it had probably been left by the tide. This species is the one peculiarly favoured in having tiny orifices for the egress of the tongue tips on each side of its lobulated snout.

Its profile, being somewhat remarkable, is here presented to the reader, who will perhaps detect a certain determination in that very beak-like snout. This species is found along the Burman coast. Another, though keeping to its native element, has explored the Pacific to the very borders of America, and has been seen on the western coast of Panama. This is *Pelamis bicolor*, of distinct black and yellow, like a striped satin ribbon. The back is black, and the belly brown or yellowish, and its rather short, flat tail is spotted with a bluish colour as well. None of his relatives venture so far from the oriental islands as *Pelamis*. His presence as far north as New Caledonia has not, that I am aware of, been authoritatively recorded; we cannot suggest, therefore, the probability of 'J. J. A.'s' sea snakes, 'stupid and fearless,' being 'incredible numbers' of the *Pelamis* family. Dr. Stradling affirms that they are 'not unfrequently met with along the eastern coast of South America, and that one found its way on board the royal mail steamship *Douro*, and concealed itself under the covering of the patent lead, having probably climbed up the quarter line as she lay made fast to the wharf at Santos.'[1]



Enhydrina. From Fayrer's *Thanatophidia.*

Some slight controversy on the possibility of *Pelamis* 'climbing' followed this statement. But Mr. F. Buckland also recorded one 'which crawled up the anchor-chain of

[1] See *Field* newspaper, June 25, 1881.

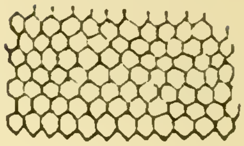
a man-of-war, when she was moored in the mouth of the Ganges. The midshipman of the watch saw something moving along the chain, and without thinking went to pick it up, when it turned upon him, and bit him. The poor young midshipman did not live many hours after the accident' (*Land and Water*, Nov. 15, 1879).

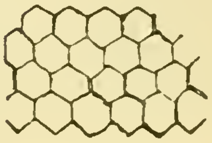
In the same issue the writer described one which was caught in the telegraph wire of the Eastern Extension Telegraph Company. One of the cables was being raised, and when it came to the surface, the snake was found coiled tightly round it. *Hydrophis* was here exercising his prehensile powers, not understanding the reason of the violent motion. Snakes, as has been already affirmed, are not restricted in their acrobatic achievements; so that even sea snakes, not naturally either climbers or crawlers, can do both on an occasion.

The more interesting question regarding Dr. Stradling's cable climber is, was it a true *Pelamis*, or one of the *Hydrophidæ* at all? If so, it was more likely to be an entirely distinct species from those of the oriental seas. Either Cape Horn or the Cape of Good Hope would be far too southward for their range, they being essentially tropical. When Panama comes to be severed by water communication, some enterprising *Pelamis* or *Enhydrina* may find its way through, and get down even to Santos; but at present, as Dr. Stradling did not *see* the snake, but only *heard* of it, the evidence of the presence of *Hydrophidæ* on the eastern coast of South America cannot be fully established.

A further facility to their agile and graceful movements in the water are their smooth, non-imbricated, or only slightly imbricated scales. These, though mostly hexagonal, and laid side by side, different from those of land snakes, yet vary much in size and form; and the head shields particularly are so abnormal, that, as Günther affirms, you can tell a sea snake at once by them (see illustrations, chap. xviii.).

Natural size.





Same magnified.

Sea snakes' scales. From the *Thanatophidia.*

To distinguish a pelagic from a fresh-water snake is, however, far easier than to distinguish species among themselves. They present great varieties of form and colour, but the transitions are very gradual, and the female is generally larger than the male, and sometimes of a different colour, which adds to the difficulty.

They are all viviparous, and produce their young in the water, where the little ones are at once able to take care of themselves, and feed on small fish or molluscs. The full-grown *Hydrophidæ* feed on fish corresponding with their own dimensions, and swallowed head foremost. Even spiny fish are managed by them, notwithstanding that they have a smaller jaw than most land snakes. Being killed by the poison of the bite on being caught, Günther explains, the muscles of the fish are relaxed, and the prey being commenced at the head, the armature does not interfere, but folds back flat as the fish is gradually drawn into the jaws.

An interesting study to the lover of nature it is to watch the wonderful movements of these sea reptiles. Swimming and diving with equal facility, flashing into sight and disappearing again in twos or scores, or in large shoals, pursuing fish, many of them of bright colouring, they offer constant amusement to the beholder. Sometimes, when the sailors are throwing their nets, they disappear beneath the waves, and are no longer seen for half an hour or more; when presently, far away from the spot where they vanished so suddenly, up they come to the surface again, to sport once more, or take in a fresh supply of air.

Pity they possess such evil qualities to blind us to their beauties, for they rank among the most venomous of serpents. They belong to the sub-order of venomous colubrine snakes, or *Ophidia colubriformes Venenosi*, those which outwardly have the aspect of harmless snakes, while yet furnished with poison fangs. In the chapter on Dentition, these distinctions, facilitated by the illustrations, are more fully explained; here it need only be said that though they have smaller jaws and shorter fangs than many other venomous snakes of their size, the virus is plentiful, and so active that the danger from the bite is great. All the pelagic serpents have also a few simple teeth behind the fangs; therefore, as Fayrer warns the natives, it does not do to trust to the *appearance* of the wound, which, though looking like the bite of a harmless snake, would demand immediate remedies. A certain conviction of danger is that the bite being inflicted in salt water, would leave no doubt as to the nature of the snake. Even a painless wound it is not safe to trust; and Sir Joseph Fayrer gives several such warnings among his cases of bite from sea snakes, two of which I will quote.

Captain S——, while bathing in a tidal river, felt what he thought was the pinch of a crab on his leg, but took no notice of it, and after his bath called on some friends, being to all appearance exceedingly well. He remained about an hour, playing the concertina to amuse the children, and declaring himself never in better health. In about two hours, feeling strange symptoms of suffocation, enlargement of the tongue, and a rigidity of muscles, he sent for a doctor, but still having no suspicion of danger. The next morning a native detected the peculiar symptoms which usually follow the bite of a sea snake ; and Captain S——, then examining the foot which the supposed crab had nipped, found marks of fangs no bigger than mosquito bites on the tendon Achilles near the ankle. Immediate steps were taken, and remedies applied which seemed to promise favourable results for a time ; but in the evening of the third day the victim was seized with spasms, and died, seventy-one hours after the accident. In this case, owing to the sound health of the captain, and no local pain ensuing to warn him, together with the stimulants and remedies applied, and the bite being where absorption was slow, his death was protracted ; otherwise death often occurs within twenty-four hours from that species of snake.[1]

The second case was that of a man who was bitten in the finger by a sea snake, and thinking lightly of it, used no means whatever to arrest the poison, and was dead in four hours.

In some cases the victim becomes quickly insensible, when, if no aid is near, he never wakes to consciousness. Immediate stimulants revive the patient, and if he can be kept awake, these, with local applications, *at once applied*,

[1] *Thanatophidia of India*, 1st ed.

may save his life. 'Hope itself is a powerful stimulant,' adds the learned experimentalist.

Many other cases are given by Fayrer of bites by sea snakes, some of which yielded to remedies and others were fatal; but for these the reader is referred to the *Thanatophidia*.

Dr. Cantor had previously made many experiments on various dumb creatures in order to ascertain the virulence of the poison of these hitherto unstudied reptiles. He found that a fowl died in violent spasms eight minutes after a bite; and a second fowl, bitten directly afterwards by the same snake, with its half-exhausted venom, in ten minutes. Fish died in ten minutes; a tortoise in twenty-eight minutes, from the bite of another species; and a harmless snake was paralyzed within half an hour.

Among the fresh-water snakes, Dr. Günther tells us of one, *Hydrinus*, which is semi-pelagic, and which indulges in little excursions down the rivers to exchange greetings with his marine relatives, some of whom, on their part, occasionally go a certain distance up the rivers. Again, among the sea snakes is one who rambles for change of air or diversity of diet over the fields and far away. In him, Dr. Günther describes one of those many transitions found in every class and order throughout nature. *Platurus* is his name; he has the ventral scales of land snakes to enable him to wander over the salt water marshes which he loves. His nostrils are on the side of his head instead of on the top, and his head shields differ from those of all his relatives. His venom fangs are small, and his tail is not prehensile, presenting the united characters of fresh and salt water and land snakes. Thus we have links between sea and land snakes, between fresh water and salt, and between these latter and fishes, for in many instances the affinities are so close that naturalists have doubted in which class to place them. When that remarkable animal, the *Lepidosiren*, which Darwin calls a living fossil, was first brought from Africa some thirty years ago, it was found to present so many characteristics in common with both reptiles and fishes, that it was for some time a mooted question in which class to place it. In appearance it more resembles the former, with its four curious filamentary limbs, which Owen considers 'the beginnings of organs which attain full functional development in the higher vertebrates.' The same high authority has decided that the only character which absolutely distinguishes fishes from reptiles, so closely are some of them allied, is whether or not there is an open passage from the nostrils to the mouth; and the 'Lepidosiren' is now known as 'the mud-fish of the Gambia,' the ichthyic characters predominating.

Sea snakes were not unknown to the ancients. Aristotle mentions them (Taylor's Translation, 1812, Book ii. vol. 6), 'Of sanguineous animals, however, there remains the genus of serpents. But they partake of the nature both of terrestrial and aquatic animals. For most of them are terrestrial, and not a few are aquatic, and which live in potable water. There are also marine serpents similar in form to the terrestrial genus, except that their head more resembles that of a conger. There are, however, many genera of marine serpents, and they are an all-various colour; but they are not generated in very deep places.'

These latter words suggest what has not been mentioned as a positive fact, while yet in part it is corroborated by Cantor, who tells us that the young sea snakes feed on soft-shelled molluscs ; we may argue, therefore, that the mother snakes come into shallow water to give birth to their young, where small fish and suitable food may abound. Aristotle was evidently aware of the distinctions between fresh and salt water snakes, and gives us the former as frequenting rivers ('potable waters').

The Greek mariners who frequented the tropical seas knew of the poisonous snakes with wholesome dread. Sir Emerson Tennant tells us that the fishermen on the west coast of Ceylon are still in perpetual fear of them. They say there are some with the head hooded like the cobra, that coil themselves up like serpents on land, not only biting with their teeth, but 'crushing their prey in their coils.'

The 'hood' part of the story is not borne out by any scientific writer; and as for the 'crushing in coils,' the sailors may possibly mistake the prehensile actions of holding on—even to a large fish—possibly for the action of crushing in the way of constricting. In self-protection, or for safety, venomous serpents do entwine themselves pretty tightly round an object sometimes. An instance of this was just now given. But constricting for the purpose of killing is happily confined to the non-venomous families. It would indeed be terrible if the 'giants of the waters' could both constrict and bite with poison fang; and of this a word or two will be said in the following chapter. Admittedly but little has been accurately ascertained about the marine serpents in comparison with the terrestrial ones. And there really may be species hitherto unobserved. The great sea serpent question is not yet satisfactorily settled; and among the lesser kind, the true pelagians, varieties are frequently occurring. Krefft describes one in the Australian Museum which, not being like any other that he had seen, he sets down as a new type. Forty-eight distinct species were described by Cantor. The whole family comprises seven genera, four of which belong to the Indian Ocean.

CHAPTER XV.

'*THE GREAT SEA SERPENT.*'

THE question of varieties and of constriction brings us to 'The Great Sea Serpent;' for, putting all the evidence together, if the creature exist at all he must be a constrictor.

I do not intend to trouble my readers with the detailed history of this great unknown, for his literature would more than exceed the limits of this whole volume. Those who are sufficiently interested in him will find ample reading in most of the encyclopedias, which again refer us to various books in which he has figured from his first supposed appearance in modern times.

Ever and again, when a new 'sea monster' has been reported, the newspapers take up the theme, and often give a *resumé* of its history, from Bishop Pontoppidan's down to the most recent specimen. References to the most important of the journalistic authorities usually accompany the more detailed accounts; but among them an excellent abridgement of 'sea serpent' literature, which appeared in the *Illustrated London News* of October 1848, is worth studying. Another of interest was in the *Echo* of January 15, 1877. In *Silliman's*

Journal of Science, 1835, was also an excellent paper. One of the best digests is that given by P. H. Gosse, in his *Romance of Natural History*, of the ed. 1860. This author, after weighing all the published evidence both from ordinary and scientific sources, and presenting it in a well-arranged and lucid form, sums up as follows :—

'In conclusion, I express my own confident persuasion that there exists some oceanic animal of immense proportions, which has not yet been received into the category of scientific zoology; and my strong opinion that it possesses close affinities with the fossil *enaliosauria* of the lias.'

Having respect for the opinion of so thoughtful a writer, and further encouraged by the fact that some of our most eminent physiologists have not thought it beneath them to give their attention to the various serpentine appearances which from time to time are seen at sea, and that the majority of them believe in the possibility of an unknown marine reptile, let us accept this idea as the basis of an endeavour to lay before my readers another summing up of evidence gathered from the still more recent writings on 'The Great Sea Serpent' of modern times.

Those who have honoured this book with attentive perusal thus far, will have become initiated in certain ophidian manners, actions, and appearances which would enable them at once to identify a snake were they to have a complete view of one. But to those who are not familiar with such peculiarities, and possess only a vague idea of the ophidian form, many a merely elongated outline at sea may be, and has been, set down as a 'serpent,' which on closer inspection, or by the light of science, has proved something entirely different.

Ribbon-fish, strings of porpoises and other cetaceans, long lines of sea-birds on the surface of the waves, even logs of drifting wood or bamboo, with bunches of seaweed doing service as 'manes' or 'fins,' have in turn, and by the aid of the imagination, been dubbed 'the sea serpent' again and again. These may be dismissed by the mere mention of a few such as examples. For instance, in *Nature*, vol. xviii., 1878, Dr. Dean describes a reported 'sea serpent,' which resolved itself into a flight of birds. E. H. Pringle describes the serpentine appearance of a bamboo swaying up and down, which at a distance had deceived the beholders into the idea of the sea serpent; others explained that long lines of birds or of sea-weeds had again similarly deceived sailors. In *Land and Water*, Sept. 22, 1877, we read that the crew of the barque *Aberfoyle*, off the coast of Scotland, thought they really had got one this time, and approaching the 'monster,' lowered and manned a boat, and seized a harpoon to 'catch' the singularly passive creature, which proved to be a mass of 'a sort of jelly-fish description,' some of which they bottled and corked down air-tight; but, alas! it 'deliquesced'!

Again, in *Nature*, Feb. 10, 1881, an imaginary sea serpent seen from the *City of Baltimore* (a ship in which the present writer crossed the Atlantic, though unfortunately not on that voyage) was pronounced to be a species of whale, the *Zeuglodontia*.

One more out of scores of similar reports, which go to show that if some unknown marine animal of a longish form is caught, those who have anything to do with it immediately label it 'the sea serpent.' In *Land and Water*, Aug. 24, 1878, Mr. Frank Buckland published a communication from an Australian correspondent, regarding a 'most remarkable fish,' of nearly fifteen feet long, and eight inches in diameter at the thickest part. It has 'no scales,' but 'a skin like polished silver,' is of a tapering form, has a very queer mouth, a 'mane' on the neck, and 'two feelers under the chin, thirty-two inches long.' And this unsnake-like thing was taken to the Mechanics' Institute of that town, and unhesitatingly labelled 'Sea Serpent!' Dr. Buckland suggested that it was a ribbon fish.

Thus, we may repeat that it is almost impossible for an unscientific person even to *see*, far less to describe, unfamiliar living forms in a manner that would prove sound data for zoologists to decide upon.

In a rather detailed communication to *Land and Water* on this subject, by Dr. Andrew Wilson, September 15, 1877, he also reminds us how easily and frequently we may trace supposed resemblances to animals or faces, where none can possibly exist; as, for instance, 'in the gnarled trunks and branches of trees.' Much more true resemblances to serpentine forms are really seen at sea; as, for example, those 'floating trunks and roots of trees serving as a nucleus, around which sea-weed has collected.' In one instance, as Dr. Wilson relates, some such object, seen from the deck of a yacht, was so deceptive even to intelligent men who scrutinized it through the telescope, that the course of the ship was changed on purpose to inspect it closely. Dr. Wilson regrets the unfortunate discredit which has been cast upon all sea-serpent stories through such erroneous observations, causing even the more trustworthy accounts to be received with almost universal ridicule, and as already observed in the opening of chap. xiii., almost to the ignoring of the true sea snakes, which are too often included among the mythical.

Briefly to enumerate some of those which appear to have recently had the chiefest claims to attention as really living creatures, otherwise than flights of birds or shoals of fish, but making due allowance for unscientific observations, and vague or exaggerated representations, we find that gigantic marine animals were observed as follows:—

1734. Off Greenland.
1740. Off Norway; described by Bishop Pontoppidan as 600 feet in length.
1809. Off the Hebrides.
1815. Near Boston, U.S.
1817. Ditto.
1819. Ditto. From 80 to 250 yards in length!
1819. One seen for a month off Norway.
1822. Ditto; and again 600 feet long.
1827. Ditto.

1829. Mr. Davidson, surgeon, R.N., described one seen in the Indian seas as precisely similar to that seen afterwards from the *Dædalus* in 1848. He wrote of it during the controversy that passed regarding the latter. Mr. Gosse regarded his testimony as of much value.

1833. One seen by five British officers off Halifax, and described by P. H. Gosse.

1837. Again off Norway.

1846. Off Norway, and in the same locality as one seen about one hundred years previously; also during the hottest part of the summer. This individual had two 'fins,' and 'the movements were like those of a snake forty to fifty feet long.'

1848. The one seen from the *Dædalus*.
1850. Off Norway.
1851. Ditto.
1852. One described by Captain Steele, mentioned by Gosse.

1857. One described by Captain Harrison, and considered trustworthy evidence.

1875. One seen from the *Pauline*, July 8, in lat. 5° 30′ S., long. 35° W. Also on July 13, 'a similar serpent' seen from the same barque *Pauline*.

1875. September 11. 'An enormous marine salamander' in the Straits of Malacca, seen from the *Nestor*.

1877. Large marine animal seen from the royal yacht *Osborne* off Sicily.

1879. Colonel Leathes, of Herring Fleet Hall, Yarmouth, informs Mr. F. Buckland of sea serpents seen from the *White Adder* off Aden, and again off New Guinea and the Cape. (See *Land and Water*, Sept. 6, 1879.)

In the above list we are struck by the fact that the coast of Norway and the northern seas *during the hottest weather* are the favourite playgrounds of these gigantic marine animals, though as for the '600' feet, we must first be assured of Norwegian measurement before forming any estimate beyond that the creatures were doubtless of great length. 'Witnesses of unimpeachable character' have produced so much trustworthy evidence as far as Norway is concerned, that no doubt any longer exists there as to 'the' or *a* 'marine animal' of enormous length. 'There is scarcely a sailor who has not seen one,' it has been broadly stated; and Norwegians wonder that English naturalists are so sceptical on the subject.

Of still more marvellous proportions was the one seen off the American coast in 1819, and which is vaguely described as from 80 to 250 yards! That outdoes Norway altogether; but then, of course, an American sea serpent *would* exceed all others.

Next to the Norwegian, the American coast was at one time so favoured by strange marine 'monsters,' that they were commonly reported as 'the American sea serpent.' Excepting these northern Atlantic visitants, others have been observed mostly in the eastern seas, rarely in the south.

This has given rise to the question, 'How is it that they are seen almost exclusively in the north?' One reason may be that there are more persons to see them, and because marine traffic is far greater in the north than in similar southern latitudes; and another reason may be, that the rocky coasts of both continents in those latitudes may afford congenial retreats for mammoth marine reptiles. We have seen that reptiles exist for a very long period without breathing, and even without air; as, for instance, those encased in baked mud in the tropics, and those frozen up or bottled up tight and hermetically sealed, as the examples given in preceding chapters.

From long observation of ophidian habits, I venture to offer certain suggestions in addition to published opinions; and I may remind my readers that as all reptiles undergo a species of hibernation, we may reasonably conclude that these huge marine ones form no exception to the rule. They may lie for months dormant in the deep recesses of the ocean, and reappear during the long days and hot weather like their land relatives. It seems strange that so far from this having been taken into consideration, it has become the fashion to ridicule the 'reappearance of the great sea serpent' at the very time when all other reptiles reappear as a matter of course. Long days are more favourable for observations, and probably log-books record many other creatures, whether mammal, bird, or fish, seen during the summer and not in other seasons, as well as 'sea serpents.' Not because this is the slack time of journalists, therefore, who are supposed to be at their wits' end for subjects, but simply because ships coming home at this time bring reports of their summer observations.

It is much to be regretted that these reports have come to be associated with 'the gigantic gooseberry,' and such seasonable wonders, because the door to investigation is thus closed. It is also to be regretted that many hoaxes have undeniably been committed to print, really to fill up newspaper columns, and feed a love of the marvellous. Professor Owen's words may well be repeated here, 'It is far harder to establish a truth than to kill an untruth.'

One more little matter is also to be seriously deplored; and this is the unscientific habit of calling all these unfamiliar animals 'monsters,' a word signifying truly a *monstrosity*, a creature with two heads, a beast with five or six legs instead of four, or other such malformations. These are truly monsters, and to use the term otherwise only creates mistaken impressions. Inadvertently even scientific men fall into this habit; naturalists and well-known authorities are seen in print to talk of these sea 'monsters,' but who in the same page denounce exaggerated expressions.

In *Land and Water* of September 8, 1877, several of our distinguished naturalists contributed papers on the evidence of the officers of the royal yacht *Osborne*, relative to a large marine animal seen off Sicily on June 3 of that year. Professor Owen also acceded to an earnest request to add a few words on the subject, and it was noticeable that more than once in his few pithy lines this eminent authority delicately hinted at the mistake of calling animals '*monsters*' without just reason for so doing: 'The phenomena were not necessarily caused by a *monster*,' he writes; 'and the words . . . denote rather a cetacean than a *monster*.' Again, 'There are no grounds for calling it a *monster*.'

On the occasion referred to, the official reports of the animal seen were sent to the Admiralty; and the Right Hon. R. A. Cross, then Secretary of State for the Home Department, requested the opinion of Mr. Frank Buckland on the matter, the result being a full account given to the readers of *Land and Water*, to which Mr. F. Buckland was so popular a contributor. In addition to Owen's valued opinion, the public were favoured with able papers by Mr. A. D. Bartlett, of the Zoological Gardens, Captain David Gray, of the whaling ship *Eclipse*, Mr. Henry Lee, and Frank Buckland himself.

From the discrepancies in the records of the four officers, and the sketches of nothing in nature which accompanied those records, not one of those able writers ventured an assertion as to what the strange animal could possibly be. The captain—Commander Pearson—'saw the fish through a telescope;' a 'seal-shaped head of immense size, large flappers, and part of a huge body.'

Lieutenant Haynes saw 'a ridge of fins above the surface of the water, extending about thirty feet, and varying from five to six feet in height.' Through the telescope he saw 'a head, two flappers, and about *thirty* feet of an animal's shoulder; the shoulder was about *fifteen* feet across.' The animal propelled itself by its two 'fins.'

Mr. Douglas M. Forsyth saw 'a huge monster, having a head about fifteen to twenty feet in length.' The part of the body not in the water 'was certainly not under forty-five or fifty feet in length.'

Mr. Moore, the engineer, observed 'an uneven ridge of what appeared to be the fins of a fish above the surface of the water, varying in height, and as near as he could judge, from seven to eight feet above the water, and extending about forty feet along the surface.'

Though we are not able to say what this strange animal really was, we can positively affirm what it was *not*. A snake has neither fins, flippers, flappers, nor 'shoulders fifteen feet broad;' therefore this assuredly was no 'sea serpent.' Nor would it be introduced here, excepting as inviting further comment on its mysterious existence.

And curious enough it is to remark the persistence with which all these anomalies are announced as '*the* sea serpent,' as if the sea produced but one solitary specimen, which is now the shape of a 'turtle;' next of a 'frog,' with 'one hundred and fifty feet of tail;' then a creature with 'fins' and a 'mane,' 'flippers' and 'flappers' and 'ridges of fins.' All these appendages are one after the other described, and yet as belonging to a 'serpent,' which has no such appendages.

A few of the recorders do really describe something more of the true ophidian, and those who do this, not being familiar with ophidian manners, are more useful as witnesses than those who at once report a 'serpent,' and afterwards proceed unknowingly to disprove their own words.

Among the more noteworthy, the following account, copied from the Liverpool papers at the time, is worth considering:—

'The story of the mate and crew of the barque *Pauline*, of London, said to have arrived in port from a twenty months' voyage to Akyab, about having seen a "sea serpent" while on a voyage in the Indian seas, was yesterday declared to on oath before Mr. Raffles, the stipendiary magistrate at the police court. The affidavit was made in consequence of the doubtfulness with which anything about the sea serpent has hitherto been received; and to show the genuine character of the story, it has been placed judicially on record. The following is a copy of the declaration, which will be regarded as unprecedented in its way:—

'"*Borough of Liverpool, in the County Palatine of Lancaster, to wit.*

'"We, the undersigned, captain, officers, and crew of the barque *Pauline* (of London), of Liverpool, in the county of Lancaster, in the United Kingdom of Great Britain and Ireland, do solemnly and sincerely declare that, on July 8, 1875, in lat. 5° 13′ S., long. 35° W., we observed three large sperm whales, and one of them was gripped round the body with two turns of what appeared to be a huge serpent. The head and tail appeared to have a length beyond the coils of about thirty feet, and its girth eight or nine feet. The serpent whirled its victim round and round for about fifteen minutes, and then suddenly dragged the whale to the bottom, head first.

'"GEORGE DREVAR, *Master*.
'"HORATIO THOMPSON.
'"JOHN HENDERSON LANDELLS.
'"OWEN BAKER.
'"WILLIAM LEWARN.

'"Again, on July 13, a similar serpent was seen about two hundred yards off, shooting itself along the surface, head and neck being out of the water several feet. This was seen only by the captain and one ordinary seaman, whose signatures are affixed.

'"GEORGE DREVAR, *Master*.

'"A few moments after, it was seen elevated some sixty feet perpendicularly in the air, by the chief officer and the following able seamen, whose signatures are also affixed:—

'"HORATIO THOMPSON.
'"WILLIAM LEWARN.

'"And we make this solemn declaration, conscientiously believing the same to be true, and by virtue of the provisions of an Act made and passed in the sixth year of the reign of his late Majesty, intituled an Act to repeal an Act of the present session of Parliament, intituled an Act for the more effectual abolition of oaths and affirmations, taken and made in various departments of the State, and to substitute declarations in lieu thereof, and for the more entire suppression of voluntary and extra-judicial oaths and affidavits, and to make other provisions for the abolition of unnecessary oaths.

'"GEORGE DREVAR, *Master*.
'"WILLIAM LEWARN, *Steward*.
'"HORATIO THOMPSON, *Chief Officer*.
'"JOHN HENDERSON LANDELLS, *Second Officer*.
'"OWEN BAKER.

'"Severally declared and subscribed at Liverpool aforesaid, the tenth day of January, one thousand eight hundred and seventy-seven, before T. S. Raffles, J.P. for Liverpool."'

In the above descriptions there is no mention of fins, flippers, or mane, but simply the manners of a huge constrictor, with the head and the tail free, and the middle portion of its body engaged in crushing the prey, a process which may at any time be seen in a captive constrictor seizing its food. The 'whirling its victim' was, no doubt, in the struggle between the two, the whale using its powerful efforts to escape, but being overcome at last. Nor in comparison with the size of the described serpent would a whale be impracticably large.

Again, in the next one seen, the true serpent motion is unintentionally exhibited in the 'shooting itself along the surface, the head and neck being several feet out of water.' Snakes continually advance with their heads elevated; and their rapid, darting movements are well expressed by 'shooting.'

'A few minutes after, it was seen elevated some sixty feet perpendicularly in the air.' *Sixty feet* at a guess. Unless some mast, the precise height of which was known, or some other perpendicular object were in close proximity, it would be exceedingly difficult to estimate the height. To an unaccustomed eye even twenty or thirty feet of snake suddenly darting upright from the waves would be a startling and bewildering spectacle; yet we know that land snakes raise themselves in this manner one-third, one-half, or for a moment even more than that; 'stand erect,' some physiologists have stated (see p. 181); so again, unintentionally, and by those not likely to be familiar with ophidian capabilities, is a natural action described.

In several other instances, the animal seen has raised its head many feet, and 'let it down suddenly;' exactly what land snakes do.

The one seen from on board H.M.S. *Dædalus* in 1848 is considered one of the most circumstantially recorded evidences of some really existing serpentine animal within the memory of many still living. It was much commented upon in the journals of that year, and claims a passing mention here.

Captain M'Quhæ, who commanded the *Dædalus*, in an official report to the Admiralty, gave the date of the 'monster's' appearance as August 6, 1848, and its exact locality in the afternoon of that day as lat. 24° 44′ S., and long. 9° 22′ E., which would be somewhere between the Cape of Good Hope and St. Helena. In his own mind the captain had no doubt whatever as to the nature of the animal, which he simply reported as an 'enormous serpent, with head and shoulders kept about four feet constantly above the surface of the sea; and as nearly as we could approximate, by comparing it with the length of what our main-topsail yard would show in the water, there was, at the very least, sixty feet of the animal *à fleur d'eau*, no portion of which was, to our perception, used in propelling it through the water, either by vertical or horizontal undulations. There seemed to be as much as thirty to forty feet of tail as well.' The animal passed the ship 'rapidly, but so close under our lee-quarter, that, had it been a man of my acquaintance, I should easily have recognised his features with the naked eye.' The size of the creature is given as about fifteen or sixteen inches diameter in the neck 'behind the head, which was, without doubt, that of a snake.' No fins were seen, but 'something like the mane of a horse, or rather a bunch of seaweed washing about its back.' Its progress was about fifteen miles an hour, and it remained twenty minutes in sight.

Lieutenant Drummond, also of the *Dædalus*, reported what he saw, and from his log-book, while the captain's was from memory. The lieutenant thought he saw 'a back fin ten feet long, and also a tail fin.' The head was 'rather raised, and occasionally dipping, and gave him the idea of that of a large eel.'

Without being an ophiologist, Captain M'Quhæ also unintentionally describes a creature of ophidian habits and proportions. He inadvertently says 'shoulders,' when, as my readers know, a snake has anatomically no shoulders, any more than 'neck.' But for all that, the raised head, and the absence of any striking movements in the part visible, are the manners of a serpent in the water, when propelled by its tail, which would be out of sight; and the captain simply describing what he saw, but giving no name, those acquainted with herpetology would at once decide that he described a long-necked and slender reptile of some sort, perhaps some enormous saurian, whose feet were under water, if not a serpent.

There were many learned discussions concerning this creature, and for these I refer my reader to the journals and scientific publications of the time. No one doubted the fact that some strange animal was seen, but the wisest refrained from giving it a name. Very similar was the verdict on the more recent object seen from the *Osborne* in 1877; but in those thirty intervening years a vast stride had been made in zoological knowledge; and in the very able papers written on this later phenomenon, we now find a general disposition to accept the fact that there *are* gigantic forms of marine animals existing, that have not as yet been scientifically described and received into systematic zoology.

Mr. A. D. Bartlett, in the discussion already alluded to, after dispassionately reviewing and criticizing the evidence of H.M.'s officers, thus concludes:—

'When we consider the vast extent of the ocean, its great depth, the rocky, cavernous nature of the bottom,—of many parts of which we know really nothing,—who can say what may be hidden for ages, and may still remain a mystery for generations yet to come; for we have evidence on land that there exists some of the largest mammals, probably by thousands, of which only one solitary individual has been caught or brought to notice. I allude to the Hairy-eared Two-horned Rhinoceros (*R. lasiotis*), captured in 1868 at Chittagong (where it was found stranded in the mud), and now known as an inhabitant of the Zoological Gardens.

'This animal remains unique, and no part or portion was previously known to exist in any museum at home or abroad.

'(We have here an instance of the existence of a species found on the continent of India, where for many years collectors and naturalists have worked and published lists of all the animals met with, and have hitherto failed to meet with or obtain any knowledge of this great beast.)

'May I not therefore presume that in the vast and mighty ocean, animals, perhaps of nocturnal habits (and therefore never, except by some extraordinary accident, forced into sight), may exist, whose form may resemble the extinct reptiles whose fossil remains we find in such abundance.

'As far as I am able to judge from the evidence before me, I have reason to believe that aquatic reptiles of vast size have been seen and described by those persons who have endeavoured to explain what they have witnessed.

'One thing is certain, that many well-known reptiles have the power of remaining for long periods (months, in fact) at the bottom, under water or imbedded in soft mud, being so provided with organs of circulation and respiration that they need not come to the surface to breathe. The large crocodiles, alligators, and turtles have this power, and I see no valid reason to doubt but that there may and do exist in the unknown regions of the ocean, creatures so constructed.

'It may be argued that if such animals still live, they must from time to time die, and their bodies would float, and their carcases would be found, or parts of them would wash on shore. To this I say: however reasonable such arguments may appear, most animals that die or are killed in the water, sink at first to the bottom, where they are likely to have the flesh and soft parts devoured by other animals, such as crustacea, fishes, etc. etc., and sinking in the deep, the bones, being heavier than the other parts, may soon become imbedded, and thus concealed from sight.'

It was gratifying to me to find my own ideas of hibernation thus supported, the above allusion to the probability of temporary repose in marine reptiles being the first I had met with.

Mr. Henry Lee, in the same issue, reminds us that the existence of gigantic cuttle-fish was popularly disbelieved until within the past five or six years, during which period several specimens—some of them fifty feet in total length—have been taken, and all doubts upon the subject have been removed. He argues, also, that during the deep-sea dredgings of H.M. ships *Lightning*, *Porcupine*, and *Challenger*, many new species of mollusca, supposed to have been extinct ever since the Chalk epoch, were brought to light, and that there were brought up by the deep-sea trawlings from great depths *fishes of unknown species, which could not exist near the surface owing to the distension and rupture of their air-bladder when removed from the pressure of deep water.*

Forcibly suggestive are such facts of still further undiscovered denizens of the deep! And as to *what* they are, fish, mammal, or reptile, or a compound of either two or all three of these, why doubt *any* possibility when we know that on land are similarly complicated organisms which so lately have perplexed our most able physiologists? Take, for example, that curious anomaly, the mud-fish of the Gambia, *Lepidosiren*, referred to in the last chapter, and which, to look at, is as much like a lizard as a fish, with its four singular appendages where either legs or fins might be. Again, we have that paradox in nature—bird, reptile, and quadruped combined—in the Australian *Platypus*, a semi-aquatic animal. 'These two fresh-water animals are,' says Darwin, 'among the most anomalous forms now found in the world; and like fossils, they connect, to a certain extent, orders at present widely sundered in the natural scale.'[1] Other equally remarkable links between the various groups might be cited to prepare us for any marine anomalies which may hereafter surprise us. Taking into consideration, also, that many of our smaller aquatic animals have their representatives on a huge scale in the ocean, why should there not be gigantic ophidian forms to correspond with the terrestrial pythons and anacondas? As in point of size salt-water fishes exceed those of our rivers, and as the enormous marine mammalia exceed those on land, we might the rather wonder if there were not *one* 'great sea serpent,' but many unsuspected species of reptiles, compound ophiosaurians, or saurophidians, or who shall say what, in those inaccessible depths.

'How is it none have ever been captured?' it is asked. In reply, Has any one ever captured a swiftly-retreating land snake escaping pursuit? Who can overtake or circumvent it when in its tropical vigour? And how vastly must the powers and swiftness of those immense pelagians exceed the kinds with which we are familiar! 'Then, Why have no bones been found?' Mr. Bartlett's reason is one of

[1] *Origin of Species*, 6th ed. 1872, p. 83.

those assigned, and in addition I may suggest that the love of locality, so strong in land reptiles, may also exist in marine ones, which probably retire to the recesses of their submarine habitats to die.

'How is it none have ever been killed?' Well! A cannon ball on the instant, and not much less, would be required to 'kill it on the spot,' as some have sagely recommended.

Mr. Henry Lee, among others, does not regard capture as impossible; and in support of my own speculations—more correctly speaking *imagination*, perhaps—I give the concluding words of his paper:—

> 'I therefore think it by no means impossible—first, that there may be gigantic marine animals unknown to science having their ordinary *habitat* in the great depths of the sea, only occasionally coming to the surface, and perhaps avoiding habitually the light of day; and, second, that there may still exist, though supposed to have been long extinct, some of the old sea reptiles whose fossil remains tell of their magnitude and habits, or others of species unknown even to palæontologists.
>
> 'The evidence is, to my mind, conclusive that enormous animals, with which zoologists are at present unacquainted, exist in the "great and wide sea," and I look forward hopefully to the capture of one or more of them, and the settlement of this vexed question.'

I cannot conclude this chapter without further reference to one other of our very popular physiologists, Dr. Andrew Wilson. The week following that in which Owen, Captain Gray, and Messrs. Lee, Buckland, and Bartlett contributed their opinions to *Land and Water*, September 8, 1877, Dr. Wilson also favoured its readers with two closely written pages on 'The Sea Serpent of Science.' Some of his introductory words have been already quoted. He then presents the claims to attention which these various 'sea monsters' offer, as reported by thoroughly trustworthy witnesses, suggesting that the idea of a 'serpent' is too restricted.

Notwithstanding much already said, the opinion of Dr. Wilson will be valued by many of my readers, and I therefore give portions in his own words:—

'As far as I have been able to ascertain, zoologists and other writers on this subject have never made allowance for the *abnormal and huge development of ordinary marine animals.* My own convictions on this matter find in these the most reasonable and likely explanation of the personality of the sea serpent, and also the reconciliation of such discrepancies as the various narratives may be shown to evince. . . . I think we may build up a most reasonable case both for their existence and for the explanation of their true nature, by taking into account the fact that *the term "sea serpent," as ordinarily employed, must be extended to include other forms of vertebrate animals which possess elongated bodies: and that cases of the abnormally large development of ordinary serpents and of serpent-like animals will reasonably account for the occurrence of the animals popularly named "sea serpents."* . . .

'Whilst to my mind the only feasible explanation of the narrative of the crew of the *Pauline* must be founded on the idea that the animals observed by them were gigantic snakes, the habits of the animals in attacking the whales evidently point to a close correspondence with those of terrestrial serpents of large size, such as the boas and pythons; whilst the fact of the animals being described in the various narratives as swimming with the head out of the water would seem to indicate that, like all reptiles, they were air-breathers, and required to come more or less frequently to the surface for the purpose of respiration.'

Apology is due to so eminent a physiologist for having first given expression to my own opinion on the *Pauline* serpent, though in tardily quoting a high authority I may risk suspicion of plagiarism. I must be permitted to explain, therefore, that on seeing the subject ventilated in *Land and Water* (to which I had for some years been a contributor on ophidian matters), I also, though uninvited, prepared a paper on 'the sea serpent.' In a letter to the Editors, I even presumed to criticise part of what had lately appeared, enclosing MS. with yet more.

In reply, I was informed that the subject would not be continued or 're-opened,' and my returned MS. is still before me, much of it now for the first time being presented to the public. To proceed with Dr. Wilson:—

> 'The most important feature in my theory, . . . and that which really constitutes the strong point of this explanation, is the probability of the development of a huge or gigantic size of ordinary marine serpents. . . .
>
> 'Is there anything more improbable, I ask, in the idea of a gigantic development of an ordinary marine snake into a veritable giant of its race; or, for that matter, in the existence of distinct species of monster sea serpents, than in the production of huge cuttle-fishes, which, until within the past few years, remained unknown to the foremost pioneers of science? In the idea of the gigantic developments of snakes or snake-like animals, be they fishes or reptiles, I hold we have at least a feasible and rational explanation of the primary fact of the actual existence of such organisms.'

In a most interesting lecture on 'Zoological Myths,' delivered at St. George's Hall, January 2, 1881, Dr. Andrew Wilson again laid much stress on the 'gigantic development of an ordinary marine snake into' one of those amazing individuals which, say, at the very least, are over a hundred feet in length!

How long would the poison fang of such a reptile be? How many ounces of venom would its glands contain? Or does the Dr. wish us to understand that as the vertebræ of a *Hydrophis* has gradually developed into the complicated structure of a constrictor, so has the poison-fang become gradually obsolete? Appalling, indeed, would it be were those enormous developments armed with poison-fangs! Monarchs of the deep they truly would be. Happily, venomous serpents are restricted in their size; but an interesting speculation has been opened in the above theory of abnormal development, and I trust it may be followed up by abler reasoners than the present humble writer.

In the previous chapter the distinguishing characteristics of the true marine snakes were described, and I feel more disposed to agree with Dr. Andrew Wilson when he says, '*or for the matter of that, in the existence of distinct species of monster sea serpents,*' than in the development of a small venomous one into an amazing constrictor. Except the 'monster.' Why should not the gigantic forms be perfect in themselves, with an inherited anatomical structure? In volume xviii. of *Nature*, 1878, Dr. Andrew Wilson again discusses the sea serpent, and thus concludes: '. . . and as a firm believer from the standpoint of zoology that the large development of the marine ophidians of warmer seas offers the true explanation of the sea-serpent mystery.'

Their physical constitution, then, as well as structure, must have very much changed to enable them to exist so far from the tropics.

And still there are the creatures with flippers, and flappers, and fins to decide upon. And then the gigantic salamander with a hundred and fifty feet of tail! But these not being ophidians, and certainly not 'sea serpents,' must not intrude themselves here.

In their enormous development alone the supporters of Darwin may justly exult, for surely in them we shall see 'the survival of the fittest.'

CHAPTER XVI.

RATTLESNAKE HISTORY.

FROM the peculiar rattling appendage with which this snake is armed, it has excited the notice of European explorers since the very first settlement of the American Continent. Whenever a traveller attempted any printed account of the New World and its products, mention was made of this 'viper with the bell.'

By and by, in 1762, a live specimen was brought to England, where it arrested the attention of the members of the Royal Society and the scientific 'Chirugions' of the day.

From this time the rattlesnake began to be honoured with a literature of its own—one which equals if not exceeds in interest that of any other ophidian history handed down to us; for Cleopatra's asp has its literature, and the *Cobra capella*, and M'Leod's boa, and some few other distinguished ophidians, but none so voluminous and inexhaustible as the American *Crotalus* with its sonorous tail.

And despite the attention of naturalists for above two hundred years, it is not yet done with. First its rattle, then its fangs, next its maternal affection and the security offered to its young in 'its own bosom,' then its 'pit,' and again its rattle—each and all in turn have continued to occupy the pen of zoologists as, with the advance of science, fresh light has been thrown upon ophiology.

American naturalists have continually something new to tell us about the *Crotalus*, and not even yet have they decided among themselves of what precise use that remarkable rattle is, either to its owner or its auditors.

The various theories regarding its construction, mode of growth, its age and supposed uses, will occupy the second part of the present subject; other rattlesnake features will come in their places, but first an outline of what the early English writers had to say about it will not be devoid of interest.

Natural history as a science was then in its infancy. The Royal Society of England had as yet no existence; snakes were 'insects,' because they lay eggs; insects were 'serpents,' because they creep; and the majority of all such 'creeping things' were 'venomous,' of course.

In those early days of science there was little or no recognition of species, two, or at most three, different kinds of rattlesnakes being named. The distinguishing rattle seemed enough to separate them from all other snakes: they were 'the vipers with the bell,' or 'the vipers with the sounding tail.' 'Vipers' they were at once decided to be, conformably with the old idea that vipers, in distinction to every other kind of snake, produced their young alive. In this respect those early observers were correct; and from their general characteristics they are still *vipers* in the eyes of science: that is, they belong to the sub-order *Viperina*, though their dentition more than any other feature separates them from the rest, and we know now that several non-venomous snakes produce live young as well as the vipers.

In appearance the rattlesnake is so well known that a minute description of it is uncalled for. Throughout the whole genera of the *Crotalidæ* the viperine character is seen in the broad, angular, flattish head; the thinner neck, distinct between it and the thicker body; a short, tapering tail, and a generally repulsive appearance with an evil expression about it, as if no further warning were required to announce its deadly qualities.

Nevertheless, many of the rattlesnakes possess an undeniably handsome exterior. Their colours are for the most part dark and rich, relieved with lighter markings and velvety black; often wearing a brilliant prismatic hue, which still further enriches their tints. And then the rattle at once announces the name of its owner.

It is not easy to decide on the writer or traveller from whom we get the first mention of the rattlesnake, which has an extensive geographical range on both the American continents. It was undoubtedly some South American explorer early in the sixteenth century, and long before any settlement in the New World had been made by the English.

In a rare old book, the first edition of which was published in London, 1614, viz. '*Samvel Purchas. His Pilgrimage in all Ages; being an account of all the Places discouered since the Creation of the World*,' we hear of many Spanish and Portuguese authors who are but little known in England, and from each and all of whom the indefatigable 'Pilgrim' has culled information. Indeed, the book is a careful compilation from all the previous writers of any worth, though those only who mentioned the Brazilian serpents need be here introduced to the reader. These, in describing some unchanging peculiarities, and in giving us the vernacular names then common, have been of much use in assisting subsequent writers to identify certain species.

Hakluyt, Hernandez, Master Anthony Kniuet, and many others are quoted by Purchas, but of them all, 'No man hath written so absolute a Discourse of Brazil as was taken from a Portugall Frier and sold to Master Hakluit,' he tells us; giving at the same time a history of the persecution and imprisonment of this unfortunate friar, whose unusual intelligence seems to have rendered him an object of suspicion. Thus do we who come after benefit by the misfortunes of our predecessors, and thus has the stolen 'Discourse' of the sixteenth century been turned to account for our edification in the nineteenth.

In the Portuguese friar's description of animals, it is not difficult to separate the true snakes from the 'Serpentes with foure Legges and a Taile,' or to identify the rattlesnakes among them. Says the writer, 'The Boycininga is a Snake called of the Bell: it is of a great Poison, but it maketh such a Noise with a Bell it hath in its Tayle that it catcheth very few: though it be so swift that they call it the flying Snake. His Length is twelve or thirteen Spannes long. There is another *Boycininpeba*. This also hath a Bell, but smaller. It is blacke and very venomous.'

These two may be *Crotalus horridus* and *Crotalus durissus*, the two commonest; or they may be only one species of a different size, age, and colouring—a confusion which frequently occurs with even more recent and more scientific worthies than the good 'Pilgrim' Purchas. In a later edition he says: 'Other Serpents there are that carrie vpon the Tippe of their Tayle a certaine little roundelle, like a Bell, which ringeth as they goe.'

Marcgrave, in his *Travels in Brazil*, 1648, further helps us to label the right snake with the long vernaculars by figuring a rattlesnake and calling it by the same name, only with an additional syllable, *Boicininiga*, *quem Cascavel*, the latter euphonious Spanish word, for a little round bell, having widely obtained ever since.

As soon as the first English colony was settled in North America, the rattlesnake again comes upon the stage. Captain John Smith, whom we may call the founder of Virginia (since it was owing to his good judgment, endurance, and intelligence that the colony did not share the fate of Sir W. Raleigh's adventurers), tells us of the ornaments worn by the Indians, and the favour in which certain *Rattells* were held by them as amulets. In his *Generall Historie of Virginia*, 1632, Captain Smith describes their barbarous adornments,—birds' claws, serpent skins, feathers with a 'rattell' tied on to them, which 'Rattells they take from the Taile of a Snake,' and regard with superstitious veneration.

With the spirit of enterprise which marked that era, and the discovery of new countries and strange creatures, 'Natural History' began to be a recognised science in Europe. Aldrovanus and Gesner had produced their ponderous tomes, and the authors quoted by Purchas were eagerly read by Ingenious Chirugions, who in England appear to have taken the lead in science; while at Florence an assembly of 'Knowing Physicians' were experimentalizing with all the Vipers procurable in Southern Europe, holding council as to the source of their 'Mischiefs' and specific 'Remedies for their Bitings,' etc., with just such tests with the 'Master Teeth' of both living and dead vipers as have of late again occupied the attention of living scientists. In 1660 the learned Redi of Florence published his book on Vipers, and soon after M. Moyse Charas, a Frenchman, produced a work which would not be a bad text-book even now.

And for the Scientific World what greater stimulus could arise than the foundation of the ROYAL SOCIETY by Charles II., and the channel for ventilating discoveries and inventions which their published *Transactions* afforded? Very early in these do we find that viper poison was engaging professional attention, and soon did communications appear from those 'knowing physicians' at Florence. A correspondence sprang up between M.D.'s of England, France, and Italy; and the details of their experiments proved very inciting to the members of the Royal Society of London, who with the limited subjects at their disposal—virtually only our own little English viper—also set themselves to work to analyze the 'Poyson Bag.'

One enthusiast, Mr. Platt, addressing the Royal Society from Florence, with an account of some of the experiments then going on, made mention of the M. Charas who had written such an important work, and ended by hoping to animate the *virtuosi* here to 'do something that may be not unworthy your knowlege.'[1]

[1] See *Philosophical Transactions*, London, 1672.

That the work of M. Moyse Charas was translated into English the following year, proves that the English *virtuosi* had really become 'animated' in the looked-for direction.[1]

In the preface of his book we read: 'If Reflexion be made on the many Wonders that are found in the Body of this Animal' (the viper), 'it will be easily granted that it cannot be inquir'd into with too much Exactness: and that it is not a Work that can be finish't at one or two Sittings.'

This little digression from the rattlesnake is not without its object; for from this correspondence through the *Philosophical Transactions* we may date the birth of ophiological science in England; and the reader will be able to place himself on that standpoint in order to reciprocate the kind of interest with which such an entirely strange and as yet unknown serpent as a rattlesnake was received a short time afterwards.

In vol. x. 1676, there is 'An Account of Virginia, its Situation, Temperature,' etc., communicated by Mr. Thomas Glover, 'an ingenious Chirugion that hath lived some years in the Country.'

This gentleman tells us of the climate and productions of the new colony, not omitting those of the animal and vegetable kingdoms; among the various strange creatures which he describes in the crude language of the time are five or six sorts of snakes, amongst which 'the Rattlesnake is the most remarkable, being about the bigness of a Man's Legg, and for the most part a yard and a half long. He

[1] *New Experiments upon Vipers, with Exquisite Remedies that may be drawn from them: as well as Cure for their Bitings, as for that of other Maladies.* By M. Charas, now rendered English, 1673.

hath a Rattle at the End of his Tail, wherewith he maketh a Noise when any one approacheth nigh him : which seemeth to be a peculiar Providence of God to warn People to avoid the Danger ; for this Creature is so venomous that the Bite of it is of most dangerous Consequence, unless they make use of the proper Antidote, of which I shall take occasion to speak somewhat hereafter.'

Such accounts, coupled with the interest awakened in the members of the Royal Society by the Florentine experimentalists, caused the first arrival of a rattlesnake in England to be a grand era in ophiological annals ; and with its eventful appearance began its scientific history.

The published records of the *Philosophical Transactions* again perpetuate the impressions it created, and also many collateral points of interest.

A paper entitled *Vipera Caudisona Americana; or, The Anatomy of a Rattle-Snake*, was read by Dr. Edward Tyson, of the Royal Medical College of London, in 1683 ; who dissected one at the repository of the Royal Society in Jan. 1682. (The above scientific name is erroneously attributed to Laurenti, 1768.)

That nothing of much value to science was previously known about the reptile we gather from Dr. Tyson's introductory words. 'It were mightily to be wisht that we had the most compleat account of so *Curious* an *Animal*. This which we *Dissected* was sent to Mr. Henry Loades, a merchant in London, from Virginia, who was pleased not only to gratify the *Curiosity* of the Royal Society, in showing it them alive, but likewise gave it them when dead.'

Thus did Mr. Loades unconsciously immortalize himself in the history of rattlesnakes. Merchants in those days were not F.Z.S.'s; and it is probable that he thought of nothing beyond ingratiating himself with the members of a learned Society by presenting them with a 'serpente' dead, whose 'Bell' had excited their curiosity when living; and he little dreamed that the origin and use of this strange *bell* would not be determined two hundred years afterwards.

Says Dr. Tyson: 'I find the inward parts so conformable to those of a Viper that I have taken the liberty of placing it in that Classe and (since it has not that I know of any Latine Name) of giving it that of *Vipera Caudisona:* for as I am informed by Merchants 'tis Viviparous, and the Epithet sufficiently differences it from those that have no Rattle.'

This scholarly anatomist had evidently devoted much careful labour to the task of hunting up all the literature that could throw any light on his much-prized specimen. He had no doubt been one of those 'animated' by the Florentine savants, and had made himself acquainted with all the viperine characters. He had doubtless read all that had already appeared in the *Philosophical Transactions*, and also the narratives of such *voyageurs* as Hakluyt, Hernandez, Piso, and Marcgravius.

Among the useful results of his researches he is able to give us many, we may say most, of its vernaculars in the countries of the New World settled by Europeans up to that date; and as in subsequent books of travel we hear of the rattlesnake frequently under these vernaculars, until, as of later years, its ordinary English name has been familiar to all, we have had a good deal to thank him for, were it only this.

In addition to the authors already named, he gives us

Guliemus Piso, Johnston, Merembergius, and 'others that have wrot of it, and its anatomy, under the names of Boigininga or Boiginininga and Boiquira, which are its Brazile Names. By the Portuguese it is called Casca vela and Tangador: by the Dutch, Raetel Sclange; by those of Mexico, Teutlaco-cauehqui or Teuhtlacotl zauhqui, *i.e.* *Domina Serpentum*: and from its swift motion on the Rocks like the wind, Hoacoatl.'

Minutely and scientifically was that 'viper with the sounding tail' dissected and studied out by Dr. Tyson just two hundred years ago; and the excellent illustrations with which his description was elucidated were subsequently used in many first-class physiological works.

Not even the 'pit' escaped the notice of that nice anatomist,—the 'nasal fosse,' or 'sort of second nostril,' as it was for a long while called,—and its use conjectured, and which has given to a very large group of venomous serpents the name of 'pit vipers,' the peculiar orifice not being confined to the American *Crotalus* alone (see chap. xxi.).

'Between the nostrils and eyes are two other orifices which at first I took to be Ears,' he tells us, speaking of this 'pit,' 'but after found they only led into a Bone that had a pretty large cavity, but no perforation.' He had seen that vipers—the European vipers which he had previously known—had not these orifices. Then he comments on the great Provision of Nature in furnishing the strong, smooth 'belly scales,' (see illustration, p. 193), and the 'very long trachea of 20 inches. *Nature* is mightily provident in supplying them with *Air*, in bestowing on them so large a Receptacle for receiving it.'

Tyson quotes from the 'contests between the noble Italian Redi, and the Frenchman M. Charas,' as to the source of the poison in vipers, and makes discoveries for himself, as for instance the mobility of the jaw in elevating and depressing the fang, the structure of the teeth, and various other matters which in this book are discussed in their several chapters, but which were then for the first time scientifically described in English by Tyson.

True that a little traditional gossip about the rattle, which he had gathered from less competent sources, creeps in towards the conclusion of the paper. While the learned M.D. writes from his own observations and scientific knowledge, he affords valuable information ; and we can dispense with the hearsay of the day. However, all honour be to Dr. Tyson of two hundred years ago, who was the first to give us 'The Anatomy of the Rattlesnake,' and its first scientific name.

As the two American continents became more widely known to Europeans, and Englishmen were seized with a desire to visit the new colonies, books of travels and descriptions multiplied too rapidly for even a passing mention in these pages ; though wherever the slightest approach to natural history was included, the rattlesnake figured conspicuously. Of those works frequently quoted by naturalists, Seba's *Rerum Naturalium Thesauri* in 1735, of four ponderous volumes, containing text in both Latin and French, and profusely illustrated, must not be omitted, though about the *Crotalus* he has not much new to tell us. He quotes Tyson and others, and explains that the many nearly similar names are '*selon la difference de prononciation des Bresiliens, qui la nomme aussi Boiquira ;*' and he thinks all these names '*ne désignent qu'une seule et même vipère.*' To these various titles of 'one and the same viper,' we shall refer again in chap. xxiii. To the list he adds that the English call it 'rattlesnake;' the French, '*serpent à sonnettes;*' and Latin authors, *Anguis crotalophorus* (or the rattle-bearing snake). He also gives us another Mexican name, '*Ecacoatl, qui signifie le Vent, parcequ'elle rampe avec une extrême vitesse sur les rochers.*'

This extreme activity in the rattlesnake is not in accordance with our alien experience. Still we hear of it from more than one writer and in widely separated habitats. The Mexican and Brazilian words may have alluded to the rapidity of motion in striking its prey, and which in its swiftness can scarcely be followed. Or it is possible that the reptile which as a captive in our chilling climate is so slow and sluggish, may, when stimulated by a tropical sun and under peculiar excitement, occasionally exhibit a vivacity incredible to us who see it only in menageries. Regarding other species of viperine snakes, we have sometimes similar evidence; and there is nothing in the structure of the *Crotalus* to contradict it.

One more of the unpronounceable Mexican names we must inflict on the reader, to show how this serpent was distinguished among all others even in length of title. F. Fernandez, or Hernandez, in his *Animalium Mexicanum*, p. 63, A.D. 1628, calls it Teuchlacotzauhqui, because it surpasses all others in '*l'horrible bruit de sa sonnette.*'

As may be supposed, anybody who could see this remarkable snake on its native soil was ready to tell something about it; and from the time that Dr. Tyson dissected his specimen and made it better known to the 'Curious,' many other communications saw light through the pages of the *Philosophical Transactions* during the next few years.

In experimenting to discover the source of the 'mischief,' one skilful 'Chyrurgeon' proved that the gall of vipers is not venomous, only bitter.

A Mr. John Clayton, in an *Account of the Beasts in Virginia*, 1694, tells us the rattlesnake's 'Tayle is composed of perished Joynts like a dry Husk. The Old shake and shiver these Rattles with wonderful Nimbleness; the Snake is a Majestick sort of Creature, and will scarce meddle with anything unless provoked.' He also describes the 'fistulous Teeth' and the poison being injected through these 'into the very mass of the blood.' Effective remedies are spoken of, as if not much doubt of a cure existed. An Indian was bitten in the arm, who 'clapt a hot burning coal thereon and singed it stoutly.'

In Italy experiments still went on, and a Mr. C. J. Sprengle wrote to the Royal Society from Milan (1722), that in a room opened at the top were sixty vipers from all parts of Italy. 'Whereupon we catch'd some mice and threw them in, one at a time, among all that number of vipers; but not one concerned himself about the mice, only one pregnant viper who interchanged eyes with the mouse, which took a turn or two, giving now and then a squeak, and then ran with great swiftness into the chops of the viper, where it gradually sunk down the gullet.' And from this sinister proceeding on the part of the viper, Mr. Sprengle argues a fact generally borne out in zoological collections ever since, namely, that venomous snakes in captivity will not eat until they become reconciled.

And so by degrees these many interesting ophiological facts have been worked out and established. In 1733, vol.

xxxviii., some experiments made by Sir Hans Sloane are recorded. A dog was made to tread on a rattlesnake which bit him. In one minute of time the dog was paralytic in the hinder legs, and was dead in less than three minutes.

Another subject of subsequent interest and even importance was some observations made by Sir Hans Sloane on the 'Charms, Inchantments, or Fascinations of Snakes,' in reply to communications by Paul Dudley, Esq., F.R.S., and Col. Beverley, both of whom believed that the rattlesnake could bring a bird or a squirrel from a tree into their mouths by the power of their eye.

A word on fascination will come in its place, but as a part of rattlesnake history Sir Hans Sloane may be quoted here. And yet a reason so long ago suggested by him, who *thoughtfully* watched a snake, seems almost entirely to have escaped notice. He thinks 'the whole mystery of charming or enchanting any Creature is simply this. Small Animals or Birds bitten, the poison allows them time to run a little way (as perhaps a bird to fly up into a tree), where the snakes watch them with great earnestness, till they fall down, when the snakes swallow them.' [1]

Sir Hans Sloane quotes a good deal from the work by Colonel Beverley,[2] and the observations made by him; particularly one which the author remarks is a 'curiosity which he never met with in print,' viz. the instinct which displays itself so strongly *after death* in the rattlesnake. A man chopped off the head and a few inches of the neck of a rattlesnake, and then on touching the 'springing teeth with

[1] *Philosophical Transactions*, vol. xxxviii. p. 321. 1733.

[2] *History of Virginia*, 1722.

a stick, the head gave a sudden champ with its mouth,' thus displaying the impulse to bite. He noticed the action of the springing teeth 'when they are raised, which I take to be only at the will of the snake to do mischief.' Strange to tell, many of the above peculiarities have been described as 'new to science' within forty years.

But among those who wrote of our American colonies, Lawson must not be omitted. Describing the 'Insects of Carolina,' viz. alligators, rattlesnakes, water snakes, swamp snakes, frogs, great loach, lizards, worms, etc., he tells us what was then new about the subject of this chapter.

'The Rattlesnakes are found on all the Main of America that I ever had any Account of: being so called from the Rattle at the End of their Tails, which is a Connexion of jointed Coverings of an excrementitious Matter, betwixt the Substance of a Nail and a Horn, though each Tegment is very thin. Nature seems to have designed these on purpose to give Warning of such an approaching Danger as the venomous Bite of these Snakes is. Some of them grow to a very great Bigness, as six Feet in Length; their Middle being the Thickness of the Small of a lusty Man's Leg. They are of an orange, tawny, and blackish Colour on the Back, differing (as all Snakes do) in Colour on the Belly; being of an Ash Colour inclining to Lead. The Male is easily distinguished from the Female by a black Velvet Spot on his Head; and besides his Head is smaller-shaped and long. Their Bite is venomous if not speedily remedied; especially if the Wound be in a Vein, Nerve, Tendon, or Sinew, when it is very difficult to cure. The Indians are the best Physicians for the Bite of these, and all other venomous Creatures of this

Country. The Rattle-Snakes are accounted the peaceablest in the World, for they never attack any One or injure them unless trodden upon or molested. The most Danger of being bit by these Snakes is for those that survey Land in Carolina; yet I never heard of any Surveyor that was killed or hurt by them. I have myself gone over several of this Sort; yet it pleased God I never came to any Harm. They have the Power or Art (I know not which to call it) to charm Squirrels, Hares, Partridges, or any such Thing, in such a Manner that they run directly into their Mouths. This I have seen,' and so forth. . . 'Rattle-Snakes have many small Teeth of which I cannot see they make any Use; for they swallow every Thing whole; but the Teeth which poison are only four; two on each side of their Upper-Jaws. These are bent like a Sickle, and hang loose, as if by a Joint. Towards the setting on of these, there is in each Tooth a little Hole, wherein you may just get in the Point of a small Needle. And here it is that the Poison comes out and follows the Wound made by the Point of their Teeth. They are much more venomous in the Months of June and July than they are in March, April, or September. The hotter the Weather the more poisonous. Neither may we suppose they can renew their Poison as oft as they will; for we have had a Person bit by one of these who never rightly recovered it, and very hardly escaped with Life; and a second Person bit in the same Place by the same Snake and received no more Harm than if bitten with a Rat. They cast their Skins every Year and commonly abide in the Place where the old Skin lies. These cast Skins are used for Physick, and the Rattles are reckoned good to expedite the

Birth.' . . 'Gall mixed with Clay and made into Pills are kept for Use and accounted a noble Remedy.' . . 'This Snake has two Nostrils on each Side its Nose. Their Venom I have Reason to believe effects no Harm any otherwise than when darted into the Wound by the Serpent's Teeth.'

This description, being an early and excellent illustration of what has since been termed 'Practical Natural History,' is given at length, and because Lawson has been a good deal quoted by subsequent writers.

So again is Catesby, who went to Virginia in 1712, staying seven years 'to gratify a passionate desire to view animal and vegetable productions in their native country.' He was the first to figure and to describe two distinct species. It is admitted that he did much for natural history, and his drawings are by far the best that had as yet appeared. Catesby therefore claims a conspicuous place among rattlesnake historians.

By this time, 1731, nine or ten of the American colonies had celebrated their first centenary, and had made considerable advances towards civilisation. In the parts visited by Catesby a good deal of the old English refinement marked the character and manners of the people. But a little domestic incident in the house where he was staying is related by him, and affords us an insight of a less attractive character in plantation life.

The largest rattlesnake Catesby ever saw was eight feet long, and weighed eight or nine pounds. 'This Monster was gliding into the House of Col. Blake, and had certainly taken up his Abode there undiscovered, had not the Domestic Animals alarmed the Family with their repeated Outcries :

the Hogs, Dogs, and Poultry united in their Hatred to him, showing the greatest Consternation by erecting their Bristles and Feathers, and showing their Wrath and Indignation surrounded him; but carefully kept their Distance, while he, regardless of their Threats, glided slowly along.'

It was not at all an uncommon occurrence for rattlesnakes to come into houses at that time, nor indeed has it been long since then in secluded parts.

Catesby himself had a narrow escape once, when he occupied a room on the ground floor, and a rattlesnake was found snugly coiled in his bed.

Notwithstanding a growing acquaintance with the rattlesnake among the F.R.S.'s, to the general public it was still almost unknown.

Even in the middle of the eighteenth century an itinerant exhibitor could say what he pleased about it to a too credulous public. An extract from an old newspaper suggests an ancestral Barnum joining hands with a journalist to make a fortune out of one thus exhibited. Not so much was expected of journalists in those days; but even now, so far as snakes are concerned, a vast number of errors creep into newspapers.

'A BEAUTIFUL RATTLESNAKE ALIVE.

'This exotic Animal is extremely well worthy the Observation of the Curious: Its Eyes are of great Lustre, even equal to that of a Diamond, and its Skin so exquisitely mottled and of such surpassing Beauty as baffles the Art of the most celebrated Painter: It is about five Feet long, and so sagacious, that it will rattle whenever the Keeper commands it: There is not the least cause for Fear, though it were at Liberty in the Room: but that the Ladies may be under no Apprehension on that Account, it is kept in a Glass-Case. It is very Active, and is the first ever shown alive in England.'—From *The General Advertiser*, LONDON, Sat., Jan. 4th, 1752.

Any 'sagacity' displayed in this exhibition was on the part of the keeper, who had discovered the exceeding timidity of this reptile, and had observed that it used its rattle whenever alarmed or provoked. However, the timidity answered very well for obedience, and no doubt drew many spectators.

A notable feature in the rattlesnake was its fecundity and prevalence.

This we gather from all who in the early days of American history had anything to tell us of the country and its inhabitants. Whether the subject of their pen were Topography, Indians, or Productions, a rattlesnake crept in. Collateral evidence of this kind, given with no motive for exaggeration, nor even as 'natural history,' may therefore be accredited.

A slaughter of rattlesnakes was as much an annual custom as the slaughter of hogs. Regularly as a crop of hay came a crop of rattlesnakes. On account of the oil manufactured from their fat, the slaughter partook also of a commercial character; but more commonly it was a war of extinction, like the battles with the Indians. Usually an annual, frequently a biennial, crusade was undertaken, the settlers being well acquainted with their habits and retreats. It was a well-known fact that, towards the close of summer, and on the first indication of frost, the reptiles returned simultaneously and in vast numbers to a favourite spot. Not only hundreds but thousands make for this winter rendezvous year after year.

Catlin, the Indian historian, tells us that near Wilkesbarre, in Pennsylvania, his birth-place, was a cavern in the mountains called Rattlesnake Den ; and to this cavern the snakes made an annual pilgrimage, collecting from vast distances, no matter what obstacles were in their way. Across rivers and lakes, and up mountain sides, straight to their Den they would go, and in those unapproachable caverns lie *en masse* in a torpid state until aroused by the coming summer, when they would venture forth again and descend into the valleys.

These were the times for the grand *battues*, one of which, an event of Catlin's boyhood, is narrated by him.

One of the first spring days, when the creatures creep out to sun themselves for only a few hours, retiring again at night, was the time chosen for the onslaught. The snakes were known to come forth from Rattlesnake Den on to a certain ledge of rock near their cavern ; and a council of war was held as to the best approach and mode of attack. Ten years previously a similar war had been waged, when the reptiles had been almost exterminated ; but of late so many accidents had occurred among the inhabitants through the fast-increasing serpents, that the farmers agreed to climb to the den and once more reduce their numbers. The boy Catlin was privileged to be of the party, and he was told to creep cautiously to an overhanging rock, whence he could see the reptiles sunning themselves on their ledge below. The rest of the party stood in readiness, club in hand. At a signal young Catlin fired a fowling-piece into their midst. There was a knot of them 'like a huge mat wound and twisted and interlocked together, with all their heads like scores of hydras standing up from the mass.' Into this horrible cluster he 'let fly,' when the party, rushing with their clubs, broke the spine of hundreds by a single blow to each, while hundreds more were saving themselves by a quick return to their den.

While counting the five or six hundred slain, and holding another council of war on the battle-field, a rattle was heard of one which in the death-struggle had escaped over a ledge instead of into its cave. With a forked stick a man approached that misguided reptile and held down its head, while another brave expert seized it by the neck so close to its head that it could not turn and bite him.

It was a very large snake, and young Catlin, inspired by the sudden thought, exclaimed, 'Tie a powder-horn to its tail and fasten a slow fuse to it, and let it go back into its den.'

'George, you are the best hunter in the Valley of Ocquago!' cried the man who held the snake; and forthwith the plan was agreed upon.

The largest powder-horn in the party was filled to the brim from the other horns, and tied to the snake's tail by a string of several feet long; and to the horn was fixed a slow fuse of about a yard in length, made of wetted, twisted tow, in which gunpowder was rolled. This accomplished while the reptile was still firmly held, it was then set free close to the mouth of its den, the whole party speedily escaping to a safe distance.

Listening, they heard the horn rattling over the rocky floor as the snake was carrying it home into the midst of its comrades, when, after the silence of a minute or so, an explosion like a clap of thunder shook the ground on which they stood, and blue streams issued forth between the crevices around the den, and a thick volume from its mouth.

Rattlesnake Den was thus cleared of its inhabitants for many long years.

Catlin affirms that the Valley of the Wyoming used to be more infested with these terrible pests than any other portion of the globe. Every summer the lives of persons as well as cattle were destroyed by them, and the 'happy little valley' would have been rendered uninhabitable but for the periodical *battues.*[1]

Howe in his Histories of Ohio and of Virginia relates many similar facts. A Mr. Stone, one of the first settlers of the 'Western Reserve' along the shore of Lake Erie, has immortalized himself as a slayer of rattlesnakes. They were 'in great plenty along the track,' and he being the first to 'survey' the land in 1796, had the honour of doing battle with them. In Trumbull County they abounded. One year, about the first of May 1799, a large party armed with cudgels proceeded to a sunny level of rock on which hosts of the reptiles had crept. Approaching cautiously, step by step, the enemy came upon them suddenly, and then began to cudgel with all their might. Hot and furious was the fight; the rattles were ringing as the snakes beat a retreat up the hill, and the ground was strewed with the slain: four hundred and eighty-six were that day collected, most of them over five feet in length.

In another of these spring campaigns eight hundred rattlesnakes were killed, including a few of their relatives the copper-head, and hundreds more of harmless snakes of which the slayers 'took no account.'

Holbrooke records that once in New York State two men

[1] *Last Rambles among the Indians*, by Geo. Catlin. London, 1865.

in three days killed 1104 rattlesnakes on an eastern slope of Tongue mountain.

Many hairbreadth escapes during these adventures form the subjects of exciting stories in the domestic annals of American settlers, but are becoming more and more histories of the past. In many localities where formerly rattlesnakes swarmed, they have almost totally disappeared or have become very rare. Probably with their friends the Indians, they will in time become wholly extinct.

New species have, however, been discovered by the explorers of the new Western States and in Tropical America, where, in the sparsely-settled districts, they still come into houses as of yore, and where the rattlesnake campaign is still an annual sport for the venturesome pioneers. In 1872, two thousand of the species *Crotalus confluentus* were killed in the Yellowstone Region.

One other question in the history of the rattlesnake—'Does it swallow its young in times of danger?' or more correctly speaking, 'Does it receive its young into its œsophagus as a place of safety?'—is considered in chap. xxvii.

Other discussions of modern times, both in assemblies of zoologists and through printed correspondence, have been on the rattle, when and why vibrated, how affected by damp, etc., all claiming a place in rattlesnake history, but considered elsewhere in this work. A whole volume might be written on this rattling tail, evolved out of the scant materials of the sixteenth century into the prolific matter of the nineteenth. You can scarcely take up one of the many scientific journals of the United States, in which zoology forms a part, without finding mention of a rattlesnake. Within a very few years the subject has been popularized in our own zoological journals also.

In connection with the venom come of course the cures, concerning which the experiments of Dr. Weir Mitchell form a notable point in rattlesnake history. But serpent venom and its remedies, so far as lies within my province to discuss them, come also in a special chapter.

In concluding this one, I will roughly enumerate the species of rattlesnakes now best known. We have seen that formerly only one or two different kinds were noticed, and the subsequent multiplication of species is due almost as much to science and to a more careful observation of the distinguishing features, as to the discovery of absolutely new ones.

The frequent Exploring Expeditions fitted out by the United States Government for Geographical Boundaries, Pacific Railroads, Geological Surveys, etc., with always a zoologist on their Staff of Scientific Men, have added much to our knowledge of natural history; and in the Reports and Bulletins of these may be sifted out information in every branch of Science. Thus in *Crotalus* chronicles, our two original rattlesnakes have increased and are still increasing. In 1831, the late Dr. J. E. Gray, of the British Museum Natural History Department, enumerated six genera and eleven species belonging to America. In 1860, Dr. Weir Mitchell gave about twenty species as belonging to two genera only, and distinguished by their head scales.

As this book has no scientific pretensions, and as its aim is rather to interest a large class of readers than systematically to instruct the few, I will not attempt a list of genera and species with all their perplexing names, if indeed a true list of all the now known species even exist. They are distinguished by the shields or plates on the head, and by the varying tails. Some have rattles so small as barely to entitle them to the name of *Crotalus*.

Then, again, a new name is frequently adopted by the discoverer of a new feature; and a number of American genera, *minus* a rattle altogether, are included among the *Crotalidæ*, an anomaly which will be presently explained. Here we have to do with only the rattlesnake proper, viz. the 'Viper with the Bell,' *Vipera caudisona* of Tyson, and the *Crotalus* of Linnæus.

This word *Crotalus*, simply a rattle, from the Greek word *crotalon*, and the Latin *crotalia* and *crotalum*, a kind of castanets, is as suitable as any that could possibly have been assigned to the snake; and most of the generic names are compounds of it: *Crotalophorus*, rattle-bearing; *Crotalina*, little rattle; *Crotaloidæ; Urocrotalon*, rattling tail; or simply *Crotalus*. Then the specific name more especially describes the snake in colour, size, character, locality, etc., as *Oregonus*, from Oregon; *Kirtlandii*, from Dr. Kirtland of Ohio, who first described that species; *horridus*, from the hideous, terrible character of this large snake; *miliarius*, a very small one; *caudisona*, sounding tail; and so on.

Their geographical range is from about 45° north, to the Gulf of Mexico, Texas, and southward; and in South America to about the same degree of climate and temperature as in the northern latitudes. They are most virulent in the hottest seasons, the tropical regions, and according to their size; though, as is the case with other venomous snakes, a small species in hot weather and with a large store of venom may be more noxious than the largest in a half-torpid state and with a small supply of venom.

There is one known as the 'Prairie rattlesnake;' another frequents the marshy districts of Ohio; another, the swamps of the Southern States along the coast; a fourth is known as the 'Western rattlesnake;' some of the 20 species described in the United States being more abundant in the mountainous regions, others near the rivers.

In the wilder regions of Central and South America they also abound; but less is known of them where there are no United States Exploring Expeditions to record them.

CHAPTER XVII.

THE RATTLE.

THIS *Crepitaculum caude*, as an American has called it, has been the theme of many speculations. Its origin and its use have been discussed alike by the scientific and the unscientific, nor have they even now arrived at any very definite conclusions on these two points. There are theories as to its development, its form and size, its age and its utility, the caprice witnessed in all of these adding to the romance of its history; and whether its length increases by a link annually, or on each occasion of desquamation, have been among the questions connected with it. If we believe what the American Indians declare, an additional joint to the rattle grows whenever a human being falls a victim to that particular snake—a tradition more poetical than rational. The Indians also think the rattle vibrates more in dry than in wet weather, and are therefore cautious in traversing the woods during rainy seasons. This belief has given rise to the idea that the rattle is affected by damp—a fact which was affirmed so long ago as 1722.[1] The most reasonable clue to this is, that there may be less to disturb the reptile at a time when all animated nature is to a certain extent inclined to retirement and repose; for if the reptile be disturbed, rain or no rain, the rattle vibrates. In English as well as in American scientific journals, the subject of the rattle is ever and again ventilated by physiologists, and new suggestions are thrown out. In the present chapter I will endeavour to give a sort of digest of all these theories, venturing to offer in addition the results of my own observations. Appended is a drawing of the first rattle I ever saw or had in my possession. It is associated with a delightful visit of several months to some very dear friends in Iowa, and it recalls more particularly one lovely September afternoon. We were driving along a wild country road, where the prairie on either side was radiant with its floral carpet, and where the Mississippi gleamed like a succession of lakes between the wooded and picturesque bluffs that formed the background to the east.

Suddenly the horses refused to advance, and without any visible reason to *me*; but the friend who was driving us recognised, in what seemed to be merely a little dry twig in the middle of the road, nothing less than a young rattle-snake.

Now, to see a rattlesnake and to hear its rattle had been the great ambition of my prairie sojourn, and as my friend threw the reins to his wife and alighted to deal a death-blow, I entreated him to spare it for a few minutes only

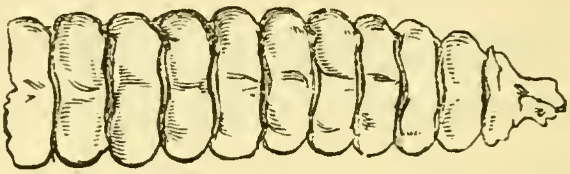
[1] See *Philosophical Transactions*, vol. xxxii. A paper on the Crotalus, by Paul Dudley, Esq.

that I might examine and hear the as yet unfamiliar appendage.

Alas! the creature had no rattle. 'It is too young: there is only the *button*,' as my friend called the rudimentary promise of one. I profited by the occasion, however, to have a good though disappointed look, not unmixed with contempt, at the juvenile Crotalus, being so very small and unworthy the ceremony. A foot or so in length, it began to make its escape into the long grass, when by one quick stamp of his heel our champion disabled it.

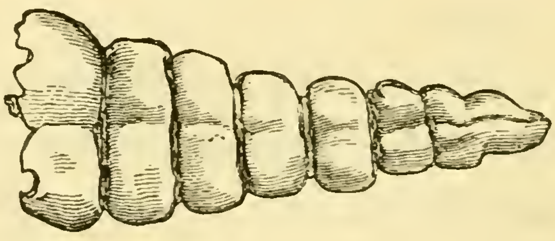
Then, throwing it into a pool of water, he remounted, and the horses fearlessly proceeded.

A few days after this, to compensate my disappointment, I was presented with a 'full-grown rattle' from a Kentucky snake, and here it is.



A fully developed rattle of a rather small snake (life size).

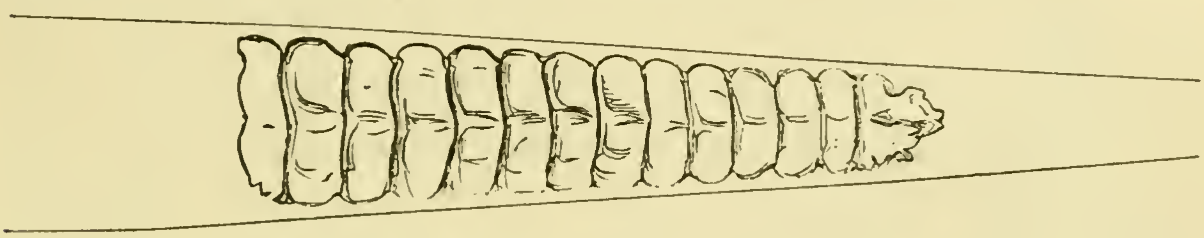
Asking how he knew it was 'full grown,' my friend explained that the links being all of a nearly uniform size, proved that the snake had also attained a certain growth during the development of that rattle. This will be more readily comprehended on seeing the next specimen, which is the rattle of a Mexican snake during early and rapid growth, and a very perfect one, presenting no flaw or friction; proving that it has not been subject to very long or very rough usage.



A very perfect rattle (natural size).

In texture this is scarcely so stout as the shaft of a quill, nor so pale, but almost as transparent. As regards size, the terminal link or 'button' may be compared to the nail of a young child, the intermediate links gradually increasing with the growth of the snake to the nails of older children, and the largest link to that of a full-grown person. From the form of this rattle—an accurate copy of the original—we may infer that it grew rapidly at first, and that the snake was large during the development of the later links.

The next, reduced in size, is the rattle of a snake which had attained full growth, but from which the younger or earlier links with the terminal 'button' are gone.



Portion of a long rattle, much reduced in size.

Extending this specimen by imaginary converging lines, we form an idea of what its length might have been if perfect, probably about twenty joints, which is a not unusual number; but we perceive at once that a rattle, as we happen to see it, is no criterion of its age or its original form. Rarely is a snake seen with a long rattle perfect and entire. But whenever it gradually tapers and ends with the pointed terminal link, we may decide that that rattle has escaped injury from its earliest development.

In form it is not unsymmetrical, and in substance it is horny, like hair, nails, quills, and hardened skin, a sort of dense and corneous integument, yet less solid than horns and claws. The links, being only interlocked and yet elastic, can be easily separated, and are consequently easily injured. An animal treading on the rattle of a snake would cause a portion at least to be lost; or in being drawn among roots and entangled vegetation, a rattle might easily get damaged: the number of links can never, therefore, be an infallible clue to the age of the reptile.

Like hair, horns, nails, it is also subject to a caprice in growth, or to the vigour of the individual; at one time comparatively at a stand-still, at another growing rapidly; in one season gaining perhaps several links, in another season none.

Neither does the number of joints bear any relation to the casting of the skin, any more than the growth of hair or nails depends on the healing of a scar. The slough, cast more or less frequently, may leave the rattle intact, or a new link may appear at such a time. Dr. Cotton, of Tennessee, had a rattlesnake which shed its skin on an average twice a year, and he observed a new link to the rattle on each shedding. On the contrary, a rattlesnake at the London Zoological Gardens, and in the collection for about ten years, had never a rattle worth mentioning. Quite a young snake of only 15 inches when brought, it grew into a fine healthy specimen, fully five feet long, and yet had never more than what Americans call the button—not quite even that, but merely an abortive pretence of unhealthy growth, as if one or two links were consolidated. I watched that rattle for several years with much interest. Thus it was when my attention was first drawn towards it; and though it sometimes gave promise of growing, and once did indeed gain another link, it soon got broken off, and never attained more than three misshapen joints.

All there was of it! From life.

Though no rattle is ordinarily developed until the snakeling is some months old, several cases are on record where young snakes have been born with the 'button,' and even with perfectly formed links. Mr. Benjamin Smith Barton, an American who wrote a good deal about the Crotalus, communicated to Prof. Zimmermann in 1800 that he had found in a parent some young ones with three rattles, *i.e.* 'links,' each. Similar and more recent cases are on record.

In colour a rattle is of a dark brown, or dull rusty black, occasionally lighter when fresh and uninjured, and then more plainly displaying its horny texture. In the Mexican rattle (p. 296) the links were semi-transparent; sufficiently so to enable us to trace the form of the interior links if held against the light. This afforded an admirable opportunity to comprehend the structure and the production of the sound, which is simply and truly a rattling of these loosely-fitting links as they are partially embraced, each one by the previous link. That is to say, each new link grows up into its predecessor, pushing it forward towards the tip of the rattle. Through this unusually clear rattle you can trace each link passing up and fitting into the preceding (prior) one, just as so many thimbles or cups would fit into each other. Only, in the case of thimbles or cups, there is nothing to keep them in place, and the slightest shake would detach the whole pile; whereas the lobes or bulging sections of each link prevent any such detachment in a rattle, except by force or accident.

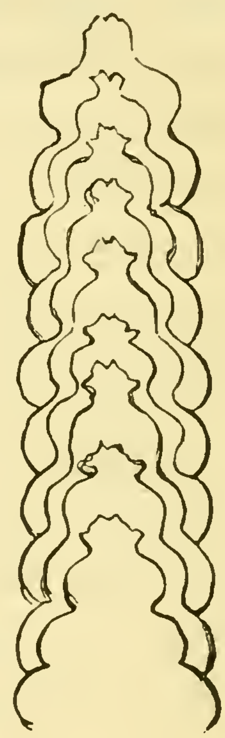
Transparent rattle (p. 296), held against the light.

The next is the rattle of a small Oregon snake. This, as is observable, is old and very much worn; so much so, indeed, that one has to handle it with care. It is, however, pulled apart intentionally to show that the links vary in form from those of the tapering specimen. Any rattle can thus be separated without much effort, as, owing to the elasticity of the substance, not much resistance presents itself. The links are just loose enough to produce that sibilant effect, like the rustling of dry leaves, or of ripe beans in a pod; or still more, like the seed vessel of our own native plant the Yellow Rattle, *Rhinanthus Crista galli*, and the American 'Rattle-Box,' *Crotalaria sagittalis*.

Small divided rattle.

Yet just so securely fitting it is as to permit of the continual vibration without loss of links.

What we *see*, therefore, is only the base or lower lobe of each joint, the rest running up into the next two or even three bases, as may be traced in the section here given.



Section of rattle.

In reading about the construction of a rattle, some perplexity may occur from the various adverbs before, behind, first, last, previous link, etc., some referring to age, others to place. Descriptions of the rattle met with in popular physiological works prove the above perplexities, and verify what is so often demonstrated, viz. the 'inability of unscientific persons to read scientific matter correctly.' The 'last' link means the one last grown, not the end one of the tail; 'pushing the preceding one *forward*' is not towards the *head* of the reptile, but literally *outward* and *backward* towards the tip of the tail. 'Previous' may mean in time, or the age of the link, or it may mean position; but a knowledge of the development assists the comprehension of such passages.

In the above illustrations it will be seen that not only do rattles differ in form in various species of snakes, but that the links themselves differ in form in one and the same rattle. Some of them are broader than others, some wider, and some more compressed. In all the above drawings I carefully and faithfully copied the originals. And in this variability we can only refer again to claws, nails, horns, feathers, etc., which are seen to differ in the same individual, according to health, season, or accident.

Where great numbers of rattlesnakes have been killed in one locality, as, for instance, during the 'spring campaigns,' their tails have presented on an average from fifteen to twenty links each. Holbrooke[1] has seen one of twenty-one links. A Crotalus at the London Reptilium had twenty-five links at one time; then ten of them got broken off, but still a respectably-sized rattle remained. The longer the rattle, the greater the risk of injury. Oliver Wendell Holmes, in his wonderful story *Elsie Venner*, states that a snake in the locality where the Rocklands 'Rattlesnake Den' existed, had forty joints in its rattle, and was supposed, after Indian traditions, to have killed forty people. He tells us that the inhabitants of those parts were remarkable for acute hearing even in old age, from the practice of keeping their ears open for the sound of the rattle whenever they were walking through grass or in the woods. And whenever they heard

[1] *North American Herpetology*, vol. iii. p. 15. By J. E. Holbrooke. 1842.

the rattling of a dry bean-pod, they would exclaim, 'Lord, have mercy upon us!' the sound so strongly resembling that of the dreaded Crotalus.

Another American naturalist records a snake with forty-four links to its rattle, but adds that this occurrence is rare and 'a great curiosity.' So one would imagine, and that the fortunate possessor of such an ensign must have flourished in smooth places. More favoured still was a snake mentioned in the vol. of the *Philosophical Transactions* just now quoted, and in which Paul Dudley had 'heard it attested by a Man of Credit that he had killed a Rattlesnake that had between 70 and 80 Rattles (*i.e.* links), and with a sprinkling of grey Hairs, like Bristles, all over its Body.' As this venerable Crotalus must have rusticated nearly two hundred years ago, we must accept the tale or tail with caution.

The family of the *Crotalidæ*, it will be borne in mind, embraces a large number of serpents with only a rudimentary rattle; a number with only the horny spine (see p. 176); and a few with a rattle so small even when fully developed, that they are received into the family by courtesy rather than by their 'sounding tail.'

A small snake with this pretence of a rattle is dangerous because it is so indistinctly heard.

This is also the case with *Crotalus miliarius*, whose rattle is so feeble as to be scarcely audible a few feet off.

So much for the size of rattles. Now for the development of them.

The theory that the rattle is the remains of cast-off cuticle, as some herpetologists have supposed, may be dismissed at once; for what would cause such vestiges to harden into a complicated and symmetrical form?

To Dumeril we owe some of our best conceptions of the growth of the rattle, which, whether it has or has not been evolved from the mere horny spine that terminates the tails of so many snakes, has certainly *now* an express provision for its production.

Like hair, claws, or nails, the rattle is horny matter excreted and hardened. In his *Elementary Lessons in Physiology*, Prof. Huxley shows us how in the growth of a nail new epidermic cells are added to the base, constraining it to move forward. 'The nail, thus constantly receiving additions from below and from behind, slides forward over its bed and projects beyond the end of the finger.' If the reader will look at his finger nail, and suppose the end bone of the Crotalus spine to be the 'bed' of the nail, he will to a certain extent be able to comprehend how the rattle grows out; but that the links become detached in succession is a phenomenon so astonishing and at the same time so difficult to comprehend, that few naturalists have ventured to state positively how this occurs. Conjecturally only and diffidently do I, therefore, presume to offer a supposition; and if my readers will once more pardon reference to human nails, and lend the aid of their imagination, they may be able to evolve a true theory out of my crude idea.

The young readers of *Aunt Judy's Magazine* were also, a few years ago,[1] invited to lend the aid of their pink little finger nails to the illustrative development of a supposed

[1] 'The History of a Rattle,' by Catherine C. Hopley, *Aunt Judy's Magazine*, July 1877.

rattle; and we will again imagine the whole tip of a finger to be covered with a round nail-cap, proceeding from the first joint, and to have grown so from birth. In growing out, this curious, cup-like nail, being never cut, would become hollow like a thimble. Pointed or tapering it would of course be, because, as the baby finger grew, the base or new portion of nail grew larger with it. We will also suppose that the joint whence the nail sprang was in constant activity, and so articulated that it *could* move with a quick and regular action or vibration; the hollow nail-cap, having attained a certain size, would become withered, and (as the constant bending of a piece of card or metal in time divides it) would be worn, and at length detached at its base. Meanwhile the growth of nail has not been arrested, but a new cap is forming within. The old, dry, and withered cap has now nothing to retain it, and would drop off, on account of its simple, conical form, like a loose-fitting thimble. But Dumeril explains to us that the terminal bones of the rattle-snake's spine present a peculiar form, several of them coalescing.

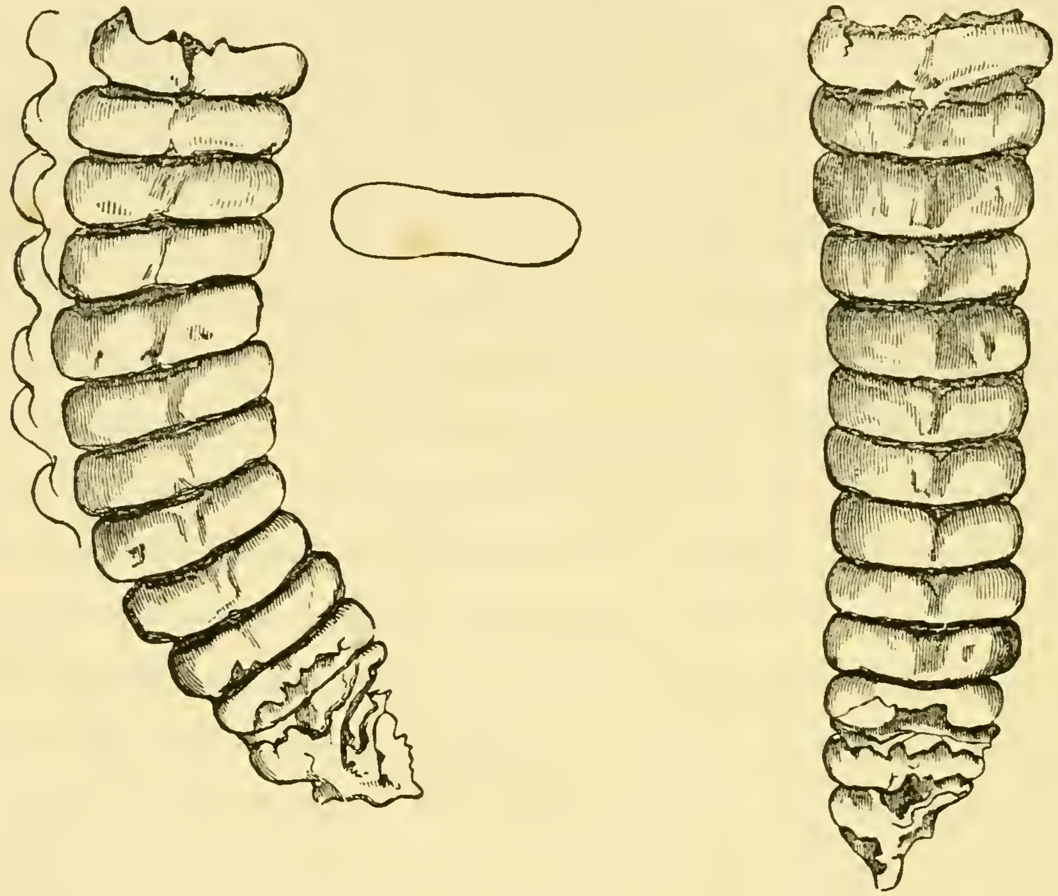
'Dans les Crotales cette extremité de la queue, au lieu d'être pointue, se trouve comme tronquée, et, par une bizarrerie que nous n'expliquons pas, il paraîtrait que les trois dernières pièces de la colonne vertébrale se seraient soudées entre elles, et comme aplaties pour composer un seul os triangulaire, avec trois bourrelets latéraux simulant des restes d'apophyses transverses des vertèbres, ainsi qu'on les voir souvent dans les trois dernières pièces du coccyx chez l'homme. Cet os anormale a été disséqué chez un Crotale, on a reconnu qu'il est recouvert d'une sorte de matière cartilagineuse dans laquelle aurait été secretée la substance cornée, comme un epiderme solide, qui conserve en effet extérieurement la forme de la pièce osseuse, sur laquelle elle a été en quelque sorte moulée et qu'elle semble destinée ainsi à protéger contre l'exfoliation, comme cela s'observe dans ceux des animaux ruminants dont la corne revêt les chevilles osseuse du véritable coronal prolongé en pointe et devenu de cette façon une arme d'attaque, et surtout de defence.'[1]

Dumeril also tells us that the peculiar structure of those few terminal vertebræ, with their knobs or pads ('*bourrelets*') upon which the skin is moulded, tends to a movement lateral rather than up and down,—that quick action which we perceive when the rattle is being vibrated. Thus the horny covering takes the form of this bone with its lobes or bulges, which instead of permitting the supposed cup-like nail to fall off as in our finger illustration, causes the links as they are pushed out to hang or cling together; and we can only suppose that the constant action loosens, and not only loosens when dead or detached, but loosens, that is to say, enlarges, the link while growing. For if you examine the spine of a skeleton Crotalus and the rattle that grew upon that spine, you will perceive that the links are a great deal larger than the '*pièce osseuse sur laquelle elle a été en quelque sorte moulée*.'

There is one other peculiarity observable in a detached rattle, which I cannot pretend to explain in any way. If you hold one up by its base or largest link, you will find it invariably hangs in a slight curve and not perpendicularly. You can straighten it, but you will not be able to curve it in the opposite direction, proving that it naturally inclines one way, whether to the right or the left of the animal while living, I cannot assert. But it is a curious feature, and one that can no doubt be accounted for by scientific observers. Thus,

[1] *Erpétologie générale*, tome vii. part. ii. p. 1457, par MM. Dumeril et Bibron. Paris.

as in the illustration below, you can curve a rattle so as to discern the interior links on one side, but not on the other. I have made the attempt with many rattles, but always with the same result. The centre fig. below is a section.



Natural position when held. Straightened by force.

This fine specimen, natural size, and also the Tapering Rattle, both from Mexico, were lent to me by J. G. Braden, Esq. of Lewes, and copied accurately.

Not the least important of all the speculations to which the rattling tail has given rise, is the question, 'Of what use is it?' for we know that nothing exists in vain. Apart from the fact that the American savages make some medicinal use of the rattle, this elaborated, curious, and not unsightly instrument has as yet had no special and determined office assigned to it to the advantage of its possessor, though theories regarding it are numerous.

Formerly, when only the dangerous powers of the reptile were understood, it was sufficient to say of it in a tone of pious thankfulness, that the Almighty had so armed this serpent as a warning to its enemies. Some of those early writers introduce the rattlesnake to us as the most benevolent and disinterested of dumb animals, conscientiously living up to his duties, obedient to that 'peculiar Providence' which has given him a rattle 'to warn the inadvertent intruder of danger.' 'He maketh such a noise that he catcheth very few,' an evidence of imprudence wholly inconsistent with his inherited 'wisdom.' Indeed, between the character given of this 'superb reptile' by Chateaubriand, and the self-sacrificing qualities assigned it by some other writers, we can only wonder how a hungry rattlesnake ever managed to survive at all, and how it is that the race is not extinct long ago.

That the early and unscientific travellers, speaking from a thankful experience of having escaped a rattlesnake through *hearing* where it was, should seek no further for the utility of the rattle, is not much to be wondered at. But so lately as 1871 one of our popular physiologists, whose work is a text-book, has expatiated on this theme so positively that it is necessary to quote his words on this 'admirable provision of nature,' which apparently has elaborated a unique appendage for the purpose of starving its proprietor!

'The intention of this organ is so obvious, that the most obtuse cannot contemplate it without at once appreciating the beauty of the contrivance. . . . It (the snake) announces the place of its concealment, even when at rest, to caution the inadvertent intruder against too near an approach.' [1]

[1] *Organization of the Animal Kingdom*, p. 732. By T. Rymer Jones.

If all the venomous serpents were thus beneficently armed (the cobras of India especially), the crusade against snakes would be at an end, or never need have been instituted; for supposing the heedless loiterer to have been a bird, squirrel, guinea-pig, or any of the lesser mammalia which form the food of most snakes, these happy creatures would have had the world to themselves long ago, while vipers had kindly starved themselves out of all traces.

'Every creature of God is good,' we must repeat and ponder over. Even a deadly rattlesnake, and every part of that rattlesnake, has its appointed use.

The 'inadvertence' (in this instance on the part of the writer who thus expressed himself) has not been without its use as well, for a more careful attention has been given to the rattle in consequence; and much controversy has since arisen among some of the ablest herpetologists, particularly in America, where much that was new and suggestive soon found its way into the scientific journals.

Briefly to summarize some of the arguments, I will repeat a few of them as suggested by some well-known naturalists. In that able periodical, the *American Naturalist*, vol. vi. 1872, the subject was thoroughly discussed. Professor Shaler, in a paper on 'The Rattlesnake and Natural Selection,' admitted that whereas he had hitherto thought and taught that the rattle did more harm than good to its owner, he now knew that the sound is so similar to that of the stridulating insects upon which some birds feed, that he had no doubt of its use in attracting these to the snake. He himself had mistaken the sound for a locust. 'Does it invite its enemies or entice its prey?' he asks. 'Those snakes that can best attract birds, are best fed.' In reply to this, a Mr. J. W. Beal of Michigan affirmed that he had often mistaken the sound for grasshoppers; which educed many similar accounts from persons who had been in danger of treading on a Crotalus through 'inadvertent approach,' supposing that only an insect were there. A child had taken it for a cicada, some one else for a locust, etc. Any one who is acquainted with the wild parts of the American Continent, is familiar with the ceaseless chirps and whizzings of those ubiquitous insects which are furnished with the stridulating apparatus, and which lead you almost to expect to see a scissors-grinder behind every tree. These are all the more deceptive on account of their varying cadences, now louder, now softer, approaching or receding, just as the sound of the rattle varies by increased or less rapid vibrations, or according to its individual size and strength. In a paper read before the Zoological Society by Mr. A. R. Wallace in 1871, he invited attention to this fact of the resemblance between the sound of the rattle and the singing of a cricket, and that its use seemed to be to decoy insectivorous animals.

Dr. Elliott Coues is also of this opinion, viz. that to an unpractised ear the sound cannot be distinguished from the crepitation of the large Western grasshopper. A case has been reported, he tells us, of a bird observed to be drawn within reach, thinking it was a grasshopper. Dr. Coues also affirms that the sound has been heard when no perceptible irritation disturbed the snake.[1]

Thus we see that the 'inadvertent intruder,' so far from

[1] From the Bulletin of the U. S. Geological Survey by Dr. Elliot Coues, Appointed Surgeon and Naturalist to the Expedition, 1878.

being warned away, is beguiled to his injury, both in the case of human beings not quick to discriminate sounds, or not having rattlesnakes in their minds, and with animals in their early experience who perhaps hear one for the first time.

Another question is, 'Does the snake sound its rattles when seeking to capture prey?'

The editor of the *American Naturalist* in the volume already quoted, thinks they do not systematically set up a rattling for this purpose; and as far as observation of snakes in confinement can be of use, this opinion may be confirmed. Probably a captive snake may have learned by experience that, hungry or not, it must wait for its periodical dinner, and that its 'dinner bell' avails it nothing. Nevertheless, we do not find that the snake uses its rattle upon food being placed in its cage, unless the rat or the guinea-pig come tumbling unexpectedly or unceremoniously upon the snake, when it would sound its rattle in alarm; but it waits quietly, silently, rather receding than advancing towards the destined prey, and then, after cautious observation, stealthily approaching to give the fatal bite. Mr. Arthur Nicols, author of *Zoological Notes*, etc., has there discussed this point, but dismisses it by declaring he has no faith in 'the dinner-bell theory.'[1]

Nor can the rattle be designed to terrify enemies or as a menace, since the sound would invite the attack of those very animals which the snake has most cause to fear, namely goats, hogs, and the large carnivorous birds that devour it. If, besides, it were used as a warning, why have the young ones, which are more in need of protection, no rattle?

[1] *The Country* newspaper, August 1878 *et seq.*

Darwin, in the sixth edition of his *Origin of Species*, 1872, writes as follows, p. 162 :—

'It is admitted that the rattlesnake has a poison-fang for its own defence and for the destruction of its prey; but some authors suppose that at the same time it is furnished with a rattle for its own injury, namely to warn its prey. I would almost as soon believe that the cat curls the end of its tail when preparing to spring in order to warn the doomed mouse. It is a much more probable view that the rattlesnake uses its rattle, the cobra expands its frill, and the puff-adder swells whilst hissing so loudly and harshly, in order to alarm the many birds and beasts which are known to attack even the most venomous species. Snakes act on the same principle which makes a hen ruffle her feathers and expand her wings when a dog approaches her chickens.' This profound thinker, then, is one of those who include the rattle among 'the many ways by which animals endeavour to frighten away their enemies.'

We may reasonably conclude that the *Crotalus*, in common with other snakes, also with dogs and cats, expresses a variety of feelings with its sounding tail, fear being the most predominant one. The Indians recognise its utility as a warning by gratefully abstaining from killing one that rattles. They superstitiously regard it as protective to themselves if not to the snake, and they in turn carefully protect the reptile. Backwoodsmen display little or no fear when they *hear* the *Crotalus*, and though they do not spare it, regard it with less bitter animosity than they display towards its cousin the Copper-head ; because, as a facetious writer has testified of it, 'it never bites without provocation, living up to the laws of honour, and by his rattles giving challenge in an honourable way.'

That the sound has a language of its own is known by the fact that when disturbed and one rattle is sprung, all other rattlesnakes within hearing take up the chorus. That the sexes also understand each other through crotaline eloquence is generally believed. In fact, to each other and to themselves they have, no doubt, as many variations in the use of their rattles, as any other animal in the expression of its tail; and probably all the above enumerated examples are at one time or another its legitimate uses. Those who have most closely observed them have detected a variety of cadences in one and the same rattle.

Those also who have carefully watched rattlesnakes under various circumstances, must perceive that timidity is one of the strongest features in this reptile. In chap. xxx. I will give examples of this. Already convinced by observation, I attributed to excessive timidity the chief agitation of the rattle, when writing on the Ophidia in the *Dublin University Magazine*, December 1875, and again in *Aunt Judy's Magazine*, July 1877. Fear causes some snakes to puff themselves; others to expand or flatten the body; fear excites the cobra to erect its anterior ribs and display its 'hood;' and, above all, fear causes most snakes to hiss. Fear is coupled with anger, in these attempts to do their best towards repelling the offender. Dr. E. Coues, in speaking of the rattle, supposes it to have possibly 'resulted in the course of time from the continual agitation of the caudal extremity of these *highly nervous and irritable creatures*.' Dr. Weir Mitchell has known captive snakes to vibrate the rattle for hours at a time; and probably, if there were opportunities of becoming more intimately acquainted with crotaline idiosyncrasies, we should discover some snakes to be more or less afflicted with temper, nervousness, terror, or other emotions which induce an animal to express its feelings in its own way.

But the most remarkable peculiarity in this snake is that no other way *is* in its power: *a rattlesnake never hisses.* Throughout the numerous arguments, theories, explanations, and suggestions, there is such an absence of allusion to this fact that we must suppose it to be very little known. Says Dumeril in describing *les petits étuis cornés, comparé à celui que feraient plusieurs grelots peu sonorés: 'Les Crotales diffèrent de tous les autres serpents connus par la faculté qu'ils ont de produire des sons sourds et rapides, ou plutôt des bruits continus et prolongés à l'aide d'un organe spécial, qui supléerait —pour ainsi dire—à la voix, dont ces serpents sont toujours privés.'*[1] But the sibilations of the rattle are often so like hissing that they have been compared to the whistling of wind among the leaves, to the escape of water through a pipe, to the whizzing of insects, the rattling of seed pods, and many similar sounds, showing at the same time the character of the noise and its variability.

Concisely recapitulating what this rattle does, we understand that in the first place it is a substitute for the voice— so far as hissing can be called voice; and that what would cause other excessively nervous, timid, terrified snakes to hiss, causes the rattle to vibrate. It may attract insectivorous birds; it may alarm other timid creatures; it may summon its

[1] *Erpétologie générale*, tome vii. p. 1456.

mate ; and, as is well known, it has sympathy with its mate ; for a second rattle is almost sure to be sounded, and they have been observed to sound in pairs or numbers responsively—it may be to express anger, fear, and for aught we know *pleasure*, in a state of liberty and enjoyment, feelings expressed by the tail of other creatures.

Why it is formed as it is, so wholly different from all other tails ; from what it has been evolved ; and how long in evolving,—all these are problems to be solved by future Darwins and future Evolutionists.

This chapter, therefore, closes with only feeble speculations after feeble attempts to explain an inexplicable phenomenon. The simplest and truest solution seems to be found in those few words, '*qui supléerait à la voix, dont ces serpents sont toujours privés.*'

Again, we wonder whether in the non-hissing serpents any peculiarity of trachea may be observed.

CHAPTER XVIII.

THE INTEGUMENT—'HORNS,' AND OTHER EPIDERMAL APPENDAGES.

HAVING decided that in animal organization nothing exists without its especial use; assuming also that the peculiar development of cuticle forming the rattle is to supply the deficiency of voice, we are next induced to examine those other appendages in serpents which are also modifications of the integument, such as the 'horns' of the Cerastes, the tentacles, snout-protuberances, and developments occasionally seen about the head of snakes, and which have all, no doubt, their uses.

'Serpents are naked,' says Günther—that is, they have no separate epidermal productions in the way of fur, feathers, hair, or wool, and all the variations of form in scales are but the folds of the epidermis.[1] The 'variations of form' include, therefore, the appendages above mentioned.

The heads of most snakes are covered with non-imbricated plates or shields. The form and position of these shields are in a great measure used in classification; 'are of the greatest

[1] *Reptiles of British India*, by Dr. Albert Günther, F.R.S.

value for distinction of species and genera.'[1] For this reason each and all of the head shields are specially named.

Ophiologists differ slightly in distinguishing them as regards assigning the exact position of some of the shields, which, like all other ophidian features, vary in closely allied species. As, for example, while one naturalist may decide that a certain shield is exactly over the eye, another may consider it somewhat to the right or the left.

Günther's classification being the one now generally adopted, I copy the names assigned by him, and the diagrams given in his work.

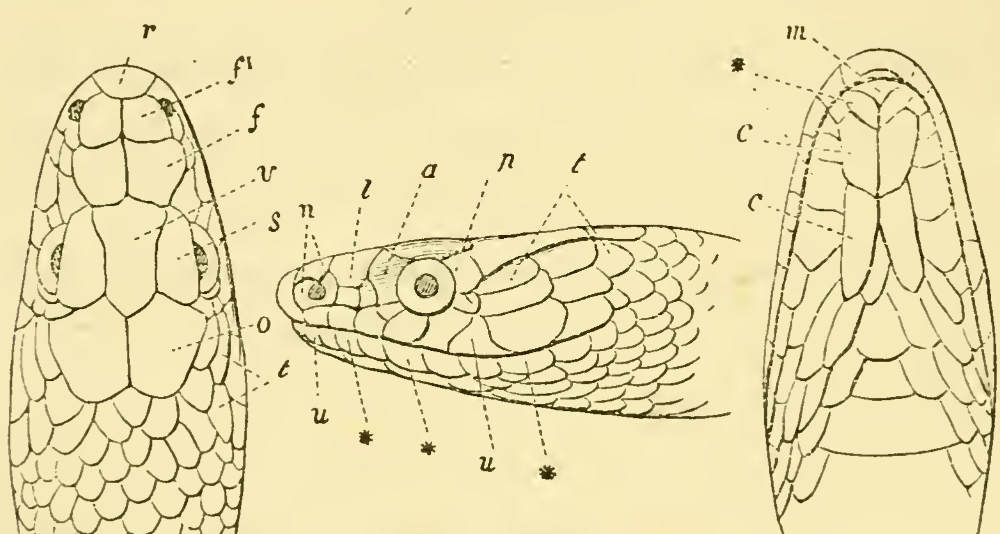


Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Top of the head of a Colubrine snake. *r*, rostral; *f'*, anterior frontal; *f*, posterior frontal; *v*, vertical; *s*, supraciliary; *o*, occipital; *t*, temporal.

Fig. 2. Profile of the same. *t*, temporal; *p*, posterior ocular or orbital; *a*, anterior ocular or præorbital; *l*, loreal; *n*, nasals; *uu*, upper labials; **, lower labials.

Fig. 3. Under side of the same. **, lower labials; *cc*, chin-shields; *m*, mental or median lower labial.

It will be observed that some of these shields can be seen both in the profile and the others as well; as, for instance, the

[1] *Reptiles of British India*, by Dr. Albert Günther, F.R.S.

temporal and the labial or lip shields. The study of them is simplified by the initial letter of each name being used in reference to them. The names used also speak for themselves; as *mental*, the chin shield; *nasals*, near the nostril; *rostral*, the beak shields.

Ophiologists in deciding species, etc., enumerate those which are more than a pair as 'upper labials' so many, 'lower labials' so many. In some snakes these shields are so large as to cover nearly the entire head; in others, they are almost inconspicuously small, or absent altogether, and much varied, as we shall see.

In the vipers the head is generally covered with small, rigid, imbricated, or over-lapping scales instead of plates, and in some the scales are so extremely fine and closely arranged as almost to represent short bristles. This is noticeable in the African 'nose-horned viper' (*Vipera nasicornis*), p. 322, where they present a curiously complicated structure.

Magnified carinated scale.

Magnified head-scale of *Vipera nasicornis*, of the coloured illustration.

Too minute to examine except under the magnifying-glass, or to attempt to illustrate, we can convey only a general idea of these curious viper scales, which to the touch are spinous, and rough as a coarse brush. They must form an unpleasant perch for a bird, if it be true that the latter is enticed by the horns of some vipers to come and peck at them, as at a worm. These rigid head-scales become gradually larger and more simple on the body, but are still comparatively small for so large a serpent. In some few of the viperine snakes, plates are present as well as the fine scales, though chiefly about the nose and mouth, exceptions which are now and then found in non-venomous ones also. The preceding three illustrations are the head shields of a Colubrine snake, in which a greater uniformity prevails. Below are given four other types, though even here variations are constantly occurring.

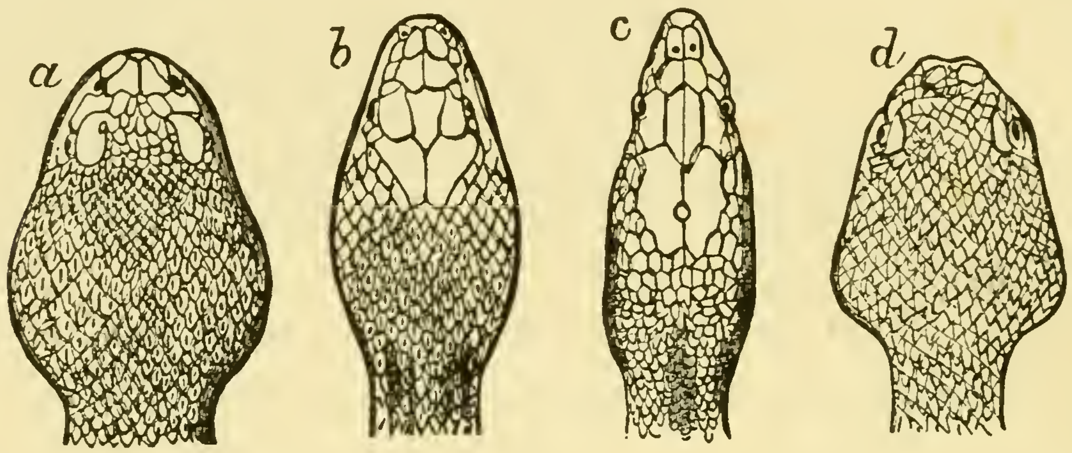


Fig. a. One of the Indian *Crotalidæ*. It has two conspicuous supraciliary shields, two equally conspicuous anterior frontals over the nostril. The rest are small, and those on the top are absent altogether. The scales are all finely carinated.

Fig. b. The head of a Colubrine snake in which the same scales appear as those in Fig. 1 of the preceding page, viz. two orbitals, etc., but are all much smaller, and do not therefore more than half cover the head.

Fig. c. The head of a sea snake, which as to design is really pretty, and, as Günther affirms, so different from land snakes in respect to head shields, that without any further investigation an ophiologist can at once distinguish the *hydrophidæ*.

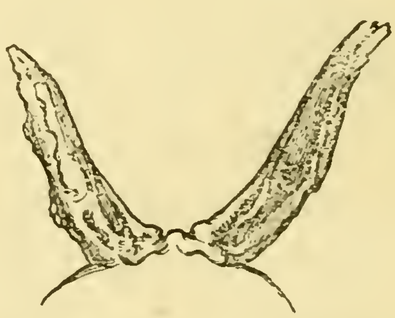
Fig. d. The head of a viper in which only very small supraciliary and nasal (or anterior frontal) shields are seen. The angular form of the viperine head is here noteworthy. In some of the Tropical American viperine species (the *Crotalidæ*) the angular head is so marked as to be separated into a genus — the *Trigonocephali*, three-cornered heads. One head is sagittate or arrow-shaped to such an extent that the serpent is known as the *Fer de lance*, the dreaded *Trigonocephalus lanceolatus* of the Antilles. There are *Trigonocephali* among the Indian Thanatophidia also.

One other very remarkable exception must not be omitted—namely, that in pythons may be seen an angular head, which makes the neck thin and conspicuous, only in a less degree; and also the absence of large head shields. In addition to this, many of the pythons have particularly short and very pointed tails—three singular viperine features in non-venomous snakes, which can only be inherited from a common ancestry.

Another caprice is seen in the carinated or keel-shaped body scales, which are found in venomous and non-venomous, land and water, ground and tree snakes indifferently; though I think one may be safe in affirming that none of the true vipers have unkeeled and polished scales. Nicholson has observed that in several allied species, some have and some have not the keel, and that those without do as well as those with. 'The history of the keel is not known,' says this author. In appearance it reminds one of the mid-rib of a leaf or of a feather, and may probably be an inherited feature in common with birds whose reptilian ancestry in process of ages had fluttered their scales into feathers. In fact, in many snakes where no keel is found, there is some slight indication of a centre line, even if it take the form of a groove or depression. In the *Tropidonoti* the keel is so developed as to distinguish the group; yet many with keels have comparatively smooth skins. The carinated scales of vipers (from *carina*, a keel) are sharply defined, like the keel at the prow of a ship, or like the breast-bone of the swift-flying birds which Mr. Sclater, in one of his zoological lectures, described as the carinate birds. It is these sharply-defined, stiff, and dull scales belonging to the vipers which produce the rustling noise when the snake is agitated, as described in the little Indian *Echis carinata* in the chapter on hissing. In the *Cerastes* I have witnessed the same agitated convolutions accompanied by the audible rustling produced by the rough scales. See illus. p. 317.

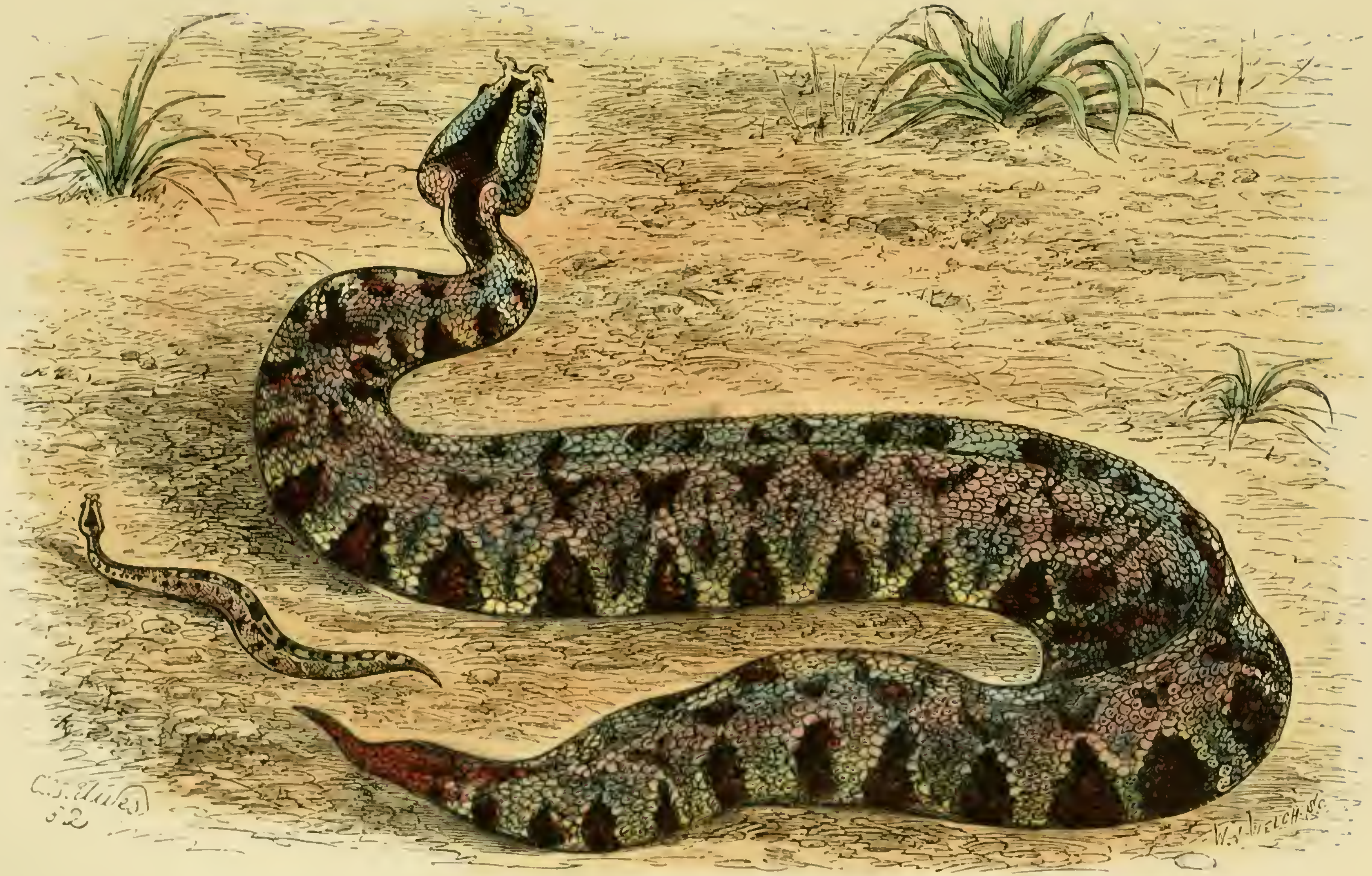
What are called 'horns' in some of the African vipers are curiously-modified scales, which, under close examination, present the appearance of half-curled leaves, sometimes of ears, like those of a rabbit or a mouse. Being only cuticle, and liable to injury, these 'horns' vary in size and colour as well as form.

The accompanying figure is from the slough of the *Vipera nasicornis* of the coloured illustration. They were not reversed in desquamation, but came off with a portion of the fine spiny head scales. They were so dry and shrivelled at the time, that



The sloughed horns of *Vipera nasicornis* (exact size).

it is hard to conceive how they could possibly be reversed, the rest of the bristly head-scales peeling off in pieces. Yet we cannot conclude from this that the horns are *never*



VIPERA NASICORNIS AND YOUNG ONE.

AFRICA.

Mother over five feet long, Viperling 9 inches.

reversed in sloughing; the individual in question having undergone long captivity in a close box during her journey from West Africa, and arriving at the Zoological Gardens in such a miserable plight that it was difficult to distinguish species or colouring for many days. In this condition she remained for five weeks, when one fine Sunday afternoon she presented the Society with forty-six viperlings.

Soon after this event she discarded her way-worn and bedraggled garment, and shone resplendent in gorgeous colouring, as presented to the reader in the coloured illustration.

Her portrait was not taken until some weeks afterwards, when the horns were therefore a little dry and shrivelled again. With the new dress they presented a well-defined and perfect curve, tapering to a point, and without any break in their outline. By degrees they became curled in the manner here represented. Her colours were of a rich prismatic hue on the sides, where the brilliant tints are so blended that to paint them is impossible. Only on the back and in the darker markings can the pattern be fairly represented. Her children all resembled her in their rich tints, and were so handsome that one almost forgot their evil propensities.

Forty of them died within a week. I begged hard for one of the deceased. The keeper of course had no power in his hands. All were wanted for scientific experimentalists.' Alas, I was no scientist, but only a woman! The following Sunday, when I was at the Gardens, the forty-first baby viper had just died. The Superintendent 'happened along,' and was greeted with another appeal from me. He would 'consider of it' and let me know 'to-morrow.' 'Oh, why not *now?'* pleaded the reader's devoted servant. 'You can't want forty-one little dead vipers!'

Suddenly to the rescue appeared on the scene no less a personage than Dr. Günther, and to him I urged my request. 'Well,' said he in reponse to my eagerness, 'one of Our Council is here, and'— Yes, the F.Z.S. referred to had, with the Superintendent, just passed the iron barrier to view the interesting little survivors, and Dr. Günther followed, while I discreetly remained outside. My suspense was not of long duration, for soon reappeared the amiable Superintendent daintily carrying a little paper bag which might have contained bon-bons. 'Fortunately,' said he, 'two of Our Council happen to be here, and so,' etc., and I became the happy possessor of the scarcely cold viperling, here faithfully represented by the side of its mother. Exultantly I carried it off to a sequestered spot,—thinking chiefly of *you*, dear readers,—and examined its 'horns,' which wore the appearance of an ornamental top-knot rather than horns. They were like a bow, or two little ears, or half-unfolded leaves. Its colouring was gorgeous, but the pattern is too fine and complicated to represent on so small a scale. The black triangular mark on the head of both mother and child was like velvet in its density. Nor was this appearance lessened under the lens; for quickly I ran off with my treasure, and spent a delightful 'evening at home' in studying its 'points,' not even excepting those of tongue and fangs. The former is represented on p. 120, and the latter on p. 360. The other results of my investigations come under their separate heads in this book.

Another of the horned serpents, *Vipera cornuta,* has a cluster of leaf-like scales in three distinct pairs decorating its nose. These in the individual at the Zoological Gardens were particularly ear-like, and there was a remarkable peculiarity about them which was not found in either of the other horned specimens when dead. It was, that when one horn was moved divergently with the finger, its fellow moved *without being touched* to correspond, and when let go *both* sprang back to their original position. I at first was merely feeling and examining them when this singularly sympathetic movement arrested my attention. Then I tried it with each of the six scales or 'horns' several times, and always with the same result. Whichever one of them was held back, the opposite one diverged at a corresponding angle.

1. Natural position.

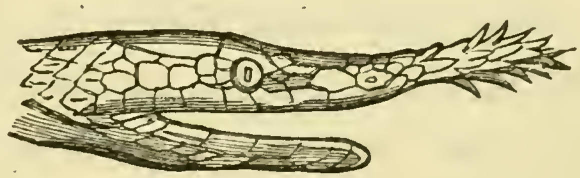
2. Three held back to their utmost.

3. Three held back partly.

Their natural position is nearly erect, and when one horn—say the longest to the right in Fig. 1—was pressed or pulled outwards, we might suppose that in a dead specimen it would drag its fellow that way also, should any movement at all take place; instead of which, it flew off in the opposite direction, like two negative or two positive poles repelling each other. If I pressed the three to the right as much as in the centre figure, the other three receded similarly to the left. Each pair acted in concert in this remarkable manner, or each two pairs, or all three pairs.

The three sketches are given merely in illustration of a phenomenon which I cannot attempt to explain or even to comprehend. They were drawn from memory, and are not therefore offered as exact representations, though near enough to serve our purpose. The movement seems to argue some peculiar muscular or nervous connection between each pair. The serpent had not been long dead; and as no others of this species have since been at the Gardens, I cannot tell whether the same sympathetic movement would be seen in the living viper. I have attentively watched the horns of the other vipers, but never detected the slightest voluntary action in them. Nor do the horns of *V. nasicornis* respond to the touch in the same way. A third of the horned vipers is the *Cerastes* of classic times. Illustrators of books from descriptions only have presented us with this serpent adorned with horns like a young heifer. They are simply scaly appendages like the rest, but when perfect do certainly curve backwards and upwards in a rather bovine fashion. It happened that a *Cerastes* was brought to the Gardens just after the six-horned viper had died, affording me a happy opportunity of examining it. It was of this viper that Pliny wrote: 'It moves its little horns, often 4 in number, to attract birds, the rest of its body lying concealed.' It is the habit of all those inhabiting sandy deserts thus to hide themselves, probably to escape the scorching, drying sunshine, and with perhaps the nose and upper part of the head exposed for breathing. I have carefully watched several of the horned vipers for a long while together, but have never detected the slightest volitional movement in their horns. A bird might come and peck at them, nevertheless. Another belonging to South Africa (*Lophophrys*) has a bunch of irregular and much shorter horns standing erect and apparently unpaired. Incipient horny scales often accompany the regular pairs, making it difficult to decide exactly which was Pliny's of the 'four horns,' and which is the *Hexacornis* of Shaw. Varieties exist and add to the perplexity; probably also hybrids occur among these as among non-viperine snakes.

A curious variety of the nasal appendages appears in the *Langaha* with the *crête de ccq;* only the crest is on the snout instead of on the head.


Profile of *Langaha*.

These spurs are merely modifications of the epidermis like the rest; but are, no doubt, endowed with peculiar sensitiveness, so that possibly they act as a sort of herald in the dark, like a cat's whiskers.

There are the pointed-nosed Dryophidians also, with scaly protuberances, and others with variously-elongated snouts terminating in long, scaly, horn-like appendages, all, no doubt, more or less sensitive, to enable the owners to feel their way, or ascertain the nature of their surroundings, especially if they are of nocturnal habits.


Profile of *Passerita*.

In some of the tree snakes, notably *Passerita*, there is no appendage, but the long snout is itself endowed with mobility. This is a nocturnal snake; a harmless and exceedingly slender, graceful creature.

But of these curious developments or prolongations, one of the Indian fresh-water snakes presents a remarkable example, almost allying it to some of the fishes with long tentacular appendages. *Herpeton tentaculum* is its name, its pair of tentacles being scaly and flexible, and in appearance somewhat like the African viper's horns, sticking out horizontally from its snout. They are employed under water as organs of touch, and probably to discern food.

These are some of the most striking head-appendages; though in the way of pug-nosed ophidians and curious profiles we might give a whole page of illustrations.

In the acrobatic chapter, mention was made of a pair of rudimentary hind limbs in some of the boas. Externally the derm is condensed into 'claws' or 'hooks.' In form they are merely long, simple appendages, which in the largest boas are about as big as a finger. Claws and hooks they are in the matter of use, being a pair, and they no doubt assist the climbing snakes in grasping.

As a condensed form of the tegument, they are included in this chapter; but as they are truly vestiges of limbs, I will digress a moment to add a word.

Says Darwin on rudimentary and atrophied limbs: 'The disuse of parts leads to their reduced size: and the result is inherited.' Some tame little lizards in my possession—our native species—when crawling about their cages scratching the sand or pushing their way among the moss and rubbish, frequently made use of their fore legs only, allowing the hind legs to drag after them, not because the latter were in any way injured, but simply because the lizards could do well enough without them. They were folded back or permitted to lie passively prone against the tail, while the arms and exquisite little hands were sufficient for the work required.

They reminded one of Darwin's words, and though my style of talking to my pets was such as to suit lizard comprehension solely, I did sometimes warn them in plain English. 'If you don't give your legs sufficient exercise, they will dwindle away by and by, and your descendants will have no hind legs at all!'

After thus moralizing to the unheeding lacertines, it was with secret gratification that one heard Professor Huxley, in his Lecture on 'Snakes' at the London Institution, Dec. 1, 1879, say—as nearly as I can remember—'In evolution or a gradual change, the lizard found it profitable to lose its legs and become a snake; all modifications are an improvement to the creature, putting it in a better condition.' In this 'better condition,' therefore, does the slow-worm find itself, when it glides noiselessly, and almost without stirring a blade of grass, into its burrow. In other lizards one may sometimes observe that the *hind* legs are most used in scratching and pushing the earth away. Thus, in the constricting snakes—these descendants of some pre-ophidian lizards—the unused limbs have become obsolete; and the spine, gaining strength with increased action, has at length become to the constrictors their hands, feet, arms, and legs, and endowed with those wondrous capabilities which were described in chap. xii.

To return to the integument. As one of its developments, the hood of the cobra may be included in this chapter, the skin here exhibiting its extensile or expansive construction. It is the longer ribs, about twenty pairs nearest the head (see p. 33), which really do form the hood. These anterior ribs, gradually increasing in length and decreasing again, are not connected with the ventral scales in the same way as those on which the snake progresses, but can be elevated or expanded in the manner familiar to the reader ; they then support the extended skin exactly in the way that the ribs of a lined parasol support the fabric ; only while the ribs of the parasol spring from a common centre, the ribs of the cobra are attached to its vertebræ, requiring no other agency than the will of the owner. The action of the ribs as expressive of emotion, in several species of snakes, was mentioned page 150. In the 'hooded' snakes (*naja*), it is seen in an extreme degree. Facing you, the angry cobra displays these umbra-like expanded ribs, while the form of the 'neck' or vertebral column in the centre is prominently perceptible. When at rest, they all lie flat one over the other, like the ribs of a closed parasol.

In the way of external peculiarities the 'gular fissure' may be mentioned. It is merely a slight groove or crease extending from the chin longitudinally under the throat for a few inches or more, according to the size of the snake ; a sort of wrinkle (*fosse*) to admit of expansion during the swallowing of prey.

Externally snakes have no indication of ears ; therefore, in the way of integument, there is nothing to describe in their organ of hearing. But the eye covering is a beautiful and wonderful arrangement.

Snakes have no eyelids, and can therefore never close their eyes, a fact which has given rise to a vulgar belief that they never sleep. Their eyes are, however, well developed, particularly in those snakes which live above ground, and are covered with a transparent layer of the epidermis, forming a capsule which is moulted with the cuticle. Physiologists tell us that it is moistened with the lachrymal fluid. Bright and glistening is the serpent's eye, except previous to desquamation, when, from the new skin forming beneath, it becomes opaque and dull, and the snake is blind for a few days more or less, according to its health at the time. Rymer Jones considers the transparent membrane cast with the slough a real eyelid in a framework of regular scales; Huxley (in the lecture already alluded to) said snakes' eyelids are as if our two eyelids were joined. In form and appearance this moulted cuticle is singularly clear and shapely: on the outer side, like a miniature watch-glass; but within it is a perfect cup, standing up and out from the surrounding scales like a cup in a saucer, the rounded base of which is the transparent skin, as here seen.

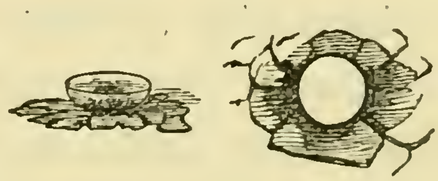


Illustration of eye covering.

For the process of sloughing or casting the skin, the term desquamation—literally, an unscaling—is often used; but this word seems rather to imply an unhealthy action, as if the cuticle peels off in pieces, than the normal operation, which is to shed it entire.

It is a matter of surprise—if we are to believe what we read—that few naturalists seem to have witnessed this process, so as to be able to describe it from their own observations; but this must be due more to lack of interest than of opportunity, since the occurrence is very frequent. Those in the vicinity of Zoological Gardens have no excuse for not observing it; yet so lately as Oct. 1879, we find a writer in *Nature*, vol. xx. p. 530, attempting to describe the 'skin-shedding,' with the admission that he has never witnessed the process, nor, he believes, 'has any observer'! He thinks snakes shed the skin 'as if you turned a narrow hem, or a glove-finger by a knotted thread fastened at the tip,' and which of course would draw the tip *inside* the finger. The glove tip is to represent the tail of the snake, which, as he supposes, adhering *at the tip*, is drawn along *inwards* as the snake proceeds to crawl out of its own mouth, or its cuticle's mouth—which has already become loosened round the lips. This, in the mind of that writer, satisfactorily accounts for the skin being usually found reversed! Can he have never seen a silkworm change its skin; or found the slough of a common caterpillar adhering to its tail; or observed the appearance of its mouth previous to the moulting? True, a slow-worm sometimes leaves its slough in a crumpled-up condition, exactly like the silk-worm's. This I have seen. On the other hand, the same little reptile, on another occasion, crawled out of its coat, leaving it perfect and unreversed through its entire length. Both sloughs have been preserved. As a more general rule the slough is reversed; but in the process it folds back and over the body, *outside* of it, in the manner of a stocking drawn off from knee-wards, and turning back till entirely reversed it leaves the foot. This common and apt illustration is easily understood if we suppose the top of the stocking to be the mouth of the slough, and the toe its tail. But as the toes might sometimes slip out of a stocking when nearly off, so does the tail of a snake sometimes slip out; this portion therefore is often found *unreversed*. More than a hundred years ago the sloughing of snakes was understood and described in the *Phil. Trans.* for 1747, vol. xl.; as also of lizards 'slipping off their skins as vipers do.' Some young vipers changed at six weeks old, and again in two months after that. 'They always began at the mouth,' said the writer. The process has been witnessed and described by many since that, though more by foreign than by English naturalists.

Some of the older writers have told us that 'a snake frequents the spot where it has cast its skin,' or, in other words, that it selects that locality for its nest—a fact as curiously stated as if you related of a person that he chose for his home the house in which he performed his toilet. Snakes have a strong affection for locality; and where their nest is, there, or near it, their garments are naturally renewed.

Another mooted question has been the precise period of sloughing; formerly the accepted opinion was that once a year, viz. in the spring, was the usual habit. This was probably from so many coils of skins being found at this season. That they do change in the spring may be established as an almost invariable rule; but not then only. No precise periods can be given with certainty, because it depends on the individual, its health and surroundings. The ophidian is a fastidious creature, and when his garment becomes soiled or uncomfortable he discards it. Thus after hibernation, when for some months numbers of snakes have been coiled in masses in a cave or under stones and rubbish, and they emerge into daylight, aroused by the sun's revivifying rays, what more natural than to cast off the old winter garb for a more comfortable suit?

Almost invariably, soon after a long journey, and on being established in a new home, a snake re-attires. We have seen what their travelling cages are! Closely nailed up, and often in air-tight boxes in which the poor things are tumbled over and over with as little mercy as ceremony during removal from one conveyance to another, they arrive—as in the case of the African viper (coloured illustration)—in such a pitiable plight that it is next to impossible to identify them. Another almost invariable rule is sloughing soon after birth—that is, in from a week to a fortnight; also, during early and rapid growth, the young snake will change frequently. Most ophiologists fix upon two months as an average time, taking one snake with another; for while one may desquamate every few weeks, another may keep his coat unsoiled for six months.

Sir Joseph Fayrer made careful notes on this subject. He had one cobra which changed in rather less than a month—viz. first on Oct. 17th, next on Nov. 10th, and again on Dec. 7th. A *Liophis* at the London Gardens changed every few weeks, and a *Ptyas*—he of the lecture exhibition (p. 214)—changed almost once a month on an average.

A curiously beautiful object is the cast-off coat, and well worth an examination. You discern the exact form of the reptile's head, mouth, and nostrils, the exquisitely transparent eye-covering, the various forms of the overlapping or imbricated folds or 'scales,' and how admirably the broad ventral plates are adapted for locomotion; particularly noteworthy too is the perfect reversion of this coat of some feet or some yards in length, turned inside out as you may turn a sleeve.

The first time I watched the process was with the celebrated Hamadryad soon after it was installed as a distinguished inmate at the Zoological Gardens. The interest attached to this *Ophiophagus* or snake-eater had caused me to observe it on all possible occasions; and as the whole front of its cage was clear glass at that time, the spectator could easily see all that occurred within.

Will the reader once more accompany me in imagination to the Gardens, and see how a snake performs its toilet? I have watched many since then, and have observed the same proceeding in them all, those in good health and able to assist themselves; in others it is a literal desquamation or peeling off of scales or fragments in a dry state. Encouraged by the very recent statement in a highly scientific journal, that no one is supposed ever to have witnessed the sloughing of snakes, I venture to again describe what I saw, having already done so in the *Dublin University Magazine* in Dec. 1875, and in *Aunt Judy's Magazine* (Sept. 1874), and elsewhere.

We stand before the cage of the interesting Hamadryad (*Ophiophagus elaps*). His name at once tells us that he is fond of trees as well as of snakes; but, alas! there is no tree in his cage, not even an old bough on which to exercise his climbing propensities. He is wonderfully restless to-day, crawling ceaselessly about as if in search of something. This, however, cannot be his object; for his head is not raised in observation, but is close to the shingle, as if too heavy to lift. He seems to be pushing it before him in a very strange manner, and is evidently suffering discomfort of some sort. All round his cage he goes, against the edge of the tank, still pushing and rubbing his head, now under his blanket, or against any projecting surface, under again, close to the floor, restlessly on and on in these untiring perambulations; what can be the cause? After a tedious while 'Ophio'—as his admirers call him—varies his movements, but only to turn the chin upwards and push his head sideways over the shingle. Now the other side he pushes along: the action is like that of a cat rubbing her head against your chair. Now he turns his head completely over, so that the top of it may come in for its share of rubbing; and such for a considerable time are his persistent movements, while we watch him wonderingly, and at length point him out to the keeper inquiringly.

'Going to change,' said Holland. 'That's the way they always do.'

To you and me, dear reader, the sight is novel and interesting; so let us continue to watch, glad that nothing more serious is the matter with this rare and valuable snake than doffing an old coat.

And soon we see the skin separating at the lips, where, no doubt, it has caused irritation and induced that incessant rubbing. Now the entire upper lip is free, and the loose portion laps back as Ophio pursues his course. Next we see the skin of the under lip detaching itself; and that is also reversed, the two portions above and below the jaw increasing every moment and folding farther and farther back with the ceaseless friction until they look like a cape or hood round Ophio's neck, from which his clean bright head emerges. Hitherto the process has been tedious, but now the ribs are reached, and they take part in the work and facilitate matters greatly. The snake has no longer to rub himself so vigorously, but simply to keep moving; and at every step, so to speak—that is, with every pair of ribs in succession beginning at the neck—the large ventral scale belonging to that pair is shoved off, carrying with it the complete circle of scales. With an almost imperceptible nudge each pair of ribs eases off a portion, which continually lengthening as it is vacated, and reversed of course, folds back more and more, till Ophio looks as if he were crawling out of a silken tube. As he thus proceeds, now very rapidly, he emerges bright and beautiful—six inches, a foot, two feet; and all the while each pair of ribs successively performs its part with that nudging sort of action, like elbowing off a coat sleeve. If we had begun to count from the very first pair, and if he had not gone under his blanket during the process, we could have told the precise number of pairs of ribs which he has to assist his toilet. He had two yards and a half of old coat to walk out of, but this he achieves in far less time than it took him to get his head clear. In his native tree or jungle he would have found leaves and underbrush to aid the operation; and it would be a great kindness to snakes in captivity to provide them with wisps of straw, when sloughing, or some rough rubbish in their cages. Soft blankets and smooth wood-work do not offer sufficient resistance for them.

The constricting snakes are less at a loss. From their pliancy of motion, and their habits of coiling—from the fact of their 'whole body being a hand,' as we have already seen, they can assist themselves by their own coils passing through them, and so helping to drag off the slough.

Those who have kept snakes tell us that the tame ones will even leave the slough in the hand, if you hold them during the process, and permit them to pass gently through the closed fingers. Owen, in his *Anatomy of the Vertebrates*, mentions as a not unfrequent action, that when the head is free from the slough the snake brings forward the tail, and coils it transversely round the head, then pushes itself through the coil, threading its body through this caudal ring.

But we have left our captive with still about a foot and a half of garment to get rid of, and this is not much less difficult to accomplish than the head-gear. He has arrived at the last pair of ribs, and now, without such agency to free the tail cuticle, he more than ever needs some opposing obstacle. He has only his blanket, however, to pass under; and at last, by dragging himself along, the process is completed, the extreme few inches sliding off unreversed.

On several subsequent occasions the Hamadryad has left the entire tail, often *nearly* all of it, unreversed, as do many other snakes. Sometimes by a succession of jerks they manage to get rid of this portion; sometimes a comrade happens to pass over the slough—a great assistance, as affording resistance. I observed this particularly in a small constrictor, one of the three that entrapped two or three sparrows in as many coils at the same moment. In this case the whole process occupied less than ten minutes. After rubbing its head against the gravel, and turning it completely over to free itself from the upper shields, its ribs took chief part as usual, and I noted particularly that each pair moved in concert, and not alternately. This little snake went round close under the slanting edge of his bath-pan, which afforded him some assistance, and by the time he reappeared in front the whole slough was discarded, excepting a few inches of tail. These few inches caused some trouble, until his friend the python happened to pass over it, when with one final jerk the slough was free and entire from lip to tip. It was the quickest and most complete sloughing I have ever watched.

When all was over, the large, beautiful black eyes of this four-striped or 'four-rayed' snake were particularly brilliant, as the little constrictor looked about and watched observantly, rejoicing in his newly-found faculty, after the blindness of the preceding days. Often the snakes are shy, and change at night; the tamer ones, however, undress when it suits them, affording frequent opportunities for observation.

The slough when first discarded is moist and flabby; but it soon dries, and then in substance is as much like what is called 'gold-beater's skin' as anything else, though a stronger texture is observable in the head-shields and the ventral scales.

The size of the scales does not appear to bear any very regular correspondence with the size of their owner; for you will notice that some snakes only three feet in length, have larger scales than others three yards in length. Some of the immense pythons have smaller scales than a rattlesnake; and again, snakes of similar dimensions have scales different both in size and form. As great a variety is seen in the form and arrangement of scales as of shields.

Snakes are to a certain extent invalids previous to the shedding of their skin, temporarily blind, courting retirement, and declining food; but they recover triumphantly the moment the slough is discarded. They then appear to rejoice in a new existence, their functions are in fullest activity, their appetite keen. At this time the poisonous kinds are most to be dreaded, probably from the venom having accumulated during the quiescent condition.

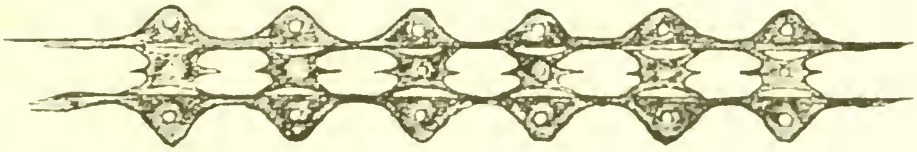
At this time, too, their colours show to the greatest advantage, their eyes are brightest, and their personal comfort no doubt is enhanced in every way.

Before taking leave of the integument, a few words about the markings or patterns and colouring of serpents may not come amiss. Mr. Ruskin, in his celebrated lecture on Snakes, exhibited to his delighted audience a fine anaconda skin, and drew attention to the 'disorderly spots, without system,' with which this snake is marked. *Taches à tortue*, as it was at first described; and by Dumeril as marked '*avec de grandes taches semées sans ordre.*' Notwithstanding the irregularity the skin is handsome. The oval spots of various sizes and at unequal distances have still a character of their own, as much as the spots of the leopard or the stripes of the zebra, no two of which are placed with mathematical precision. Mr. Ruskin had but few kind words to bestow on ophidian reptiles, but the disorderly patterns of their coats he greatly disapproved. Moreover, the great artist was inclined to pronounce a sweeping verdict on the conspicuous 'ugliness of the whole *poisonous* families' without exception.

Now unfortunately we have had occasion to lament the good looks of many venomous kinds which are easily mistaken for harmless snakes. Some of the American *elapidæ* are amongst the most beautiful, with their black, white, and crimson rings. The African viper and her young one baffle the artist's palette in their prismatic hues, as do several other of the horned snakes. Indeed, for rich colourings the venomous kinds rather carry the day. The *form*, it is true, is often clumsy and ungraceful in the vipers, but as an exception we have '*vipera elegans*,' and others of less ugly and slighter forms.

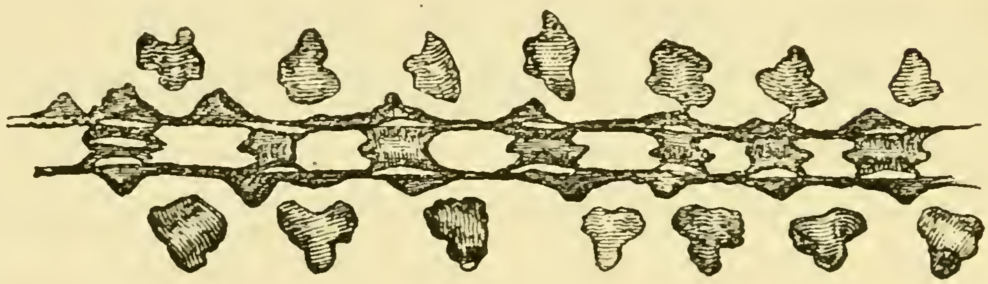
Since the subject was thus presented to us, I have, however, observed the markings more closely; and it really is curious as well as interesting to note how very nearly the various patterns approach to a perfectly geometrical design, yet failing in the same manner that a bad workman would fail in imitating the pattern given him to copy.

To Dr. Stradling I am indebted for a very handsome boa skin from Brazil. Spread upon the carpet it is like a piece of oilcloth, and at the first glance I exclaimed, 'Even Mr. Ruskin could not disapprove of this.' But on closer inspection one was obliged to admit 'disorder' throughout. The skin is about ten feet long, and the whole way down the centre of the back runs a pattern which an accomplished artificer would thus represent.



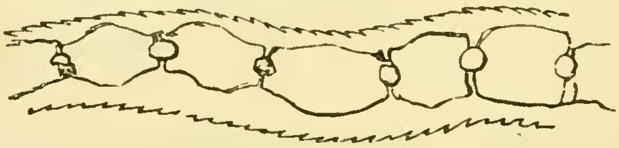
Plan of design.

There is evident intention of two straight lines with points at equal distances, a very pretty centre of rich brown, picked out with darker shades and spots of white. Throughout the entire ten feet of skin most of the points and intermediate centres had a splash or spot of white, and most of the points were opposite, but no two feet consecutively could I find with better finished markings than this.



Exact pattern with the lateral spots.

The outer spots also were evidently of triangular intentions, and for the most part occupying the spaces midway between the points. These, of lighter tints, also run the whole length of the snake, the pattern of course diminishing with the size tailwards, but varying in no other way. The question is not whether the strictly geometrical or the less perfect design would be the handsomer, or we might give the preference to the pattern as we find it; but looking closely at any elaborately-marked snake, it certainly *is* curious to perceive that in every case there is this same attempt at something too difficult to accomplish, as when a novice in fancy-work does her stitches wrong. The same thing is seen in the snakes of the frontispiece, and the same is seen again even in this simple pattern, a chain running down the back



Pattern of a snake.

of little *Echis carinata*. The spaces are unequal, the black cross bands imperfect, and the centre spots some round, some oval, some almost absent.

May we conclude that this incompleteness is a sign that the design is not fixed by long inheritance? But if it were so, and presented to us with geometrical precision, it is doubtful whether we could admire it equally!

CHAPTER XIX.

DENTITION.

IN the preceding pages it may have been observed that the adage, 'There are no rules without exceptions,' occurs so frequently in ophidian physiology that the latter are almost in the majority. Concerning the teeth especially, the forms of dentition in the various families, the distinction of species by them, the size and position of poison fangs, etc., the rules involve so many exceptions that we can perhaps render the subject less perplexing by dispensing with rules altogether. 'The gradations of teeth are very imperceptible,' said Prof. Huxley in his lecture at the London Institution. So numerous are their stages of development that there is really no well-defined gap between the venomous and the non-venomous species. 'We do not know for certain whether the ordinary teeth are poisonous or not,' Huxley also said. The recent researches into the nature of salivary secretions will throw more light on this subject. A large non-venomous snake, like other normally harmless animals, if biting angrily, with its abundant salivary glands pouring secretions into its mouth, might inflict a very ugly wound, especially on a feeble or frightened victim.

A few rules may, however, safely be offered as 'without exception,' and these I will point out in order to clear the way a little towards a better comprehension of the exceptional ones.

All true snakes, poisonous or not, that have teeth at all, have the six jaws described in the first chapter, viz. the right and left upper jaw, the right and left lower jaw, and the right and left palate jaw. The latter are called 'jaws,' not anatomically, but merely as answering the same purpose, being furnished with teeth; each true jaw and the palate being considered as two or a pair, on account of the independent action imparted to each by the especial muscles and the elastic tissue which unites them, where in the higher animals they are consolidated.

With but one exception (the *egg-eating Oligodon* or *Anodon* family) all other true serpents, whether venomous or not, possess the two rows of palate teeth.

All can move or use each of the six jaws, or any two, three, or more of them independently, as we observed in feeding, some of the six holding the prey while others move on. Some writers have conveyed the idea that there is a regular alternation and even rotation of the jaws in feeding, No. 1, 2, and so on in succession till all the six have moved, and then No. 1 in its turn again; but observation inclines me rather to decide that there is no other rule than the feeder's individual convenience, according to what its teeth may be grasping, any more than there is in other creatures that without reflection or intent, and not strictly in turn, eat now on one side of the mouth and now on the other (except in the case of some poor mortal with the toothache, when, having only the two jaws, his distressful efforts are chiefly directed towards relieving that side of its ordinary duties). Snakes, for aught we know, may have the toothache: loose teeth they frequently have; they suffer from gum and mouth affections too, and no doubt can at such times relieve a whole jaw of its work.

In all true snakes the teeth are long, conical, and curved: not planted perpendicularly, but directed backwards; these long, fine, claw-shaped instruments presenting a formidable obstacle against the retreat of a creature once seized by them. Their arrangement is a species of trap, like the wires of a mouse-trap: to enter being easy enough, but to escape against the spikes being impossible.

All snakes renew their teeth throughout life. Except fishes, therefore, no creatures are so abundantly supplied with teeth as are the Ophidia.

On account of this continual loss and replacement of teeth, the number is rarely so fixed and determinate as to be characteristic of the species. Probably no two snakes, not even brothers and sisters of the same brood, may possess precisely the same number of teeth at a given age; because they are so easily loosened and lost, that the normal number might rarely occur in all the members of the same family at the same time. In the scientific language of Rymer Jones, 'the facility for developing new tooth germs is unlimited, and the phenomena of dental decadence and replacement are manifested in every period of life.'

Says Nicholson, 'The teeth are replaced not merely when accident has broken off the old ones, but they are all shed at more or less regular intervals, coinciding with the casting of the epidermis.' Not on *each occasion* of sloughing, as we may, I think, understand this, but, like the casting of cuticle, contingently, according to the condition of the individual. Not altogether, either, or at certain periods of life, as a child loses his first teeth and gets a second crop, or as an adult cuts his wisdom teeth, but 'a crop of young teeth work their way into the intervals of the old teeth, and gradually expel these latter.' All the spaces and depressions between the maxillary and palatine rows are occupied by the matrix of tooth germs. Not a cut can be made in this part of the palate without the knife turning up a number of young teeth in every stage of development.[1]

Independently of this accidental number, the maxillary presents certain phases which characterize families. For instance, a true viperine snake has in the upper jaw fangs *only:* non-venomous snakes have a whole row of from fifteen to twenty-five maxillary teeth, and in intermediate species their normal numbers vary considerably. Some of the highly poisonous families, notably the cobras and the sea snakes, have a few simple teeth in addition to fangs. The length of the jaw, therefore, diminishes in proportion to the number of teeth it bears. Only the viperine snakes are limited to the poison fang in the upper jaw; but fangs, like the simple teeth, are shed, broken, or lost, and renewed continually.

Behind the one in use—the functional fang—others in various stages of development are found—'a perfect store-

[1] *Indian Snakes*, by Ed. Nicholson, M.D. Madras, 1870.

house of new fangs,' as Mr. F. Buckland in his facetious style called them ; 'lying one behind another like a row of pandean pipes.' In the skeletons of viperine snakes these may readily be observed. In the living example they are enclosed in a capsule, hidden by the loose gum sheath, called a gingeval envelope. So when the functional fang meets with an accident, or falls out in the order of things, the supplementary fangs in turn supply its place, each becoming in time firmly fixed to the jaw-bone, and ready to perform the office of its predecessor.

Poison fangs succeed each other from behind, *forwards;* the simple teeth from the inner side, *outwards.*

Before proceeding further, it may be well to explain that what is meant by the *true* snakes in the foregoing rules, are those which do not possess the lizard features; *Anguis fragilis,* and some of the burrowing snakes which approach the lizards, not having the palate teeth. But here again we are tripped up with exceptions, since we are told that in dentition the boas are allied to the lizards; yet they have palate teeth.

The importance of dentition in distinguishing snakes is seen in the names assigned to them from their teeth alone. In giving a few of these terms we enable the reader to perceive at once, not only how very varied are the systems of dentition, but in what way they vary, the words themselves conveying the description.

The names here given are without reference to venomous or non-venomous serpents, but only as belonging to certain families whose teeth present characteristics sufficiently marked to be named by them.

From *odous, odontos,* a tooth.

Anodon, . . .	Toothless.
Boodon, . . .	Ox tooth.
Cynodon, . .	Dog's tooth.
Deirodon, . . .	Neck tooth.
Dinodon, . . .	Double tooth.
Glyphodon, . .	Grooved or carved tooth.
Heterodon, . .	Abnormal tooth.
Isodon, . . .	Equal toothed.
Lycodon, . . .	Wolf's tooth.
Ogmodon, . . .	Furrowed or grooved tooth.
Oligodon, . . .	Few toothed.
Rachiodon, . .	Spine toothed.
Sepedon, . . .	Noxious tooth, or a tooth causing putridity.
Tomodon, . . .	Stump tooth.
Xenodon, . . .	Strange tooth.

In Dumeril's system very many families, including sometimes several of the above, are grouped according to their teeth, thus :—

Aglyphodontes, .	Teeth not carved or notched.
Holodontes, . .	Whole or entire teeth.
Anholodontes, .	Without whole or entire teeth.
Aproterodontes, .	Without front teeth.
Isodontiens, . .	With even teeth.
Apistoglyphes, .	Grooved at the back, or the back teeth grooved.
Proteroglyphes, .	Grooved in front, or the front teeth grooved.
Solenoglyphes, .	Cut or carved with a canal.

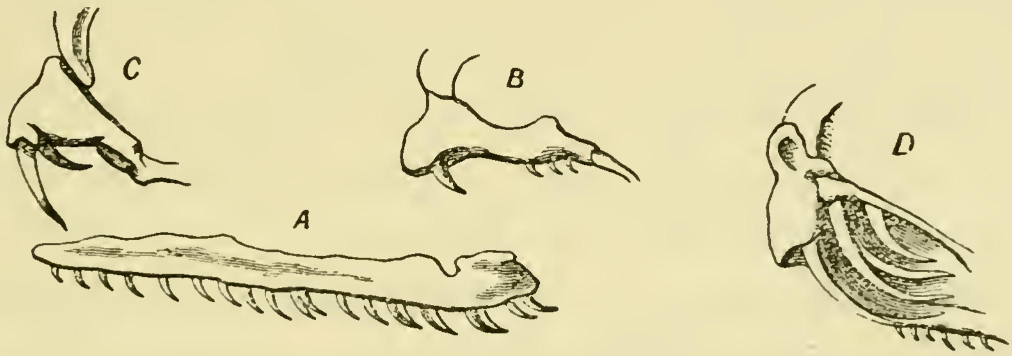
And some others whose names are equally descriptive.

These various characters, with the exception of *Aproterodontes*, which refers to the under jaw, have reference to the upper jaw only. It might be tedious to the reader to enter into a minute description of each of the above groups: sufficient for our present purpose is it to show that such varieties exist, and that a simple, even row of teeth, as a family distinction, is oftener the exception than the rule.

Some of the teeth increase in size posteriorly, others are largest anteriorly; others, again, are larger towards the middle of the jaw, and decrease at either end. Some harmless snakes have 'fangs,' that is to say, fang-like teeth, but not connected with any poison gland, and at the back instead of the front of the jaw. Again, there are some non-venomous species that have the power of moving these fang-like teeth, raising or depressing them as vipers move their fangs, and as will be further described presently. Some grooved teeth convey an acrid saliva, others are without any modification of saliva, the long teeth being of use in holding thick-skinned prey.

Thus we find every gradation both in number and in form until we come to the true fang, the 'murderous tooth' of the terrible cobra, the *hydrophidæ*, and the *viperidæ*. And noteworthy it is that the fewer the teeth in the maxillary bone the more terrible are they. Fig. A of the four illustrations given opposite is the jaw-bone of the Indian Rat snake, *Ptyas mucosus*, already 'honourably mentioned' in these pages. The illustration being taken from Fayrer's *Thanatophidia*, may be received as a faithful representation. This conveys a good idea of jaws generally in non-venomous snakes of that size, say from six to ten feet long. In some of the smaller kinds the jaw and palate teeth are so fine as to be almost imperceptible to the naked eye. To the touch they feel like points of the finest pins. Draw your finger along or press it against a row of 'minikin pins,' and you will form a correct idea of these tiny weapons. I have often *felt* when I could not *see* them in the mouth of a small harmless snake. Pass the tip of your little finger gently along them towards the throat, and they are almost imperceptible even to the touch; but in withdrawing your finger *against* the points, you feel how excessively fine they are.

The accompanying illustrations are from nature, and exemplify the various lengths of jaw in four snakes, not differing very greatly in size.



Four jaws. From Fayrer's *Thanatophidia of India.*

Fig. A. Ptyas mucosus, with simple teeth only. That they are not very regular is probably owing to the stages of growth in those that have replaced others.

Fig. B. A venomous snake, *Bungarus*, the 'Krait,' with a fixed fang in front and a few simple teeth behind it.

Fig. C. Jaw of the cobra, with a longer fixed fang, and one or two simple teeth behind it.

Fig. D. The shortest jaw of them all, that of the Indian viper *Daboia*, in which the maxillary is reduced to a mere wedge of bone. These, with four or five reserve fangs, are here folded back 'depressed.' A few palate teeth are also seen.

Having given a slight sketch of the various forms of dentition, and arrived at 'fangs,' we may recapitulate, in what Nicholson calls 'roughly speaking,' four stages of development in these latter.

First, the 'fangs' of the harmless snakes, such as *Lycodon*, *Xenodon*, *Heterodon*, etc., which have no poison gland, but whose saliva may be slightly and occasionally injurious.

Secondly, those having a salivary gland secreting poison and a grooved fang in front of some simple teeth, *Hydrophidæ*.

Thirdly, the maxillary bone shorter, bearing one poison fang with a perfect canal, and one or two teeth behind it. In some of these there is a slight mobility.

Fourthly, the maxillary bone so reduced as to be higher than long, and bearing only a single tooth, viz. a long, curved, and very mobile fang, *Viperina*.

These four classes, be it observed, are only designated 'roughly speaking.' Nicholson describes a close gradation in the development of the poison glands also to correspond with those almost imperceptible stages. The poison gland is after all only a modified salivary gland. It lies behind the eye, whence the venom is conveyed by a duct to the base of the fang, down along it, and sometimes through it, and is emitted at what we may for the present call the point, into the wound made by it, something on the principle of an insect's sting. As when inserting the sting the pressure forces the poison out of a gland at its base, so does the pressure of certain muscles act upon the poison gland when a snake opens its mouth to strike. In some of the most venomous, viz. the viperine families, the largely developed glands give that peculiar breadth to the head. There is a hideous, repulsive look about some of these, that seems to announce their deadly character, even to those who see one for the first time. The evil expression of the eye, with its linear pupil;

the peculiar curve of the mouth, with its very wide gape downwards, and then up again, are unmistakeably treacherous, venomous, vicious.

Like all other animal secretions, the poison is produced, expended, and renewed, but not always with equal rapidity; climate, season, and temperature, as well as the vigour of the reptile, influencing this secretion. The hotter the weather, the more active the serpent and all its functions. When the poison gland is full and the snake angry, you may see the venom exuding from the point of the fang, and by a forcible expiration the reptile can eject it. I have seen this in the little *Echis carinata* and its congener the *Cerastes*. I am not certain whether the *Cerastes* hisses or not, but under terror or excitement it moves itself about in 'mystic coils' as Echis does, producing a similar rustling noise with its scales; but both of them, if angry, will strike at you with a sound which may be compared with a sneeze or a spit, at the same time *gnashing* their mobile fangs and letting you see that they have plenty of venom at your service. They may almost be said to 'spit' at you, though literally it is the mouth 'watering with poison,' combined with the natural impulse to strike, which produces this effect. We can, however, by this judge of the force with which the venom is expelled, which in a large viper must be considerable.

Travellers have told us that a serpent 'spouts poison into your eye.' If an angry one strike, but miss its aim, the poison is then seen to fly from its mouth, sometimes to a distance of several feet. Whether a snake is so good a marksman as to take certain aim with this terrible projectile, or whether he possess sufficient intelligence to attempt it, we may doubt. Dr. Andrew Smith tells us that this belief prevails among the natives of South Africa.

A bright object always attracts snakes, and some victimized traveller's eyes may have been remarkably brilliant, and in consequence smarted under the accident. Be that as it may, the poison is sometimes so abundant that you may see it flow from the mouth over the prey. The glands being excited, just as are the salivary glands of mammals, the mouth 'waters' with poison. In the Hamadryad I have seen it flow, or more correctly 'dribble,' down over the snake it was eating. This noxious secretion assists digestion in the same way that the ordinary saliva in the human mouth does. Says Dr. Carpenter, 'The saliva prepares food for the business of the stomach; and if the ordinary operations of mastication and insalivation be neglected, the stomach has to do the whole work of preparation as well as its own especial duty of the digestion.' That the digestive powers of snakes are strong, we know from the fact that nearly all animal substances are converted to nutriment in the stomach of a healthy snake. The abundant saliva must be a powerful agent in the process, because mastication takes no share in the work. This has become more than mere conjecture, since recent experiments have shown that snake venom possesses strong peptic qualities; that, like pancreatic juice, it will even dissolve raw meat and albuminous substances. Recent experiments have also shown that the salivary gland is the laboratory in which the poison of venomous serpents is elaborated; that ordinary saliva is there intensified, concentrated, and endowed with its toxic properties.

During the two hundred years that have witnessed the development of natural history into a science, many and various have been the methods of zoological and particularly of ophiological classification. A few of these methods are sketched out in chap. ii. It will be seen that the character of the teeth had not for a long while much weight in classifying snakes. According to Schlegel, Klein in 1755 was the first to separate the venomous from the non-venomous snakes in classification. But after him Linnæus, then the greatest naturalist of modern times, distinguished snakes chiefly by the form of the ventral and sub-caudal plates; so that in the six genera which he established (*Amphisbæna*, *Cecilia*, *Crotalus*, *Boa*, *Coluber*, and *Anguis*), rattlesnakes and boas, colubers and vipers, with others of the most opposite characters, were jumbled up together; and the little burrowing blindworm and the venomous sea snakes were supposed to be related, because they neither of them had ventral scales! On account of his vast researches and great reputation, subsequent naturalists were slow to entirely overthrow his system and to venture on reforms of their own, and our cyclopedias are suffering to the present day from the confusion of the various methods of classification adopted by so many naturalists, as a few quotations presently will show. Dandin, 1802, though his work was reckoned by Schlegel the most complete up to his time, comprehended all the venomous snakes under the head of 'vipers.' Cuvier divided the vipers (with *crochets mobiles*) from those with fixed fangs; but yet was unsound in many other respects, confounding the *Elapidæ* with the *Viperidæ*, although he professed to separate them. Another confusion arose out of the word *cobra*, Portuguese for snake, so that wherever the Portuguese settled most snakes were *Cobras*. In India the English have retained the name *Cobra* for the snakes with the hood, which name is now confined to the one group, *Capella*.

'The characters of dentition offer in a great many cases a decisive method for distinguishing the species,' says Günther; 'but as regards the combination of species into genera and families, it is of no greater importance than any other external character by itself. . . . Still I am always glad to use the dentition as one of the characters of genera and species whenever possible—namely, whenever it corresponds with the mode of life, the general habits, and the physiology.'[1]

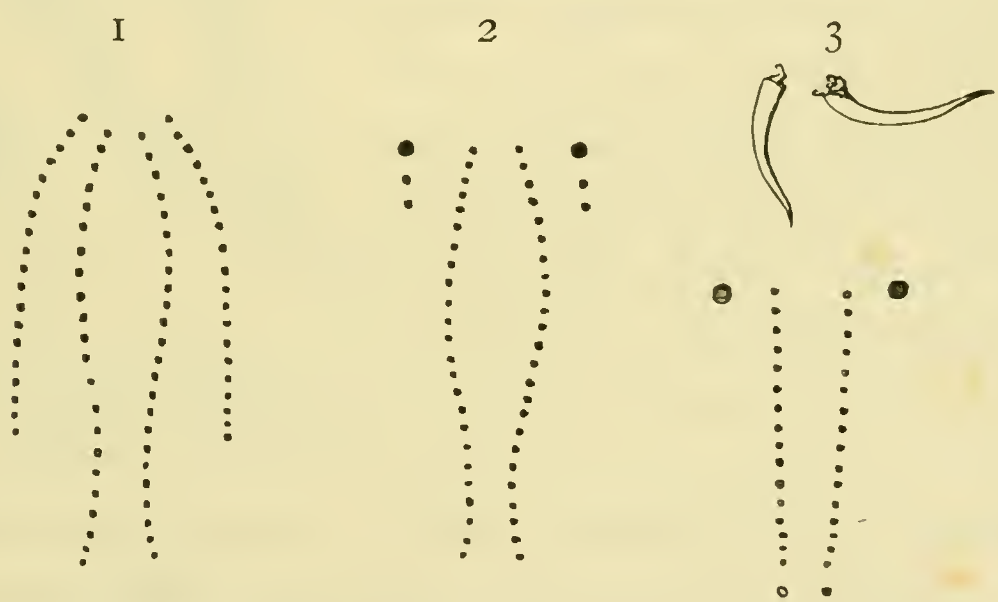
Since the publication of Dr. Günther's work, *The Reptiles of British India*, 1864, the distinctions of the various types of dentition seem to have been more clearly comprehended; and as this work is the accepted authority among English ophiologists, and will best commend itself to the reader, it shall be our guide in the present attempt to simplify much complication.

The five groups of snakes described in chap. ii. are divided into three sub-orders of Ophidia as follows:—1. *Ophidia colubriformes* (the harmless snakes). 2. *Ophidia colubriformes venenosi* (those which, not having the viperine aspect just now described, are the more dangerous from their innocent appearance). 3. *Ophidia viperiformes* (the viperine snakes).

Although apparently named from their form only, it is the teeth which have chiefly to do with these latter distinc-

[1] Introduction to the *Catalogue of the Snakes in the British Museum*, 1858.

tions, as will be seen on reference to the dotted examples of upper jaws. The first have the six rows of simple teeth (four above, as seen, and the lower jaw teeth), in all from 80 to 100 perhaps. The second have the two rows of palate teeth, the lower jaw teeth, and a *fixed* fang on each upper jaw, with one, two, or more simple teeth in addition. The Australian poisonous serpents are nearly all of this group, the only viperish-looking one, the 'Death adder,' having fixed fangs like the cobras. The sea snakes and the *Elapidæ* are included. The third have only four rows of simple teeth, viz. those of the lower jaws and those of the palate, with a solitary moveable fang in each upper jaw.

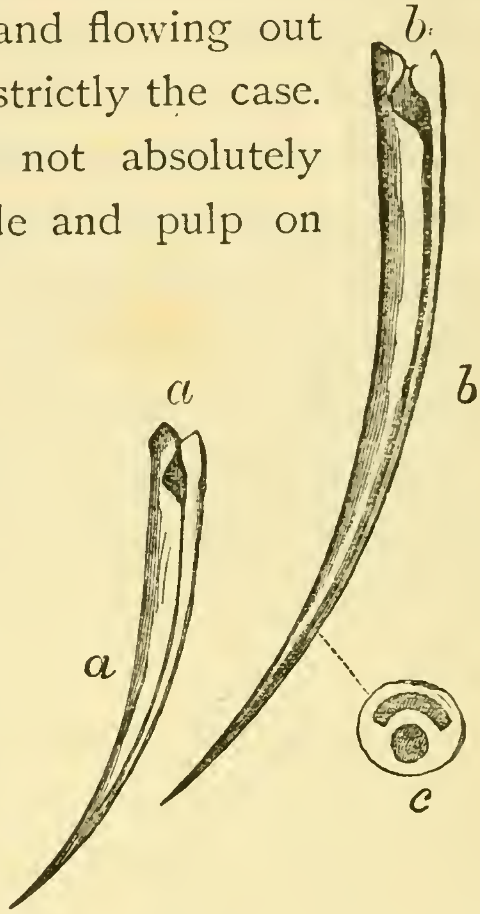


From Fayrer's *Thanatophidia.* The four larger dots represent fangs.

Fayrer divides the poisonous snakes of India, again, into four families, viz. *Elapidæ* and *Hydrophidæ*, with fixed fangs; and *Viperidæ* and *Crotalidæ*, with mobile fangs.

But without so many perplexing distinctions, I hope to be able to interest the reader in that wonderful piece of mechanism, the poison fang, and by the aid of the authorities to represent it in simple language.

We have long been accustomed to read that a serpent's fang is a 'perforated tooth' or a 'hollow tube,' as if a miniature tusk had a hole bored through its entire length, the poison entering at the root and flowing out again at the point. This is not strictly the case. Fangs in their construction are not absolutely 'hollow,' with ivory on the outside and pulp on the inside, but are as if you had flattened out an ivory tusk and folded or wrapped it over again, so as to form a pointed tube. It would then have dentine both on the outer and inner surface. This involution may be compared with that seen in a long narrow leaf, in which the larva of an insect has enwrapped itself. The various degrees of involution are extremely close, as also would be the forms of leaves and the extent of curling which each caterpillar had effected. Some fangs are folded so as to leave the—*join*, we will call it, easily perceptible. Others leave a groove more or less evident; while in others the fold is so complete as to have disappeared entirely. Schlegel, in describing the insensible passage from solid teeth to fangs, affirms that traces of the groove are always perceptible: '*On découvre toujours les traces de la fente qui réunit les deux orifices pour le venin.*'[1]



Two fangs magnified, showing the slit more or less complete. *c*, a section. From Fayrer's *Thanatophidia*.

In a mixed collection of thirty odd fangs of various snakes

[1] *Physiognomie des serpents*, par H. Schlegel. Amsterdam, 1837.

lent to me by Holland, the keeper, for examination, and sent all together in a little box, there were few in which I could not discern the join. The keeper was not sure to which snakes each belonged, excepting one or two of the largest, which were those of a puff adder. Those of the larger *Crotalidæ* I could identify by the peculiar curve. In a functional fang of the 'bushmaster' (*Lachesis mutus*), which I myself took from its jaw, there is a well-defined line, like a crack, the whole way down, from the base to the slit; in a rattlesnake fang, also in my possession, there is a faint appearance of this line or join; and in a young Crotalus fang it is still there,—only a faint crack, such as you would contemplate with alarm in your egg-shell china, still there it is.

It is scarcely necessary to explain that fangs differ in size in different families, as well as proportionately to the size of the possessor. In sea snakes they are not much larger than the simple teeth behind them. In the Cobra they are larger than in the Bungarus; in the viper they attain their largest size.

But in one respect all fangs agree, and that is in their delicacy and fineness. Under the microscope, the stronger the lens the greater the degree of exquisite polish and sharpness revealed. To handle those of very young vipers is as difficult as it would be to handle fine needle-points of similar length. One can compare them with nothing else, except perhaps the fine thorns of the sweet briar, which are equally unmanageable, and, as compared with manufactured articles, equally exquisite.

Sir Samuel Baker describes the fangs (both functional and supplementary) of a puff adder which he found. His words, if not strictly scientific, are so graphic as to convey a true idea of these terrible weapons. The viper was five feet four inches long, and fifteen inches in girth in its largest part. The head was two and a half inches broad. Sir Samuel counted 'eight teeth' (fangs), and secured five of them, the two most prominent being nearly one inch long. 'The poison fangs are artfully contrived, by some diabolical freak of nature, as pointed tubes, through which the poison is injected into the base of the wound inflicted. The extreme point of the fang is solid, and is so finely sharpened that beneath a powerful microscope it is perfectly smooth, although the point of the finest needle is rough!'[1] He describes the aperture in the fang as like a tiny slit cut in a quill.

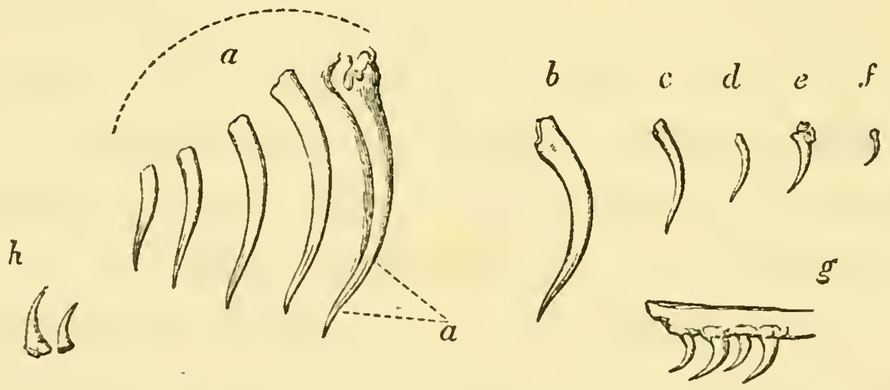
This 'slit' is a very important feature in the fang, and is the cause of much trouble in deciding whether a bitten person has been poisoned or not. It is in reality a very small space *near* the point, where the involution of the fang is incomplete, that is, where it has remained unjoined. This is to permit the emission of the venom. It is not close to the point, which, as Sir S. Baker affirms, is solid. Being solid, it is stronger and sharper, penetrating the skin of the victim more easily, and making way for the venom which in viperine fangs then follows and escapes through the slit into the wound. By this we comprehend how a person may receive a puncture only, or a scratch with this extreme but solid point, but not deep enough for the poison to enter. The space between the lines at *a* in the next illustration shows where this slit in

[1] *The Albert Nyanza, or Great Basin of the Nile*, by Sir Sam. Baker. London, 1866.

the fang is found. In the larger fangs it may be readily discerned with the naked eye: under a magnifying glass it is distinguishable in all. It is distinct in the fangs of the young Jararacas now before me, and extends nearly half-way up the fang in these.

The examples of fangs here given are all from nature, and as near to the exact size as it is possible to be in delineating objects of such exceeding fineness and delicacy. Excepting the *Xenodon's* and the baby viper's, the others belong to the *Crotalidæ*, whose fangs are mostly distinguishable by a slight double curve or flange. The viperine fang is a continuous curve (see *f*), but in the *Crotalus* the point curves very slightly back again and downwards.

For the Brazilian specimens, I am indebted to Dr. Arthur Stradling, who presented me with the snakes, out of whose jaws I myself procured them. In this *Lachesis* there were two fangs *visible* on one side, and only one on the other, viz. the functional pair, and one nearly ready to replace one of these. In addition to the pair were four reserve fangs hidden under the functional one on the right side. I say 'under,' because anatomically they were *beneath*, though locally *above* when the snake was in its natural position. All these five fangs I got from only one side, and in addition some others too small to represent. There may be yet more in the membranous capsule, as mine was a sadly unscientific search for them, and without any very powerful magnifier. Like Charas, I 'grovelled' for them! From a young *Jararaca* I also got out the functional and four or five supplementary fangs from one side, also an exceedingly small and short jaw-bone, leaving the other side undisturbed. Even the principal fang (*d*) is too fine to represent faithfully in printer's ink; the others are to the naked eye and to the touch almost impalpable. When we reflect on the exquisite sharpness and finish of these minute weapons, and the fatal injury they are capable of inflicting, we are filled with awe and amazement at the virulence of the subtle fluid which oozes through that almost invisible aperture. The brother of this tiny African viper (*f*), when only a few hours old, struck a mouse, which was dead in less than one minute. The whole forty-six of them (p. 321) were born with the 'murderous teeth' in their vicious little jaws. The fang here represented was loose in its mouth. A pair of perfect functional fangs remained.



Fangs and some simple teeth from my specimens.

a. Functional fang and four supplementary fangs from *Lachesis mutus* (Brazil).
b. Rattlesnake fang.
c. Fang of young rattlesnake (Brazil).
d. Fang of young *Jararaca* (Brazil).
e. Pseudo 'fang' of *Xenodon* (Brazil).
f. Loose fang from the mouth of *Vipera nasicornis*, aged one week.
g. Portion of palate bone bearing four teeth, from *Lachesis mutus* (Brazil).
h. Two lower teeth from the same.

Picture to yourselves the intensity of that invisible molecule of venom, which could ooze through an equally invisible aperture in this last diminutive weapon, and be fatal to life in a minute of time! From the effects observed on victims, I am inclined to place these large African vipers amongst the most venomous of all serpents of their size.

It may be of interest to remark that the fang of the baby viper found loose in its mouth does not resemble those remaining, either in form or structure. That it cannot be a jaw tooth is evident from its size. Jaw and palate teeth there are, but discernible only to the touch, and under a magnifying glass. The fixed fang from the side on which I found this loose one, is a trifle shorter, and much finer than its fellow. In the loose one here given I can hardly discern any involution at all, but on touching it with the inky point of a fine needle, the stain shows it be hollow, and clearly so, at its base. In the two fixed fangs, however, the involution is so incomplete that, minute as they are, the point of a very fine needle can be drawn all down them without slipping off.

One of them, the larger, on being touched with ink, revealed this open groove or incomplete involution so distinctly that I tried the other and was convinced at once. The loose one may be a first and only half-developed fang. They are almost as transparent as glass. I requested the keeper to look into the mouths of those subsequently dead, but he found no other loose fangs. Of the remaining forty-five deceased, let us hope those into whose hands they have fallen will be able to throw some further light on the development of fangs in very young vipers. Fayrer tells us that a young cobra is not venomous until it has cast its first skin, which is usually within a fortnight. White of Selborne found no trace of fangs in young vipers which he examined with a lens; but these had not yet been born. The possible cause of functional development in this little viper's fangs may be found in chap. xxiv. of this work.

Another erroneous impression regarding fangs has been produced by confusing those that are 'fixed' and those that are 'moveable.' All truly are fixed firmly into the jaw; but in the viperine snakes the very short bone itself is moveable by a volitionary action, so that it partially 'rotates,' and with it the fang. The *Elapidæ* have fixed or 'permanently erect' fangs, and when the mouth is closed these fit into a depression in the lower jaw. Viperine fangs only can be erected or depressed at pleasure. It is those which spring into place for use like a pen-knife half opened, and which when at rest are folded back, like the knife shut up again. This action has been most lucidly described by Coues in connection with the *Crotalidæ*, under which head I will quote from his paper. Schlegel himself is not very clear in his distinctions between those serpents that have 'moveable' fangs and those which have not, but Cuvier had already described them as *crochets mobiles.* Indeed, it is since the date of Schlegel's work that more complete investigations have revealed closer anatomical distinctions. We therefore find in some of our highest-class encyclopedias, if not of recent date, mis-statements regarding fangs which unfortunately have been quoted in many works. 'Venomous serpents depress their fangs,' says Schlegel's translator, true to the text, but as if it were common to all. Describing deglutition, Schlegel says 'the same in all' '*sans en excepter les venimeux, qui lors de cet acte redressent leur crochets et les cachent dans la gaine des gencives, pour ne point* *les exposer à des injures.'*[1] This, however, is the case with the *Viperina* only. It is common, for the reasons just now assigned, to find the cobra classed among the vipers, in some popular encyclopedias; and in one, a valuable and generally trustworthy American edition of 1875, we read, 'moveable fangs like the cobra, viper, and rattlesnake.' A cobra has *not* moveable fangs. Another, an excellent English edition, but of not very recent date, includes *all* venomous snakes under the head of 'vipers;' a third in general terms states that 'venomous snakes have no teeth in the upper jaws, excepting the fangs, and that the opening of the mouth brings these into position;' whereas it is now known that a viper can open its mouth and yet keep its fangs depressed and sheathed. In several other encyclopedias the description of fangs is suited to vipers only.

It is not necessary to designate names, as these things will be set right in the new editions. They are mentioned more with a view to show that ophiology has advanced with rapid strides of late, rather than presumptuously to criticise our standard works. Perhaps in another twenty years my own poor efforts will be exposed as 'old-time misconceptions.'

The renewal of poison fangs is another subject of interest to ophiologists: how the next supplementary fang becomes fixed, *anchylosed* to the jaw-bone; and how and when the connection with the poison duct is completed. Mr. Tombes, in a paper read before the Royal Society in 1875, describes a 'scaffolding' of bone thrown out to meet and grasp the

[1] *Essai sur la physiognomie des serpents*, par Herman Schlegel. Amsterdam, 1837.

new fang, to 'interdigitate and fix it in its place; this soft bone rapidly developing and hardening.' Sufficiently marvellous is the functional fang in itself; the insertion of the venom, a mode of subcutaneous injection invented long before the doctors thought of it. 'A most perfect hypodermic syringe,' Huxley calls it. Suddenly the hypodermic syringe is removed, say by accident, by force, or by gradual decay, and all connection with the gland is cut off; yet within a given period a second, a third, an unlimited number in turn replace it: the connection is restored and the hypodermic syringe is ready for action again. How the new one is brought into relation with the poison duct has afforded much speculation, and in the American scientific journals, as well as those of Europe, papers on this subject appear from time to time. Dr. Weir Mitchel of Philadelphia affirms that when the fang is lost by natural process it is replaced in a few days: when by violence, several weeks elapse before the next is firmly fixed.[1] He speaks of the rattlesnake chiefly. Fayrer gives the periods in several cobra experiments. In one cobra whose fangs were carefully drawn out on Oct. 7th, new fangs were 'anchylosed' to the bone in twenty-four days. In another, thirty-one days elapsed before the new ones were ready for use; and in two others, eighteen days. In all of these cases the new fangs were capable of inflicting deadly injury by the time stated.

But the perfection of mechanism culminates in the viper fangs; and reasoning from analogy, the intensity of poison in their glands also. When at rest, these lie supine along the jaw, but can be 'erected,' *i.e.* sprung down, for use by a special

[1] *Smithsonian Contributions.* Washington, 1860.

muscle. The two fangs above the dotted illustration of viperine dentition (p. 355) show both positions. Nicholson affirms that the Indian viper Daboia can inject as much poison in half a second as a cobra can in three seconds; 'that whereas a cobra's virus flows in small droplets, the viper's runs in a fine stream.' Though a much smaller snake than the cobra, Daboia's fangs are nearly double the size, as may be observed by comparing the figs. *C* and *D* (p. 349). There seems reason to believe also that this viper (which in its features Fayrer considers a true Indian type) can inflict injury with more than the pair of functional fangs. 'In reference to the connection of the poison fangs with the maxillary bones,' says this learned experimentalist, 'I would note that second or even third supplementary fangs may be anchylosed with the principal one to the maxillary bone. I have before me the skull of a Daboia, for which I am indebted to Mr. Sceva, in which this is the case; and where there are five well-developed poison fangs on each side, of which on one side two are anchylosed to the bone.'[1] (Described by Mr. Tombes, *Phil. Trans.* vol. clxvi. p. 146.)

This may explain what we so often read in the description of venomous snakes found with two, three, or more fangs on each side. In my *Lachesis* two were distinctly visible before I began to dig for those hidden in the loose membrane, of which there seemed an abundance, and I am nearly certain that the second one had its own particular sheath. The spirit in which the specimen had so long been immersed, as well as my awkward probings, forbid me to speak with certainty regarding this second sheath.

[1] *Thanatophidia of India*, 2d ed. p. 72.

After one of his rattlesnake bites—twenty days after—Dr. Stradling informed me by letter: 'My little *durissus* is shedding its skin; but when that is over, I shall certainly examine its mouth. Now that my arm is on the verge of ulceration, I find what I had not noticed before, that each puncture is *double*—two large ones and a tiny second one, about $\frac{1}{12}$ inch behind each, standing out in black relief against the scarlet skin.'

Neither of these experimentalists stated positively that the reserve fangs were in connection with the duct, a phenomenon which I believe is still unexplained. Fayrer removed the functional fangs from an *Echis carinata*, and observed that there were no others fixed at the time, though there were others loose in the mucous membrane. *On the fifth day another pair were anchylosed and ready for use!* As will be presently seen, this little viper of sixteen or eighteen inches (almost too small to recognise near the great python in the frontispiece), displays corresponding vigour both in the potency of its venom and in the renewal of its weapons.

From the foregoing illustrations of numerous pointed teeth, the question might arise, 'How are they disposed of when the mouth is closed? and from the narrow space which is apparent in the flat head of a snake, and the close fit of the jaws, how do the four or six rows meet without interfering with each other?' This difficulty is obviated by the teeth *not* closing one upon the other as ours do. Nor are the palate teeth in the centre, or they would wound the upper part of the trachea and the tongue sheath, which occupy considerable space. They close down on each side of these organs. 'Every relief on one surface fits into a corresponding depression on the other surface, and accurate apposition of every part is obtained,' Nicholson explains to us. 'The four upper rows of teeth divide the roof into three parts, and the lower jaw teeth fit between the upper maxillary and palatine teeth.'

There remains yet much more to describe in connection with the poison fang, which might come in the present chapter; but as the two following will treat of the *Viperidæ* and the *Crotalidæ*—the dentition being the same in both—the viperine fangs shall claim further space under those heads. These three consecutive chapters, and also chap. xxii. on some exceptional forms of dentition, must necessarily be somewhat blended; but I divide them thus in order to present the distinct families more clearly, and render the subject less tedious to the reader.

CHAPTER XX.

VIPERINE FANGS.

THOUGH the ensuing chapter will be devoted more exclusively to the *Crotalidæ* or rattlesnakes, it were well to repeat here that the two families *Viperidæ* and *Crotalidæ* comprise the sub-order of Ophidia 'VIPERINA,'—those that have the isolated, moveable fangs, the term *isolated* having reference to the functional fang only. It may appear incongruous to present the illustration of a viperine jaw with a whole cluster of fangs, while affirming that there is the one pair only; but the pair in use are 'solitary,' because the jaw bears no simple teeth, as in those with fixed or permanently erect fangs.

The first observation of the mobility of the viperine fang and its peculiar structure is ascribed to Felix Fontana,[1] an eminent naturalist and Professor of Philosophy at Pisa, in the eighteenth century. He formed the cabinet of Natural History at Florence, and died 1805, in his 75th year. But the *mobility* or action of rattlesnake fangs was known

[1] *Ricerche fisiche sopra il vel no della vipera.* Lucca, 1767.

long prior to Fontana, and he probably borrowed the expression 'dog-teeth' from the old Virginia writers who thus called the fangs. Purchas (1614), quoted in chap. xvi., describes 'venomous Serpentes, one ten Spannes long, with great Tuskes, which they hide and stretch out at pleasure.'[1] And again, in describing 'foure kinds of venomous Snakes. The first is greatest, Jararacucu, that is great Jararaca, and they are ten Spannes long: they have great Tuskes hidden in the Mouth along their Gummes, and when they bite they stretch them like a Finger of the Hand; they have their Poyson in their Gummes, their Teeth crooked, and a Stroake vpon them whereby the Poison runneth. Others say they have it within the Tooth which is hollow within. It hath so vehement a Poison that in foure-and-twentie Houres and lesse it killeth a Man.'[2]

There can be no doubt but that viperine fangs are here described, those belonging to the South American *Crotalidæ*, under their vernacular but then their only names. Dr. Ed. Tyson, who dissected the first rattlesnake that was handed over to science (p. 275), quite understood the mobility of the fangs, and of the existence of supplementary teeth, though not fully comprehending the nature of these latter; which 'I could not perceive were fastened to any Bone, but to Muscles or Tendons there. These Fangs were not to be perceived upon first opening the Mouth, they lying couched under a strong Membrane or Sheath, but so as did make a large Riseing there on the Outside of the lesser Teeth of

[1] *The Relations of the World, and the Religions observed in all Ages and in all Places discouered since the Creation*, Book I. 1st ed. p. 842. London, 1614.
[2] *Ib.* 4th ed. p. 1393. 1625.

the Maxilla' (meaning the reserve fangs), 'but at Pleasure when alive they could raise them to do Execution with, not unlike as a Lyon or a Cat does its Claws.'[1]

He found seven reserve fangs on each side; and though they were not, as he tells us, 'fastened to any bone,' the illustration represents them growing in regular order according to size in the jaw.

In another paper read before the Royal Society in 1726, also anterior to Fontana, on the 'Fangs of the Rattlesnake,' the writer, Captain Hall, describes the dissection, which was under the direction of Sir Hans Sloane; and 'then the Muscles that raise the poisonous Fangs appear.' This anatomist also found reserve fangs. 'Putting by this Membrane, the fatal Fangs appear, which on first View seemed only one on each Side, till searching further there appeared four more. The first and largest is fixed in a Bone;' four others were loose in the membrane.[2]

Several of the old authors quoted in the chapter on Rattlesnake History of the Seventeenth Century were quite aware of the action of the 'Springing Teeth,' 'Master Teeth,' or 'Canine Teeth,' as the fangs were variously called; and Lawson, 1707, describes 'the Teeth which poison are two on each side of the Upper Jaws. These are bent like a Sickle, and hang loose as if by a Joint.' Fontana's observations were possibly of greater scientific importance, otherwise it is singular that his equally thoughtful predecessors, from whom

[1] Paper on the 'Vipera Caudisona,' by Ed. Tyson, M.D., *Philosophical Transactions*, vol. xiii. p. 25. 1683.

[2] *Philosophical Transactions*, vol. xxxiv. p. 309. 1726.

he no doubt culled much important information, should have been overlooked.

In these viperine fangs there is an analogy between the vipers and the lophius, a fish with moveable teeth; only in the fish, as Owen tells us, the action is not volitional,—the teeth bend back to admit food, and then by elastic muscles spring up again to retain it.

The true nature of the reserve fangs was surmised by Mr. John Bartram, who in 1734 wrote from German Town, in the American colonies, to a F.R.S., 'On a Cluster of Small Teeth at the Root of each Fang or Great Tooth.'[1] He had a rattlesnake, 'now a Rarity near our Settlements,' and dissected it, when he 'found in the Head what has not been observed before by any that I can remember; *i.e.* a Cluster of Teeth on each side of the Upper Jaw at the Root of the Great Fangs through which the Poison is ejected. In the same Case that the two main Teeth were sheathed in, lay four others at the Root of each Tooth in a Cluster of the same Shape and Figure as the great ones, and I am apt to think for the same Use and Purposes, if by an Accident the main Teeth happen to be broken. May not these be placed to supply a Defect successively, for the Support of this Creature?'

Mr. Bartram was singularly correct in his diffidently-offered surmises; nor is it likely that in such a remote district as German Town then was, he had ready access to foreign publications, or would have claimed originality had he been cognisant of the work of M. Moyse Charas, *New Experiments upon Vipers*, translated from the original

[1] *Philosophical Transactions*, vol. xxxviii. 1733-34.

French in 1673. Charas, after describing the '*Great Teeth*,' refers to the 'smaller teeth' (reserve fangs) 'that are there in a Nursery, and are, if we may say so, in expectation to serve instead of the many Teeth, whether these come to fail of their force, or fall out of themselves.' The author, to add weight to conclusions evidently originating from personal investigations, tells us that he had 'taken Pains to grovel with a good deal of Patience in the Gums of innumerable Vipers.'

The Italian Redi, even prior to Charas, had also 'grovelled' in the gums of Vipers, and observed the canal or slit in the fang, '*si fendono per lo lungo dalla radice alla punta*,' and that these canaliculated teeth in the moveable jaws (*ossi mobili*) were for the conveyance of the venom.[1]

Thus, one hundred years prior to the work of Fontana, the structure of the viperine jaw was understood and described by several—we may almost say many—anatomists, to whom let due honour be rendered for their individual and independent researches; from all of which Fontana had doubtless benefited.

And so from numerous sources we might go on culling and quoting; *Philosophical Transactions* of France, Florence, Germany, and America, as well as of England, showing us that little by little the scientific workers examine, compare, correspond, till out of their life's labours a fact is established that may be printed and learned in six lines, but which—as is well worth remembering—often represents the brain and eyes and time of ages of scientists.

Next to engage attention was the *structure* of the fang

[1] *Osservazione intorno alle Vipere*, by Francesco Redi. Florence, 1664.

and the 'involution' described in the last chapter. A paper on this subject by Thos. Smith, Esq., F.R.S., was read before the Royal Society in 1818. Mr. Smith claims to have been the first to observe this involution as being altogether different from the perforation of the pulp originally supposed to be the case. He first noticed the slit in a cobra's fang (he being in India), and afterwards in a Hydrus (sea snake), and it led him to further investigations. With a microscope the slit was perceptible in a rattlesnake fang (which was also observed by the present writer before reading this account).

One more paper in the *Philosophical Transactions* on this subject must be commended to the interested student. It is the one already quoted (p.363), 'On the Succession of Poison Fangs,' by Charles Tombes, M.A., vol. clxvi. p. 470, 1876. In this paper is presented the result of all the most recent investigations, enriched by still deeper researches, but of too scientific a character to be introduced in this simple narrative of the progress of ophiology. We may, however, say that Mr. Tombes finds the character or function of succession differs in the vipers from that of the venomous colubrines; and this, as the construction of their fangs and maxillary jaw differs, is what we might look for.

A few more words descriptive of the external aspect of the *Viperidæ* may summarize what has already been said of them. Schlegel suggests that their 'noxious character is expressed in all their parts.' With the exception of brilliant colouring, this may be accepted as a rule. The broad, flat, angular head, rendering the 'neck' thin and conspicuous, has gained for many of them the generic, sometimes specific name of *Trigonocephalus*. From their deadly qualities, *Clotho*, *Severa Atrox*, *Lachesis*, and *Atropos* are among their names; while *caudalis* and *brachyura* describe the short, thin tail as opposed to the long and tapering tails of most colubrines. The true vipers—those that have not the nasal fosse—belong particularly to Africa, the *Crotalidæ* proper to America, the chief distinction being that the *Crotalidæ* have and the *Viperidæ* have *not* the 'pit' (see p. 277), of which more in the next chapter. The rigid, lanceolate scales covering the head are another viperine characteristic; also thick, heavy bodies, tapering at each end, and rough, carinated scales. They inhabit for the most part dry, arid deserts and sandy uncultivated places of the Old World, Africa being their most congenial habitat. The coloured viper and young one convey a good idea of their general aspect.

Ophiologists do not agree in the arrangement of genera and species, on account of the forms running so much into each other. Gray gives nine genera and twenty species; Wallace, three genera and twenty-two species; and Dumeril, six genera and seventeen species. The Death adder of Australia (p. 172) is a heterogeneous species. Its aspect is viperine, yet it has not viperine fangs, and does not therefore belong to this chapter. Schlegel thinks it ought not to be separated from the true vipers, but Krefft does not state positively that it is viviparous, so it is altogether anomalous.

The researches of Dr. Weir Mitchel of Philadelphia have been of great value to ophiologists. For two whole years he gave the best portion of his time to the study of rattlesnakes, having a number of them under constant observation. An exhaustive paper by him was published in the *Smithsonian Contributions*, Washington, D.C., in 1860, giving details of experiments with the venom and the treatments adopted. But of especial interest here are his observations on the fangs and their volitional action, it having previously been supposed that the mere opening of the mouth brought the fangs into position, which is not the case. As the *Crotalus* can move each side of its mouth independently, so it can use one or both fangs. 'When the mouth is opened widely, it still has perfect control over the fang, raising or depressing it at will.' Dr. Mitchel saw that though both fangs were present, both were not always used. When a viperine snake yawns extensively, as it so often does, you may sometimes perceive the fangs partially erected or entirely so, or the 'vibratile motion' in them observed by Fayrer. When the snake is angry, this vibratile action is much like that of a cat gnashing the teeth; but when only in a yawn, the partial and unequal erection of one or both fangs has the appearance of being involuntary. In this I speak from observation. The effect is similar to that seen about a person's mouth in trying to suppress a yawn—a sort of convulsive, nervous twitching. Whatever the cause, you perceive the fangs moving, but *not* moving always in accord.

The shedding or replacement of the fangs is, Dr. Mitchel thinks, a regular process, as in the teeth of some fishes, though not regular as to time. Sometimes, but not always, they are shed with the casting of the cuticle. He 'cannot suppose that the almost mature secondaries are awaiting an accident;' which agrees precisely with the opinions of Dr. Edward Nicholson and other physiologists quoted in the last chapter: 'A crop of young teeth' (or of fangs) 'work their way into the intervals of the old teeth, and gradually expel these latter.' When lost by accident or by violence, therefore, the process of replacement is slower, as we can readily conceive, the 'secondary' next in turn not being as yet ready for duty.

Though the American scientific journals devoted to zoology are rich in ophidian literature, there are few available to English students; and I regret I am unable to ascertain from across the Atlantic the latest researches and conclusions regarding this and several other correlative points. To Professor Martin Duncan I am indebted for the loan of a volume which forms one of the 'Bulletins' of the United States Geological Surveys, containing a valuable 'Report' on the Crotalus by Dr. Elliot Coues, of the United States army, late surgeon and naturalist to the United States Northern Boundary Commission, 1878.

It is these frequent Exploring Expeditions of America that have done so much to enrich science in all its branches; as to them are appointed efficient geologists, botanists, naturalists, and other scientists, who send in their 'Reports' to Government, to be soon reproduced in the form of large, handsomely-illustrated volumes. Copies of these (often consisting of ten to eighteen thick quartos) are presented to the members of Congress, governors of States, and to many others in office, also to literary institutions. You may have access to them in almost every large town in America; and there is no information connected with the history and natural productions of the nation (including the aborigines) that cannot be found in their pages. And as our Trans-atlantic cousins are always exploring some new territory, and have still untold square miles of mountain and valley to explore, their scientific 'Reports' in huge quarto tomes can be more easily imagined than counted.

This little digression from the viperine fangs is by way of introducing Dr. Elliot Coues. The volume in question was not forthcoming at the British Museum, therefore I ventured to trouble Professor Duncan with some inquiries, which were kindly responded to by the sight of the work itself.

There is in Dr. Coues' paper a good deal of what has been here already described; but there is also so much that is of additional interest, that for the benefit of those students who are not within reach of the British Museum (where, no doubt, the fast arriving quartos will get catalogued in due time), I will transcribe from the text some of the passages as relating to viperine fangs generally.

'The active instruments are a pair of fangs.' . . . They are 'somewhat conical and scythe shaped, with an extremely fine point; the convexity looks forward, the front downward and backward' (referring to the slight double curve in the Crotalus fang as shown in the illustration, p. 360). They are hollow by folding, 'till they meet, converting an exterior surface first into a groove, finally into a tube.' . . . The fang is 'moveable, and was formerly supposed to be hinged in its socket. But it is firmly socketed, and the maxillary itself moves, which rocks to and fro by a singular contrivance. The maxillary is a small, stout, triangular bone, moveably articulated above with a smaller bone, the lachrymal, which is itself hinged upon the frontal. . . . This forward impulse of the palatal and pterygoid is communicated to the maxillary, against which they abut, causing the latter to rotate upon the lachrymal. In this rocking forward of the maxillary, the socket of the fang, and with it the tooth itself, rotates in such a manner that the apex of the tooth describes the arc of a circle, and finally points downward instead of backward. This protrusion of the fang is not an automatic motion, consequent upon the mere opening of the mouth, as formerly supposed, but a volitional act, as the reverse motion, viz. the folding back of the fang, also is; so that in simply feeding the fangs are not erected.' (But I think I may affirm positively that sometimes the vipers do use their fangs in feeding. When they open their mouths—or rather the jaws alternately very wide—I have seen first one and then the other fang occasionally engaged in the food and again disengaged unsheathed. On other occasions the fangs have been folded. In some large African vipers, the 'River Jack' and others that were in the Society's Gardens a few years ago, I was able to observe this easily.)

The fang is folded back 'with an action comparable to the shutting of the blade of a pocket-knife; . . . one set of muscles prepares the fangs for action, the other set stows them away when not wanted. . . . The fangs are further protected by a contrivance for sheathing them, like a sword in its scabbard. A fold of mucous membrane envelops the tooth like a hood. . . . The erection causes the sheath to slip, like the finger of a glove, and gather in folds round its base. . . . It can be examined without dissection.' (And with the naked eye in a large viper, even during life, you may sometimes perceive this sheath or hood half off.) 'Each developing fang is enclosed in a separate capsule,' says Dr. Mitchel, which is just what I thought I saw in 'grovelling' up the poor Bushmaster's reserve fangs. There was an immense deal of loose skin to remove, which under skilful manipulation would doubtless have presented the form of sheaths of various sizes. At last I came to a great deep cavity as big as a bean or a hazel nut, and this I left neat and uninjured for some one else to explore. It might have been the poison gland! The young Jararaca's mouth is too small to reveal its mysteries.

But now we come to the most amazing of all the wondrous detail of this living hypodermic syringe. Those who have seen a viper or a rattlesnake strike its prey, are cognisant of the lightning-like rapidity of the action. So swift is it that often a spectator is not sure whether the snake touched the victim or not. A flicker, a flash, and the bite has been given. Dr. Mitchel, describing the singular inactivity of rattlesnakes in confinement, points out the striking contrast between this repose and the perilous rapidity of their stroke. Now let us look at the amount of business transacted in that flash of time. Says Dr. Elliot Coues: 'The train of action is first reaching the object; secondly, the blow; thirdly, the penetration; fourthly, the injection; and fifthly, the enlargement of the wound (the latter by dragging upon it the whole weight of the body by the contraction of certain muscles, which cause the fangs to be buried deeper and thus enlarge the puncture); and all these five actions accomplished in that instantaneous stroke!' This is what Fayrer means when explaining that 'the real bite is when the snake seizes, retains its hold, and thoroughly imbeds its fangs.' 'Sometimes the lower teeth and the palatine become entangled (and sometimes a fang is left in the wound). . . . The force of ejection may be seen when a serpent striking violently misses its aim, and the stream has been seen to spirt five or six feet. A blow given in anger is always accompanied by the spirt of venom, even if the fangs fail to engage.' . . . Another curious piece of mechanism, and one not previously described that I am aware of, is a provision for the fangs when they fail to bite. 'A serpent always snaps his jaws together, and thoroughly *closes them* when he strikes; therefore, if the fangs failed to engage, they would penetrate the lower jaw. But there is a certain movement among the loose bones of the skull (perhaps not yet thoroughly made out), the result of which is to spread the points of the fangs apart, so that they clear the inner sides of the under jaw, instead of injuring them.' Coues here describes rattlesnakes particularly, but no doubt the same extends throughout the viperines. . . . 'In a large snake the entire gland may be an inch long and one-fourth as wide, having the capacity of ten or fifteen drops of fluid. There is no special reservoir for the venom other than the central cavity of the gland. Formerly there was thought to be such a storehouse; but when the tooth is folded back, certain muscles press or compress the canal to prevent a wasteful flow: in other words, the communication is shut off!'

In this wonderful exhibition of the ivory hypodermic syringe there has not, I trust, been so much repetition as to render the subject tedious. Presented in such graphic language and from such a source, it must attract almost every intelligent reader, while the viperine fang is absolutely acting before his eyes. On this subject, then, no more need be said; though on the Crotalus family generally some interesting matter still remains to be told.

CHAPTER XXI.

THE CROTALIDÆ.

IN the several chapters in which the rattlesnake has been introduced, the reader has seen that for about 250 years it has been an object of interest and of study among naturalists, and that first one and then another has made fresh examinations of its various parts, giving to the world new items of information as the results of such observations.

And can there remain anything further to find out about it? we may ask in surprise. Yes, there is. There yet remains to comprehend and decide upon one feature which thus far has defeated conjecture and investigation—the 'pit' (p. 277). Possibly among the indefatigable observers in the land of rattlesnakes, recent labours may have been rewarded by some new evidence of the utility of this peculiar orifice, and already their zoological journals may have enlightened ophiologists on its functions. At the present moment I am not aware of such information; and time will not permit of further delay to enable me to send a message of inquiry across the great deep.

Hitherto the pit has certainly plagued not only zoologists, but all classifiers of the Ophidia; because serpents that have this facial depression embrace so many widely differing genera, some of them resembling in all other respects the true vipers, and others the rattlesnakes, so that they have come to be distinguished as the 'pit vipers.'

One of our most able biologists, A. R. Wallace, in his *Geographical Distribution of Animals*,[1] informs us that 'the *Crotalidæ*, including the deadly rattlesnakes, abound most in the oriental regions' (though not a single rattlesnake is found there, or in the Old World at all). Let us seek for the reason of this apparent incongruity, and how it is that a large number of serpents which have no rattle come to be placed among those which have an instrument specially constructed to produce a rattling sound.

Not to weary the reader by attempting to describe the various systems of classification adopted by the many herpetologists who were the contemporaries and immediate successors of Linnæus, we will rather invite his imagination to picture the geographical history of our globe during that age. Travels, explorations, the establishment of new colonies, and the settlement of new territories marked the era; and, as a sequence, new and hitherto unknown fauna were continually brought home to Europe. We have seen, too, how natural history had been growing into a science, and how travellers and zoologists stimulated each other by their researches and writings. To recall a few of the names with whom reptiles are associated, and to remind the reader that one arranged them according to their scales, another

[1] Ed. of 1876.

their form, a fourth their teeth, a fifth their habits, and so on, and that even at the present day the classification of them is far from complete, the present writer will be absolved from attempting anything beyond generalization.

Studying snakes towards the end of the last century, were Laurenti, Buffon, Bonnat, Lacepède, Klein, Seba, etc.

In the early part of the present century were Latreille, Shaw, Daudin, Oppel, Merrem, Wagler, Neuwied, Cuvier, and many others till we come to Gray, Fitzinger, and Dumeril, 1844. This last author, in his introduction to *Les serpents solenoglyphes, dit Thanatophides*, including the most deadly snakes, devotes several pages to the subject of the 'pit,' and why it had especially occupied the attention of those herpetologists who were endeavouring to improve the previously imperfect systems. Wagler in 1824 assigned the name *Bothrops* (from βόθρος, any hole, or pit, or hollow dug) to vipers with the pit that had only scales and no plates or shields on their head, separating these from the rattlesnakes and from those that have shields (see illus. p. 318). This nomenclature of Wagler's did not commend itself to other herpetologists, and Fitzinger, in his *Systema Reptilium*, 1843, extending the group, retained the name for one of the five families into which he divided all the venomous snakes. Fitzinger's fifth family, the *Bothrophides*, included some of the Indian pit vipers; but as some of these latter have shields on their head, they could not be admitted into Wagler's group with scales only. As the present object is to demonstrate some of the perplexities of naturalists, and to arrive at the reason why so many snakes without the *crotalon* are called *Crotalidæ*, we will quote Dumeril's reasons, inviting the reader to picture to himself the interest with which new examples were brought home for investigation, and the obstacles presenting themselves to herpetologists, who find one feature claiming alliance to this snake, while another feature points an alliance to an entirely opposite one.

So Dumeril shows us why some of the herpetologists wished to admit *every species that has the nasal fosse* under the generic name *Bothrophidæ*, and others would have limited the term to a few, because the name does not suit them all equally well. '*Beaucoup d'autres serpents presentent aussi des enfoncements creusés sur la tête et sur le bord des lèvres.*' These depressions, called by Professor Owen 'secreting follicles,' may be easily distinguished on the upper lip of some of the larger constrictors. In the Reticulated python you can count these pits like deep dimples round the mouth. In the Diamond snake (*Morelia spilotes*) they are remarkably deep along the lower lip.

Of those 'follicles' in the *Crotalidæ* Dumeril writes: '*Les fossettes paraissent devoir être des organes particuliers dont l'usage ou la fonction n'est pas connu il est vraix, mais qui semble avoir quelque importance par leur position constante entre les orifices réels des narines et les yeux, et leur structure anatomique assez compliquée. À cause de la grande analogie qu'ils ont tous avec les serpents à sonnettes, nous avons preféré appeler ceux-ci les crotaliens.*' [1]

The above words are under the head of '*Les Crotaliens*,' a name retained, he had already explained why. '*Les solenoglyphes qui ont les narines doubles en apparence seront pour nous les Crotaliens quoique cette dénomination puisse, à*

[1] *Erpétologie générale*, tome 7, p. 1451.

tort, porter à croire que ces espèces font du bruit avec leur queue: elle indique seulement leur rapports avec les crotales établis d'après la présence des fausses narines ou fossettes dont nous venons de parler. On nomme quelquefois ces Ophidiens Bothrops.'[1] . . . '*Comme ce caractère conviendrait à tous les Crotaliens parcequ'ils ont tous des fossettes dites lacrymales, ce nom* (*Bothrops*) *devient par conséquent trop général.*'[2]

In retaining *Bothrops* as a generic distinction, a large number of non-venomous and constricting serpents must have been included, which probably induced Wagler's opposers to say of him that he 'created a system in which the venomous and non-venomous were huddled together pell mell.'

Thus we see that on account of the nasal fosse the Indian crotaline snakes could not be true vipers; they could not be exclusively *Bothrophidæ*, for the reasons given above, and they certainly are not rattlesnakes; but for want of a better name they are '*Crotalidæ*,' as they have (minus the rattle) more features in common with rattlesnakes than with any others.

In the slough of a rattlesnake you may see the form of this pit. It is lined with scales, and reversed in sloughing, perfectly shaped as a tiny glove finger.

When Dr. J. E. Gray, F.R.S., etc., edited a short-lived little magazine in 1831 called the *Zoological Miscellany*, the whole of the known *Crotalidæ* consisted of ten genera and thirty species, of which sixteen species belonged to Asia and its adjacent islands, one to South Africa, and the rest to America. When he published his catalogue of snakes

[1] *Erpétologie générale*, tome 7, p. 1367. [2] *Ibid.* p. 1503.

belonging to the British Museum in 1849, he enumerated eleven genera and thirty-seven species. Wallace, 1876, gives eleven genera and forty species, the eastern examples of which belong to India, Siam, Java, Borneo, Tartary, Thibet, Japan, and Formosa. Still more recently some belonging to the Western States of America have, I believe, been added by Cope or Coues, the latter informing us that up to the date of his paper, 1878, eighteen species and upwards of the rattlesnake proper had been described in the United States, nearly all in the west and south-west. So, as those vast deserts are being explored, new species are continually discovered.

Of the Indian species of *Crotalidæ*, those minus a rattle, Fayrer says that they are chiefly in Malaya and Indo-China. Many of them, the *Trimeresuri*, are arboreal, and like the foliage in colour. They have the viperine aspect, but are 'less formidable than their American congeners,' being of much smaller dimensions. Only one, *Halys*, has anything approaching to a rudimentary rattle, a tail ending in a spine. Of the *Trimeresuri*, the tree species, Fayrer affirms that few deaths are ascribed to them. Some attain to above three feet in length. He thinks a feeble person might die of their bite. They are of a sluggish habit, and lie quietly hidden among the leaves of low bushes and ferns. They will even suffer themselves to be moved without attempting to bite, but one that was pressed to the ground with a stick struck so hard as to break both its fangs. They feed chiefly on insects. Their habits are crepuscular if not nocturnal, and Fayrer does not state positively that they or any of the Indian *Crotalidæ* are viviparous.

Of the principal American *Crotalidæ* that are not true rattlesnakes, the 'Bushmaster' (*Lachesis mutus*) stands first. This is undoubtedly the largest venomous serpent known. In length it equals the Hamadryad; and in thickness, the large African vipers. On looking closely at the illustration of this reptile's tail (p. 176), it will be seen that in addition to the spine which terminates it, there are several rows of fine, elaborated scales, which under the microscope appear almost as curiously pointed as those on the head of *Vipera nasicornis*. Dumeril thus describes the tail: '*Ponctuée, et précédée de dix ou douze rangées d'écailles épineuses, un peu courbées en crochets à la pointe.*' This is the snake called *Crotalus muet*, or 'dumb rattlesnake,' by Linnæus, and which is supposed to simulate the sound of the rattle by vibrating this point against the leaves; but many other snakes do this whether their tail is pointed or not, as we saw in chap. xi. Any small thing, such as a twig rustling among dead leaves, would produce the same sound. The near approach of *Lachesis* to *Crotalus horridus* of the same habitat is, however, seen in this rudimentary rattle, the agitation of which may similarly be attributed to the timidity of these 'highly nervous and irritable creatures,' to repeat Coues' words; for deadly as they are, timidity strongly displays itself. Watching the venomous snakes when their food is dropped into their cages, their excessive caution, amounting to cowardice, is remarkable, and this with the rattlesnakes especially. One will fix its eyes on the rat which is running about, and shrink back terrified if it approach too closely. Then if the quadruped is a moment quiet, the snake appears to be considering whether it will be advisable to attack it or not. Stealthily and slowly it approaches its head, but on the slightest movement of the little animal, recedes in alarm, and is some time before it makes a second venture. I have seen a rattlesnake thus timidly advancing and recoiling three or four times before it has the courage to give the fatal stroke. Even after the bite it watches its victim with a steadiness in which terror is the strongest expression; and when the rat has remained motionless for a time, and the rattlesnake ventures near to investigate and make sure it is dead, one faint gasp or dying struggle will cause the reptile to dart back in excessive alarm, and wait again some minutes before venturing near. After long and patient observations, I am still doubtful whether stupidity or timidity predominates in viperine natures.

Of the other well-known and formidable American *Crotalidæ* is the '*Fer de lance*' (*Trigonocephalus lanceolatus*) of the Antilles and Central America. This has also a pointed tail. The Jararaca of Gray (*Craspedocephalus Braziliensis*) is another, but without the point. Of the true rattlesnakes, Dumeril gave five genera in 1844, viz. *Crotalophorus*, *Crotalus*, *Caudisona*, *Urocrotalon*, and *Urosophus*.

From the two species originally known, we see how they have gradually multiplied as the country has been more thoroughly explored. In 1860, Dr. Weir Mitchel affirmed that twenty species had been then described; probably the most recent 'Reports' or Bulletins will tell us of yet others. And these latter are exclusive of the non-rattle-bearing *Crotalidæ*.

Dr. Mitchel's experiments were with the northern species, chiefly *Cro. durissus;* and as a relief from this wearisome classification, some of his observations will be welcome. One very noteworthy result is that the Crotalus does occasionally produce a sound independently of the rattle. Not a prolonged hiss, or by any means so loud as the innocent snakes, but merely 'the expiration of air from the lungs just before striking.' I have never observed or heard this in our London rattlesnakes, but it no doubt is of the same character and degree of sound as that produced by the *Cerastes* and the little *Echis*, and which more resembled a short, feeble, spitting sound. Still, as we are informed by Dumeril that rattlesnakes are 'deprived of voice,' it is interesting to know that, on the authority of Dr. Weir Mitchel, some slight sound, though not a regular hiss, does sometimes accompany the action of striking.

An inquiry has lately met the eye in one of our scientific journals as to whether a rattlesnake drinks. Dr. Mitchel clears away all doubts on that subject by impressing upon those who keep these creatures the importance of giving them plenty of water, particularly when changing the skin. Deprived of it, the cuticle comes off unhealthily—*desquamates*, in fact, in bits. At the casting of the cuticle, or previous to the process, they will not only drink, he tells us, but lie for hours in the water. When they were disinclined to eat, and had fasted long enough to endanger their health, he fed them by force with milk and insects, and the way he managed was to get their mouths open and insert a tunnel a safe distance down their throat. While held in this position, a repast consisting of insects and milk was pushed down the tube of the tunnel in sufficient quantities. The most surprising circumstance in connection with this style of feeding, and also with the process adopted by Dr. Shortt of Madras in filling his cobras 'as full as they could hold' with sour milk, is that these fastidious and frightened reptiles did not disgorge the diet. Both experimentalists, however, found it answer, reminding us of some advice given to the keeper at the London Ophidarium in the case of the Hamadryad, which, having no snakes to dine off one winter, elected to fast. To force frogs or fish down its throat was suggested; but no one could be found brave enough to undertake the task, and happily 'Ophio' survived till a relay of ring snakes arrived.

Both Mitchel and Coues corroborate what has been observed by others regarding the increased virulence of the bite when moulting; but both are of opinion that this is owing to an accumulation of venom, as the snakes have not been feeding or expending their store for some days. Even while not feeding, their venom is secreted all the same, and they survive many months, even a whole year and more, without food. Dumeril mentions one that lived twenty-five months without feeding.

A startling and almost horrifying demonstration of what physiologists would perhaps attribute to nervous or to muscular irritability is described by Dr. Mitchel, namely, an action that had been begun in life, carried out in a headless snake. On p. 281 was described the astonishment of Colonel Beverley, who observed the severed head of a rattlesnake attempting to bite. 'Then the head gave a sudden champ.' Long after a snake is dead the tongue will be exserted as in life; and in other actions they, as it were, carry out their intentions though deprived of vitality. 'The headless trunk will strike,' says Dr. Mitchel, and continue to do this when touched or irritated as if it still had its head and its fangs to strike with!

Mr. George Catlin in his *Life among the Indians* relates a circumstance of this kind which may well be introduced here, as illustrative of this amazing fact—a rattlesnake coiling and springing after it is decapitated. His party were going down a river, and had just landed to explore a little, when he saw a large Crotalus, and seizing his gun fired at its head. At the same moment it leaped and sprang towards him, apparently striking him on the breast, Mr. Catlin being on the point of leaping back into the boat. He thought he had fired and missed his aim, and was a dead man, nevertheless much wondering at having missed his mark. Meantime, an Indian, seeing a spot of blood on the front of Mr. Catlin's linen smock, exclaimed, 'You are bitten!' and without ceremony the smock and flannel shirt were torn open, and a spot of blood on his breast was exposed to view. Promptly the blood was washed off, and the Indian on his knees had his mouth at the wound preparing to suck out the poison. Quickly looking up, however, he rose to his feet, and with a smile of exultation said, 'There's no harm! You'll find the snake without its head.'

Stepping ashore again, and pushing aside the long grass, there, sure enough, was the headless rattlesnake, coiled up where it had fallen, and with its headless trunk erect, ready for another spring. Mr. Catlin had *not* missed fire, but the creature so near the spring, was so ready at the instant with its aim made, that it leapt and struck Mr. Catlin probably on the very spot where it would have bitten him had the sportsman missed his mark. The bleeding trunk had printed its stroke with blood, driving the stain through the dress to the skin. 'How curious it is,' Mr. Catlin remarks at the conclusion of his narrative, 'that if you cut off the head of a rattlesnake, its body will live for hours, and jump at you if you touch it with a stick, when if you break his spine near the tail, with even a feeble blow, it is dead in a minute. This we proved on several occasions.'

Mr. Catlin also helps to confirm what has been already stated in these pages, viz. the certainty of the mate being within hearing of the rattle, and responding when one of them sounds an alarm; also that 'they can track each other and never lose company, though when met are not always seen together, so that if we kill one over-night and leave its dead body, the other will be found by its side in the morning.'

A near relative of the rattlesnake is the 'copper-head,' *Trigonocephalus contortrix* of the United States, known also as the 'Red adder,' and the 'Dumb rattlesnake.' It is the *Boa contortrix* of Linnæus, who, as we explained above, and also in chap. ii., divided the Ophidia into only three or four families, calling an immense number, both venomous and harmless, 'boas.'

This member of the *Crotalidæ* is said to be as venomous as the rattlesnake, and is much more dreaded, because it has no rattle to give warning of its proximity. When a bitten person survives, the effects of its bite are said to be felt annually, as in the case of the rattlesnake, and the injured limb 'turns the colour of the snake.' In regard to this latter symptom, said to show itself in the case of so many snakes, the bitten limb assumes all manner of horrible tints in most cases, and it does not require a great stretch of imagination to detect colours resembling the also many-tinted aggressors. Still there may be more in this than we at present know of.

In the cranberry swamps and tamarack marshes in the northern districts of Ohio formerly were found immense numbers of a small and very dark brown rattlesnake known as the *Massasauga.* It is seen lying in clusters like small twigs on dry leaves, and still is found in considerable numbers in some remote districts. The illustration of the small rattle (p. 302) was sent me from that neighbourhood, and is, I believe, from a true 'Massasauga.' This is the one (as I think I am safe in stating) that was first (1810) described by Dr. Kirtland, a distinguished naturalist of Ohio, and after him named *Crotalophorus Kirtlandi.* Its range is confined to the swampy districts of Northern Ohio and Southern Michigan. Its rattle being scarcely audible, this little snake gets frequently trodden upon, and persons are as frequently bitten ; but Dr. Kirtland stated that he had never known any one to die of its bite, which is scarcely worse than the sting of a hornet. It is a link between the last-named snake, the 'copper-head,' and the rattlesnake, having head-shields like the former, and tail of the latter. These small species no doubt help to add to the confusion of evidence regarding the virulence of rattlesnake bites, one person affirming that they are deadly, and another, that recovery is common. The degree of venom between the smallest and the largest of the *Crotalidæ* can no more be compared than can the constriction of the little slow-worm round your fingers with the constriction of the anaconda.

A word in conclusion about the rattlesnake's enemies; and of these hogs come first, next to man. Wild hogs, peccaries, and deer in their native haunts, and doubtless an immense number of snake-eating birds, devour young rattlesnakes. Deer strike them with their hoofs, jumping on them with wonderful adroitness, so as to pin them down with all four feet. Pigs in the west derive no small part of their subsistence from snakes; and, as is now a well-known fact, the introduction of hogs has done more than anything else—not even excepting the annual *battue*—to diminish the number of rattlesnakes. The venom being 'innocuous to hogs,' is a fact only partially stated. A thin hog, bitten on a vein, might die as speedily as any other victim. It is because the venom fails to penetrate the fat, or, as Dr. Coues more ably expresses it, 'the fluid fails to enter the circulation through the layer of adipose tissue.' Pigs are not invariably exempt, any more than is the mongoose, from the cobra's bite. In both cases adroitness assists the animals to evade the strike, and in the latter case the thick fur of the mongoose is as great a protection to it as the fat is to the hog.

Dr. Coues mentions a danger not often anticipated in dealing with rattlesnakes when you wish to examine them. This is their habit of twining themselves around the arm, or wherever they can get hold. 'Grasp it fearlessly at the back of the neck,' he says; 'but even then a large one can constrict enough to paralyze both arms.' A man who was thus trammelled had to be relieved by a bystander. We are not always prepared for constricting rattlesnakes!

CHAPTER XXII.

THE XENODONS.

AND MY 'DISCOVERY.'

THOUGH there are only about eight species that have a legitimate right to this patronymic, there are—as my readers have seen in chap. xix.—great numbers of 'strange-toothed' snakes that have a zoological, or rather a dentitional right to it. The present chapter, however, will comprise only a few of those most nearly allied to the recognised *Xenodons*, which with *Heterodon* must occupy some pages.

The *Xenodons* have an especial interest, not only on account of their remarkable dentition, but their vernacular names, which in Brazil, where these snakes are common, have led to much and frequent confusion. This can be remedied only after considerable lapse of time, for the confusion has unfortunately been disseminated in print, and the vernaculars, confused by local prejudices, still obtain. The incident of my own first acquaintance with a *Xenodon* will in part explain the kind of puzzle which prevails; and a little personal gossip about this may, I trust, be tolerated.

A snake mentioned by a number of writers and travellers as the *Jararaca* had plagued me long and terribly, from the contradictory accounts of it. What *is* this Jararaca? And is it the same as the *Iarraracca* or the *Ibiracua* or the *Iraracu-assa* or the *Shiraraca*, or several other nearly similar names which appear in books about Brazil. Had one gone straight to Gray or Dumeril, the recognised and scientific name for it could have been ascertained at once; but we do not so readily find out which *are* the right books to pounce upon, nor had I in those days learnt the necessity of trusting to scientific works only for the unravelling of travellers' tales; but I hunted in dictionaries and encyclopedias and travels and those old authors again, but with no better success.

In Wallace's *Travels in the Amazon* we read: 'Hanging up under the eaves of our shed was a dried head of a snake which had been killed a short time before. It was a *Jaráraca*, a species of *Craspedocephalus*, and must have been of formidable size, for its poison fangs, four in number, were nearly an inch long. . . . The bite of such would be certain death.'

With this picture of a large Brazilian serpent, drawn by such an authority as Wallace, one read in Ogilvy's dictionary: '*Jararaca.* A species of serpent in America, seldom exceeding eighteen inches in length; having prominent veins on the head, and of a dusky, brownish colour, variegated with red and black spots.'

Then Webster—evidently from the same source: 'A species of serpent in America,'—word for word the same as far as the black spots—'very poisonous. Native name in Surinam.' And in a newer edition, Webster, in addition, gives its scientific name, *Bothrops Jararaca*; and that it is 'a native to (*sic*) Brazil.'

'Oh! if a *Bothrops*, then it is one of the *Crotalidæ*,' was the decision arrived at. Kingsley, in his *At Last*, mentions a 'mangrove snake, much dreaded by being so like the deadly Cascobel, viz. *Trigonocephalus jararaca*.' Thus with our puzzle we combine a *Bothrops* with the 'pit;' a *Trigonocephalus* with the worst of the viperine heads; and according to Wallace, a *Craspedocephalus*, which, at a guess, must be that it has something rough about the head to entitle it to this specific.

Few of the encyclopedias described it individually, or threw more light upon it. Worcester's dictionary states that the Jararaca is 'a species of venomous American serpent seldom exceeding eighteen inches;' and gives Wright as an authority. Spix and Martin[1] in their list of venomous snakes describe *Jararacucu*, called also *Shiraraca*, as a *Bothrops*; and also a *Jararaca mirim*, a small one. Marcgravius[2] figures a *Iararaca*, a small snake of a bright red with black spots.

And now for our old friend the Pilgrim Purchas. 'Of snakes that have Poison, *Iararaca* is a Name that comprehendeth foure kinds. The first is the greatest *J*. There are other smaller *Jararacas*, about half a Yard long. They have certaine Veines in their Head like the Vipers.'

Have those 'prominent veins anything to do with its name *Craspedocephalus*'? But how about its being only eighteen inches? This was the pursuit of snakes under

[1] *Travels in Brazil.* London, 1824.

[2] *Historiæ Rervm Natvralivm Braziliæ.* Antwerp.

difficulties, the clearing away of which was accomplished only by slow degrees, as one book after another offered new contradictions with still other varieties of spelling. Without doubt this perplexing reptile was viperine, rough, angular-headed, crotaline, and probably hideous; but as for colouring there were many doubts about that.

After several years' familiarity with the *name* of this puzzling 'Jararaca,' and curiosity increasing at a corresponding ratio, the reader can imagine the effect produced by unexpectedly seeing at the London Zoological Gardens one day in September 1880 a new label to one of the cages in the Ophidarium thus inscribed, 'CRASPEDOCEPHALUS BRAZILIENSIS. THE JARRARACCA. Presented by Dr. Stradling.'

A live Jararaca at last! Now we shall know all about it.

But how is this? The serpent before me was not a viper, not rough-headed, not a *Bothrops*, because it had only one pair of nostrils. It had smooth, polished scales, large, beautiful, round eyes, with no 'red spots' and not a spice of venom or of viperishness about it. And I stood staring and wondering, and—I must confess—*disappointed* at this meek-looking, smallish snake being a representative of the terrible, 'formidable' picture that had been conjured up. 'I don't believe that's a *Jararaca!*' were my inward conclusions. 'I am *sure* it isn't! It *can't* be. It does not agree in any way.' Then came the keeper to the cage, to tell me of this new and valuable addition; but I only repeated aloud my already firm convictions.

'Here's the gentleman who brought it from Brazil, and he ought to know,' returned the keeper in justifiable argument as he motioned with his hand towards a stranger by his side. The name of Dr. Arthur Stradling, a Corresponding Member of the Zoological Society, was already known to me. Though personally unacquainted, he had, indeed, through the columns of *Land and Water*, replied to some communications of my own. This informal introduction, therefore, led easily to the exchange of a few words about this contradictory 'Jararaca,' the name by which—as he assured me—the snake was known in Brazil. He had not, he said, examined the mouth of this snake during the voyage home, knowing its deadly character; and had simply accepted it as the 'Jarraracca,' according to its Brazilian vernacular. I ventured to point out the non-viperine aspect of the so-called 'deadly' reptile before us, and suggested that if it were indeed venomous it could only be an elaps, also that there were probably several that were known by this name. This led to a correspondence, both by letter and through the columns of *Land and Water* (Oct. 1880), on the subject of vernacular names; but as these belong more especially to the ensuing chapter, I need only say here that Dr. Stradling returned to Brazil determined to investigate this confusion of names, and I thus gained a valuable ally in my endeavours to identify some of the perplexing vernaculars of Brazil with the scientific descriptions.

On a subsequent voyage, Dr. Stradling obtained three more of these so-called Jararacas, and described them by letter, and subsequently in *Land and Water*.

Echoing my own perplexities, he asks, '*Is* there such a snake as the *Jarraracca?* When I got three more living specimens of the same this last voyage in Pernambuco, I began to have my doubts, for I could not reconcile them with the description at all. One died, which fact I did not, by ill luck, discover till it was worthless; but I observed, as I thought, a well-developed fang. A few days later a good opportunity presented itself for picking up one of the survivors and examining its mouth; then to my surprise I found that the supposed fang was really a large curved tooth, situated quite out of the natural position of a fang, but symmetric with one on the opposite side. Then I looked at the other one, and finally let both bite me, which settled the matter. I set it down as *Xenodon* (a harmless snake), and was gratified to find on reaching home that Dr. Günther had pronounced my specimen at the Gardens' (the one brought the previous September) '*Xenodon rhabdocephalus*, the long-headed snake, on its death. But I don't find any mention of this extraordinary isolated tooth anywhere, though I have a vague idea that Dr. Wucherer, who has perhaps been the most earnest student of the Brazilian Thanatophidia, spoke of it in a communication to the Society some years ago. The real "Jarraracca" is still veiled in mystery.' I also was 'gratified' to find the Corresponding Member of the Zoological Society so generously justifying my doubts about the supposed *Jararaca*, both in his letter to me and in a paper to *Land and Water*, 2d April 1881.

This was the first time I had ever heard of a *Xenodon*, a name which Dr. Günther was then so good as to explain meant 'strange tooth;' and he drew a little diagram of the jaw with five simple teeth curving back, and then a long, fang-like back tooth. Strange indeed! *Heterodon* I knew possessed a large, fang-like tooth, which had caused it to be called ugly names. Now here is more heterodox dentition.

Dr. Wucherer's account of the *Xenodon* was discovered in the *Zoological Society Proceedings* for 1861. He also had been a C.M.Z.S.[1] in the same region, and his report of the curious *Xenodon rhabdocephalus* is that it is very voracious, feeding chiefly on frogs, but will swallow his friend too, should the latter have hold of one on which he has set his heart. It flattens itself remarkably, and thus gets through a very narrow chink. It is a fresh-water snake, called *Cobra d'aqua* in Brazil, also *Surucucu* (from its evil reputation). But Dr. Wucherer says not a word of those fang-like teeth.

Meanwhile Dr. Stradling had most kindly sent me the magnificent specimen of '*Curucucu*' (*Lachesis mutus*), in spirits; and this, together with the investigation of certain other vernaculars, made the *Xenodon* of only secondary interest in our correspondence until exactly six months afterwards, when, on landing, June 1881, he wrote that he was sending a *Heterodon* and another *Xenodon* to the Gardens.

'Where are the new snakes?' I asked the keeper, hurrying to the Reptilium early next day.

'What new snakes, ma'am? There are none fresh since you were last here.'

'Ah, well, they are coming! Most *interesting* kinds. I shall wait for them.'

Sure enough, ere long a boy was seen approaching from the office with a 'box of snakes.' He also brought the news that the Doctor was expected 'directly.'

[1] Corresponding Member of the Zoological Society.

Consigned to their cage, how I hovered about those 'strange-toothed' Colubers that long midsummer day! How I wished they would bring their heads close to the glass and yawn the widest of yawns, and how I waited for the ophiological dentist to come and exhibit their 'fangs!' for the donor of these valuable acquisitions had been devoting himself to the discovery of antitoxics, and was supposed to be snake-proof, and to do what he pleased with both venomous and non-venomous kinds. But the long midsummer day waxed on, and I gazed at the *Xenodon* till I knew every mark of his leaf-like pattern; and the day began to wane, and my hopes of seeing the wonderful teeth began to wane also. And I felt I had a sort of claim upon this *Xenodon*, the 'Jarraracca' about which we had corresponded.

I had relied so much on having the pseudo-fangs scientifically displayed to me, that when the visitors were departing and the keeper was at liberty, I told him about these strange teeth which I was so anxious to see, and at last persuaded him to open *Xenodon's* mouth for me, and to hold it open (which operation the keepers understand very well) while I made the dental examination myself.

After all there was nothing in the shape of a fang to be seen!

'Posterior tooth long, compressed'! 'Last tooth very long, compressed, ensiform'! and so on, said the authorities; but nothing of the kind was here! I could see to its very throat, and the rows of tiny palate teeth and the four rows of jaw teeth, all exceedingly small, but never a fang. So I stared and wondered, and then in my bewildered amazement and vexation I passed my little finger along the jaws and *felt* the upper teeth.

This practical investigation no doubt greatly offended the imprisoned patient, for suddenly down came a pair of regular fangs—they *looked* like fangs;—and as my finger pressed the jaw on one or on the other side, I saw these fang-like teeth move, vibrate, exactly like the viperine fangs. When my finger was removed, up they went, folded back in their sheath in true viperine fashion. My finger got a slight prick, for they were exceedingly sharp; but knowing there was no venom in them, that did not concern me, and in a few minutes the sensation was gone. But how was it that Dr. Stradling had made no mention of this extraordinary viperine mobility of the fangs? And what kind of jaw must a snake have to move its back teeth in this manner! For we saw in the previous chapters that the mobility of the fangs is in proportion to the diminishing length of the maxillary bone, that the excessive mobility of the viperine fang is owing to the greatly reduced size of that bone, that a slight mobility is observable where the jaw is somewhat less reduced, and so on; but here is a harmless Coluber with a jaw long enough to hold five or six fixed, simple teeth, and then an extremely mobile long one at the back. Can the jaw be divided in the middle? Thus I marvelled.

'Now let us look at Heterodon.'

But that pretty little snake positively refused to open its mouth; so, fearing to alarm it, or cause it to disgorge its last meal, I did not encourage its forcible detention.

Not to lose a moment, I then and there pencilled a note to

Dr. Stradling, begging him to tell me if he had observed anything unusual in *Xenodon's* 'fangs.' That I had examined them and seen what appeared very extraordinary; but before describing it, was desirous of having my observations confirmed by him.

But the Dr. had been unexpectedly appointed to another ship, which would sail immediately. Many weeks must, therefore, elapse before his reply could reach me.

That day there was but one direction to which my ophidian compass directed my steps, viz. the British Museum; and several days were spent there hunting every possible book to find any mention of *Xenodon's* moveable teeth, but in vain. Surely a feature so exceptional would have been described had it been observed. Pardon, kind reader, these many words about 'so small an affair;' but you who are naturalists know the peculiar charm of finding 'something new,' producing, as Charles Kingsley described, 'emotions not unmixed with awe,' that among the happy memories of study or of travel 'stand out as beacon points.' It was my great ambition to add 'something new' to science. But here was I with a secret 'discovery,' and not knowing what to do with it. And 'if anything should happen' to *Xenodon* meanwhile! Then the keeper would be reprimanded. Plainly, courtesy demanded that the secretary of the London Zoological Society should receive an explanation of my infringement of rules; therefore, in a letter to him, I described *Xenodon's* whole history. I also wrote a detailed account of *Xenodon* to a friend who edited a zoological publication, under the delusion that I should be invited to contribute a full, true, and particular account of these wonderful teeth to half the zoological journals of Europe! 'First observed by C. C. H.!' But no!

Weeks of wondering suspense passed by. Then everybody went 'out of town.' On meeting Dr. Günther one day at the British Museum, I told him what I had seen. 'The teeth or the jaw moves?' he asked catechetically. That I could not explain, as it was precisely what one wished to ascertain. 'You must dissect that snake,' he said, adding that he had had no time to examine it yet. All this was duly reported to my Brazilian correspondent, who with a generous impulse promised to send me 'the very first *Xenodon*' he got. Alas! as I told him, it was useless to give it to *me*, who could neither kill nor cut up snakes. He did not inform me whether he, also, had observed any mobility in the 'fangs;' so I could not yet flatter myself that I had 'added to science' in any way. Professor Halford, when in England, had dissected the head of the dead specimen at the Zoological Gardens (the supposed *Jarraracca*) for poison glands, but of course found none; and I trusted to some scientific friend 'happening by' who would further examine its maxillary bone and report to me; but ophiological anatomists do not present themselves every day. Dr. Stradling was absent; so unless other enthusiasts proceed to an examination before this page meets the public eye, there will still remain these 'strange-toothed' maxillaries inviting dissection.

Dr. Stradling, however, after a while informed me that he had *not* observed the mobility of the fangs, nor had he seen any mention of such anywhere excepting in my paper to *Land and Water* (July 9, 1881). He thought those pseudo-fangs 'of considerable importance in bearing on the experiments that were then being carried on in Brazil with permanganate of potash, and particularly should a non-ophiologist be the experimenter.' A snake is brought as a 'Jararaca,' a name applied by the authorities to one of the very deadly viperine snakes. This snake—the so-called 'Jararaca'—bears an evil character. It has also very suspicious-looking 'fangs.' It bites an animal which is put under treatment, and though requiring no treatment whatever, a supposed 'antidote' might get all the credit of a 'cure.' He did not for a moment infer that such had been the case in Brazil with those scientific experimentalists, but only what might be in consequence of the confusion in names. And the correspondence on this subject that appeared in the papers during the latter part of October 1881 certainly did betray some confusion between the various *Jararacas* and *Jararacucus* that had inflicted bites.

Dr. Stradling had also looked in the mouth of the dead specimen of *Xenodon rhabdocephalus*, and he informed me that one of the 'fangs' came out in his hand. 'It did not break off,' he wrote; 'and its articulation with the bone, if any, must be loose and ligamentous.' I must not presume to offer any opinion about its 'articulation,' except that its being 'loose' might be only in consequence of a new tooth pushing it out, or that it was about to fall out of itself. My readers will unite in thanking Dr. Stradling for considerately forwarding me this 'fang,' which so conveniently detached itself in time to be added to the rest of the illustrations, fig. *e*, presented on p. 360. It will be observed that it is a stouter and less symmetrical tooth than the true fangs; but it was very large in proportion to the simple teeth in the same jaw and on the palate, and which are not bigger than the palate teeth seen behind the recumbent fangs of *Daboia*, p. 349.

Of these true *Xenodons* there are eight species; but the strange-toothed group includes *Tomodon*, *Heterodon*, *Simotes*, *Liophis*, and several others that have large posterior teeth, some of which are grooved, others not, but all without a poison gland.

Searching page after page about *Xenodon*, something one day suddenly caught my eye that had hitherto escaped notice. In his *Odontography*, Owen, describing the South African snakes *Bucephali*, says: 'Their long grooved fangs are firmly fixed to the maxillary bone, *or are slightly moveable* according to their period of growth; they are concealed by a sheath of thick, soft gum, containing loose, recumbent, grooved teeth ready to succeed those in place.'

'So, then, a mobile tooth was already known to science.' Of *Bucephali viridis*, Dr. Andrew Smith describes the 'posterior or *mobile* and grooved teeth of the maxilla.' He says: 'Some are placed for immediate use, the rest are recumbent between those and the inner portion of the spongy sheath which envelops them; anterior teeth fixed.' He considered these back teeth not poisonous, but only for holding or preventing the escape of food. 'They may convey an acrid saliva.' Still we are not informed *how* the teeth move.[1]

These snakes—the Bucephali—like the far-famed horse of Alexander the Great, owe their name to their large, ox-shaped head. They are the 'Boomslange' or tree snake of the Dutch settlers, and are by some ophiologists

[1] *Zoology of South Africa.*

included among the *Dendrophidæ*, or true tree snakes, as they live in trees; but Dr. Andrew Smith considers that their teeth sufficiently separate them from these.

That there is something exceedingly interesting to study out in the *Xenodon* family cannot be doubted. 'The transition begun in the Bucephali,' says Owen,[1] 'is completed in the poisonous serpents,' but where the virulent character of the saliva begins it is hard to say.

Despairing of any distinct comprehension of a jaw-bone which permits of moveable back teeth, the last resource was to hunt up a skeleton. At the Museum of the Royal College of Surgeons none was to be found; but through the kindness of the officials at the British Museum, one was at length unearthed from the subterranean labyrinths of untold treasures there. It was the skull of *X. gigas*, the largest of the family, and a splendid specimen for examination. There were two large posterior fangs on each side. On one side were two or three more large reserve fangs—a cluster of them. All were recumbent. They were all much larger than that of *X. rhabdocephalus*, those in reserve varying in size relatively to their development and position. In this specimen there were also two double rows of palate teeth, and an abundant but most disorderly row of simple teeth in the lower jaw, with some reserve ones packed closely on the inner side below the row in use. They exactly illustrated the words of Nicholson and others, 'the crop of young teeth everywhere working their way into the intervals of the old ones.'

In the skulls of *Liophis meremii* and *Liophis cobella*,

[1] *Odontography*, vol. i. p. 225.

of which Dr. Wucherer says, 'Dentition similar to Xenodon,' the former had teeth gradually increasing a trifle posteriorly, but nothing like fangs. *L. cobella* had a very long jaw of fifteen or sixteen teeth, but no fangs.

On a second occasion I made a dental examination of the living *Xenodon* in order to be fully convinced of the nature of its back teeth, and in both instances the fangs were depressed until the snake was provoked into displaying them. It exhibited no spitefulness or attempt to bite, and in both cases folded back its fangs the moment my finger was removed, as if glad that the ceremony was over.

Heterodon d'Orbignyi, being a small and delicate snake, was not again enticed to exhibit its jaws; but my forbearance was otherwise rewarded. One day it was dining off a rather large frog, and its mouth, close to the glass, was stretched open to its fullest extent. The frog had disappeared so far as to be within the mouth, wedging it wide open; and I then saw a fang well erected and in use, *moving*, being detached, in fact, from the food. It appeared to be somewhat nearer to the front than *Xenodon's* fangs, with perhaps only three or four simple teeth before it. But that it was a sheathed fang and *mobile* I have no doubt whatever, having seen it very distinctly. I told Tyrrell at the time that *Heterodon's* fangs were also moveable; but now for the first time I impart this new secret to the public. *Xenodon* also greedily seizes upon inconveniently large frogs, but it has never displayed its fangs to me while feeding, as the pretty little *Heterodon* did. One more singular thing did this little *Heterodon*, and that was to assist itself by coiling its body round an unmanageable frog one day. It did not regularly constrict it in order to kill it; but *when caught* in the mouth, it helped itself to restrain the straggling limbs by a few coils. Dr. Wucherer affirms that he had never seen its congeners *Liophis* or *Xenodon* squeeze or coil themselves round their prey, but *Heterodon d'Orbignyi* certainly does.

Another peculiarity of the American *Heterodons* is that of flattening their heads and the upper part of the body when angry or molested. It is this, together with their pseudo-fangs, that have procured them the name of 'spread-head,' 'spreading-adder,' 'puffing-adder' or 'blowing viper,'—because at the same time they hiss violently,—or simply 'the adder,' and '*blausser*,' or the blower.

There are several species of them, all, with the exception of *H. d'Orbignyi*, having undeniably ugly, viperish-looking heads, '*Anguis capitæ viperino*,' or '*Serpent à la tête de vipère*.' The snout terminates in a large, conspicuous, recurved scale which gives them a pug-nosed or rather a hog-nosed appearance. Catesby, who was the first to describe the 'hog-nosed snake,' said 'it hath a visage terrible and ugly.' In *H. niger* and *H. platirhinos* this is most apparent. They belong mostly to the New World, both north and south. One in Virginia is called, from its bright markings, the 'calico snake,' the word calico in America being applied chiefly to coloured prints used for dresses. Another is called 'the mountain moccasin,' the latter name in the United States being applied to venomous kinds.

In the flattening of the head and body, *Xenodon* and *Heterodon* approach the cobras; in the strange dentition they approach the vipers; in their true nature they are harmless colubers: thus do we see the wonderful links or gradations between opposite families, which have been such a perplexity to the early naturalist.

The *Heterodons* have the reputation of 'feigning death' when annoyed. This peculiarity has been commented on by many who have experimented upon the snake for this purpose. Holbrooke observed it in *H. platirhinos,* and came to the conclusion that it was done at will. 'It will deceive its tormentor by feigning death, remaining flat and motionless.' It otherwise 'flattens the head and upper part of the neck, which it lifts and waves, hissing loudly.' This is the true cobra manner. He often worried it and tried to make it bite, when it only projected its head in that menacing way, but with closed mouth. On the contrary, other experimentalists describe it with widely expanded jaws when thus annoyed. In an excellent American magazine, *Science News,* the *Heterodons* formed the subject of several papers a few years ago. To my friend, Mr. J. E. Harting, I am indebted for some numbers of *Science News,* in which *Heterodons*' performances are fully described. One, on being intercepted in its retreat, 'threw its head back with widely expanded jaws; but instead of striking, it turned completely over on its back, remaining stiff and motionless, with jaws fixed in rigid expansion, feigning death.' Reptilian intellect was, however, insufficient to carry out the feint, inasmuch as its full muscular power was exercised to maintain its position. 'On concealing myself,' continues the narrator, 'it cautiously righted itself and made off; but only to repeat the *ruse* when again caught.'[1] Dr. J.

[1] *Science News,* Feb. 15, 1879.

Schneck, in the March number for the same year, describes a similar action on his worrying them with a switch, when, after making futile efforts to attack, they would seem to bite themselves (which they really never do), and then turn on their backs as if dead. After a few moments of quiet they would turn over and beat a hasty retreat. Several other writers in *Science News* confirm Holbrooke's experience, that 'under no provocation can it be induced to bite.' Those we have seen at the Gardens verify this; exhibiting an extremely inoffensive nature, though no death-feigning or summersault performances. And I am more inclined to attribute the rigidity to a sort of paralyzed terror than to any pretence of being dead. The same thing is observed in some insects. If you blow on them or alarm them, they will flatten themselves against whatever they may be crawling on, and cling close and stiff as if dead, but presently escape. Some other snakes, also, as well as the *Heterodons*, keep rigidly still as if paralyzed when molested, previous to attempting any escape, though I do not remember any others that turn over on their backs in so singular a fashion.

A few more words about the *Deirodon* with its still stranger teeth must come in the next chapter.

CHAPTER XXIII.

OPHIDIAN NOMENCLATURE AND VERNACULARS.

IN a lecture on 'Chameleons' at the Zoological Gardens, Professor St. George Mivart described in his peculiarly lucid, facile manner, some of the features possessed in common by totally different zoological families, and facetiously added, 'It is tiresome how a single species will come and interfere with our nice definitions in classification.'[1] I will devote a chapter to the confusion arising from some such mixed features.

In the classification of the Ophidia these tiresome complications present themselves more, perhaps, than in any other creatures. We have seen how snakes of entirely opposite families may possess one single feature in common and differ in other generic respects; as, for instance, in the moveable but innocuous fang of the *Xenodons;* in those

[1] *Davis Lecture*, July 28th, 1881. Since the above was written, Professor Flower on 'Armadillos,' at the opening lecture of the 'Davis Series,' June 8th, 1882, further corroborated the difficulties presented in these mixed characters, which have caused zoologists to place the armadillo among the *Edentata*, ant-eaters, sloths, etc., notwithstanding it is permanently supplied with teeth.

'pits' or depressions in the face; the viperine form of head; the position and number of head-shields; the sub-caudal plates, and so on; and in such resemblances I am strongly inclined to suspect that there are other interfering causes than a common ancestry, though this, no doubt, has much to do with it.

'What is to prevent our having one fixed name, and keeping to it?' exclaim the sorely-puzzled amateur naturalists. And well they may, on seeing in some works on ophiology a list of synonyms sometimes filling several pages.

By way of illustration let us take the little spine-toothed snake described among the egg-eaters in chap. iii. This snake was known to be *edentulus* by Linnæus, who nevertheless gave it the generic name of *Coluber*, because it has two rows of sub-caudal plates; and the specific *scaber*, because it has roughly-carinated scales—both names equally applicable to a score of other snakes, and not at all describing its unique dentition. This latter was first made a distinguishing feature by Jourdan, 1833, who assigned it the generic name of *Rachiodon*, spine-toothed. Lacepède called it simply *La rude;* Wagler, *Dasypeltis*, thick or rough-scaled, the integument rather than the dentition still receiving prior attention by the majority of observers.

Dr. Andrew Smith in 1829 more closely watched its habits, and considered that its peculiar dentition was sufficient to separate it from the *Oligodon* (few-toothed) family, under the new generic name of *Anodon*, with the specific *typus* to mark it as a distinct type. Afterwards he found that the word *Anodon* had been already adopted by naturalists for a shell-fish, and he contented himself therefore with Wagler's name *Dasypeltis*, adding *inornatus* for its specific, otherwise *D. scaber*. It is a small, slender snake, rarely exceeding $2\frac{1}{2}$ feet in length, and of an inconspicuous brownish colour. That it is an extremely slender little snake is evident from the portion of spine copied from the skeleton in the museum of R. C. S., and given in the chapter on egg-eating snakes. Jourdan's name *Rachiodon*, though the best that had hitherto been assigned to the spine-toothed tree snake, was yet rather vague, as the teeth might be anywhere along the spinal column; and Professor Owen still further improved upon this name by calling it *Deirodon*, neck-toothed; for though, as already stated, a snake has no true 'neck,' the word *Deirodon* designates the position of those gular teeth; and for convenience, everybody speaks of a snake's 'neck' in allusion to the part immediately behind the head. So the little egg-eating tree snake is equally well entitled to the generic names of *Oligodon*, few teeth; *Rachiodon*, spine teeth; *Anodon*, toothless (as far as true teeth are concerned); and *Deirodon*, neck-toothed. In habits it differs entirely from the *Oligodontidæ* family, which are ground snakes. The Deirodons are frequently found concealed under the loose bark of dead trees; and Dr. A. Smith observed three species all having a like organization, which induced him to conclude that all feed alike on birds' eggs.

As very few snakes have such an exceptionally distinguishing organization as the *Deirodon*, few are so happy as to escape with only half a score of titles. Many species that have been longer known have had their names similarly improved upon by fifty naturalists, and are still undergoing renomination as new observers discover closer alliances with one or another family. This is particularly the case in America, where a nomenclature entirely differing from our own is often adopted. It will probably be the same in Australia as the science of ophiology advances and as native naturalists increase. Says Krefft, in allusion to these commingling features and many synonyms: 'It is difficult for even the scholar to master the vexatious question of snake classification.' Add to the scientific names an equal number of vernacular ones, and we encounter a list sufficient to dismay the merely lukewarm student at the very outset.

Let me here suggest the utility of first getting at the *meaning* of scientific terms as an immense assistance towards fixing them in the memory. In the construction of generic and specific names some peculiarity is, or should be, described. This I have endeavoured to keep before the reader throughout this volume; and by first looking at the *meaning* of the word, it is at once simplified, while that peculiar feature for which it is named is also grasped. Occasionally a name baffles us, it is true, and one fails to see cause or reason in it; but this is an exception. Other names without apparent reason are from persons, as, for instance, when a Mr. Smith thinks to immortalize himself by calling a snake *Coluber smithii*. Probably the next observer would find this too general to be of much use, and discover some peculiarity more worthy of a specific.

Not long ago, when Lacerda was experimenting with our distinguished ophidian, the 'Curucucu' (*Bothrops* or *Lachesis rhombeata*), it was variously introduced to the public through the daily press, as the *Bothraps rhambeata*, the *Hachesis rhambeata*, and the *Lachesis rhambeata*. It is doubtful whether many of the 'general public' imagined these three names to represent the same snake, or whether —except possibly from the last generic one—they could form any idea of the reptile therefrom. Of the many papers that fell under one's notice, *Land and Water* alone on this occasion spelt the words correctly. As yet there is no journal devoted to the Reptilia, and the study is evidently not attractive. Nor do we expect all naturalists to be ophiologists; but those of the editors who were zoologists might have hazarded a guess and made sense of the generic *Lachesis*, seeing that a deadly, fateful serpent was intended. Some of the scientific 'weeklies' having started the wrong names, unscientific 'dailies' deferentially transcribed them. The errors were chiefly traceable to caligraphy, and are mentioned here to exemplify the advantage of seeking a meaning in scientific appellations, the meanings of some names being so obvious that in spite of a wrong letter you may frequently decide upon them.

This fateful *Lachesis* of South America has been as perplexingly described by unscientific travellers as the *Jararaca*, and as hard to identify. It has been a stumbling-block and a snare ever since the time of Waterton, who thus wrote of it:[1]—'Unrivalled in the display of every lovely colour of the rainbow, and unmatched in the effects of his deadly poison, the *counacouchi* glides undaunted on, sole monarch of these forests. He sometimes grows to the length of fourteen feet. He is commonly known by the

[1] *Wanderings in South America*, by Charles Waterton. London, 1825.

name of *Bushmaster*. Man and beast fly before him,' etc. Waterton 'wandered' between the years 1812–1824, making several journeys to South America, primarily with the view to ascertain the composition and effects of the Wourali poison, and on this subject his information was of value. But his descriptions of serpents partook of the prejudices of that date, and were more picturesque than zoological. What he saw and wrote of possessed the charm of novelty in those days, and Sir Joseph Banks addressed a letter to him expressing 'abundant thanks for the very instructive lesson you have favoured us with, which far excels in real utility anything I have yet seen.'

Endorsed by such an authority, what wonder that fourteen feet of radiantly splendid 'Bushmaster' should figure in the encyclopedias of the day, and be copied by bookmakers and magazine contributors for years and years —even to the recent date of 1874! Hartwig, 1873,[1] gives Waterton's 'rainbow hues' nearly word for word, with the addition of one of the scientific names, *Lachesis rhombeata*. Kingston, 1874,[2] aided by his imagination, improves on Waterton. The *Curucucu*, or *Couanacouchi*, 'sometimes fourteen feet, is the largest known poisonous snake. It is remarkable for the glowing radiance of its fearful beauty, displaying all the prismatic colours. It mounts trees with the greatest ease,' etc. (It lies half concealed *under* the trees among dead leaves.) Another writer of *Travels round the World* (meaning the British Museum Reading-room) contents himself with simply a 'rainbow-

[1] *The Tropical World.* London, 1873.
[2] *The Western World.* London, 1874.

coloured' Bushmaster; so now in imagination we add indigo, blue, green, etc., to the 'fearful beauty.' Meanwhile other writers on Brazil introduce it as the Surucuru, Sorococo, Couroucoucou, Souroucoucou, Surukuku, and similar names, varied only by a transposition of letters and the addition of accents. Tschudi mentions it under its scientific name, *Lachesis rhombeata*, the 'Flammon' in Peru.[1] Sulivan,[2] who, like Waterton, rambled in South America, tells us 'the Couni Couchi or Bushmaster is the most dreaded of all the South America serpents; and, as his name implies, he roams absolute master of the forest. They do not fly from man, but will even pursue and attack him. They are fat, clumsy-looking animals, about four' (not fourteen) 'feet long, and nearly as thick as a man's arm. They strike with immense force.' A man had been bitten in the thigh and died, and 'the wound was as if two four-inch nails had been driven into the flesh. So long are the fangs, and so deep the wounds, that there is no hope of being cured.' P. H. Gosse quotes Sulivan regarding the enormous fangs, both of these latter writers judiciously omitting the 'rainbow' colouring.

Most snakes, even the dingiest, occasionally display an iridescence which is certainly beautiful; and Waterton may have seen his Counicouchi when the sun lighted up the recently-renewed epidermis and showed him off in unusual brilliance; only, unfortunately, the copyists have imagined the greens and crimsons and blues of the rainbow, and rendered it a tedious business to poor patient plodders

[1] *Travels in Peru.* London, 1847.

[2] *Rambles and Scrambles in Essequibo.* London, 1852.

to arrive at the truth. In the *Encyclopædia Metropolitana*, 1845, we find another clue to identification. '*Trigonocephalus mutus*, a native of the Brazils and Guiana, and from six to seven feet long, is known to the Brazilians as *Surukuku*, and is probably the *Boschmeester* of the Dutch and the *Cœnicoussi* of the native inhabitants.'

Many writers of travels give the vernacular names only, while the more scientific who do give generic and specific names, may each give a different one and perhaps omit the vernaculars; and in none of the authorities does one discover the name 'Bushmaster' at all; while as to colour and the true size we can be sure of nothing.

Presenting these complications to Dr. Stradling, whose kindly proffered co-operation I had gladly accepted, he wrote: 'The vulgar names are often *local* in a limited area, so that the same snake may be known by half-a-dozen different synonyms in as many different provinces—not only that, but these names are often applied to other snakes; and thus, while some species are blended together, many imaginary ones are created.'

This in part explains the varieties of spelling seen above; the two names *couanacouchi* and *curucoocu* being applied to one snake by different tribes of the native races extending over a rather wide area.

Further confirmation of these indiscriminate terms we find in three other writers, viz.:—First, Dr. Dalton:[1] 'The boa constrictor is known as "Bushmaster" by the colonists. "Camoudi" is a name indiscriminately applied to all large snakes. There is the land Camoudi, and the water Camoudi,

[1] *History of British Guiana*, vol. ii. p. 370. By G. Dalton, M.D. Lond. 1855.

while the Kunikusi or Courracouchi of the Indians is *Crotalus mutus*, which is termed "Bushmaster" in the forests.' Secondly, H. W. Bates[1] says: 'The natives called *Trigonocephalus atrox* the Jararaca.' Thirdly, Dr. Otho Wucherer[2] affirms that a 'venomous tree snake (*Craspedocephalus bilineatus*) is called *Surucucu patyoba*, from the palm on which it is found, and another tree snake is *Suru. Uricana*, from another palm in which it resides; while *the* Surucucu (*Lachesis mutus*) lives in holes in the ground. It is about ten feet long.' This latter is called *Suru. bico di jacca*, from the resemblance of its strongly-keeled scales to the prominences on the 'jack fruit;' *Xenodon rhabdocephalus* is also *surucucu*, while the true 'Jararaca' is *Craspedocephalus atrox*.

Here are contradictory *Curucucus* and *Jararacas* in plenty, all impressing upon us the importance of comparing evidence if we wish to arrive at a truth.

'Why spend so much time about a mere name?' Well, as in the solution of a problem, you desire to 'get it right.' Besides, you ask, 'Why so many names to one snake?' and in sifting out this *Curucucu* and the *Jararaca*, we discover reasons for the many synonyms.

A. R. Wallace once more presents a clue:[3] 'At Säo Gabriel I saw on the rocks asleep one of the most deadly serpents in South America, the "Surucurú" (*Lachesis mutus*). It is very handsomely marked with rich amber brown, and armed with terrific poison fangs, two on each side.' Here we are enabled to associate a scientific and a vernacular

[1] *The Naturalist on the Amazons*, by H. W. Bates. Lond. 1873.

[2] *Proceedings of the Zoological Society*, Jan. and Nov. 1861.

[3] *Travels in the Amazon.* Lond. 1855.

name with a 'handsome,' though not a 'rainbow-coloured' serpent. Sir J. Fayrer describes the *Ophiophagus* as the largest known venomous serpent '*except* the Bushmaster, which is said to attain fourteen feet.'

By this time, in addition to the ever-varying vernaculars, we learn of Waterton's 'Bushmaster' as *Lachesis mutus; L. rhombeatus; Crotalus mutus; Trigonocephalus mutus.*

It will be observed that the word *Trigonocephalus* is used as a generic name by some naturalists, and as a specific by others; and it may with reason be applied to most of the American thanatophidia which are not *elapidæ.* It therefore, at least, enables us to ascertain that the snake of doubtful identity has this viperine characteristic of the angular head; and as there is only one very small true viper at present known in the New World, we may further decide that not being an *Elaps,* our puzzler is a *Bothrops* with the *doubles narines,* and therefore equally meriting either of the descriptives *atropos, atrox, furia, megæra, clotho, cophias,* and other such fearful appellatives freely used to designate the deadly qualities of the worst class of serpents. In reply to a communication of mine to *Land and Water,* of 2d October 1880, Dr. Stradling[1] entered more fully into this question of vernaculars, and what he says of Brazil we find to be the case everywhere:—

'Whatever meaning the colloquial titles have is generally grounded on some popular error.'

This we saw in the case of *Xenodon* and *Heterodon,* both called all sorts of bad names on account of their supposed fangs.

[1] *Thanatophidia,* p. 8.

'In Brazil, *Jeboia* and *Cas-cavel* are the universal names for the boa and rattle-snake; every snake with red in its markings is a coral snake ("corral," from the Spanish word for a ring), every one found in or near the water would be a *Cobra de agua*, and every other is a Jarraracca or a Curucucu.

'I believe every country has a pet bugbear among serpents. "Fer-de-lance" is the cry in St. Lucia when a snake rustles away in the bush or inflicts a bite unseen, "Bushmaster" in Demerara, "Toboba" in Nicaragua, "Vaia" in Mexico, "Vivera de la cruz" in the River Plate. Over and over again have I had snakes of widely different species sent to me, each guaranteed to be a genuine Jarraracca, until I began to doubt whether the Jarraracca had any existence at all. I believe that the one I sent to the Zoological Gardens the other day is the real thing—*Craspedocephalus Brasiliensis*—at last' (the *Xenodon* after all!) 'and I think I have sifted the Curucucu down by elimination till I can fix the term on *Trigonocephalus atrox*.

. . . .

'I fear we shall never get a decent classification till some competent observer studies them on their native soil; the excellence of the books on Indian reptiles is doubtless due to this. We want a man in authority to settle the very vernacular for us—one who can say, "This and no other shall be the Jarraracca, this the Bushmaster," etc., for it is undoubtedly a great advantage to have a well-defined native or local synonym. The marvel is that the present classification should be so good as it is. Look at the difficulties. When people see a snake they rush at it, smash it with sticks or stones, pick up what is left of it and put it in a bottle of canha, cachasse, rum, or other coarse spirit, label it with a wrong name, and send it home. And these are the materials an ophiologist has to build on.' [1]

Krefft, speaking of the confusion of vernaculars in Australia, also says: 'To make a work on ophiology useful to all, *co-operation is necessary;* and as a good, sound English name is prefixed to every species, it is to be hoped that such name will, if possible, be retained.' He is referring more particularly to the 'Diamond snake,' which on the mainland is the harmless *Python molurus*, and in Tasmania the venomous *Hoplocephalus superbus*, with very broad scales. Therefore he 'hopes that Tasmanian friends will accept the designation "Broad-scaled snake" in lieu of "Diamond" for their poisonous species.' In the accounts sent to England, the indiscriminate use of

[1] *Land and Water*, October 16, 1880.

such prefixes as the *black* snake, the *brown* snake, causes infinite perplexity, and not unfrequently furnishes argumentative articles to the journals. 'Carpet' snake is another vernacular applied to a harmless species in Australia, and to the extremely venomous little *Echis* of India. Then every country has its 'Deaf adder' which is neither an 'adder' nor 'deaf.' And the 'moccasin' of the United States is a still existing stumbling-block.

Another great confusion in classification has been in consequence of some of the earlier naturalists representing young snakes, or those of varying colours, as distinct species. It is very common for a young snake to differ in colour from the parent, and also common for those of the same brood to differ from each other. Of *Coluber canis* Dr. A. Smith says scarcely any two are marked and coloured alike. In a brood of the broad-scaled Tasmanian snake, *H. superbus*, there were upwards of thirty young ones, some of which Krefft describes as banded, and of a light colour, the rest being black. Our English slow-worm varies from dead black to nearly white, or flesh colour, one of the latter being an inmate of the Gardens at the time of writing, March 1882. The English viper also varies in colour, and we have heard of a perfectly yellow ring snake.

In England we have so few snakes, viz. the ring snake, the coronella, and one viper, and these three so distinct, that we are not likely to be perplexed with many varieties; but in tropical or semi-tropical regions, where closely-allied species abound, it may be suspected that *hybrids* not unfrequently create confusion as well as a multiplication of supposed 'species' not likely to cease. In our small

London collection, hybrids have been produced at least twice within a few years; and we fear that the habit of hibernating in mixed multitudes leads to some immorality among the Ophidia. It is like the overcrowded dwellings of the poor, and the 'free-lovers' of America; and perhaps to ophidian unions between congeners occasionally may be traced not a few of the varieties which so curiously and closely blend different species and are a plague to classifiers. This is mere speculation.

The Indian vernaculars are as abundant and perplexing as those of Brazil. Of the cobras, Sir J. Fayrer says there are many varieties which the natives consider different species. 'The snake charmers are poor naturalists, and disseminate many false notions as well as dangerous ones about the cobras.' In the *Thanatophidia* nine or ten varieties are figured, all of the one single species (*Naja tripudians*), though all bear different vernaculars. The two chief distinctions in the markings are the spots on the back of the 'neck,' which, when the hood is distended, are easily distinguished. One with a single ocellus is the *Keautiah*, known as 'Kala samp,' 'Nag samp,' etc., being chiefly of the field or jungle. The other with the double ocellus is the 'spectacled cobra,' and essentially of the town. This is the 'Gokurrah' of the natives, and the favourite of the snake charmers. Being common all over a country which boasts of thirty-six written languages, the reader can imagine the number of vernaculars bestowed upon the *Cobra capella*.

The *ophiophagus* is almost equally favoured, as this snake also varies in colour, particularly in the young ones, which Fayrer affirms might easily be mistaken for a different species. Probably wherever snakes abound, the vernaculars are correspondingly numerous.

'And after all which *is* the Curucucu, and which *is* the Jararaca?' Being the proud possessor of both, I may describe them from nature; but conflicting opinions as to their identity still exist, because there are features in common among congeneric species, and what one author may decide is the *Curucucu* another will call the *Jararaca*. Dumeril, Gray, Günther, and other modern ophiologists have, however, so far simplified difficulties, as to recognise only one of each in our zoological collections, notwithstanding the liberal use of both terms in Brazil.

Our Curucucu, then, *Lachesis* or *Crotalus mutus*, has the flat, viperine head, covered with fine scales. The only plates are the upper and lower labials, one over the eye, and a pair of rather large ones under the chin. The 'pit' is very distinct, showing it to be a *Bothrops* and one of the *Crotalidæ*. The body colour is of a pale maize, approaching umber towards the back, and lighter on the belly, with a chain of rich chocolate-brown, jagged, rhomboid spots, edged with darker tints, along the back. It is undeniably handsome, and in life no doubt was iridescent, but alas for the 'rainbow splendours,' they have vanished! In length it is about nine feet, and in girth as big as one's arm in the largest part. Its tail tapers suddenly. One sees in the strongly-keeled scales the 'prominences' alluded to by Dr. Wucherer; and as the fangs are represented life-size on p. 360, the reader can judge for himself about the 'four-inch nails.' Mine is probably a nearly full-grown serpent, therefore an average-size specimen, and much the same as the one brought to the Gardens in the summer of 1881, which lingered a pitiable object for six or eight months, eating nothing, and gradually wasting.

The *Jararaca* is a slighter snake, and in colour of an olive tint with darker markings, not unlike Xenodon's jagged leaf pattern along the back. Its right to the name of *Craspedocephalus* (*craspedo*, derived from a Greek word signifying an edge or border) is recognised by a peculiar ridge round its flat, angular, and almost lance-shaped head. It is also a *Trigonocephalus* and a *Bothrops*. My specimen being only half-grown is about three feet long, and the thickness of your little finger. 'Is there not great confusion in the application of the terms *craspedoceph.* and *trigonoceph.?*' wrote Dr. Stradling, on sending me these much-prized specimens. Yes, there certainly is; but by this time the reader sees the reason for this, and also for the many appellatives which they derive from the Fates and the Furies. Not to weary the reader with further lists of names, I will refer him to Gray's *Catalogue of the British Museum Snakes*, p. 5, for *the* accepted *Jararaca* of the authorities, and to Dumeril, tome vii. pt. ii. p. 1509, for the same; both authors giving the numerous synonyms, and the latter the reasons for many of them. The student will there see how Wagler is supposed to have described young snakes as different species; and if further investigation be invited, a good deal of entertainment may be had from Wagler himself and his folio volume,[1] *Serpentum Braziliensis*, with its wonderful coloured illustrations. Then for the *Curucucu*, the *Lachesis mutus* of

[1] By J. B. von Spix, *Publié par Jean Wagler.* Monarchu, 1826.

modern ophiologists, see p. 13 of Gray, and p. 1486, tome vii. pt. ii. of Dumeril et Bibron. From these authors we may go back to Marcgrave, 1648, for the '*Cvrvcvcv Braziliensibus*, fifteen palms long, truculent and much to be feared.' Marcgrave's book is embellished with marvellous pictures which are not likely to enlighten us much; but through him we are enabled to identify some of his serpents with the vernaculars, for, like the Pilgrim Purchas, the vernaculars were all he had to guide him.

Authorities recognise six or seven species of *Craspedocephalus*, presumably all having the easily distinguishable edge like a thin cord round their heads, and which doubtless were the 'prominent Veines' described by Purchas in the Brazilian species, now generally recognised as '*the* Jararaca.' I will invite my readers to 'co-operate' and call no harmless little snakes by this name, which originally implied something terrible.

'And what is the outcome of all this etymological jumble?'

'Well, we at least learn that as in English the words snake, adder, serpent, have a somewhat general signification, so have some of the Brazilian vernaculars. But I cannot help thinking that many of these names had more of natural history in them than we are apt to suspect, though no doubt the original meaning has become much corrupted during three hundred years' colonization. The native races knew quite well that some snakes were dangerous and some harmless, which is more than can be said for the present occupiers of South America, who think all venomous as a matter of a course.

The differences in spelling the same word may guide us in the pronunciation of it; as, for example, the *c* sometimes as *k*, in Camoudi, or Kamoodi, and as *s* in Curucoocu or Sooroocoocoo. In these latter words we also find the *u* identical with *oo*, as in the Hindû or Hindoo words. Again, the *j* is as *i* in *Jararaca* or *Iararacca*, or more probably a sound with which we are unfamiliar, as the word is sometimes *Shiraraca*. The frequent transposition of syllables hints at a meaning which may be worth seeking by a philologist, should he be also an ophiophilist. Some local information on these points I much hoped to obtain; but alas! (*for this chapter*) the trips to Brazil of my excellent ally came to an end! Independently of which, the native dialects could only be studied in the far interior, where, here and there, some tribes may still be found in their pristine simplicity, though it is very doubtful whether their dialects to-day are those from which the first European settlers obtained their *Curucucus* and *Jararacas*.

The repetition of syllables in these strange dialects seems to point at some intention. Can those frequently occurring *raras* and *cucus* represent degrees? For instance, we are told that the Jarrara*cucu* is 'the largest of the Jarraracas.' And we are quite sure that the *Cucu*rijuba, 'which killeth by winding certain turnes of his tayle,' is the boa constrictor; and that the *Cururiubù*, 'which keepeth alwaies in the water, is the anaconda, these syllables evidently representing bulk or something formidable: as we have them abounding in *curucucu*, the most formidable of all serpents. Then *Ibibo* might imply beauty or gay colouring. A snake, *Ibiboco*, with red and black rings, 'the fairest but of foulest venom,' is undoubtedly *Elaps lemniscatus;* while Ibiboboca, '*ainsi nommé par sa grande beauté*,' is '*harmlesse*.' *Peba* as a termination may imply danger; as there is the Jararac*peba*, 'most venomous,' and a 'very venomous' rattlesnake, Boicininin*peba*. The curious repetition of *in* in *Boycininga*, rattlesnake (p. 272), seems to hint at the length of its rattle and the degree of crepitation it produces, especially as we find the substitution of *g* for *c* in some of these words, and the soft *gi* rapidly repeated is not unlike the true sound.

There is a long and slender tree snake 'that eateth eggs, and goeth faster on the trees than any man can runne on the ground, with a motion not unlike swimming.' Its correspondingly long name is *Guiaranpiaquana!* Vain indeed would be any speculation as to what that may mean. Vain also, and I fear tedious, may all this guess-work be to discover meaning and poetry in what may probably be dead languages. Who shall say how many thousand years ago these singular repetitions conveyed to the savage mind (but *was* it savage?) an idea of the creatures around them?

CHAPTER XXIV.

DO SNAKES INCUBATE THEIR EGGS?

WE come now to treat of facts no less interesting than surprising in ophidian biographies. Already we have recounted almost marvellous powers possessed by this class of animals — functions which are volitionary, such as the management of their trachea, the voluntary folding back or unfolding of certain teeth, the practical adaptation of their ribs and coils to what we may almost call manual work, and now, most astonishing of all, the voluntary deposition or retention of ova, even of young.

'Snakes are either oviparous or viviparous,' is what we are accustomed to read, followed by the explanation that the former are those which lay eggs, and the latter those which produce their young alive. To these two chief distinctions, the more recent one of ovoviviparous has been added, to describe some intermediate cases where the egg is ruptured in parturition, so that again a fully-formed young one is born. For broad distinctions the three terms do well enough, though many exceptions exist. The grand distinction of '*viper*' as applied to those snakes which produce live young, was adopted when snakes were first observed and described by classic writers.

'Vipers alone are viviparous,' wrote Aristotle. 'Sometimes the little vipers eat through their mother and come forth. The viper brings forth one at a time in one day, but she brings forth more than twenty little vipers. Other serpents produce their eggs externally, and these eggs are connected with each other like the necklaces of women. But when they bring forth, they deposit their eggs in the earth, *and there incubate them.* These eggs they disclose the following year.' We do not quote the above as all fact, but rather to show how very much there has been to *unlearn* since Aristotle was accepted as an authority. The shadow of truth and the mention of a possible fact as an invariable rule are dangerous mistakes, for, as we have already shown, where a snake is concerned, one can rarely feel safe in asserting anything as positive. It is not impossible that, owing to disease or accident, some gravid viper may have been so wounded as to enable her young to make their début through her ruptured side. Such an occurrence has been seen in our own time. Aristotle or his authority may even have witnessed such an accident, and recorded it under the supposition that it was normal. In whatever way the error may have originated, it is only one out of many that are propagated even to the present day by the uninformed.

At the moment of writing, we read in one of our first-class 'dailies,' alluding to a brood of young vipers lately born at the Zoological Gardens: 'The young viper comes into the world in the shape of an egg, and its first business is to push through the filmy membrane which envelops it in its imprisoned form.' This is contrary to our accepted ideas, though partially true in this instance. The word viper is generally supposed to be derived from the Latin *vipera*, a contraction of *vivipara*, to produce alive. The above words therefore are inapplicable as a rule.

So far as was known in Aristotle's time, only certain venomous species common in the countries with which classic writers were best acquainted did produce live young, and they were mostly what are still known as 'vipers,' a term restricted to these and explained as being derived from such signification.

Opportunities of study and of observation afforded in menageries and zoological gardens at the present day have caused the term *viper* as relating to gestation to be discarded, or many non-venomous snakes must be included, thus overthrowing all our notions of vipers. As was shown in the preceding chapters, the name is now associated with dentition.

German and French ophiologists affirm that the three distinctions of *oviparous*, *viviparous*, and *ovoviviparous* are founded on no other ground than the greater or less development of the fœtus at the time of deposition.

The nature of the egg-covering or 'shell' has also to do with this. In eggs which take a longer time to mature or to 'hatch,' the external covering is thicker and more leathery; in those which are hatched either before or on deposition, the shell is thinner, more membranous. Always, however, there is a calcareous element in the shell, and the eggs are generally, *but not invariably*, linked together.

Heat and moisture are essential to the hatching of eggs. When at liberty the snake selects some spot among decaying leaves, or in a manure heap where decomposition produces sufficient warmth. In the tropics, where the sun's rays alone suffice, a soft moist bed is more easily found, and here it is that immense broods are produced.

The period of gestation can scarcely be pronounced upon with certainty. It depends not only on the size of the snake, but on the degree of warmth that can be enjoyed as an assistant to mature the eggs. Schlegel mentions three or four months from copulation to the laying of eggs in the species indigenous to France. But as other circumstances combine to cause variations in these periods, it is very unsafe to fix upon the precise time of gestation.

Says Rymer Jones, 'Reptiles do not sit (*sic*) upon their eggs, hence the latter have only a membranous envelope. In many of the reptiles which lay eggs, especially the *Colubri* (colubrine snakes), the young one is already formed and considerably advanced in the egg at the moment when the mother lays it; and it is the same with those species which may at pleasure be rendered viviparous by retarding their laying.'[1] The latter words are traced to Cuvier, and prove that this most remarkable power has long been recognised.

In the first few words of the above, Jones spoke of reptiles generally from toads to turtles; with the latter, soft eggs would certainly fare badly did they attempt to incubate them. Still the term 'reptiles' is misleading, because, as is now well known, some snakes do incubate,

[1] Article 'Reptilia' in Todd's *Encyclopædia of Anatomy*, vol. iv. pt. i. p. 264.

and some lizards are suspected of doing the same. Even our common ring snake has been found coiled upon her eggs.

Serpents are allied to birds in producing young from eggs, but in reptiles the eggs differ from those of birds in undergoing a sort of incubation from the very first; so that at whatever period a snake's egg is examined, whether it has been laid or not, the embryo will be found more or less advanced. Sometimes in an egg just deposited, a perfectly formed fœtus will be found. 'Serpents are *always* oviparous,' says Schlegel; 'and it is a mistake to suppose that all venomous snakes produce live young, and all non-venomous kinds lay eggs. Neither has the diversity of generation any relation to the organization of the animal itself. *Coronella lævis* produces living young, but other *coronellas* lay eggs. In 1862, when very little was known of the *Coronella lævis*, Mr. Frank Buckland had one in a cage in London, which to the surprise of most persons produced live young ones. This may have been solely owing to her captivity and her retention of eggs till hatched. Some boas lay eggs, others are viviparous. In the latter case the young are enclosed in a thin membrane, which they tear or break at the moment of birth. In those that are a long while hatching, the tunic is of a thick, coriaceous texture, not easily ruptured. Thus, to sum up with one other authority, Der Hœven: 'In many serpents and lizards the development begins in the body of the parent before the egg is laid, and in some the membrane of the egg is broken by the young one before birth.'

This latter condition has been considered viperine, but even in a viper the young have been produced in a membrane. This was the case with *Vipera nasicornis* at the London Zoological Gardens, on Sunday, November 6th, 1881, that gave birth to forty-six viperlings. Some of them had no vestige of membrane clinging about them; others had, but burst it immediately and began to crawl; while yet others did not burst their 'shell' at all,—if indeed so filmy and thin a membrane could be called a shell,—but died within it. When the membrane burst, it was seen to collapse and shrivel up into nothing, as children's air balls do when they are torn; but the texture of these balls is strong in comparison with the extreme tenuity of the viperine egg tunic. Yet it was strong enough to contain a young one, as in the case of those unbroken. There is no means of ascertaining the precise length of time this viper had been in captivity; but as her young ones had all such fully-developed fangs, and the precocity to strike and kill a mouse as soon as born, this was probably another case of postponed deposition. On a previous occasion, September 1875, a family of young vipers born at the Ophidarium were '*some quite clean and others with the remains of the egg covering about them.*' The quotation from my notebook refers to the Daboia of India, 'Russell's viper' (*Vipera elegans*). Still these may be exceptional and possibly abnormal cases, but are examples worth noting, and another proof of the many exceptions to what we are accustomed to believe invariable rules.

White, in his *History of Selborne*, mentions the capture of a viper in which he found fifteen young, the shortest being seven inches. They were active, spiteful, and menacing, and yet 'had no manner of fangs that we could find, even with the help of our glasses.'

Mr. Frank Buckland tells of a man who cut open a string of snake's eggs, and the young, thus prematurely introduced into the world, 'showed fight.'

Of historical ophidians which have figured in many pages, first comes chronologically the Paris python, that in 1841 laid fifteen eggs and incubated them. She has already been alluded to in chap. iv., but claims further mention presently.

A python in the Amsterdam collection next hatched twenty-two eggs.

In 1862 a python at the London Gardens laid above a hundred eggs,—'more than a bushel,' according to the keeper,—and settled herself to hatch them. Much interest attaches itself to this lady's history; but first to complete our list chronologically, the following harmless species in the London collection have within the last ten years produced live young, being examples of that 'diversity of generation' of which Schlegel speaks.

August 1872, the 'seven-banded snake' (*Trop. leberis*) had five young and some eggs at the same time.

June 1873, a *Coluber natrix* had seven young ones. (I cannot affirm positively that these were born alive; I think not, from an especial entry in my notebook concerning them; but the records of the Zoological Society in which I have sought for confirmation do not announce them as 'hatched.')

August 1873, a yellow Jamaica boa (*Chilobothrus inornatus*) gave birth to fourteen young ones, ten of which survived. They crawled up to the top of their cage as soon as they saw daylight, and showed signs of fight. One little aggressor struck at me when I held it, and tried to bite me through my glove,—an impertinence which was permitted in order to test its powers. It constricted my fingers as tightly as if a strong cord were wound round them, and when not thus occupied it wriggled and twisted itself about in such energetic contortions that I could scarcely hold it. The activity and daring of the whole fry proved their perfect development. On another occasion the same species produced eight, and on a third occasion thirty-three young ones, but of these dates I am not quite sure. In some cases a few eggs were produced at the same time, but they were hard and bad and of the consistency of soap. The manners and actions of the three equally well-developed families were similar. They were always on the defensive, and able to fight their own battles. When the keeper put his hand into the cage, they seized upon it and held on with their teeth so tightly that on raising it they hung wriggling and undulating like a living, waving tassel.

Another boa from Panama, on 30th June 1877, had twenty young, which displayed ability to take care of themselves forthwith by leaving the marks of their teeth on Holland's fingers. These twenty were all produced during the night, or before the arrival of the keeper the next morning, and were lively and spiteful, biting any one who attempted to touch them, and sharply enough to draw blood. Mr. E. W. Searle, who described them in *Land and Water* at the time, July 1877, said: 'This is probably the first recorded instance of the breeding of boa constrictors in captivity.' He seemed also to infer that this proved the boa to be viviparous instead of oviparous, as 'had been always understood.' Having already known of cases of abnormal, and also of postponed production of eggs or of young, I ventured at the time to cite such cases in *Land and Water*, July 7, 1877, adding: 'We must not too hastily conclude that because one boa constrictor produced a family of lively young ones, this species is invariably viviparous.' Also in the *Field*, July 14, 1877, I suggested that 'the circumstance might be received rather as a further example of snakes breeding under abnormal conditions,'—opinions further confirmed by subsequent observations.

The little fry were supplied with young mice, which they constricted as if they had served an apprenticeship; but the mother left them entirely to themselves, and betrayed no other unusual feelings than to hiss when disturbed. When they were seven weeks old, they in one night ate twenty-four mice and a few young rats between them. They all cast their first coat before they were a week old. The mother had been in the Gardens about eight years. All but one of this fine family were alive in the following November, and two are still living at the time of going to press, viz. 'Totsey' (illus. p. 201) and one brother.

The dates of these few following cases are a little uncertain, also exactly how many survived of those that were born.

A 'seven-banded' snake (*Trop. leberis*) had six.

A 'chicken snake' (*Col. eximius*).

A 'moccasin snake' (*Tropidonotus fasciatus*) had nine young ones. This species has sometimes produced young and eggs at the same time.

A 'garter snake' (*Tropidonotus ordinatus*).

A boa constrictor had eight pretty little active snakelings that at two days old pretended to constrict my fingers, and forcibly enough to prove their powers.

On two occasions at the Gardens within the time specified, hybrids have been born between *Epicratis angulifer* and *Chilobothrus inornatus*, and I can but think that occurrences of this nature must happen among snakes in their wild state occasionally, which may throw some light on the perplexities of classifiers.

In August 1878, three were born alive; and in recording the event the Secretary to the Zoological Society, P. Lutley Sclater, Esq., Ph.D., F.R.S., etc., writes that there can be no question as to the pairing of these two snakes, both in the same cage, and as there was no male *Epicratis* in the collection. Three were alive and six bad eggs were produced.

In September 1879, two more hybrids were born between the same pair; who, at any rate, remained constant to each other.

Of the venomous serpents that have fallen under my own notice at the Zoological Gardens, the little Indian viper (*Echis carinata*) had three young ones in July 1875. Only two survived a few weeks. They changed their coat at an early day, but ate nothing; nor did the mother, who soon died. One may mention here that the vipers in collections rarely do survive long after giving birth to young. This may be only owing to an unhealthy condition in captivity, but merits inquiry.

Four common adders (*Vipera berus*) and several broods of the Daboia have also been produced.

The African viper of the coloured illustration is another example, as having afforded opportunities for observation.

In point of numbers we find the families varying from three or four to upwards of a hundred. When the parent is in health, the young are produced easily and rapidly. *Vipera nasicornis* deposited her forty-six children within about three hours. A Java snake (though not in our London Ophidarium) produced twenty-four young ones in twenty minutes. Anaconda, in April 1877, on the contrary, exhibited considerable protraction, extruding bad eggs at irregular intervals for many days. She will form the subject of the next chapter.

Incubation, or the hatching of eggs by the maternal warmth, seems not to have been suspected by ophiologists until a comparatively recent date; but by the non-scientific, the barbarian and the untutored natives of hot countries, who see, but dream not that in future ages what they saw and incidentally spoke of would be of weight to the enlightened of as yet unexisting nations,—by such the fact was known long ere its worth *as a fact* was recognised. Yet, as has been already seen in these pages, evidence given without intent and purpose often is of scientific importance. Aristotle spoke of incubation; but with classic writers the difficulty of sifting fact from fable may cause the whole to be rejected.

We owe to Zoological Societies and menageries the confirmation of the *couvaison* of at least one species of serpents. Subsequently we are told, 'The python only incubates,' this snake being generally mentioned as the one exception; and only within a very few years has maternal affection been accredited to any others. Mr. P. H. Gosse was informed by the negroes in Jamaica of the habits of the yellow boa. Sir Joseph Fayrer was informed by the jugglers that 'over and over again they had dug cobras out of their holes *sitting on their eggs.*' Dr. E. Nicholson was informed 'on trustworthy authority that the Hamadryad has been found coiled upon a nest of evidently artificial construction.' He thinks snakes always watch over their eggs, and frequent the locality where they have deposited them. The keeper at the Gardens confirms this by his own observations. 'They do care for their eggs in their own way,' he assured me, and display unusual irritability and wildness at such times.[1] In menageries, however, their habits are always more or less artificial; they cannot seek spots for themselves, or exercise maternal instinct beyond doing the best they can under the circumstances. Anything in the way of extra indulgences, such as soft rubbish, moss, or sand, is duly appreciated when eggs are about to be deposited, and we find maternal ophidians resort at once to this.

In a footnote, vol. xvi. p. 65 of the *Annales des sciences naturelles*, we read:—'*Il paraît que l'incubation des serpents est un fait si connu dans l'Inde, qu'il entre même dans leur contes populaires. M. Roulin m'a fait remarquer dans le*

[1] Since this was written, Dr. Stradling informed me that a very tame ring snake in his Reptilium laid some eggs and coiled herself upon them zealously for some days. A remarkable proof of her care for them was seen in her trying to bite when disturbed. He had never before known *Coluber natrix* to display this anger. In the *Zoologist* of September 1882, the Doctor contributed a long and important account of this incubation with its attendant features.

second voyage de Sindbad le marin (nouvelle traduction Anglaise des 'Mille et une nuits' par W. Lane, tom. iii. p. 20) *le passage suivant : Alors je regardai dans la caverne, et vis, au fond, un enorme serpent endormi sur ses œufs.*'

Here again, by accident, an ophidian habit known in the 8th century has been revealed to the scientific of the 19th century.

In the 17th century, when the Royal Society was founded and scientific information of all descriptions was welcome in their published *Transactions*, the subject of serpent brooding appeared in those pages. In vol. i. p. 138, a few terse words exactly express what modern ophiologists have of late years verified. 'Several have taken notice that there is a difference between the brooding of Snakes and Vipers; those laying their Eggs in Dung-hills by whose warmth they are hatched, but these (Vipers) brooding their Eggs within their Bellies, and bringing forth live Vipers. To which may be added,—That some affirm to have seen Snakes lye upon their Eggs as Hens sit upon theirs.' This was published in 1665.

The truth of ophidian incubation in at least one species was finally established at the *Musée d'Histoire* at Paris in 1841, when *Python bivittatus* or *Python à deux-raies*—named from two black lines diverging from the mouth—incubated her fifteen eggs. This celebrated serpent has enriched zoological annals in several points of interest. She assisted to confirm the question of whether snakes drink, and, as will be seen, whether they will take dead food. In connection with the present subject, the observations made by M. Dumeril during her incubation in the months of May and June 1841 are of such interest that I will translate from a paper read at the *Academy of Sciences* in Paris, by M. Valenciennes, 19th July 1841, and published in the *Annales des sciences naturelles*, tom. xvi. 2me série, p. 65. It will be remembered that M. Dumeril (to whom we are indebted for the most complete work on *Erpétologie générale* that graces the shelves of our Great National Library) was at that time Professeur d'Erpétologie au Musée de Paris, and specially charged with the management of that part of the menagerie.

M. Valenciennes began his paper by reminding his audience that the temperature of birds rises in various degrees during the period of incubation, proposing the questions, 'Do reptiles not offer a similar phenomenon?' 'Do they never brood on their eggs?' As far as was known of native reptiles, the answer would be in the negative. However, M. Lamarre-piquot, in his travels in Chandernagor and the isle of Bourbon, seems to show that a large serpent of India, and some other species, *se plaçait sur ses œufs et les echauffait en developpant pendant ce temps une chaleur notable.* Many eminent naturalists doubted this, until it was confirmed in the Paris python, in which was an example of prolonged and uninterrupted incubation for the space of fifty-six days.

M. Valenciennes proceeded to describe that she was in a cage with others, and that a temperature higher than the outside air was maintained. During January and February she coupled several times, and in February ate six or seven pounds of raw beef that was tied on to a live rabbit of middling size. Food offered her afterwards, for three weeks in succession, she refused; but, as described in chap. iv., she drank no less than five times during her brooding. Sloughing occurred on the 4th April. Generally gentle and quiet, she became excited on the 5th May, and tried to bite any one who approached her. Her condition being evident, she had been left alone and undisturbed in her cage; and at six o'clock on the morning of the 6th of May, laid an egg, fourteen others being deposited by half-past nine A.M. The eggs were soft at first, of an oval form, and an ashy-grey colour, but afterwards became rounder and of a clear white. They were all separate. She collected them in a cone-shaped pile, and rolled herself round them, so as to completely hide every one, her head being at the summit of the cone. For fifty-six days she kept perfectly motionless, excepting when manifesting impatience if any one attempted to touch her eggs. Notwithstanding this want of trustfulness on the part of the interesting invalid, M. Dumeril achieved some important experiments regarding her temperature.

Reptiles are 'obedient to the surrounding temperature,' we may repeat, but in the present instance there was warmth in her perceptible to the touch (*une chaleur notable*). The temperature of the cage was 20° (Reaumur?), that under the woollen coverlet where she reposed was 21°; but in her coils, where M. Dumeril inserted one of the best thermometers that could be procured, she was 41°, and always of a higher temperature by some 20°. Placing the thermometer either upon her or between the folds of her body, only a slight variation was perceptible, but it was invariably higher than the surrounding air.

On the 2nd of July one of the shells split (*la coque s'est fendillée*), and the head of a little python appeared. During that day the little creature only twisted about within its shell, now its head, now its tail being visible outside, and withdrawn again. The next day the wee snake made its debut altogether, and began to crawl about (*s'est mise à ramper*). It lost no time in exploring to the remotest corners of its blanket, and by degrees showed itself to the world. During the next four days eight were similarly hatched, the seven remaining eggs, at various stages of development, having apparently been crushed by superincumbent weight.

The mother, on the 3rd of July, ate six more pounds of beef, after her fast of nearly five months; but with the posterior part of her body still folded over the eggs. She then quitted them, and displayed no further care, having covered them for so long a time, and even defended them with such assiduity. From ten to fourteen days after being hatched, the young ones all changed their coats, and then ate some little sparrows, throwing themselves upon them, and constricting them like grown-up pythons.

M. Valenciennes drew attention to the circumstance that only in hot countries do serpents incubate their eggs, *i.e.* only the serpents indigenous to hot countries. In temperate ones, where the average warmth is insufficient, they resort to artificial heat; as, for instance, manure heaps, or decaying vegetation.

Thus was this important question settled, and the hatching of the young brood in Paris became a chronological era in ophidian annals.

When therefore, in January 1862, twenty-one years afterwards, a python *seba* in our own Gardens laid upwards of a hundred eggs, immense interest and curiosity were excited among the zoologists of the day, for here at home in London was a grand opportunity for observing the one only snake which at that time was supposed to exhibit any sort of maternal instinct. Plenty of damp moss had been supplied to her, the temperature maintained in the cage being supposed sufficient for her well-being. She pushed the moss into a kind of nest, and when the 'long string of eggs' were deposited, she arranged them in a nearly level mass, and then coiled herself over and around them so as to hide and cover them as much as possible. Sometimes she changed her position a little, and re-arranged her eggs, and in various ways rendered herself worthy of record.

Ophiologists had scientific facts to verify: this opportunity must not be neglected for ascertaining whether so cold a nature, and in midwinter, could produce sufficient warmth by lying there day after day upon her bushel of eggs. So thermometers were ever and anon thrust between her coils, or held close to her; first here, then there, after the example of M. Dumeril in Paris. Other disturbances in the way of cleaning out the cage and supplying her companion in captivity with food and water were angrily resented by the poor patient, who had no chance of the tranquillity that she would have sought for herself in her native tropics. Besides which, the chances against hatching were far greater in her case than in the Paris and Amsterdam pythons. The former saved only eight out of her fifteen, and here we had, in round numbers, one hundred, more than she could successfully cover at one time. Moreover, a most untoward accident happened one night by the tank overflowing among her eggs, necessitating a complete disturbance of them. What wonder, then, that she was irritable and even savage during the whole time of her incubation! One egg, examined fifteen days after it was laid, contained a living embryo, so there were hopes of some at least maturing. For more than seven weeks she remained patiently brooding, when all hope of hatching any of the eggs had vanished, and it became necessary to take them from her. This was done by degrees, and the task was no easy one. The keeper watched his opportunity to raise the sliding door at the back of the cage, make a snatch at those nearest him, and shut down the slide with celerity, or the exasperated mother would have seized him. He nearly got his arm broken more than once by the despatch he was compelled to use. Sometimes, so quick was she, that in thrusting down the slide she was nearly jammed by it. Holland protected himself by holding up a corner of the rug so as to hide himself when he had occasion to open the slide door; yet one day she 'jumped' at him, seizing the rug, and with a toss of her head jerking it back with such violence that a shower of the gravel came hailing upon the glass in front of the cage, to the consternation and alarm of the spectators gathered there, and who at the moment imagined the glass was broken, and that the infuriated reptile would be among them. But they were behind her; it was only towards the keeper that her fury was directed: he had taken away the last of her eggs. When, then, he shut down the slide, she kept her angry eyes fixed upon it for a long while. Presently she sought in her empty nest, upon which, so long as any eggs had remained to her, she had re-settled herself after each irruption. At last she took to her bath, in which she remained for a long while.

After the scenes witnessed during those seven weeks, no one could doubt the existence of maternal affection; and this was worth proving, as some authors would have persuaded us that snakes, and particularly the non-venomous ones, manifest total indifference regarding their eggs. The other important fact, an increased temperature, was also again observable, proving that a serpent can really hatch her eggs by the warmth of her own body.

Last summer, 1881, another python laid about twenty eggs at the London Ophidarium, but, alas! neither were any of that brood hatched. For future broods, now that the fact of a raised temperature has been proved, the next scientific triumph will be to develop the young ones, dispensing with thermometers, and substituting perfect tranquillity, with every possible aid and comfort to the mother.

That snakes under these peculiar circumstances do appreciate little 'delicate attentions,' ample proof has been afforded in the Jamaica 'yellow boa' (*Chilobothrus inornatus*), the species which on several occasions has produced broods in London, and the one in which Mr. P. H. Gosse verified the marvellous instinct of withholding its eggs when circumstances were not propitious for their deposition. This is one of the 'Colubri' alluded to by T. Rymer Jones, 'which may at pleasure be rendered' (*i.e.* render themselves) 'viviparous by retarding their laying.'

But when Gosse published his work on Jamaica (1851), he did not appear to be aware of what Jones and Cuvier had said on this subject, but stated the result of his own observations. He had become convinced that this species of snake forms a sort of nest, and incubates its eggs; when subsequently, one that he had in captivity produced living young, he was staggered. 'Is it possible,' he wrote, 'that a serpent normally oviparous, might retain the eggs within the oviduct until the birth of her young, when circumstances were not propitious?'

'Is it possible,' again asks an American naturalist, so lately as 1879,—'can it be true that *Heterodon platyrhinos* and *Tropidonotus sipedon*' (both harmless) 'are sometimes viviparous and sometimes ovoviviparous?' This writer, F. W. Cragin, had been told that the two above species were ovoviviparous (a word of no value as a definition), and he writes in the *American Naturalist*, vol. xiii. p. 710, that out of twenty-two eggs of Heterodon, ploughed up out of the sand in Long Island, one he put into alcohol to preserve it as found, and the others were hatched on the fourth day, showing that sometimes at least it is oviparous, as supposed are some of the *Eutænias*.

Mr. Gosse describes one Jamaica boa in confinement, that was ill and inactive, refusing food. It was unusually vicious, and bit hard enough to draw blood, the effect of the fine teeth being like a severe cat-scratch. It rendered itself further offensive when disturbed, by emitting an insufferable odour, and at length gave birth to living young.

That this snake when at liberty lays eggs, he had seen, and in a nest of artificial construction. One that he knew of was excavated in a bank. The snake was seen issuing from a narrow passage just large enough to admit it. Dry, crumbled earth had been discharged at the entrance of the passage, where it lay in a heap. The bank being dug into, the passage was found to lead to a cavity lined with soft rubbish, leaves, etc., which must have been carried there. Mr. Gosse does not pretend to affirm positively that the snake constructed that secluded nest for itself. It might have done so, pushing out the mould by the lateral undulations of its body, as the burrowing snakes do, and carrying back the soft trash in its mouth; or, if it only chose a nest formed by some other animal, this proved maternal care. There were eggs in the nest, the shell being like 'white kid.' 'On snipping one, a clear glaire exuded, in which was a large, whitish vitellus, stained with blood vessels, and containing a young snake seven inches long, but immature.' One fœtus writhed. The fœtus being formed and capable of motion, proved, Mr. Gosse thought, that the eggs had been some time laid. Incubation is a characteristic of that family, the author affirms. Of the various cases he knew, one female boa brought forth eleven snakes. In another snake that was killed, ten or twelve fully-formed young ones were found.

One of these 'yellow boas' in a private collection displayed unusual restlessness and uneasiness, crawling about its cage as if in search of something. Those who had the care of it suspected that she was with eggs, and supplied her with fine sand. This appeased her somewhat, and after twirling herself around to form it into a kind of nest, she laid some eggs. One of the same kind at the Gardens accepted gratefully some soft cotton wool which a lady brought for her and her young progeny, all of whom nestled themselves in it contentedly and speedily.

Two other noteworthy cases have to be recorded, but they shall form the subject of the ensuing chapters.

CHAPTER XXV.

ANACONDA AND ANGUIS FRAGILIS.

MAXIMUS and MINIMUS. Yet by right of its name *Anguis*, our little slow-worm—truly a lizard—claims a place in these pages; by right of form also, and by right of promise; and still further, because on the authority of some of our eminent physiologists there is in the dentition of some of the boas an affinity with lizards; and inasmuch as this little limbless lizard affords a good example of those whose ancestry, as Huxley tells us, found it profitable to do without their legs and become snakes, she shall be introduced in company with the largest of all her ophidian cousins.

Anaconda also, in having vestiges of hind limbs, affords in these another example of what Darwin calls atrophied organs, remnants of what were once, no doubt, a pair of very excellent saurian legs.

Illustrious naturalists who were authorities in their day—as, for instance, Linnæus and Cuvier—included slow-worms with serpents, the links between them being so close.

They have also been included among the burrowing snakes, many of which have no better right to the name of *Anguis*. With the advance of herpetology more minute distinctions of classification occur, and anatomy now proves in the 'brittle snake' a stronger relationship to lizards than to serpents. It has eyelids, like the lizards; no palate teeth, non-extensible jaw-bones, and more consolidated head-bones; so that you never see the facial distortion in these lizard-snakes when feeding, that is so striking in the true ophidians. It has scales alike all round, and also a distinct neck and a vestige of sternum and pelvic bones whence formerly two pairs of legs proceeded. From an evolutionary point of view, therefore, it is even in advance of Anaconda, which has still its 'spurs' to get rid of.

Space need not here be occupied in a recapitulation of other features and the manners and habits of *Anguis fragilis* beyond what the subject in hand demands; and in connection with this our two anguine heroines will be found to display one other striking feature in common. For the rest, in Bell's *British Reptiles* it is treated at length. In Wood's *Natural History*, also, there is a long and minute account of the slow-worm, including details of a most interesting character, as being gathered from personal observations.

Anaconda, however, claims historical priority.

As a water snake it has already been partially described (p. 228), and some of its synonyms were given in explanation of its scientific name *Eunectes*, to trace its right to be included among the water snakes, and *murinus*, to show the nature of its food. Being a native of tropical America—which embraces many extensive countries and includes numerous tribes of the aboriginal inhabitants—this serpent is also known under numerous vernaculars, puzzling enough to the reader of travels who does not at first sight realize that the book in which he now reads of the *Matatoro* describes one region, and the volume in which he has read of the *Sucariuba* or of the *Jacumama* describes another, and that these are one and the same snake. The spelling and pronunciation of even the same word among adjacent tribes add to the perplexity. Among other of Anaconda's familiar vernaculars, which we meet with in all South American books of travel, are *Aboma*, *Cucuriù* or *Cucuriubù*, *El trago venado*, *Camoudi* or *Kamoudi*, *Sucurujù*, and others. The name by which it is now generally known, *Anaconda*, or *Anacondo*, was fixed by Cuvier in 1817.

Very exaggerated ideas as to its size have obtained, probably traceable to Waterton, who tells us the Spaniards of the Oroonoque positively affirm that he grows to the length of from seventy to eighty feet; and that as his name *Matatoro* implies, he will eat the largest bull. Before yielding full faith to such stories, we must ascertain whether that 'bull' corresponded in dimensions with our Durham prize ox, or the miniature bovines of the Himalayas. Hartwig improves upon Anaconda's dinner capacities in telling us that the 'Hideous Reptile will engulph a horse and its rider, or a whole ox' (prize ox, no doubt) 'as far as its horns.'

Turn we to science and to ocular proof of what Anaconda really is—for there are and have been living examples in our zoological collections, and whatever she may have been 'formerly,' her modern dimensions rarely exceed thirty feet.

In the present case her interest lies in her maternal aspect, for it is the one that was brought to London in 1877 of which we now speak, and who astonished the ophiological public by giving birth to fully-developed young ones in April of that year.

In *Land and Water* of the preceding February, Mr. Frank Buckland described the arrival of this snake at Liverpool in a box, which with its occupant weighed over 2 cwt., and of the necessary examination 'he' (the snake) was obliged to undergo by Mr. Bartlette previous to purchase. Being at length conveyed to the Zoological Gardens, 'he' was reported as being thin and as having no inclination to feed, but glad to remain in 'his' bath almost continuously.

It was brought from the vicinity of the Amazons, and must have been cramped up for many months in this close prison. No wonder it turned at once into its native element, although the small tank restricted its movements almost as much as its travelling box. The poor thing was seen to be suffering discomfort, presumably from its long journey and close confinement; and one day, when endeavouring to extend itself and move more at ease in the narrow space between the tank and the front glass, it forced out the entire frame by the power of its coils. Fortunately the huge python and two other Anacondas in the same cage at the time were in a torpid condition; or had those four powerful snakes been lively or spiteful, and all at liberty at this crisis, grave results might have accrued. Aid being at hand, the loosened frame was promptly re-adjusted; but this practical illustration of Anaconda's powers was a useful lesson to snake keepers.

The peculiar condition of this snake not being suspected, not even her sex, the appearance of two fully-developed though dead young ones on April 2d was an important event in the Ophidarium, and one to be forthwith chronicled in the *Zoological Society's Proceedings*. The secretary, at the ensuing meeting, exhibited the two young Anacondas, and afforded some interesting details concerning the mother. During the next few days four more young ones were born, but all dead; and during several weeks, others in a high state of decomposition were produced. 'She might have had a hundred!' said the keeper, who felt fully persuaded that she had voluntarily 'kept them back.' Four were well developed; one was partly coiled in the ruptured shell, which was of a tough, coriaceous texture, white, and as thick as orange peel.

Occurrences of this nature send us to our book-shelves. The python and some of the boas had laid eggs, and Anaconda might have been expected to do the same, as we read in the papers that wrote 'leaders' on the event. But suddenly we all discover ('*we*' second and third rate naturalists, who regard the biological professors at a respectful distance, and aspire only to a printed half column in a similarly aspiring journal),—we all discover that Cuvier had long ago pointed out that *l'Eunect murin* is viviparous (like the regular water snakes), and that Schlegel had subsequently confirmed the fact from personal observation. Thus we learn as we go.

Those born dead in London offered no exception, therefore, to the rule, but were rather to be regarded as one of those cases in which the mother, under circumstances unpropitious for the production of her progeny, retards the deposition of her eggs or her young.

Let us picture to ourselves the condition of this poor Anaconda. Just at the very time when instinct would have guided her to the spot most favourable for the coming brood, she is transferred from her native lagoons, and crowded into a dark close box just large enough to contain her. Though without water for many months, this 'good swimmer' arrives alive, a proof of her astonishing powers of endurance; but she has now no morass, no lagoon or refreshing river in which to invigorate herself and aid her natural functions, and the young ones die unborn. The poor mother soon showed evidence of disease and suffering, and was after a time mercifully put to death.

There was no possibility of ascertaining the period of gestation in her case, but there was every reason to regard it as one of postponed functions, and another illustration of that astonishing capability described by ophiologists of snakes which 'may at pleasure,' *i.e.* at will, retard the laying of eggs or birth of young!

The prejudice against snakes has been so strong, that there are persons who would even exclude them from zoological collections. Should these pages fall under the eye of such persons, they must admit that the Ophidia in captivity present grand opportunities towards the attainment of scientific knowledge. These important results far outweigh the less pleasing spectacles.

And now for our little *Anguis fragilis*, with all her wrong names and the wrong impressions produced thereby, which, with some particulars of her behaviour in captivity, shall form the subject of the next chapter. Here she will, I think, be accepted among those examples of abnormal incubation which belong to the present one.

Searching for the lovely little *Drosera* and its attendant exquisite mosses on 'The Common' at Bournemouth (the one close to the town), on the look-out for lizards also, I saw what at first sight appeared to be an extremely long, black slug, lying on a smooth little patch of grass in the sunshine. Approaching to inspect this shining nondescript, I at once recognised a slow-worm. Being not only entirely and deeply black, but unusually short and proportionately thicker than any I had ever seen, the familiar 'worm' had not at first sight been identified. Its short, blunt tail had evidently lost an inch or two; and its bulk suggested a speedy increase of family. Already I had four others and a green lizard, the male *Lacerta agilis*, which I had also captured. The date of 'Blackie's' capture was August 26, 1879; the precise time being important, because, as just now stated, the period of gestation depends much on the degree of external warmth that can be had to assist in maturing the embryo; and, as many of my readers will recollect, very little sunshine had we that summer. Chilly rains and cloudy weather marked the season; and to this I attributed the fact that at the end of August the slow-worm was still enceinte, when, as Bell informs us, its ordinary time to produce young is June or July.

Taking her up, 'Blackie' struggled and kicked, if such a remnant of tail can be said to 'kick' (the action being very similar), and displayed activity enough to show that she could be quick enough when occasion required it. Knowing her shy, burrowing instincts, I at once laid her on the mosses which filled my little basket, and down she retreated, there remaining without further trouble.

Deposited in a box with the others, she acted similarly, remaining hidden under the sand and moss, and never showing herself on the surface, as the rest did whenever a hopeful gleam of sunshine tempted them. Just the tip of her little black, shining nose was sometimes visible, as if she were getting a breath of fresh air on the sly.

One of the other slow-worms—already several weeks in my possession—had appeared to be in a similar condition, and was much wilder than the rest, effecting escape and circumventing me in a variety of ways, while her companions were comparatively tame and contented. The green lizard, also, had to be well watched, being exceedingly active, darting away like a flash whenever the cover of the box was removed for an instant. Their cage was necessarily and cruelly small, in anticipation of a journey to London, and that I might have them in my own keeping while on the move, which I expected to be for some weeks. It was covered with a net secured by a strong elastic; but they could easily reach the top, and managed most cleverly to push up this net, and so get out. The way in which one of them called 'Lizzie' achieved this, is described in the ensuing chapter. Here we must keep to our subject.

The box was generally close to an open window, in order to catch any chance ray of sunshine; but the truant propensities of the inmates necessitated a frequent investigation, and a raking up of the moss and sand with which they were supplied, much too often for Blackie's peace of mind. She continued wild and alarmed, defeating search by quick movements below. The ever active lizard, too, had frequently to be hunted out; for whether he had retreated below, or had gone off altogether, could not be ascertained unless the box and its inmates were turned out bodily to count heads—a species of roll-call not tending to tranquillize the unquiet pair. These trifles are mentioned to show the sort of life the poor little captives led for many weeks. They were raked over or turned out literally topsy-turvy every few hours. Only at night had they any peace; for being well disposed reptiles, who kept regular hours and retired early to rest, but *not* rising betimes in the morning, they could be safely left uncovered until and unless sunshine enticed them upwards.

All ate and drank regularly but Blackie, who, so far as I was able to ascertain, was a total abstainer.

Thus, in their incommodious box, they lived until the middle of October, when (after making visits on the way, and secretly harbouring my 'snakes' like stolen booty) I arrived in London. At that time the sun seemed trying to atone for its summer deficiencies, and whenever any of its grateful warmth could be obtained through the London atmosphere the lizards were deposited in a window, but Blackie remained always below. Suddenly she also grew refractory. She got out of the box, and had frequent falls from the table to the floor. So had the other restless one, necessitating still more frequent roll-calls, and bringing troublous times on themselves. I had observed in a former pet, that when the season of hibernation was approaching, *Anguis fragilis* had exhibited an errant disposition, and I had attributed it to a natural instinct to seek a winter retreat; but in the present case only these two tried to get away, and in both there appeared to be a similar motive.

On one occasion, late in October, Blackie could not be found for several days, and was even given up for lost, when, on removing a number of books that, when unpacked, had been temporarily stacked against the wall, there lay the little black slow-worm in so narrow a space between a quarto volume and the wall that it seemed impossible she could have got there. Strange to tell, the poor little thing no longer struggled to get away, but seemed even glad to be lifted and fondled and restored to her moss.

On the 2nd November, some frosty days having arrived, and no more worms and flies being procurable, I thought it time to put them away for their winter sleep, having been so instructed by Mr. Green, the taxidermist at Bournemouth, of whom I had purchased several. So, having dismissed all idea of an increase in their numbers, I prepared a large deep jar and furnished it with soft hay, moss, and sand, enough for them to burrow into, intending to consign it and them to an attic.

The first thing on the morning of the cold foggy 3rd of November 1879, I went as usual to examine the box and its inmates—as yet in my sitting-room. Lifting the moss to count heads, I saw what on the first glance in that half daylight seemed to be a small tender snail, apparently injured in some way, and crawling extended in a wonderfully thin line from its shell. What presented a snail to my thoughts was because a few days previously—insects being now no more, and other food hard to procure—my maid had brought in some small snails as an offering for the 'snakes.' These having been declined, I wondered to see one in the box, but turned away faint-hearted from the unpleasant duty of removing a half-crushed snail, as I took it to be.

After being fortified with a hot breakfast, daylight being now brighter, I began with dainty fingers to remove the moss. Judge of my amazement to find three of the loveliest little tiny scraps of life, wriggling, twisting, diving, and defiantly—let me rather say intelligently, or instinctively—using their tongues like grown-up slow-worms. They were Blackie's children. Not a doubt about it! Three were free from the shell, one of which was still connected with it by an inch or more of the umbilical cord; and within the shell—a mere membrane—was some yellow yoke and a good deal of glaire, so that the membrane still retained the rounded form. Possibly I had ruptured this egg in disturbing the moss. There was another egg quite perfect, and within that could be discerned the little creature curled up, and presenting those convolutions which in the half light had looked so like a small snail shell. On tenderly taking up this perfect egg, the wee reptile within threw itself into such an agitation that it burst its prison house, and emerged prematurely into the cold, rough world. A yolk as big as a hemp seed and much of the glaire remained behind. It was a precisely similar case to that of a young Typhlops in Jamaica, described by Gosse, where the reptile 'crawled nimbly out of a ruptured egg, but remained attached to the vitellus.' In the present instance the umbilical slit was ominously gaping, showing that the poor little creature was not nearly ready to battle with life. In the other that was not yet wholly detached, the slit was less, and in the two which had hatched themselves (no doubt during the night) it was nearly closed.

During the day six more were born, and four of the six in the membranous shell. *Anguis fragilis* is always considered to be viviparous ; but so are vipers, and here in three distinct cases under public observation the young have been produced in a membranous covering.

The activity of these tiny creatures was marvellous. If meddled with, they seemed as if agitated by a galvanic battery. Their whole length vibrated with nervous irritability. In colour they were black beneath and a silvery white above, with a spot of black on the head, and a fine, thread-like line of black all down their back. The head was the largest part, the body tapering gradually to the tail. They were in length about 2½ inches. Very bright black eyes had they, and manners like the adults, pressing their head against the hand, or wherever they were, with the instinct to burrow and hide. Their silvery aspect, together with their mobile susceptibility, was truly mercurial. To hold or retain them was simply impossible ; as well try to restrain a stream of quicksilver. In a fury of agitation they would leap and turn over and twist themselves away like eels. Flaccid and tender and apparently boneless, the difficulty of taking up and restraining such shreds of vitality was no less difficult than interesting. The wee, half-matured fury that rushed impetuously into the world spent itself in restless efforts to dive into the earth. It grew gradually more feeble, and died the third day. Altogether there were eight or more. Three were hatched before I saw them, the rest were produced in the membranous 'shell,' and in all the shells the remains of the yolk were seen. A remarkable feature was that these remains of egg all vanished in a manner that wholly baffled my investigations. The yellow yolk was too palpable to become absorbed in the moss and sand ; it could not have escaped notice. With the greatest care I searched and examined every spray of moss, every blade of grass, over and over again, but could discern no trace ; neither the skin nor any slimy glaire, nor one tinge of yolk, nor any globulous collections of moisture whatever. Blackie did not eat them ; for she remained at the bottom of the box while the cares of maternity were upon her, never moving. There was no possible doubt about her being the mother of the brood. Her companions in captivity came to the surface as usual during an hour or two of sunshine, and then retired underground.

In removing the moss that first day to look for Blackie, I saw by an enlargement at the lower part of the body that her family was still increasing ; and if such a creature *can* appeal, the look with which she feebly raised her head as if to entreat not to be disturbed, was one not to be disregarded. So I left her unmolested the whole day, and indeed until she began to show herself and move about like the rest, coming up if enticed by sunshine, and retiring early below, as they all did daily.

I communicated this interesting event to Mr. Frank Buckland at the time, and to the editor of a zoological journal, inviting both to inspect the interesting family. I also sent a short account of the November brood to *Land and Water.* Mr. Buckland was, I believe, absent from town; and my MS. (now before me) was returned from *Land and Water* for 'want of space.'

Evidently the November brood were after all but sorry little slow-worms, beneath the notice of scientific eyes, and unduly endowed with imaginary importance in the estimation of their enthusiastic guardian!

In my careful examination of the contents of the cage next day, in order to ascertain the chance of yet other silvery shreds of life, I observed a little dry, globular substance, which had a somewhat suspicious look. It was firm to the touch, and on breaking it, showed a veiny sort of conglomerate appearance, as of layers or convolutions. Several of these hard, dry masses I afterwards found, all on being broken presenting a similar appearance. Then it suddenly occurred to me that they must be dried-up eggs of the other slow-worm, and that she must have deposited them some time previously. The surface of sand was easily accounted for by the frequent turning over and stirring up of the soft rubbish in the cage. At first thinking only of Blackie, and being satisfied that these singular little masses contained no life, I threw them away; when, too late, resolving to keep some and investigate their nature, only one more could be found; but this one was preserved in spirits of wine, together with two or three of the tiny slow-worms. The female that conjecturally laid them had frequently got out of the box and sustained many falls to the floor; which, even had other circumstances been propitious, might sufficiently account for the destruction of embryo life. But in addition to accidents were the extremely cold and sunless summer and the ten weeks of disturbed and comfortless existence; and then the green lizard was for ever scrambling about and scratching the earth in all directions. He alone was enough to make a conglomerate of the unmatured eggs.

The remaining one of the supposed eggs was put aside with other specimens, and almost forgotten till the present time. Looking at it now after it has been two years in the spirits of wine, I find the sandy surface washed off and deposited as sediment, and in a partly torn and ruptured membrane behold a perfect little *Anguis fragilis* quite as big as those others which were hatched. Whether this happens to be a more perfect embryo than those that were hardened, or whether it has grown softer and more distinguishable through being in liquid, it is impossible to say, except that here it is. There were, then, *two broods*, as had been anticipated, and in both cases eight or nine. The precise date of the hard eggs is not clear; probably they were produced first. The warmth of the room at length did for Blackie what the sun had failed to do; and even then her young ones were not fully matured. The other one, through many vicissitudes, in common with her big cousin Anaconda, produced bad eggs. Truly are not these two—or say only one—is not Blackie's case a verification of what the author of *British Reptiles* affirmed of these slow-worms: 'There is no doubt that the duration of the period of gestation must depend on the temperature to which the animal is exposed,' even if this be not another instance of retarded deposition.

A word more, in conclusion, about the tiny progeny.

To the touch having no more bone or substance than an earth-worm of the same size, their ability to burrow seemed marvellous. When placed in the sunshine—such as there was of it—they basked in apparent satisfaction, retiring betimes and working themselves underground to the depth of four or five inches. Often two or more were missing, when every scrap of earth and moss had to be spread on a newspaper and minutely separated to search for them. Indeed, I have never felt certain whether the family originally consisted of eight, nine, or ten, having a strong suspicion that their grown-up relatives or the lizard had supposed them to be worms placed there for their express delectation. And when, one day, the number was reduced to six, and the green lizard looked unusually plump and impudent, the young fry were quickly transferred to a separate home, a glass bowl, through which they could be watched without molestation, and up which they could not possibly crawl. The smallest of worms (the weather being warm again) and a cockle-shell of water, the softest of sand and the prettiest of mosses, ministered to their comfort; but though they grew very slightly and their colour became more defined, I do not think they partook of food or water during the whole six weeks that they were thus watched and cared for. One from the first day was always livelier than the rest. It was one of those that had been hatched first or possibly born alive, being perfect, and with the navel closed when I had first discovered it. Through the glass we could see them deep down in the earth, and so close to the side that they could nearly always be easily counted. Not at all sociable were the little ones, one here, another there, as if getting as far apart as their home permitted. In the evening, if placed on the table near the lamp, they seemed to mistake that for sunlight, and would come up and ramble restlessly about on the surface for several hours. Their vitality was amazing.

One evening when showing them to a friend and permitting their antics upon the table, one of them was suddenly and mysteriously missing. We had carefully guarded the edge of the table; indeed, they were well in the centre of it, and it seemed impossible for them to fall off. We searched the carpet, notwithstanding, and with most careful scrutiny; and finally deciding that the truant must have been replaced with some moss unobserved, gave up the search.

Next morning, on entering the room, my maid thus greeted me: 'Lor', Ma'am! if I didn't find one of your little snakes down on the carpet close to your chair, and for all the world I as near as possible tramped on it. I put it in along with the others, and it worked its way down in no time!'

Imagine that poor little shred of life passing the night in frantic efforts to burrow into the carpet and retire below according to custom! Whenever held or touched, their first impulse was to conceal themselves beneath, and they would dive and butt with impetuous agitation in their endeavours to push themselves out of sight.

The event in the family had caused me to postpone the hibernating arrangements; so as long as the others ate (a thaw enabling us to dig up worms again) and courted daylight, I kept them in the warm room. But as will be remembered, very severe frost set in that winter (1879–80), and no more worms could be dug up. While hibernating, no pangs of hunger could assail them ; and though it cost me an effort to consign those beautiful wee things to the cold and gloom of a temporary tomb, yet it seemed the kindest thing to do under the circumstances ; so, in company with their unsympathizing mother and cousins, they were stowed away in moss and darkness, but in a box instead of the jar. Well !—that is all ! My ignorance and its sad results were alluded to on p. 165. I can only hope the poor little victims died insensible to their cruel fate.

CHAPTER XXVI.

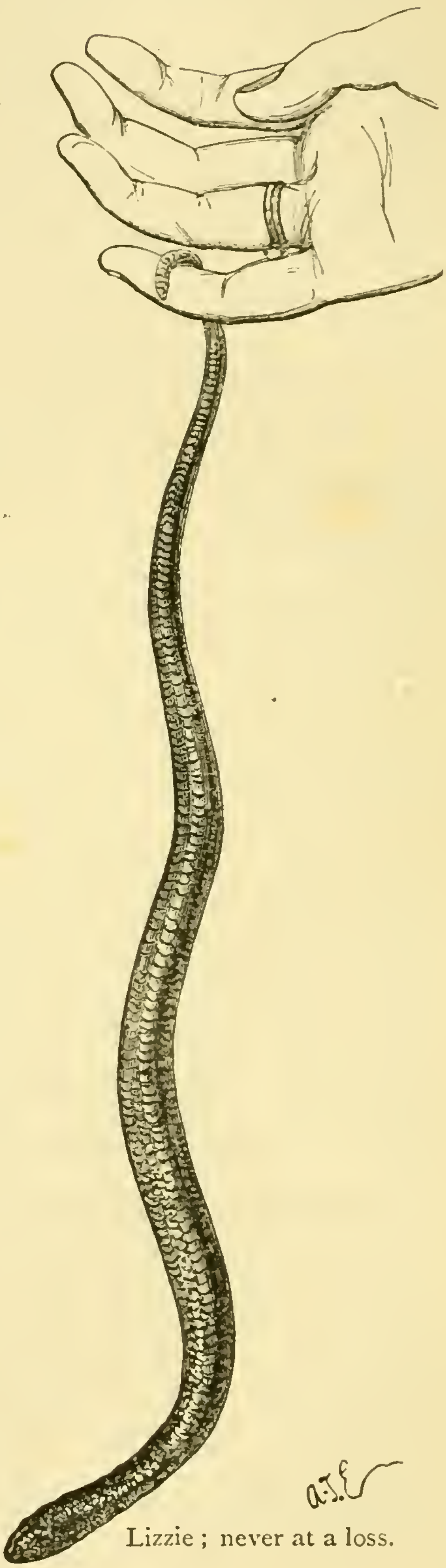
'LIZZIE.'

THIS tame slow-worm was promised a chapter to herself in my book, and I trust my readers will not tire of her doings, but vouchsafe their kind attention to an exhibition of still other feats in which the little *Anguis fragilis* vies with the Great Anaconda.

In her maternal aspect we have done with her. The heroine of the present chapter was for a much longer time in my possession than 'Blackie' and those other poor victims, and therefore tamer. When my friends exclaimed, 'Why on earth do you call that little snake "Lizzie"?' the simple reply was: 'Because she is not a snake, but a lizard.' In what respects the slow-worm is a lizard my readers already know; I will therefore describe what I hope may prove of zoological interest. Already 'Lizzie' has ingratiated herself with the readers of *Aunt Judy's Magazine*,[1] as also with her personal acquaintance for her gentle and innocent manners.

[1] 'Wrongly named; or, Poor Little Lizzie,' by Catherine C. Hopley. June 1880.

First let us briefly review her many wrong names, 'blind-worm,' 'slow-worm,' 'deaf-adder,' 'brittle-snake,' and endeavour to account for them. Of her name 'snake' (*Anguis*), from its external aspect, enough has already been said. The 'brittleness' shared in common with several of her foreign relatives, known as 'glass snakes,' proceeds from a power of contracting the muscles into rigidity when molested: that is, when, on finding themselves in a helpless condition, slow-worms grasp firmly whatever they can attach themselves to. In fact, this little snake only displays constricting powers as far as it is able; for it really does constrict the fingers which detain it, with a force as great for its size as its cousin Anaconda uses in killing its prey. Were the giant constrictors to entwine us with proportionate power, they would gain the day. In the case of *Anguis fragilis*, *we* are the masters; and were we to attempt violently to unwind one from our fingers, it would break 'in halves' in its resistance, or rather in its redoubled efforts to cling the tighter and so save itself. May it not in this respect, also, claim kinship with its giant rivals, and show their common ancestry? On pp. 183 and 187 reference was made to the 'blind-worm' in connection with other 'brittle' snakes, and in the use of their pointed tails. Our native 'blind-worm,' in not having the hard point at the end, has escaped the imputation of trying to 'sting' with that imaginary weapon, although it uses its tail with equal and similar force, and for the same purpose. In handling the little reptile, you will feel it pressing the tip of its tail against whatever part comes in contact with it, as a hold, a fulcrum, and motive power. Upon a smooth surface it would be entirely helpless without this assistant to progression, its scales being too even and polished to afford hold of any kind. You will see it sweeping its long tail this way and that, in search of some hold or obstacle against which to push itself forward; and failing this, the point is pressed close to the table or floor as may be. When in any unaccustomed position, as, for instance, when held in the hand, you will see the tail instantly twining itself about the fingers for safety, the creature trusting itself entirely to its aid, and being helpless when its movements are fettered in any way. If not strictly prehensile in the way of affording support, as the tail of a true boa does, that of *Anguis fragilis* is not far removed from it. Hold one that is accustomed to be handled and in good health, and permit it to hang by the mere tip, as in the accompanying illustration. So far from falling, the little creature will at once draw itself upwards and backwards with perfect facility, till it feels itself equally balanced, when the tail will be sent in search of hold; it will cling quickly round a finger, and then *Anguis* feels itself safe once more. My



Lizzie; never at a loss.

tame slow-worms accomplished this with perfect ease whenever so suspended.

Others, unaccustomed to such a position, or in a not very robust condition, must be treated cautiously under this experiment, and not permitted to fall; but in every case the tail will be seen to be a very important agent to the reptile. It is longer in the male than in the female slow-worm—more than half the entire length in the former, and less than half in the latter. The males are, therefore, longer on the whole, though the body itself is longest in the female. Regard should be had to this, when, roughly speaking, they are said to 'break themselves in *halves;*' because it is not the body which breaks, but only the tail, or a portion of it, in common with other lizards.

The power of the tail in this reptile was again seen when its home was a bell-glass, such as is used for gold-fish. The one in which my first family of slow-worms dwelt, was almost as high as their own length, so that I considered them sufficiently secure without any cover to it. But after a little while they effected an exit. *How*, was at first a mystery, until I saw them perseveringly raising themselves in a perpendicular direction against the side. Many a slip and many a trial had they, but they rarely desisted until success crowned their efforts. When their head had once gained the edge of the glass, they easily drew themselves up and over it, and let themselves down on the outside, as you would draw a cord over the edge. The perfect smoothness of the glass, the nice balance required, and the gradual lowering of themselves, rendered this proceeding still more astonishing; for as the glass was on a stand there was a considerable distance between the edge and the table. A slow-worm's progression is truly marvellous. In this little creature one can detect no action of the ribs; they are too fine and too close. Its scaly armour, moreover, is smooth and firm; and as for ventral scutæ to 'afford hold,' it has none. Yet with ease it draws itself over that polished rim, as it draws itself up and over your finger, when suspended by the mere tip of its tail.

Soon the slow-worms accomplished this feat so knowingly that it became necessary to cover them over, which was done with gauze having a strong elastic cord hemmed into it. They practised their climbing powers all the same, and though not able to get over the edge, tried and pushed hard enough to stretch the gauze considerably; so that, unless well pulled down, it lay only loosely and bagging over the top.

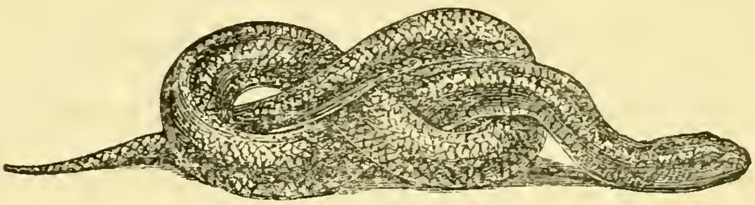
Judge, then, of my amazement one day to find Lizzie *outside* the glass, resting contentedly in the loose fold round the edge above the elastic. The little creature had absolutely got over the edge, but the tightness of the elastic baffling the outside descent, there it lay.

In *Nature*, vol. xx. p. 529, Mr. Hutchinson describes and illustrates an exactly similar feat accomplished by a 'little snake' nine inches long. It was put in a glass jar ten inches high, having also for a cover a bit of coarse muslin secured by an elastic band. The reptile was missing, the muslin and the band were intact, when, after a mysterious surprise and search, the little snake was found under the rim of the jar *inside* the muslin. The writer does not say what snake it was, but he afterwards observed it 'ascending easily,' standing on the tip of its tail, and supporting itself against the side of the jar by the abdominal scales creating a vacuum, 'like the pedal scales of a common house lizard;' it was not a slow-worm, therefore. He felt quite satisfied about this adaptation of the scutæ, a mode which, in describing the larger snakes climbing up their glass cages, I called 'compressure,' p. 215. Mr. Hutchinson does not tell us, either, how much earth or rubbish covered the floor of the jar, though there must have been an inch or more, to enable a snake of nine inches to raise its head over a ledge ten inches high. Lizzie not having ventral scales to help her, used her tail only as a support, then nicely maintaining the perpendicular. Many times she failed in achieving success, but she did achieve it, and grew so enterprising in consequence that I shall now confine my story to her. At first she lived in a box, the top of which she could easily look over, and she was occasionally permitted to get out and ramble among some ferns on the same table. Sometimes this box was also covered with a muslin, having elastic hemmed into it, and she soon discovered that this with persevering attempts could be raised. The use of the tail was here remarkable. With it she maintained her 'stand,' so to speak, while with her head and the forepart of her body she tried to loosen the net; using persistent and powerful efforts to lift it, by repeatedly tossing back her head. She acted in every way as if determined not to be baffled, and with an apparent intention or reflection that was, without doubt, the result of experience. In higher creatures this application of force to produce a certain result would be pronounced 'intelligence.' In the little slow-worm there was undeniably a perception of cause and effect. On one occasion when she had got her tail on the edge of the box, and her whole length in the stretched muslin along the top, she so far succeeded with the forcible action of the head that she worked the very strong and tight elastic up, but not at all to her own satisfaction; for it instantly contracted under her, bagging her most effectually. She was caught in a trap of her own construction.

Seeing her so wonderfully energetic, and by no means 'slow,' either in action or intelligence, the next thing was to ascertain whether Lizzie was 'deaf' in addition to her other pseudo-failings; but by the various tests used to exercise her aural faculties, I am inclined to think her powers of hearing served her almost better than those of sight. When permitted to ramble among the plants and over the table, the *sound* much more than the *sight* of her box and its contents attracted her. Never averse to go home and retreat into her moss, the rustling of this or the scraping and rubbing the sides of the box—any *noise* with it with which she was familiar, would cause her to turn towards it, when the sight of it alone failed to entice her. After a time she turned her head, if even from across the room I made a sudden and sharp noise to attract her attention,—such as the tapping of a spoon against a cup, or the peculiar talk I indulged in for educational purposes. She undoubtedly became familiar with certain sounds, which were repeated till she did look round. Not—as I am bound to confess—that it was a strikingly intelligent look! rather the contrary, I fear: still, as the object was to test her powers of hearing, the result was satisfactory. The origin of this reputed deafness is difficult to conjecture. In the way of external ears, those of the slow-worm are less distinct than those of lizards generally, but more so than in snakes, which have no visible aural apertures; whereas in the slow-worms they can be discerned if sought for, though they are very small and indistinct.

Not much less perplexing is the supposititious 'blindness' of the slow-worm. This must have had its origin in days long before 'gentle-folk' took rural walks for the purpose of observing natural objects; long before Shakspeare's time, and when slow-worms were far more numerous than now. Probably those who saw most of them were the peasantry, and that in winter time, when, in their out-door work, they would discover a number hibernating. A score or two of slow-worms in company with a few snakes and adders brought to light in turning up stones or earth, would attract the rustics, when a stray one in summer time would pass unnoticed or, at any rate, unexamined. Though the larger reptiles would be equally torpid, their eyes would show all the same, while the slow-worm's eyes would be so tightly closed that their place could hardly be found. Thus they were presumably 'blind.' This is mere conjecture in seeking a reason, but 'blind worms' they were in England long before the *typhlops* (p. 187) of the tropics was known, and long before any other 'naturalist' than Topsell and his like wrote upon 'Serpentes' and the *Amphisbæna Europæa.*

Topsell, by the way, whom we quoted on the subject of tongues, thought he knew all about slow-worms, and gave them credit for a length and power of tail far exceeding those of the present day. 'They have been seen to suck a Cow, for then they twist their Tailes about the Cowe's Legges. The Slow-worm biteth mortallie, and the Cow dyeth!' Consistent this with the 'Blind-worm's sting' of the poet of that day. Of the six or seven that have been in my keeping at one time or another, not one has, under any provocation, attempted to bite me. They were handled continually, twirled about, and tied into knots (with gentle treatment, of course), but not one of them ever broke itself in 'halves' or opened its mouth with malice intent. Lizzie sometimes in winding about my fingers got herself into very pretty knots, and in such tied-up fashion when placed



Lizzie in a knot.

on the table she would remain motionless for a time, and then begin to move away. Curious was the effect at this juncture. The knot was not loosened at all; but as the little reptile began to move, the knot passed downwards, and she crawled out of it, while its form remained the same to the very end of the tail. It was similar to what we saw when the little four-rayed snakes constricted their birds; the form of their coils altering no more than would a slide passed along a rope. Neither did such a knot disturb Lizzie. She appeared quite unconscious of it, and simply crawled out of it. Perhaps any 'brittleness' discoverable may have been from rough handling, as one can easily suppose a too abrupt untwining of the reptile when clinging round the fingers would so alarm it that it would cling the tighter. A gentleman assured me that he had seen one break in 'halves,' and the two portions lying on the table. Not being a scientific observer, he could not describe the appearance of the fractured part, except that they seemed to contract; and this is what I have observed in the tail of lizards when accidentally abridged. The owners do not appear, however, to concern themselves about it.

The name 'worm' given to this little reptile is merely as a creeping thing, a 'worm of the earth,' in common with many other small crawling creatures which are not earth-*worms*. Its quality of 'slowness' is only another name for caution. Quick and active it can be; but in retreating down among the moss or hay, or whatever you provide in its cage, then you see the perfection of slowness. Not a blade stirs, not a sound is heard, and one may repeat here that the manner of progression in *Anguis fragilis* is not the least of all the ophidian wonders we have witnessed. In the earth it can burrow itself to the depth of several feet. In soft rubbish it simply vanishes slowly; its hard, polished scales permitting it, as it were, to slide down into and among the hay with that gently gliding motion which enables us to perceive how very well it does manage without the ancestral limbs.

One other name it has, 'adder,' which, perhaps from association with the true adder or viper, has gained it its evil character of being venomous.

But this word 'adder,' like 'worm,' was formerly used for many creeping things, and is derived from old Saxon and Danish words *atter*, *eddre*, *ætter*, etc., and the German *natter*, which has a similar signification, any low-lying or crawling creature. Even in this nineteenth century the 'slow-worm' still bears an evil character in some rural districts, and in Wales more particularly.

A few weeks ago, a Welsh lady, hearing me speak of my tame slow-worms, asked if I were not afraid to handle them.

'Why?' one naturally asked.

'Because they are so poisonous,' she replied.

I explained that this erroneous idea had probably originated in the little creature being sometimes called an 'adder,' and so forth.

My friend did not take the explanation kindly, but rather resented the possibility of her being mistaken. 'They are so very common in Wales,' she said, 'and I am sure they are venomous there.'

Another lady of the company, subsequently speaking of this, remarked, 'I should certainly be inclined to believe what Miss F. says about them (the slow-worms), because she lives so much in the country and is such an observer.'

This speaker was a lady of really superior intellectual attainments; but she had never attempted to overcome a strong prejudice against anything in the shape of a snake. She would not *permit* herself to be convinced that any of them were either harmless, clean, or beautiful; but, like the monks who would not look through Galileo's telescope, for fear of seeing what it was heresy to believe, my friend preferred to hug her prejudices!

One little bit more of gossip in taking leave of Lizzie. The party were young gentlemen, all of them of studious and intellectual tastes and good position. 'How *could* I endure to touch those horrible slimy snakes?' one of them exclaimed, on hearing a lady inquire about my pets. I assured him they were as clean and dry as the ruler on the table. The young gentlemen exchanged dubious glances, and nearly all of them attributed to my undue partiality the assurance that they were not 'slimy.' 'I always thought they were,—didn't *you?*' they said to each other.

A word must be added on the subject of skin-shedding in the slow-worms, various processes having been described; as that it is 'always shed in pieces,' 'always splits on the head first,' etc. As no two of my pets doffed their coats at regular periods, or precisely in the same manner, I judged that, as in snakes, the sloughing depended principally on the health of the individual, or the temperature. They all invariably began at the lips, rubbing their heads till the skin separated round the mouth exactly as snakes do, and then crawled out of it. In one case the skin was shed *unreversed* throughout the entire length. This was pushed off and left behind in a crumpled form, but in picking it up it extended uninjured to its original length, perfect from mouth to tail. Others were reversed as far as the tail, which slipped out 'like a sword out of its scabbard,' as described by Mr. Bell; others were reversed throughout the length. Sometimes they were in pieces, and this was, I think, attributable to insufficient moisture. One did not change after August; others changed several times during the summer; so that there appears to be the same sort of caprice, or more probably of unascertained causes for variable processes, in casting the cuticle as in snakes.

'Lizzie's' bibulous propensities were mentioned p. 89.

In vain was she tempted with milk, but water appeared to be almost more necessary than food; at least, after being deprived of both, she took that first and eagerly.

So much has been said of the burrowing habits of the slow-worms, that I must mention a remarkable exception. Never did I see mine *ascend*, except when attempting to escape; nor, when placed among the plants on a flower-stand, did they ever *raise* their head, but would work their way downwards, clinging and holding on by their tail till they reached the floor. Always *down* was their instinct, even down the stairs on several occasions; never up. But since the completion of this chapter, some slow-worms have been deposited at the Zoological Gardens that evince a climbing tendency; and this strikes me as being so novel a feat that I add a line. The little creatures—one of which is of a pale flesh-colour, almost white—live in a cage with some tree frogs, behind the door on entering the Reptilium. Here they are, May 1882, often seen lodged in the branches of the shrub, and reposing there at ease, as if in quiet enjoyment. The 'white' one I first observed in the tree, and subsequently others. So frequently may they be seen reposing in this way among the leaves, that to climb seems to have become a confirmed habit or taste; and in concluding the history of *Anguis fragilis*, I record this singular diversity of habit as one other strong feature in common with the giant Anaconda.

CHAPTER XXVII.

DO SNAKES AFFORD A REFUGE TO THEIR YOUNG?

THE question, 'Do vipers swallow their young in times of danger?' is one less easy to solve to the satisfaction of the unbelievers than some of the preceding inquiries, because the proof demanded is an almost unattainable one. 'Bring me a viper with its mouth tied up, and all her young ones in her *throat*, and then I will believe you,' say the sceptics. Now, in the first place, a man does not go hedging and ditching, or to reap corn, nor does a gentleman go to his field sports, or for a country stroll, ready provided with a cord and a bag and an assistant for the express purpose of capturing maternal vipers, who at sight of him receive all their little ones into their mouths; and, in the second place, if he did so, making it the one business of his walk to seek for and entrap such vipers, he might spend a great many summers in the search before his trouble was rewarded. Even were he so fortunate, it is doubtful whether he would be believed by all persons; for viper-swallowing, like 'the Great Sea Serpent,' has been a subject so contemptuously dismissed that investigation is arrested, and few in England would now risk their reputation by committing their names to print in connection with it. It is much to be regretted that this has of late years been the case with several English publications whose columns should be open to a fair examination of evidence on all zoological questions. The influence of such journals, therefore, checks progress; for until prejudice is got rid of, there can be no advancement in any science.

As is well known, the late Mr. Frank Buckland was to the last sceptical on this question. His specialty was not ophiology; but the mass of readers do not stop to inquire about this; and he, being a popular writer as well as a popular character, was accredited by thousands who quoted him, while themselves no naturalists, nor in any position to form an independent opinion. Some contemporary journals unfortunately display the same prejudices, even at the time of writing, causing zoological publications, which should embrace every branch of biology, to be devoted almost exclusively to the specialties of an editor.

Happily this scepticism is not universal. In the American publications devoted to zoology, information in every branch is welcomed as worthy of consideration; and though truth has often to be sifted out from a very gigantic pile of rubbish, still it is worth the search; and we can but feel that the rapid advance of our Transatlantic relatives in every branch of science is due, in a great measure, to the dismissal of prejudice and to the encouragement of every new idea.

So far as snakes are concerned, their field is wide, it is true. In England our observations are limited to our one viper, whereas America is the land of snakes, no less than are India and Australia ; and while our native viper is growing rarer every year, the opportunities for observation in the Western World are wherever a new settlement is planted.

Thus, when, in February 1873, Professor G. Browne Goode, of Middletown University, Connecticut, invited, through the columns of the *American Agriculturist*, all the authentic information that could be procured on the question, 'Do snakes swallow their young?' he received, as he tells us, no less than 120 testimonies from as many persons in various parts of the United States that single season.

The area in which information was collected included twenty-four States and counties, 'almost all the evidence being valuable.'

Professor Goode was intending to bring the subject before the *American Association for the Advancement of Science*, to convene at Portland, Maine, the following August ; and he spent the summer in collecting information.

At that session of 1873, in the Biological Section of the Association, 'A Science Convention on Snakes' was held, and a paper was read by Professor G. Browne Goode, the subject offered for discussion being—'*Do snakes offer a temporary refuge for their young in their throats, whence they emerge when the danger is past?*' On this occasion the chair was occupied by Mr. F. W. Putnam, one of the editors of the *American Naturalist*, and secretary to the Association. Professor Joseph Lovering was the new President on Professor Lawrence Smith's retiring ; and among those who took part in the discussion were several eminent naturalists

New York and other journals published reports of the Convention at the time; and the entire paper by Professor Goode was given to the world in the Annual Reports of the *American Association*.

From these I will condense the principal matter, quoting also from a paper on the same subject written by F. W. Putnam in vol. ii. of the *American Naturalist* for 1869. Indeed, the two accounts are so blended that I can only recommend both to the perusal of the interested reader, Professor Goode having reproduced much from Putnam's paper in the *American Naturalist*, which, as he informs us, was the first that led him to take an interest in the subject.

He began by reminding his audience that it had long been a popular belief that the young of certain snakes seek a temporary protection from danger by gliding down the open throat of the mother, though it had been of late doubted by so many naturalists as to be classed among the superstitions; but that now a summing up of the evidence would show conclusively that the popular idea is sustained by facts.

The traditions of the North American Indians show that the belief has prevailed with them from prehistoric times. In England also, as he reminded us, as early as the sixteenth century, allusions to it are found in Spencer's *Faerie Queene*, 1590, Canto I. vv. 14, 15, 22, 25. From this a word or two only need be quoted regarding the

> 'Half serpent, half woman,'

with

> 'One thousand young ones sucking upon her poison dugs,'

when she is disturbed in her dark cave :

> 'Soon as that uncouth light upon them shone,
> Into her mouth they crept, and suddaine all were gone.'

Again, in Sir Thomas Browne's *Pseudoxia*, or 'Vulgar Errours, published in 1672, we find: 'For the young ones will upon any fright, for protection run into the belly of the Dam. For then the old one receives them into her mouth, which way, the fright being passed, they will returne againe; which is a peculiar way of refuge.'

He quotes from the *Humorous Lieutenant* of Beaumont and Fletcher the words, 'This is the old viper, and all the young ones creep every night into her belly.'

The Professor also mentioned the American traveller, Mr. Jonathan Carver, who, towards the end of the last century, recorded that he had seen a large brood of young rattle-snakes retire for safety into the throat of the parent, which he killed, when no less than seventy young ones made their escape. Practical experience demands, How had he time to reckon up these active, wriggling, tangled fugitives? Nevertheless his story found favour and has been subsequently recited as probable. Chateaubriand believed the fact, and glowingly expatiates on the 'Superb Reptile which presents to man a pattern of tenderness.' . . . 'When her offspring are pursued, she receives them into her mouth: dissatisfied with every other place of concealment, she hides them within herself, concluding that no asylum can be safer for her progeny than the bosom of a mother. A perfect example of sublime love, she refuses to survive the loss of her young, for it is impossible to deprive her of them without tearing out her entrails.' Elsewhere, with less of admiration for the exemplary *crotalus*, Chateaubriand says, 'By a singular faculty the female can introduce into her body the little monsters to which she has given birth.'

One of the early writers who witnessed this offer of refuge was M. de Beauvoir, who saw a disturbed rattlesnake open her jaws to receive five young ones. This amazed spectator retired to quietly watch the result, when, after the lapse of some minutes, the mother snake recovered confidence, and she again opened her mouth and 'discharged' her little family. Professor Palisot de Beauvoir was an eminent French naturalist of the beginning of this century, and the author of *Observations sur les serpents*, published in Daudin's *Histoire naturelle*, Paris, 1803. He was accepted as an authority on many other points of natural history; and it is not improbable that he influenced Cuvier's belief in the ophidian maternal refuge.

It certainly does seem incredible that an occurrence so unprecedented should have been conceived of in the first instance without some ocular demonstration of it.

Another American traveller, whose testimony Professor Goode considered of worth, was St. John Dunn Hunter,[1] who saw young ones rush into the rattlesnake's mouth, and re-appear when 'the parent gave a sort of contractile motion of the throat as a sign that danger was past.'

Coming down to our own times, Professor Goode mentioned Dr. Edward Palmer, of the Smithsonian Institute of Washington, a well-known traveller and collector, who in Paraguay saw seven young *crotali* run into their mother's mouth. After the snake was killed, they all ran out. The parent and her brood are now in the National Museum at Washington, D.C. Similar occurrences were witnessed by Professor Sydney J. Smith, of Yale College; the Rev.

[1] *Memoirs of Captivity among the Indians.* London, 1823.

Chauncey Loomis, M.D., of Middletown University; Dr. D. L. Phares; Mr. Thomas Meham of Philadelphia; a member of the Convention then present; and other 'gentlemen whose statements as naturalists were not to be doubted.' 'Due weight should be given to the wide distribution of the witnesses and the remarkable concurrence of their statements,' said the speaker.

Professors Wyman and Gill, and other physiologists then present, showed that there is no physical reason why young snakes should not remain for a time in the body of the mother. The gastric juice acts slowly on living tissues, and as for respiration, it is almost impossible to smother reptiles. 'Snakes can live for a long time immersed in water, and even in bottles hermetically sealed, and why not in a place of refuge?' argued Mr. Putnam. Instances were given of frogs escaping from the stomach of snakes; also of other snakes swallowed by a larger species returning to the light of day.

As a habit, if the swallowing 'is not protective there is no parallel; if protective, a similar habit is seen in some fishes of the South American waters, of the genera *Arius*, *Bagrus*, and *Geophagus*, where the males carry the eggs for safety in their mouths and gill openings.' Mr. Putnam instanced the Pipe-fish (*Syngnathus Peckianus*), whose young when in an aquarium have been seen to go in and out of the pouch of the male fish; and that a belief prevails among some sailors that young sharks which suddenly disappear have gone into the mouth of the mother. Some South American fishes carry their eggs in their mouth, and why should there not exist an equally motherly regard on the part of snakes?

Mr. F. W. Putnam, secretary to the Association, had made himself acquainted with all the English 'viper-swallowing' literature of any importance up to the date of his paper on the subject in the *American Naturalist*, 1869. Previous to that date, *Science Gossip*, the *Field*, the *Zoologist*, and other English journals had devoted more space to the subject than subsequently; and from these Mr. Putnam cited many records from intelligent observers, in proof 'that snakes *do afford refuge to their young*.' Of especial importance, as corroborative evidence, were the statements and anatomical investigations of Dr. Edwardes Crispe, F.Z.S., etc., who had for a long while been studying the physiological possibility of such a retreat. On the question, Would not the young snakes be rapidly digested in the stomach of the parent? this anatomist showed that they would not come in contact with the gastric juice at all, and that there is ample room in the expansile œsophagus to receive them. He had made experiments with various snakes by filling the stomach with water, in order to ascertain its capacity in bulk. In 1855, Dr. E. Crispe had read a paper on this subject at one of the meetings of the Zoological Society, and again in 1862, when his previous opinions had become confirmed. He had 'positive evidence enabling him to state with certainty that the English viper and some other venomous snakes do swallow their young at an early period.'

Towards the end of the last century, Gilbert White, in his *History of Selborne*, refers to the prevalent theory, and the instances recorded by him are by the earlier editors of his works regarded rather as evidence than the contrary. In the edition of 1851, the editor Jesse, himself a naturalist, took pains to ascertain facts concerning vipers, and he believed in the evidence given him. He had found vipers in their mother's 'stomach' (he does not say oviduct) 'of a much larger size (seven inches) than they would be when first excluded.'

(In the later editions of the *History of Selborne,* it is much to be regretted that doubts are again thrown on the subject; and this in face of the opinions of men of eminence, who had written from observation, and had physiologically shown the possibility of such a refuge.)

Mr. Putnam also quoted Mr. M. C. Cooke, the author of *Our Reptiles,* and at that time editor of *Science Gossip.* Here is a herpetologist well able to form an unbiassed opinion, and who in his work says on this question: 'Men of science and repute, clergymen, naturalists, in common with those who make no profession of learning, have combined in this belief. Add to these, gentlemen whose statements in other branches of natural history would not be doubted.' Among them were Henry Doubleday, Esq. of Epping, a well-known entomologist; the Rev. H. Bond, of South Pellerton, Somerset; T. H. Gurney, of Calton Hall, Norwich, a well-known ornithologist; and several others of similar scientific standing.

Curiously, no one appears to doubt a similar maternal instinct as displayed in our little native lizard, *Zootica vivipara!* Mr. Doubleday related the case of one being accidentally trodden upon, when three young ones ran out of her mouth. It was immediately killed and opened, and two others that had been too much injured by the foot to make their escape were still within the parent. At the time when a controversy on the viper question was going on, Mr. Edward Newman edited the *Zoologist*, and he himself related a most confirmatory case of this viviparous lizard. A gentleman who was collecting, caught one with two young ones ; all three were consigned to his pocket *vasculum*. On reaching home the two young ones had disappeared, and the mother looked in such goodly condition that he thought she must have made a meal of her offspring. Next morning, behold ! there were the two little ones and their devoted parent all safe and sound. She had sheltered them within her body ! And, as Mr. Newman added, 'the narrators are of that class who do know what to observe and how to observe it.'

In May 1865 a clergyman in Norfolk communicated to *Science Gossip* that he had seen six or seven young vipers run helter-skelter down their mother's throat. He killed the parent and 'out came the little ones.' In July another correspondent of the same paper saw several young vipers vanish in a like manner, adding, 'By the way the mother opened her mouth to receive them, he would say they were accustomed to that sort of thing.' Mr. J. H. Gurney recorded that a viper with young ones was disturbed, when two of the latter ran into her open mouth, the second one after getting half in wriggling out again. The viper was cut open to seek a reason for this, when a recently swallowed mouse was found stopping up the way. The first had managed to get into safe quarters, but the second could not pass.

In Oct. 1866 the question was revived by Mr. Thomas

Rider, who wrote to the *Field* newspaper that on September 21st he had seen a number of little vipers about three inches long run down their mother's throat. His account was followed by a number of letters from various persons, who very lamely tried to convince him that his eyes had deceived him; that what he had seen was the wriggling tongue, and a good deal more of such feeble talk, which Mr. Rider took in gentlemanly good-humour. He further described that at first he clearly saw the young ones *at a distance* from the parent; that, the latter being killed, the young were found *within* her; that in carrying her, two of them had *fallen out of her mouth;* that he felt quite sure that what he stated was correct. His description was so graphic and evidently truthful that the distinguished naturalist Thomas Bell wrote also to the *Field* to express his great satisfaction at so authentic an account, confirming his own previous impressions. 'I did not doubt the fact before,' he said, in the *Field* of October 27th, 1866, 'but such an attestation as this from such an authority' (an educated country gentleman) 'must be considered as settling the question.'

For the next few weeks in the Natural History columns of the *Field* a number of letters from various persons appeared, the majority taking up the cudgels to resent the insult offered to Mr. Rider and the eminent herpetologist Thomas Bell, F.L.S., F.R.S., and one of the Council of the Zoological Society; and to quote still other cases of viper-swallowing. 'Only a purblind, stupid person,' wrote one of them, 'could possibly mistake young vipers for a tongue.'

J. Scott Hayward, Esq. of Folkington, Sussex, wrote that three of his men while haymaking found a viper, and one of them crushed its head with his boot. A young viper 'scrabbled' about his boot after its mother. They then cut off the viper's head, and seven young vipers crawled out at the neck. The other had been too late, but was evidently trying to follow the rest. There was no possibility of mistaking seven little vipers for one hair-like tongue in this case; but a man 'convinced against his will,' etc., and therefore the editor again abruptly closed the subject.

Of the hundred or more instances occurring in America, and now presented to the assembly, those considered of especial interest were published in the Reports of the Association; and after some further discussion Professor Gill said that he considered the evidence sufficient to finally decide the matter. 'Since many important facts in biology are accepted on the statements of one single observer, these testimonies are claimed to be sufficient to set the matter for ever at rest.'

This was the conclusion arrived at by the members of the American 'Science Convention on Snakes,' in 1873.

Of the witnesses introduced on that occasion, Professor Goode dismissed those who had only *found* the young snakes within the parent, but had not *seen* them enter. 'Let us not trust to untrained observations,' he said; those whose testimony was accepted being, in addition to the well-known men already mentioned—'an intelligent class of farmers, planters, and business men, intelligent readers of an agricultural magazine.' . . . 'The well-attested cases included many non-venomous species, the habit probably extending to *all those which are known as oviparous*, as well as the *Crotalidæ*. The examples embraced the garter snake, *Eutania sirtalis* and *E. saurita;* the water snake, *Tropidonotus sipedon;* the rattlesnake, *Caudisona horridus;* the copper-head and moccasin, *Ancistrodon contortrix* and *piscivorus;* the "*Massasauga*," *Crotalus tergiminus;* the English viper, *Pelias berus;* and the mountain black snake, *Coluber Alleghaniensis.* Probably all the *Crotalidæ* might be included. It remains to be shown whether the habit extends to the egg-laying snakes, but as yet no proof had occurred. The Professors then present invited still further observations and reports, affirming that the breeding habits of more than twenty-five of the North American genera were entirely unknown.'

The following are a few of the cases recorded.

A 'water moccasin' (probably *Ancistrodon piscivorus*) had been seen for several days unwelcomely close to a southern residence. A gentleman wishing to entice her away from the water so as the better to kill her, had a rabbit placed near, which by and by she seized and had nearly swallowed, when those on the watch made a noise to alarm her. She quickly disgorged it, gave a shrill whistling noise, and five young snakes ran from under a log down her throat. The men cut off her head and found the five young which tried to get away.

'A farmer who was mowing saw a number of little snakes and a large one. He went a short distance to fetch a fork to kill them, and on his return found only the large one left. He struck it on the back, and seven ran out of her mouth.'

'Another farmer saw a "striped snake," and noticed a number of young ones near to her head. He alarmed them, and the young ones rushed in at her open mouth. He stepped back and watched to see what next would happen, when presently some of them came out. He killed the mother, and all the rest ran out.'

A gentleman in Ohio saw a water snake on a bank. He got a pole, and with one stroke of it wounded her, but not so much as to disable her. She instantly made for the water, swam about her own length, when she 'wheeled round' with difficulty, and placing her under jaw just above the level of the water, opened her mouth wide, when some ten or twelve young snakes ran or swam down her throat; after which she went in search of a hiding-place. She was, however, killed and opened, and 'about twenty' living young snakes were found within her, 'two or three of which were seven or eight inches long.' Out of the 120 cases recorded, sixty-seven of the witnesses saw and described the actions so distinctly as to leave no doubt in the minds of their hearers; and of these, twenty-two heard the parents' signal 'whistle,' or hiss, or click, or rattles, according to the species observed.

A man Charles Smith was ploughing near Chicago, when his plough caught and turned over a large flat stone ('rock,' as they call it there), exposing a very large rattlesnake and her young ones. The mother rattled the alarm, and all the young ones ran down her throat. Smith killed the old one, and immediately the young ones began to crawl back from her mouth and were killed by him. Thirteen of them were five or six inches long.

Some of the witnesses, after killing the snake into which they had seen the young ones retire, saw them shaken out again by dogs which had seized the mother. A few of the observers went on several successive days to watch a certain snake that was known to have a nest close by; and on each occasion when alarmed, the young ran into the parent's mouth.

Mr. Putnam also mentioned a 'striped snake' (which he had considered ovoviviparous) bringing forth live young ones at the end of August; she 'having been a long while in confinement.' (This was no doubt a case of retarded functions.)

In vol. iii. of the *American Naturalist*, 1870, an interesting record of the 'blowing snake' (*Heterodon platyrhinos*) appears. One of these snakes had been wounded in her side, and over one hundred young ones from 6 to 8 inches long came forth from the wound. They were all active, all blowing and flattening their bodies like thoroughly wide-awake *Heterodons*. Sixty-three of them being uninjured died in alcohol, thirteen were much lacerated, as was the mother, and the rest escaped. Says the narrator, 'We *know* that this snake is oviparous. Had she swallowed them, or can she be also ovoviviparous?' (Well, she might be either or both as occasion demanded!) This is one of those examples which might have given rise to the supposition handed down by Aristotle, and explained p. 431.

One hundred snakelings from 6 to 8 inches long seems almost incredible from the space they would occupy. Yet in bulk they would not be more than one large snake which the mother could easily swallow. The accommodating ribs render such habits more feasible than at first sight would appear. *Heterodon platyrhinos* is a wonderfully prolific snake. In the *Zoological Society Proceedings*, vol. vi. 1869, S. S. Ruthven states that he has observed it to bring forth over one hundred *live* young at a time.

One more example shall be added, of what Professor Goode considered a remarkable instance of hereditary instinct. In a hay-field was found a nest of eggs, one of which was cut open, when a small but perfectly formed 'milk adder' within immediately assumed a menacing attitude and 'brandished' its tongue. Some of the other eggs were then torn open, the young in which acted in a similar manner. Then the old snake appeared, and after endeavours to encourage this unexpected family, put her head on a level with the ground and opened her mouth, when the young ones vanished down her throat.

It is worthy of notice that in many of the above cases the mother snake made a signal noise, that the young ones understood this signal, and that she opened her mouth in a manner which they readily comprehended. 'This concurrence of testimony is not to be disregarded,' says Professor Goode. And the reader will admit the force of these evidences. Those witnesses, dispersed over thousands of square miles, had entered into no compact to make their accounts agree; nor did one spectator in Kansas know what another in New Jersey was looking at or writing about.

After such a weight of evidence, and in face of the decision arrived at by the American Convention, it is greatly to be lamented that the *Field*, so far from advancing like our American friends, now retrogrades on this question. So lately as October 1881, when another case was cited of the maternal refuge, the Editor closes his columns against investigation; and refuses to be convinced unless he were to see 'the young vipers at the Zoological Gardens obligingly run in and out of their mothers' mouths,' which is a performance we are never likely to witness. For, in the first place, the young are often produced in mid-day, in the presence of the crowd of visitors. Thus, from their birth accustomed to publicity, they have not the motive as when in their native haunts they are suddenly alarmed at the first sight of an apparition in human form. And in the second place, the young are generally removed at once into a separate cage, and they lose all knowledge of their mother. Both mother and progeny are familiar with humanity; and the former is much more likely at the sight of the keeper to open her mouth for a mouse than to invite her children to enter therein.

In the foregoing portions of this volume I have been able frequently to bring personal observations to verify what books have taught me. With the present subject this cannot be the case. I have neither seen a viper in the act of giving refuge to her young ones by receiving them into her mouth, nor have I ever had the circumstance described to me by any one who has witnessed the proceeding. This is not surprising, seeing that my studies have been prosecuted almost entirely in London. For any information obtained at the Gardens I am indebted solely to the keepers, whose opportunities of observation when aided by intelligence and experience merit the confidence of the inquirer.

So astonishing a phase of ophidian habits—let us say only *reputed habits*—was, however, to me one to excite very special interest, as well as to induce inquiry and a possible solution of the mystery; and towards this solution the facts related in chap. xxiv. and xxv. appear to me to come foremost in our aid. 'All snakes that are ovoviviparous,' was the decision arrived at by the American ophiologists; or *viviparous*, for we have seen that the two words have but little value as a distinction. I would venture so far as to render it thus :—

In snakes which are either viviparous, or in which from some cause or other extrusion has been so postponed that the young are conscious of existence before birth. Conscious also when born that they had been safer in that pre-natal condition than now when assailed on all sides by dangers hitherto unknown. This idea—and probably an untenable, unphysiological, and foolish idea, which science might laugh to scorn in an instant—still the idea did flash into my mind one day in the summer of 1873, when Holland, announcing a brood of young ring snakes which had just been hatched at the Gardens, and describing their baby terrors, said, 'It is funny to see how they all try to wriggle back into their shells again.'

'Then those little Colubers had been conscious of security before they were hatched,' I reflected, 'and conscious when they did emerge into activity that the shell had been a safe refuge to them.' (This was prior to the American Convention, of which I knew nothing until long afterwards.)

Consciousness of locality must, I think, have a good deal to do with the maternal refuge; and that snakes possess this consciousness in a strong degree has been already shown in their habit of returning to the same spot to hibernate year after year: and not only for winter quarters; but a strong love of locality and a memory of home are observed wherever snakes abound. 'They remain in a hole or a crevice of the wall for years,' Fayrer affirms. In his

Prairie Folk, Parker Gilmore tells of a family of 'Puff adders' (by which probably *Heterodon platyrhinos* is meant) that had taken up their abode under the boards of a porch for several years and could not be routed out. Nicholson, also, in his *Indian Snakes,* informs us that when he was stationed at Kamptee in 1868, a cobra and a pair of *Bungarus acutus* lived in his bungalow for a long while. He could not find where the cobra lived, but the Bungari made themselves at home in a hole of the wall under his dressing-table. He never saw either of these interlopers, but identified them by the skins which they 'periodically cast;' taking advantage of his absence, no doubt, or of his nocturnal somnolence, to perform their toilet under his looking-glass!

The often recounted tale of an Indian who had a tame rattlesnake that went away every spring, and returned regularly each autumn to a certain tub which it had appropriated for its home, is only an example of affection for locality; but by those who were not cognisant of this habit, the story has been produced with a strong flavour of the marvellous, and the Indian who knew by the season when to expect his creeping friend, was not slow to attribute the regular return to especial regard for his own person. That *crotalus* coming alone so regularly, was probably a lone widow or widower; because we also know that the *pair* of snakes are usually seen together, and that they follow each other with strong conjugal affection. This is not irrelevant to the present subject; because the *affection* of ophidians, whether conjugal or maternal, is what we are now considering. The quality was well known in classic ages, though it has been denied them in modern times. Many writers on snakes, while affirming that they 'exhibit no phase of affection,' describe their constantly going in pairs; or the fact that they become 'vicious if their retreat is cut off.' 'In their peregrinations male and female are always in company,' says Catlin; 'and when only one is seen, the other is sure to be within hearing.' When a female has been killed and left on the spot, the male always comes. The Indians profit by this knowledge of conjugal devotion to lie in wait and kill the mate. They place the dead one near the hole of their retreat, and watch the egress of the survivor, which is sure to come and inspect its dead companion.

Sir Emerson Tennant observed a decided affection between the sexes of the cobra. In his *History of Ceylon* he gives several proofs, as for instance a cobra being killed in a bath, and the next day the mate being found there. In Baird's Report of one of the Pacific exploring expeditions, a good deal is said about the Bull snake (*Pituophis*), which follows its mate by the scent. Once a fine individual having been captured and placed in a barrel near the tent, a large one of the same species was shortly afterwards found close by, and in a direct line from where its mate was caught.

So much for conjugal affection. As regards maternal devotion, we certainly had a proof in the pythons remaining week after week on their eggs. True, they took no notice of the little ones when hatched, because they were well able to take care of themselves. The mothers had fulfilled their duties beforehand. Snakes which are vicious at no other time, menace those who approach their nests or cut off their retreat. This is a fact universally recognised, alike in Africa, India, Australia, and America: wherever a traveller, a hunter, or a resident incidentally mentions snake habits, he confirms this home affection.

'Snakes, if aggressive at no other time, are always spiteful when they have young,' says Fayrer. And an anecdote is related of a man who stumbled on a nest of young Hamadryads, and was pursued a long distance by the angry mother. Terror added wings to his flight, as she came fast upon him. In despair he plunged into a river and swam across, but on reaching the opposite bank, up reared the furious Hamadryad, its dilated eyes glistening with rage, ready to bury its fangs in his trembling body. Escape now seemed hopeless, and as a last resource he tore off his turban and threw that at the enemy. With characteristic stupidity the snake plunged its fangs into this, biting it furiously. After wreaking its vengeance upon the turban, it glided back to its nest and its young ones; and so the man escaped.

Apropos of Indian snakes, Nicholson, though a practical ophiologist, never heard of snakes swallowing their young in India. This may be because so large a proportion of them are egg-laying, and because the only two vipers, *Daboia* and *Echis,* are nocturnal, very shy, and not so frequent. Most of the other members of the Indian *viperine* snakes, the *Crotalidæ,* are tree snakes, which, like the sea snakes, are more likely to be dispersed and separated from their progeny, and to take refuge in flight. They are, besides, less frequent, shy, nocturnal, or crepuscular; and belong more to Malay and Hindoo China, than to the localities in which observations are more feasible. Fayrer does not even state positively that they are viviparous. At the same time

Nicholson will 'say nothing certain about the young going down the throat, but sees no reason why not.' 'They can do without air for half an hour or so, and a snake's throat is sufficiently capacious to allow a frog to croak *de profundis clamavi* when he is two feet from daylight.'

Among unprejudiced observers there are still some who are inclined to attribute to optical delusion the sudden disappearance of young snakes; arguing from their astonishing rapidity of motion, and the almost inappreciable space into which they can creep and hide in their mother's coils. Mr. Arthur Nicols, in his interesting papers on Snakes, published in *The Country* newspaper, in 1878–79, describes a case of this kind from personal observation when in Australia. He disturbed a snake with a number of young around her, the latter quickly vanishing. He discharged his gun, and the old snake was almost cut to pieces with shot. Approaching, he found all the young ones hidden beneath and about her, and when he stirred them up they persisted in hiding among the shattered coils, returning thither to the last.

Mr. Nicols states only that it was a poisonous snake, not giving the specific name. She had probably incubated her eggs, and the young had remembered the shelter of their mother's coils. That it was a display of filial refuge is, however, undeniable.

A similar occurrence is related in the *Field* of November 10th, 1866, by a Mr. Brittain, as an argument against the swallowing process. He had seen young vipers run to their mother for protection, and so completely out of sight that only on disturbing them they were found to have secreted themselves in her coils. These may have been at a more advanced age, and had ceased to enter the mouth.

It is remarkable that hitherto, excepting in *Pelias berus*, we hear of this maternal display as peculiar to America only. Whether a more intimate acquaintance with the snakes of other countries will reveal new instances in the course of time, we cannot conjecture. It is to be wished that observations on this head may be published, and investigations encouraged; or in the minds of the million, the maternal œsophagal refuge will still be classed among the fables.

Taking it for granted, then, in deference to the American 'Convention,' that snakes do offer refuge to their young, it is curious to speculate as to how the habit originated and became a confirmed one. Maternal instincts have, without doubt, been strong from the first; and we must suppose that similar dangers to those which induce a snake now to summon her young ones had also been the cause of postponed functions in the mother, and that hers were precocious little reptiles before they ever saw light.

Because we cannot assume that in a state of *security* an oviparous snake would 'retard its laying' and become ovoviviparous or viviparous; nor that a viper would intentionally retain her young until their fangs were developed (see p. 360), so that they should be able to take care of themselves; or a rattlesnake till its young had rattles as well as fangs (see p. 299), these being the principal species which do shelter their young. And the habit must have had a beginning; there must have been some training, some development of instinct, to lead up to what we now see, viz. a snake deliberately giving a signal, lowering her head to the level of the ground or water, opening wide her mouth to receive her young, and giving them a second sign when they might safely venture forth again.

This is the state of things supposed to exist at the present time; and it would seem to be an organized habit, perfected in process of ages, and one in which the mother's instinct, and a *consciousness of harbouring active young ones before introducing them to surrounding dangers*, must have had a considerable share.

In concluding this speculative chapter, I can only humbly beg to 'second the motion' put to the learned assembly at Portland, Maine, in 1873, to the effect that the subject will receive the attention of ophiologists in all the snake countries of the world.

CHAPTER XXVIII.

SERPENT WORSHIP, 'CHARMING,' ETC.

IN the preceding pages it has been my endeavour to resolve some of the superstitious myths into zoological facts, and to explain by the light of science those peculiar features and manners of the Ophidia which from the earliest traditions of the human race have been regarded as supernatural.

In reviewing the general organization of these reptiles, their marvellous powers and habits, can we wonder at the impressions they have created in untutored minds? Let us picture to ourselves our earliest ancestors with their dawning intellect contemplating the instantaneous coil of a constrictor; or the almost invisible action in a flash of time with which the death-dealing stroke of the poison fang is effected. From a source which was incomprehensible, like the burning, scathing fluid from the skies, came a 'sting,' an agony, death! Awe-struck and filled with sacred terror were the beholders, as before them lay the paralyzed, tortured victim. Can we wonder that the slender, gliding 'worm' which inflicted this mortal injury should have been regarded as an evil spirit, a devil, and invested with maleficence?

Add to the two great death-dealing powers of the serpent race—constriction and venom—those other peculiarities which have here been faithfully recorded, the seeming renewal of life after the annual sleep, a mystery enhanced by the restored brilliancy and beauty of the reptile on its change of cuticle; let us picture to ourselves those wondering savages now watching the limbless creature as it glides into sight and is gone again, or as with fixed and glittering eyes it flickers that mysterious little tongue; let us imagine them crowding near to behold a serpent feeding, or to witness the still more amazing spectacle of a brood of young ones vanishing down their mother's throat. There is enough of the mysterious in an ophidian to excite the awe and wonder of even a nineteenth-century beholder, taking each one of these surprising doings singly; but considering that any one serpent may be endowed with nearly all of these phenomenal powers, let us imagine the effect produced by them in the savage mind. To worship such an incomprehensible creature was only consistent with all we know of the influences which first awakened faith in a supernatural Being.

Consequently we find that in every country where a serpent was known, it plays its part in the mythology and religion of that country. We may examine the antiquities of any nation which has left a monument of its history and beliefs, and a serpent will be represented. Scarcely an Egyptian sculpture (in its entirety) can be found in which the serpent does not appear. The same may be said of the Hindoo monuments, their temples, buildings, and sculptured caves; also of Mexican, Japanese, Chinese, and other ancient mythologies.

Singularly, too, no other object in nature—no birds or flowers or beautiful things—have been so universally adopted in personal ornaments as the serpent idea. And in times of remote antiquity—as relics prove—personal adornments, bracelets, coronets, and rings in the form of serpents were as much in favour as at the present day. We may, indeed, affirm that the modern bracelet is but a reproduction or a restoration of those of antiquity, dating as far back as artificers in metals can be traced. Rough and rude representations of still earlier times are extant. And where the human race in its savage state had no knowledge of art, the reptile itself, or such relics of it as could be preserved, were adopted as personal decorations. Thus were the American Indians found by the early colonists, with their belts of snake skins, with the rattles of the Crotalus strung in their ears, and with necklaces and chains of snake bones and 'rattels.' Mackeney, Catlin, Schoolcraft, and other historians of the American Indians relate numerous instances in proof of the universal veneration and superstition with which the serpent is regarded by those savages. If they kill a rattlesnake, it is immediately skinned and distributed in small pieces among the tribe for their medicine bags, while the captor is pompously decorated with the skin. If on a journey they meet a rattlesnake in their direct path, this is taken to be a sign that they must go no farther. Some of the Indian traditions bear a remarkable resemblance to the prophetic symbols of the Hebrew faith.

'If thou bruise its head, it shall bruise thy heel.' This in their eyes is regarded as 'destiny,' and they will on no account kill one that lies in their path, lest it should cause the death of the destroyer's relatives. The Indians are also supposed to possess the art of snake-taming to an extraordinary degree. We are assured by more than one writer that they also pet rattlesnakes, investing them with divine attributes, and sheltering them during the winter; though in this case the 'tameness' may be partially due to the inertness resulting from the season of the year. On returning spring they permit their *Penates* to issue forth again.

The ancient temples of Mexico were richly embellished with carvings of serpents. One of them represents a serpent idol of not less than seventy feet long, in the act of swallowing a human being. Also, there is the 'God of the Air,' a feathered rattlesnake; and an edifice known as the 'Wall of Serpents,' from the numerous reptilian forms crowded upon it. But it is not necessary to enumerate antiquities, with most of which the reader must be already acquainted, the object here being rather to endeavour to account for those other attributes which have grown out of serpent worship, such as 'fascinating,' taming, 'charming,' 'dancing to music,' etc.

Not that serpent worship is extinct by any means. In India it is still so strong as to amount to a fatality; for the high annual death-rate from snake bites there is not half so much because the natives can't be cured, as because they *won't* be cured of what they regard as a just punishment from their deity. This we shall have occasion to show further on. That serpent superstitions are still rampant among the low-caste Hindoos, is borne out by all modern writers on the native faiths or customs. A. K. Forbes in his *Hindoo Annals*, or *Râs Mala*, tells us that cobras are looked upon as guardian angels. One cobra 'guarded' a cave in which treasures were deposited; another cobra 'guarded' a garden; and very good guards we should say they were, as few persons would venture too near to such an 'angel.' One of the supposed 'Divinities' is the *Poorwug Dev*, or spirit personified by a snake, which is not allowed to be killed or injured; and if it bite a person, that individual is supposed to be justly punished for some fault. Fatalism forbids any attempt to cure that unhappy victim, and he swells the annual death-rate. Due honours are paid to these 'guardian angels' found in most hamlets. Periodical festivals are held to them: their retreats are then garlanded with flowers, and, as already stated, eggs and milk are placed as propitiatory offerings. One of the Bengalese traditions is, that a male infant auspiciously shaded by a cobra will come to the throne.

And is the reptile which brings such distinction and honour into a family to be ruthlessly destroyed? 'No Hindoo will willingly kill a cobra,' Colonel Meadows Taylor tells us, in his *People of India*. Should one be killed accidentally within the precincts of a guarded village, a piece of copper money is put into its mouth, and the body is burned with offerings to avert the anticipated evil. The *najas*, or hooded snakes, from their habit of erecting themselves on the approach of persons, are those especially regarded as guardians. It was the same in Egypt. In the *najas* are also supposed to dwell the spirits of highly-favoured persons, or those whose lives had been of remarkable purity and goodness,—another motive for their being protected. It is still the same in many parts of Africa, where the natives think ill luck follows the death of a python.

In works where medical statistics are given, such as Fayrer's *Thanatophidia*, we learn the fatal results of these superstitions. When the natives find a cobra in their houses, as is not unfrequently the case, says Fayrer, 'they will conciliate it, feed and protect it, as though to injure it were to invoke misfortune on the house and family. Even should the death of some relative, bitten by accident, occur, the serpent is not killed, but caught and deferentially deported to the field or jungle, where it is set free.' No one can peruse the above without seeing how largely the percentage of deaths is traceable to native superstition. Fayrer also shows us the fatal consequences of the confidence placed in the snake 'charmers,' who are considered to be especially favoured by their deities, and endowed with curative powers. Much interesting reading, apart from medical science, will be found in the *Thanatophidia* on the Hindoo faith in the *müntras* or spells and incantations used by the charmers in cases of snake-bite. Out of some ninety such cases selected by Fayrer from returns sent in by medical officers in the Bengal Presidency, nearly half proved that either no remedies at all were tried, or that recourse was had to native nostrums or *müntras*. Briefly to enumerate a few of the reports: 'Boy bitten by *keautiah*, charms and incantations; died in half an hour.' 'Man keeping a krait (Bungarus) for "Poojah" (worship) was bitten, and died in seven hours, notwithstanding native nostrums.' A woman bitten died in three hours '*in spite of incantations*'! 'A man bitten while asleep had "*leaves to smell*," but nevertheless died in three hours!' 'Woman bitten at night, got up and had *müntras* (chantings) to expel the poison. She died four hours after the bite notwithstanding; and her infant at the breast died two hours after partaking the maternal nutriment.' And many similar cases. What wonder, then, with this miserable fatalism prevailing over that vast and densely-populated country, that death by snake-bites should amount to many thousands annually? One more case must be recorded to show how deeply rooted the faith. A tall, strong young man was bitten in the hand, while sleeping out of doors. No medicine was given, but *incantations* were muttered over him. In an hour he was a corpse: yet the village where this happened continues to do Poojah (adoration) to the cause of the evil. By far the largest percentage of deaths is attributable to the cobra, though this is not a proof that its numbers predominate so much above other snakes, as of the religious veneration in which it is everywhere held. It is found all over the peninsula, even as high as 8000 feet on the sunny slopes of the Himalayas. The names of castes, *Nâg*, *Nâgo*, *Nâgojee*, *Nâgowa*, etc., found among all classes of Hindoos, have all reference to the *Nâg* or *Nâja* deities, says Colonel Meadows Taylor. To this author, as well as to Forbes, Ferguson,[1] Fayrer, and Miss Frere,[2] the reader is referred in verification of the above. If further to pursue the subject of snake

[1] *Tree and Serpent Worship*, 2d ed., by J. Ferguson. London, 1873.
[2] *Old Deccan Days*. London, 1870.

worship, *The Serpent Myths of Ancient Egypt*, by W. R. Cooper, 1873; *The Serpent Symbol*, by Squires, 1851; *Sun and Serpent Worship*, by J. S. Phené; and *The Native Races of the Pacific States of North America*, by H. H. Bancroft, are some of the many books that afford interesting matter. These latter, however, allude more particularly to ancient nations. Among many living and semi-barbarous tribes serpent superstitions exist, though, perhaps, more strongly in West Africa than elsewhere, excepting India at the present time. In Africa, not the venomous so much as the large constricting snakes are the objects of care and veneration. In *Dahomey and the Dahomeans*, F. E. Forbes relates some amusing instances of the sacred devotion of the Fetish women, or guardians and slaves of the python deities at Whydah. A Fetish house or temple devoted to the snakes was built round a large cotton-tree, and in this a number of pythons were permitted to roam about at their pleasure. When they ventured beyond the precincts, their Fetish attendants went in search of them, and by gentle persuasions (probably in the form of poultry or other dietetic arguments) induced them to go home: while all who met them bowed down and kissed the dust of their path. Morning and evening the devotees prostrated themselves before the sacred abode of these ophidian deities, either to worship the invisible god *Seh*, or his representatives in serpentine form.

From frequent and gentle handling, snakes thus protected naturally grow tame. The Fetish attendants become skilled in managing their reptile gods, and are not slow in investing themselves with especial powers for their office. And to this may the origin of the so-called 'charmers' be traced;

for 'snake charming,' like snake worship, dates back to the very earliest ages. With a more intimate knowledge of the reptilian class which modern zoology has brought about, comes happily a clearer insight into the tricks of the snake-men, jugglers, and charmers of Egypt and the East. Snake-taming to-day is not confined to *Saadees* and *Samp Wallahs;* it is not even confined to non-venomous snakes, of which pythons have always proved very amenable pets. Mr. Mann's tame pythons (see 'Introduction') were popular performers at the time they were introduced in Chancery, and his pet constrictor, 'Cleo,' was honoured with an obituary notice from the pen of Mr. Frank Buckland, in *Land and Water*, after she died 'of grief,' as was said, at the illness of her master.[1] The amiable 'Cleo' (or Cleopatra) was the 'constant companion' of Mr. and Mrs. Mann for several years, and they soon learned her wishes when she 'asked' for either food, drink, or fresh air. 'A short time before her death she contracted a friendship for a young kitten,' was always 'fond of children,' who displayed no fear of that sociable ophidian. But she was shy of strangers; and this I myself realized on paying my respects to her; for not until she was fully convinced that I had no evil intentions, and not without much coaxing and persuasion on the part of her guardians, could Cleo be induced to approach me.

Several of the constricting snakes at the Zoological Gardens of even larger size than Cleo are exceedingly tame, permitting themselves to be handled. One of them, a temporary inmate during the winter of 1881–82, was introduced to the public by Dr. Stradling through the

[1] See *Land and Water*, June 10th, 1876.

columns of *Land and Water*, April 3, 1880, as 'Totsey,' together with her brother 'Snap,' the latter named 'from a trifling infirmity of temper when young.' These two were the offspring of the Panama boa who gave birth to 20 live young at the Gardens, June 30, 1877. Of these twenty, Mr. Sclater notified, at one of the Zoological Society's meetings in the following November, that all but one were still alive. Of the two which became the property of Dr. Stradling and were tamed by him, he wrote, 'Any one can handle them with impunity;' and that they recognised him among others in the dark, permitting him only to touch them at such a time. 'Lolo' and 'Menina' are the pretty names of two other tame constrictors belonging to this ophiophilist, and whose amiable and interesting manners were recorded in the above journal. Of 'Totsey' the Dr. writes, 'She is the most gentle and affectionate snake I ever had.' As this same Miss Ophidia happened to be an inmate at the Gardens in January 1882, when the pair of illustrations (p. 205) were in preparation, she adorns that page; though in truth it was one of her brothers or sisters, then rather smaller, that really did hang thus on the branch as I sketched it at the time, September 24, 1880.

That some of the most venomous serpents are also capable of being tamed we have many proofs. They use their fangs in self-defence, actuated by fear or hunger; and where no fear exists, a serpent would not deliberately crawl about, expending its precious and only protective power, *venom*, on any object it met with. Would a cobra or a crotalus in its native woods approach any living thing it saw and indiscriminately strike it with its poison fangs? No. Its primary impulse would be to escape. It strikes only under provocation or hunger. Therefore if a venomous snake in captivity become so familiar with your presence as to cease to fear you, it would also abstain from biting you. Not that one would recommend Jararacas or cobras for pets, notwithstanding the assurance of some residents in India that the latter are capital guards to a dwelling, and in some are even encouraged instead of dogs, as the less liable to bite of the two! Miss Frere, in her interesting reminiscences of India, *Old Deccan Days*, gives instances of children playing with the cobra without injury. She mentions a Brahman boy who could without any other music than his own voice attract and handle with impunity any venomous serpents that might be within hearing. They would come out of a thicket or a dry stone wall—their favourite refuge. Such instances are sufficiently rare to be regarded as miraculous, adds the authoress, still they do occur. 'How much is due to gentleness of touch and fearlessness, how much to any personal peculiarity which pleases the senses of the snake, it is difficult to say.' The boy above alluded to was believed to be the incarnation of some divinity, and the magistrate took note of his proceedings.

But at last, through some inadvertency, he got bitten; when he died, notwithstanding the divinity he was supposed to enshrine, notwithstanding the spells and *müntras* which might be pronounced over him.

The cobra is supposed to have originally had seven heads, as we see represented on Hindoo temples. The 'hood' is believed to be the remains of these seven heads; and the *Gokurrah*, whose pattern of the double ocellus had gained it the name of the 'spectacled cobra,' is held in the highest esteem of all from the two spots being considered the footprints of the god *Krishna*. These are the especial favourites of the professional snake charmers.

When it is borne in mind that snakes have been tamed by persons of only slight experience, we can easily comprehend that with a life's practice, and with inherited facilities, the Oriental jugglers must acquire peculiar expertness in dealing with their 'charmed' specimens. Originally, no doubt, the office of the professed snake tamer was connected with the sacred rites of serpent-worshipping communities, but has now greatly degenerated into the trade of jugglers and tricksters. That some of these do acquire extraordinary skill in dealing with their dangerous captives cannot be denied. Profound faith is placed in their performances by the natives, who attribute to them supernatural agency. From being close observers of reptile character, they know how far to venture on familiarities. They thoroughly understand the movements of the sluggish and timid serpents with which they are toying; and while keeping up a perpetual gabble to divert the attention of the spectators, aggravated by the tum-tumming and so-called 'music' to which the snakes are supposed to 'dance,' they themselves keep just beyond striking reach, and provoke the snake to follow the waving motion of their hands. The true object or impulse of the snake is to bite the irritating cause, the pretended motive is 'dancing.' To follow the movement of the object which provokes them is instinctive, music or not; and without any din and cackle and jargon, the cobras would do this all the same. Long practice and an intimate acquaintance have given the jugglers confidence and dexterity, while on the part of the snake fear is the chief characteristic. Even the tamest cobra is only watching the opportunity to escape, and the moment the juggler ceases his performance, down it drops, and makes for its basket. Should the performance not be ended, the snakes are called to attention by being sharply pulled back by their tail, when up they rise with hood expanded, and with just enough of power and spirit left in them to recommence the 'dance,' more truly to make one more futile attempt to strike their tyrannical masters. It is only a repetition of the same kind of 'obedience' and 'intelligence' that was accredited to that first rattlesnake ever exhibited in England.

That showman (introduced p. 285) had become well acquainted with crotalus idiosyncracies, and knew how to turn them to account before an ignorant crowd.

Those who have to deal with venomous serpents tell us, that with caution and expertness they are not difficult to handle; and this is verified by all who describe the performances of Oriental snake-charmers. Not only cobras with fangs extracted, or mouths sewn up, or composition 'cerastes' with artificial horns fastened on to the heads of harmless snakes, but those with perfect fangs and well-filled poison glands, are handled with equal facility. By pressing down the snake's head gently with a stick and then seizing it firmly close behind the head, so close that it has no power to turn it, you fetter its movements. Or to snatch up a venomous snake by its tail and quickly support it festooned on a stick which you draw gently towards the head, and then secure that as above, is another method adopted; or, again, to seize the tail and pass the hand swiftly along the body till the head is reached, and *then* grasp the neck. These are among the various ways of handling poisonous serpents, according to the purposes required of them. Every movement must be carefully watched, however, and the head not released until the entire snake is free to be returned straight into its cage. Even wild and vicious cobras are thus fearlessly dealt with by experts; and those which are in process of taming are put through a daily training. They are made comfortable in a basket, conciliated with food and milk, soothed by softly stroking them with a brush and by kind and gentle handling.

I once stood by and looked on while the keeper unpacked a box of cobras. He took each one out by its tail, and dropped it into another box with such expedition that the fearful reptile had not time to turn and bite him. Not that he ventured to lower his hand into the midst of the writhing angry tangle of snakes, but first, at a respectful distance (the writer still more deferentially contemplating the transfer from afar), he, with a long-handled hook, contrived to draw out a snake tail first, and getting the tip over the edge of the box, this he seized, thus, one after the other, shifting eight of the dozen cobras. Both boxes had lids, of course—glass slides, which were cautiously but quickly drawn aside, and as sharply closed again.[1] These deadly reptiles, after being some weeks, perhaps months, in a small close box, were not, as may be supposed, in a very lively condition, but sufficiently so to erect themselves and hiss like a flock of

[1] *Times*, 1st July 1875, paper by C. C. H. *Ibid.* 7th July.

geese, striking at the lid and the glass, and doing their best to alarm the manipulator, and also to suspend the breath of my awe-struck self. Calmly and safely, however, Holland concluded his task.

By pressing down the head with a stick, or seizing it quickly by the tail, American Indians similarly manage the rattlesnakes. Not they alone, however, are skilled in taming these deadly reptiles. Here, at home in England, domesticated *Crotali* are not unknown. Dr. Stradling thinks they may be rendered as harmless as non-venomous kinds, by a gradual training; and has succeeded in so far taming one that he felt safe in offering it as a gift to even an unskilled non-charmer. 'I have a very *nice* tame rattlesnake between four and five feet long, in good condition and feeding well, which I shall be delighted to send you,' he wrote me, August 1881. 'It has got so tame that you might handle it without fear at any time you wished to investigate any part of it.' It is perhaps superfluous to add that this amiable and exemplary reptile was gratefully declined.

The reader's devoted servant had not undergone a course of prophylactics as the Doctor had. He is both an expert and to a certain extent venom-proof at the same time; but for all that the snake was, as he affirmed, tame enough to be handled with impunity by those who might have sufficient courage to venture. That interesting and accommodating rattlesnake is no more, but was even more honoured in death than in life. A true martyr to science, it was sacrificed that its friend and teacher might prosecute his experiments, and also swallow some of the contents of its poison gland, in order to convince two or three challenging sceptics that he could do this with impunity.[1]

As in all other trades, there are various grades among the Oriental snake-tamers. The legitimate 'charmer' of India—the *Samp Wallah*—prides himself on being a descendant of the prophet, and the secret of his art is cherished as an heir-loom in his family. This also is the case in Arabia and Egypt, where the astonishing feats which, without any doubt, are performed by professional 'snake men,' are attributed to special and secret powers, jealously guarded from age to age. It may be possible that, like the Psylli of old, they may have recourse to some drug which renders their person repugnant to the serpent, and thus provides immunity from a bite. Not yet altogether discarded, either, is the ancient belief that in the body of the viper itself is found a specific for its poison. Since the days of Æsculapius, decoctions of vipers and recipes enough to form an Ophidian cookery-book and pharmacopeia combined, have found favour not only among the 'faculty' of classic days, but among all our ancestral dames. We are told that vipers abound in volatile salts that are cures for many ills. Certain it is that 'viper wine,' viper broth, viperine salts, the powder of dried vipers, preparations from the dejecta, the oil, and even the slough have all enjoyed a high reputation, and I believe are—*some* of these at any rate—still in vogue in secluded districts where the refinements of medical science have not yet replaced them. It is remarkable, too, that for skin affections their virtues chiefly commend them-

[1] Some interesting correspondence on this subject appeared in the *Field* during August and September 1881.

selves. The ancient belief that to devour vipers proved a specific for their bite, has to the present day prevailed among the snake-charmers of Egypt, who—whether or not from this practice—are said so to assimilate their bodies that the venom does not harm them. The Bushmen of South Africa, it is asserted, swallow poison to render themselves proof against its effects; and history records many other tribes who have had such confidence in their own and an inherited immunity, that they hesitated not in exposing their infants to deadly serpents. The Persian word *Bezoar*, a popular drug, means counter-poison; in allusion to the immunity from poison which persons who feed on venomous snakes are believed to enjoy.

Though much discredit has been thrown on these so-called 'immunities,' and though it is so very difficult to know what to believe where a serpent is concerned, the possibility does appear to be borne out by some authentic writers of our own time. The late John Keast Lord, when in Egypt, had frequent opportunities of observing the tricks of the jugglers; and not only he, but, as he assures us, many intelligent and educated Europeans, fully believed that some secret power was practised by the 'high-caste' charmers, who really did exhibit astonishing feats with their snakes. Of these, the habit of devouring the reptiles alive can here admit only of bare allusion.[1]

In *Dahomey and the Dahomeans*, F. E. Forbes tells of the natives walking fearlessly bare legged in the grass where snakes abound, and that on one occasion on alluding to the

[1] *Anecdotes of Serpents*, by the late J. K. Lord. Messrs. Chambers's *Miscellany of Tracts*, Edinburgh, 1870.

danger, a boy said to him: 'No fear; if my father is bitten, he knows of an herb that will cure him.'

Another recent authority whom we are bound to respect is Schliemann. In his work *Troy and its Remains*, published in 1875, he writes (p. 117): 'We still find poisonous snakes among the stones as far down as from thirty-three to thirty-six feet, and I have hitherto been astonished to see my workmen take hold of the reptiles with their hands and play with them: nay, yesterday I saw one of the men bitten twice by a viper, without seeming to trouble himself about it. When I expressed my horror, he laughed, and said that he and all his comrades knew there were a great many snakes in this hill, and they had therefore all drunk a decoction of the snake-weed, which grows in the district, and which renders the bite harmless. Of course I ordered a decoction to be brought to me, so that I also may be safe from these bites. I should, however, like to know whether this decoction would be a safeguard against the fatal effects of the bite of the hooded cobra, of which in India I have seen a man die within half an hour. If it were so, it would be a good speculation to cultivate snake-weed in India.'

A correspondent in *Land and Water*, signed 'R. C.,' quoting Schliemann, inquired the name of this snake-weed, but without eliciting information. Most of the countries in which snakes abound would seem to rejoice in 'snake-weeds' and 'snake-roots.' 'It has pleased nature that there should be nothing without its antidote,' said Pliny; and though 'the faculty' tell us that no antidote for snake venom has as yet been discovered, it nevertheless appears to be certain that the

Arabs, the Nubians, Egyptians, and other nations seek to procure immunity from snake-bite by the use of certain plants, of which the *Aristolochias* seem to be most frequent. The juice or a decoction is drunk, the root chewed, and an infusion used for washing the skin. The South American Indians are said to be able thus to protect themselves; and we have the high authority of Humboldt in support of the theory that the famous *huaco*, and other poisonous plants with which they inoculate themselves, may impart an odour to their bodies which is repugnant to the snakes.

It would be well to obtain definite information as to what the 'snake-weed' of Schliemann was, *botanically*. It is also important to ascertain the species of 'viper' that is there so abundant; then there would be a basis for investigation. The testimony of a traveller like Schliemann is not to be disregarded. Besides him, Livingstone, P. H. Gosse, and others have affirmed the same thing, viz. the existence of antidotal plants, but which, in the hands of science, seem never to disclose their virtues!

As a part of the present subject comes a serpent's supposed love of 'music,' and on this head again the evidence is contradictory. Setting aside the idea of 'music,' in the way of melody or harmony, we may be able to arrive at a clue to the undeniable fact that snakes do exhibit some consciousness of *noise*. 'Music,' properly so called, is certainly very far removed from the gourd-rapping and tum-tumming of the Oriental jugglers; yet the snakes display a consciousness of these uncouth sounds. Mr. Mann affirmed that Cleo and his other pet boas manifested undoubted feeling—let us call it consciousness—when the piano was being played. Dr. Arthur Stradling, on the contrary, tells us that his own snakes 'are almost always within hearing of a piano, and never show the slightest emotion at the sound.'[1] His observations, I believe, refer chiefly to his life at sea, where his cabin did duty as concert-room, menagerie, and all else combined, and where, apart from piano, there would be ceaseless noise and jarring; or even if on shore, the 'always' would rather support my own theory or speculation as to any feasible solution of the fact that serpents are affected by *noise*, not 'music.' And my idea is, that it is the jarring or vibration *through solids*, and not the mere sound, that thus affects the snakes. Since first venturing to express this idea in the *Dublin University Magazine*, Jan. 1876, I have continued to observe the effect on snakes of what we may call *disturbing noises*. At the Gardens, where they become accustomed to noises of all kinds, it is less easy to arouse them; but when the place is unusually quiet, the experiment may be tried. The 'snake men' of the East, whose trade is to hunt out snakes by means of sound, effect this by *rapping* on the wall or ceiling, or by making loud, clucking noises with their tongue as much as by their so-called 'music;' and Pliny,—if we may cite Pliny to suit our purpose and discard him otherwise,—or whoever *he* quotes, affirms that snakes are more easily aroused by the *sound* of footsteps than by the sight of the approaching person. A custom is prevalent in Ceylon, we are told, of using a jingling stick in the dark to strike the ground in order to frighten snakes out of the path. The jingling 'music' here is disturbing, not alluring, but as

[1] *Land and Water*, April 3d, 1880.

regards the knocking it proves sensitiveness to vibration conveyed by the ground. The American Indians are *experts* in the way of ascertaining sounds as conveyed by the ground. They throw themselves prone upon the earth, pressing their ear close to it, and are able to decide with great accuracy the direction, the distance, and the nature of a far-off sound. May we not conclude, then, that the perception of sound to a serpent is through solids, a feeling more than a hearing of noises? The creature, always prone to the ground or other solids, and with an internal aural apparatus, must be peculiarly sensitive to vibrations thus conveyed.

'Lizzie,' the heroine of chap. xxvi., was proved to be sensitive to disturbing noises, and her ophidian relatives are probably similarly affected. As to *tune*, any sharp sound will answer; and as to time, it is not the 'music,' but, as we have already hinted, the waving hand or knee, or bright colours used by the *charmers*, to which the movements of the serpents respond. This also is a subject quite worth scientific investigation.

A word in conclusion about the 'fascination of the serpent's eye,' a fable of so remote a date that it is as hard as any to eradicate. Even scientific observers admit that there is a *something* that attracts the eyes of birds or small mammals such as squirrels, timid creatures which often stare fixedly at ourselves as much as at a snake. Dr. A. Smith says: 'Whatever may be said in ridicule of fascination, it is nevertheless true that birds and even quadrupeds are, under certain circumstances, unable to retire from the presence of their enemies, and what is even more extraordinary, unable to resist the propensity to advance from a situation of actual safety into one of danger.[1] He has seen birds collect round the African tree snakes, particularly the Boomslange (described p. 407), and fly to and fro, shrieking, until one of them almost touches its lips.' Exactly so. We are not *told* as much, but every one who knows anything of snake life will feel quite sure that those tree snakes were making good use of their delicate tongues in order to ascertain all they could about those enticing shriekers; and that the birds were equally desirous of knowing what dainty in the shape of worm or flitting creature that tongue might be. In the case of the rattlesnake the 'fascinated' birds are probably enticed by the insect they think they *hear*, as well as that they think they *see*, in the supposed worm wriggling so temptingly and vanishing so strangely. The snake remains rigidly still the while, the only moving thing being that investigating tongue.

My observations at the Zoological Gardens first led me to this conclusion. On the feeding days several years ago, when watching to detect the 'fascination' one had been led to expect, I noticed that the birds—even the sparrows and finches—were attracted by the tongue of the snake, and would stop when hopping about the cage and look intently and curiously on the vibrating tongue. Some would venture on a closer inspection, and remain gazing, or would even peck at it, until a movement of the snake told them that the motionless object from which that wriggling thing protruded was a living animal. Then they might hop away indifferently, happily unconscious that what they had perched on as a

[1] *Zoology of South Africa.*

branch or a log was animated with a hungering after themselves.

Any further 'spell,' or 'fascination,' or attraction might be attributed to a soporific or paralytic rather than a pleasurable influence; and arising from the noxious breath of a venomous serpent, or the fixity of its eyes, never blinking. Horses, dogs, and other animals have an intuitive perception of the vicinity of a snake, and refuse to advance; is it therefore reasonable to conclude that the lesser animals are not similarly affected? It is serpent nature to wait motionless for its prey. Any creature coming unexpectedly upon that rigid object, with its fixed, glittering eyes, would, actuated by mingled alarm and curiosity, stop to make itself acquainted with the extraordinary sight, the only life or motion in which would be the tongue suddenly and silently appearing and disappearing. A bird might be beguiled within striking distance, or might stop spell-bound. We ourselves are sometimes impelled to approach an unaccountable yet terrifying object. Fear has also a paralyzing effect, and we remain motionless, breathless, with eyes as fixed as a serpent's.

Observation of nature and an inquiry into causes will often present very commonplace reasons for what appears to savour of the marvellous. A snake has just made a meal of some fledgelings. The mother bird has witnessed her offspring vanishing by degrees, and she frantically hovers over the reptile, fluttering to and fro, and probably uttering cries of distress or of enticement, in the hope of her young ones' return. Birds have been observed thus endeavouring to rescue a half-swallowed fledgeling. The naturalist at once comprehends the reason; the poet thinks the birds are 'fascinated.'

I am not aware that any other ophiologist than Dr. Stradling, in discussing the 'fascination' idea, has attributed to the tongue of a snake an allurement in the shape of a prospective meal. In one of his papers to *Land and Water* (April 2, 1881) he described a hen that had been put into the cage for his anaconda's dinner, making 'a determined dab at the snake's tongue, sometimes two or three dabs in quick succession,' every time the quivering black line caught her eye. 'Now why does she do that?' he asks. 'Certainly from no animosity towards the snake, in whose presence she has not the slightest consciousness of danger, as she was otherwise engaged in pecking up the maize that was in the cage. My own idea is that she mistakes the tongue for a wriggling worm,' adds the observer in almost the very words I had used more than six years previously,[1] long before we had exchanged a word on the subject or were even acquainted. He further described in the same issue of *Land and Water*, and also in the *Field* (June 3, 1882), how a scarlet *tanager* in Costa Rica had been attracted out of a tree down close to a snake by its quivering tongue, the only moving thing about it. Dr. Stradling had seen a frog similarly snapping at the tongue of a snake, and thinks that one of the chief uses of the mysterious little organ is to attract insectivorous animals. My own observations prove the tongue to be a *successful* lure, which may go a good way towards explaining 'fascination;' but whether an *intentional*

[1] Papers on the Ophidians in the *Dublin University Magazine*, January 1876 et seq.

lure, any more than an intentional intimidation, as discussed in chap. v., I hesitate to affirm.

'Fascination,' then, may be sometimes imputed to curiosity, sometimes to an anticipated morsel. It may partake of fear, or it may be an involuntary approach; it may be the struggles of a poisoned creature unable to get away, or the maternal anxieties of a bird or small mammal whose offspring has fallen a victim to the snake. Divesting it of all poetry or magic, it will admit of several matter-of-fact, albeit sometimes tragic explanations.

CHAPTER XXIX.

THE VENOMS AND THEIR REMEDIES.

ON a subject which has baffled research in all ages, viz. the endeavour to discover an antidote for snake venom, it scarcely becomes me to speak. Yet, as in the foregoing chapters, I may at least venture to lay before my readers some general account of the various remedies used in snake regions, and, for the benefit of residents in those countries, describe the most approved means of treating the bites of venomous serpents. Information of this kind will not, I trust, be wholly useless.

First, it may be as well to impressively repeat what has been already constantly affirmed by all our scientific experimentalists on snake venoms, that 'as yet *no antidote to them has been found*.' Remedies there are in abundance; and it is just as great an error to believe that all snake venom is incurable—*i.e.* that a bitten person must necessarily die—as that there are countless 'antidotes,' as persons broadly and loosely call the various means of cure.

At the time when Professor Halford's treatment by subcutaneous injections of ammonia were so popularly discussed, you might read week after week of 'Halford's newly-discovered antidote for snake-bites.' Professor Halford, so far from claiming the discovery of an 'antidote,' emphatically explained that ammonia thus used was 'only a mode of treatment.' 'It must never be forgotten,' he said, 'that ammonia cannot *destroy* the venom;' by which we comprehend what the scientific mean by an 'antidote,' something that effectually *destroys*, *neutralizes*, *and annihilates* the poison. Sir Joseph Fayrer, after long and elaborate experiments with the Indian thanatophidia, prescribes various remedies and modes of treatment, 'but do not confuse these with *antidotes!*' he urges.[1] 'To conceive of an *antidote* to snake poison in the true sense of the term,' he explains, 'one must imagine a substance so subtle as to follow, overtake, and neutralize the venom in the blood, or that shall have the power of counteracting and neutralizing the deadly influence it has exerted on the vital forces. Such a substance has still to be found, and our present experience of the action of drugs does not lead to hopeful anticipation that we shall find it.'

Notwithstanding these confident assertions, we are continually reading of 'an infallible cure for snake-bite, never known to fail;' 'another antidote to snake-bite;' or that 'at length an antidote has been discovered,' which on investigation may be something tried long ago, and occasionally with success, or it may be a plant or a chemical preparation which under certain circumstances effects a cure, but none of which will stand the above definition of *antidote.* Each new attempt is announced as 'an antidote' nevertheless. Dr. Arthur Stradling was

[1] *Thanatophidia of India.*

severely hauled over the coals for 'boasting of an antidote, when it accidentally transpired that he had been experimenting on himself 'with a view to discovering, *not an antidote*, but a prophylactic against the venom,' to use his own words.[1]

More recently still permanganate of potash has been announced as an antidote; and no doubt in some cases it has proved a successful *remedy*, as occasionally, but not invariably, other treatments have been. There still, however, appears to be the same lack of substantial evidence with regard to its being an 'infallible antidote' in the chemical acceptation of the term; and indeed as venoms themselves vary, a remedy that might prove effectual in one case might fail in another. Dr. Stradling, than whom perhaps few are more competent to offer opinions on the subject (he having for five or six years subjected himself to experiments and carefully noted the effects on his own person, as others have noted the effects on animals and birds bitten), says that you might as well hunt through the pharmacopeia for a drug that will be a specific in every kind of fever, or 'to look for a general antidote to opium, strychnine, bella donna, arsenic, and mercury poisoning,' as to expect to find one antidote for every kind of snake venom. 'When we know how many different venoms there are, we may look for an antidote to each,' he has explained.

Years ago the venoms were classed under the heads of *Viperine*, *Echidnine*, *Crotaline*, etc.; but Dr. Stradling states that he has found very different venoms in *Crotalus horridus* and *Crotalus durissus*, and that he prepared himself differently for each species of snake with which he experimented,

[1] *Land and Water*, September 11, 1880.

having in five different species found five distinct and separate venoms. The bite of one snake more rapidly affects the blood, that of another the nerves; while the local and the constitutional symptoms also vary; but 'all are attended more or less with rigors, delirium, syncope, convulsions, paralysis, and coma.' Many of the so-called cures have not been cures at all, because, as was afterwards found, the snakes that inflicted the bites were not venomous. This we can understand from the indiscriminate use of such vernaculars as 'adder,' 'jararaca,' 'cobra,' as explained in previous chapters. Or, if undoubtedly a bite has been given by an undoubtedly venomous kind, it does not follow that a full charge of venom accompanied the bite. The glands may have been previously exhausted, the snake may have been feeble, or it might not have expended its poison. For among other marvels we are led to believe that vipers, perhaps also the *elapidæ*, have a control over their store of venom, and do not involuntarily expend it, that is, when *forced* to bite. 'Great doubt exists as to the efficacy of forced bites,' says Nicholson. Dr. Weir Mitchel came to the same conclusion in his rattlesnake experiments, viz. that a snake 'is able voluntarily to control the shedding of its poison when inflicting a wound or grasping an object with its jaws.' This accounts for many bites not having proved fatal, and for reputed antidotes having effected 'cures.' Nor, when we come to think of it, does this control of the venom appear so extraordinary after all. The poison gland is a modification of ordinary salivary glands; and, if we may have recourse to a not very elegant comparison, a person or an animal can simulate the *action* of biting or of spitting without ejecting saliva. Again, as Dr. Stradling expresses it, 'snake virus is a natural secretion provided for the distinct physiological purpose of enabling the reptile to secure its prey.'[1] Fayrer also explains that some snakes, naturally sluggish, 'bite reluctantly;' but, if irritated and made angry, then 'with great force and determination.' In the one instance a bitten person might recover, in the second case die, because here the snake 'thoroughly imbedded its fangs' (p. 379).

It is often asked, 'Which is the most poisonous snake?'—a question as difficult to answer as, 'Which is the most poisonous plant?' Dr. Günther's opinion is that the degree of danger depends less on the *species* which inflicts the wound, than on the bulk of the snake, the quantity of its venom, the season or temperature, and the place of the wound. Quantity for quantity, the virus of one snake is more active or more powerful than another, and different in its effects; but then the lesser discharge of poison directly into a vein might be more serious than a full discharge in a part where absorption is slow. Also exactly the same quantity, minim for minim, would more seriously affect a warm than a cold blooded animal, more seriously affect a feeble and timid person or animal than the brave and vigorous. Yet, as there is a notable gradation in the development of the poison apparatus, the perfection of which culminates in the viper, it seems not unreasonable to decide that as a rule a viper is more virulent than an elaps of the same size—let us say *bulk*, because the viperine snakes are short and thick and the *elapidæ* long and slight. Each snake is supplied with venom adequate to its own requirements, that is, enough to kill the

[1] *Nature*, July 6, 1882: 'Hydrophobia and Snake-Bite,' by Dr. A. Stradling.

prey on which it subsists, a large viper with a larger supply for a larger animal; and a small elaps with enough to kill its little bird or mouse. There may be exceptions; as, for instance, in the *Callophis intestinalis*, whose glands are abnormally developed, though it is not a large snake; still accidents or experiments rather go to prove that a viper is more noxious than an elaps under similar conditions. Fayrer proved the virulence of *Echis carinata*, the little Indian 18-inch viper's poison, by diluting a quarter of a drop of its venom in ten drops of water and injecting it into the leg of a fowl, which died in ten minutes; while the same proportions of cobra venom killed a fowl in thirty minutes. Nicholson affirms that the Russell's viper can eject as much poison in half a second as a cobra can in three seconds. But if the viper be in a torpid condition, it might eject little or none. A strong Daboia bit a feeble bull, which died; but two feeble Daboias bit a strong bull, which recovered. These latter vipers were moulting, and their functions were inactive—the bites feeble, perhaps. In fact, the conditions are so many and great, that after all it is hazardous to form any definite conclusion. Some notes of the effects on bitten animals, taken at the Zoological Gardens while the snakes were being fed, shall be faithfully recorded in the ensuing chapter.

With regard to the many drugs used in various countries for the cure of snake-bite, it is curious to note that, as a rule, they are procured from the most deadly plants. As 'like cures like,' so poison cures poison. Most of them are powerful stimulants, in which lies their chief virtue. Among them are *aristolochia*, *opium*, *ipecacuanha*, *senega-root*, *guaco* or *huaco*, *asclepias*, *liatris*, *euphorbia*, *polygala*, *ophiorrhiza*, etc.

A long list might be written. It is noteworthy, too, that the natives of the countries in which these plants are variously found, have strong faith in them, and indeed use them with more or less of success. The early writers on America entertained no sort of doubt as to the efficacy of the plants or preparations used by the Indians. Purchas, in 1626, after describing the '*Ibiracua*, which causeth by his biting the Bloud to issue thorow all Parts of the Bodie, Eyes, Mouth, Nose, Eares,' etc., says: 'But the Indians are acquainted with a certaine Herbe that will heal their Woundes.' Lawson, Berkeley, and Catesby tell us the Indians were never without a remedy, which they carried about with them, but the preparation of which differed in each tribe. Border Americans of the present day, also, are never at a loss when snake-bitten, though the most popular of modern remedies is whisky. (Not that this offers any exception to the rule, that poison kills poison; the comic philosophy being that whisky, as the stronger poison of the two, 'goes in for first innings, so to speak.')

Some of the poisonous antidotal plants in South America are used in the preparation of the celebrated *wourali* or *curare*, with which the Indians poison their arrows. Snake-venom and pounded fangs are also constituents of this, which is why the effect in the blood—as has been shown in experiments—is similar to that of snake-bite. Some of the tribes are said to acquire immunity from the most virulent snakes by swallowing the potent herbs of their region. Inoculation with deadly vegetable juices is another of their remedies; and Tschudi informs us that after this inoculation, snake-bites are harmless for some time, but that the process has to be repeated. Sullivan has not much faith in the process; nor has Dr. Stradling. But there is one undeniable fact connected with the poisonous snakes of most countries, viz. that death by them is comparatively rare; and only in India do we hear of thousands dying annually. Dr. Carpenter, Humboldt, and, I believe, other writers of equal weight, have suggested that the poisonous plants used by native tribes, both internally and externally, may impart to the person an odour which is repugnant to snakes; and if this be the case, how would it be to institute compulsory inoculation among the low-caste Hindoos, who are the chief sufferers in India? Or, could not a few pariah dogs there be inoculated with the juice of some of the native plants, such as the 'earth gall' of Malay (*Ophiorrhiza mungos*), as the Indians of the Orinoco protect themselves with the *Vejuco de huaco?* Should the process succeed with valueless animals, it might afterwards be attempted in human beings. Perhaps already it has been attempted, and it would be gratifying could I flatter myself that it was through my suggestions of several years ago. Or I may be only betraying my own ignorance of surgery and of the pharmacopeia in suggesting it at all.

There are many popular vegetable 'antidotes' of the log cabin and the rough border-clearings of America, but the 'faculty' form no high estimate of them. Dr. Weir Mitchel tested some twenty or thirty plants which owe their reputation to Indian traditions, but without success. 'In the hands of science they failed.' But then is there not always some delay before the patient can reach the hands of science? It is the prompt treatment, and having the remedies always ready, that may ensure success among the natives. Probably many a bitten person, if alone in the desert, dies, and there are none to record his death. Nevertheless we have good reason for believing that the natives do learn how to manage deadly snakes or to avoid them. In South Africa it is very rare to hear of a person dying of snake-bite ; and the natives go bare-footed there as much as in India. Some of the deadliest serpents also are found in Africa. In Australia, where there is a still larger majority of poisonous snakes (more than two-thirds of the whole number), and also bare-footed natives, deaths are comparatively infrequent. Krefft gives us a list which may be of interest to the residents there, viz. the proportions of the venomous to the harmless species of snakes :—

	Venomous.		Harmless.
New South Wales, . . .	21	out of	30
Victoria, ...	8	,,	12
South Australia, . . .	13	,,	15
West Australia, ...	11	,,	15
Queensland, ...	28	,,	42

Whereas in India, including Ceylon, the venomous families are five to the thirty-five innocuous ones. In India alone Günther describes twenty families of snakes, out of which four only are venomous. When, therefore, we read the annual statistics of India, and the enormous death-rate, which suggest resolutions towards the extermination of snakes, we may again hint that education must join hands with science in order to find remedies. Europeans are seldom bitten ; you might count the numbers on your fingers in as many years. Dr. Edward Nicholson has shown that while in twelve years (1860–1871 inclusive) only four British soldiers died from snake-bite, thirty-eight died from the bite of mad dogs; and he thinks it would be more beneficial to the community to kill off some of the hordes of these dangerous animals which infest the country during the summer months. Moreover, that '*in comparison with preventible diseases and a percentage of the entire population, snake-bites are sensational trifles.*' He thinks the savage crusade against snakes worse than useless, and argues that it would be better to seek remedies for diseases that harm more Europeans in a week than snakes do in a century. Others tell us that the number of deaths is greatly exaggerated, and that many by violence or through fatalism and barbarities are set down to snakes.

But to return to remedies, one would suppose that drugs or plants which kill venomous snakes would be also cures for their bites. It is an old belief that vipers contain in themselves an 'antidote' to their venom, and hence the number of popular medicines prepared from their bodies. Conversely, some of the deadly poisons of the pharmacopeia are death to snakes. *Aristolochia* produces powerful effects on the African vipers; the white ash (*Fraxinius Americanus*) is an equally rapid poison to the rattlesnake, as Prof. Silliman proved. It is said that these reptiles are never found in the vicinity of this tree. It was the white ash which Oliver Wendell Holmes introduced into his story of 'Elsie Venner,' as being destructive to *crotalus* life, and the novelist wrote from his experience of its effects. Similar cases have been recorded in the *Philosophical Transactions*. Pennyroyal, says Charas, was held to the nose of a viper, 'who by turning and wriggling laboured hard to avoid it; and in half an hour's time was killed by it. This was in July, at which season these creatures are computed to be in the greatest vigour of their poison' (1657).

Another drug which is poison to a venomous snake is *tobacco*, within the reach of most persons. This, among native remedies, has always been in favour, and we have heard of its efficacy ever since 'the weed' was known to Europeans. Various species of tobacco and its allies are indigenous to most tropical countries, and probably were in use for both man and snake-bites long before civilised nations took such comfort in smoking. In classic ages it was believed that human saliva was fatal to vipers, and it is even affirmed that the Hottentots often kill a puff adder by merely spitting upon it. One must infer from this that their saliva is saturated with some drug which they chew; and from classic authors we might discover that the practice of chewing tobacco, opium, or other drugs obnoxious to snakes, was in use from very early ages. Those classic authors who tell us that human saliva is fatal to snakes had not studied snake nature enough to assign a reason for this, though in all probability a reason did exist. 'Man carries more poison in his mouth than a snake,' said an old Virginian writer, alluding to *nicotine*. 'He can poison a rattlesnake more quickly than it can him.' Nicholson states that it also rapidly affects a cobra, and he recommends it, should you wish to destroy the snake uninjured: 'You have,' he says, 'but to blow into its mouth a drop or two of the oil from a dirty tobacco-pipe.'

Two young men chopping wood together in Virginia espied a rattlesnake. With a forked stick one of them held its head close to the ground, keeping its body constrained with his foot, while his comrade took from his own mouth a quid of tobacco, which he forced into that of the snake. The reptile was then released, and had not crawled a couple of yards before it was convulsed, swelling and dying within a short time. Leaves of tobacco as a plaister, or chopped tobacco as a poultice, are applied to a bite by the American backwoodsmen, after the custom of the Indians; or finely chopped tobacco, mixed with moist gunpowder and some pulverized sulphur, formed into a plaister, and laid on the wound, and then set fire to. Tschudi, in his *Travels in Peru*, p. 434, saw this remedy successfully applied by an Indian to his wife's bitten foot. A nausea-exciting drug was swallowed at the same time. With the copperhead snake (*Ancistrodon contortrix*) it is equally efficacious. These and rattlesnakes are said to be never found in tobacco fields.

Strychnine appears to have a similar effect to tobacco on snakes. Fayrer found cobras extremely susceptible to the influence of strychnine. An almost impalpable quantity caused a cobra to 'twist itself up in a rigid series of coils and die.'

A good many experiments have been tried by a subcutaneous injection of strychnine into dogs and other animals, immediately after being bitten, but without sufficient success to warrant the adoption of it as an infallible remedy. In some of the cases, indeed, the deaths from tetanus suggest the question, 'Did the cats and dogs die from venom, or from strychnine?' As virulent poisons are administered in virulent cases, how would it be to *swallow* strychnine in chemically-prepared doses?

Carbolic acid is another drug which produces powerful effects, causing the reptile to 'double itself up in numerous folds, remaining as stiff as if cast in metal.' Creosote, also, snakes hate, Fayrer tells us, and recommends that these two drugs may at least be of use in driving them away from dwellings, as many of them have an objectionably domestic disposition. A few drops of carbolic acid poured on the floor of their cages kill venomous snakes in a very short time. A large *Bungarus* died in ten minutes in this way.

Dr. Weir Mitchel approves of carbolic acid so far as to recommend every backwoodsman to supply himself with a little of it, which is easily portable and manageable in capillary tubes. In several of his experiments with *crotalus* venom, carbolic acid applied to the wound was attended with success. But it must be *done at once.* The whole secret of cures—when cures can be effected at all—lies in promptness. It is celerity on the part of the Indians which ensures their success. In an instant, if his comrade be bitten, the savage is on his knees, sucking the wound, grasping the limb firmly, or strapping it tightly above and below the bite, knowing quite well the importance of checking the circulation. He has his 'poison pills,' and tobacco in his pouch. He explodes gunpowder on the wound and loses not an instant. Nor does the victim lose heart. He submits with courage and confidence, and in these lie another element of success. Many cases are on record of persons being at death's door through fear alone, when bitten by a harmless snake, but recovering on being assured that there was no danger. And other cases are well known where bitten persons have died of fright and the depressing influences surrounding the accident, when they might possibly have recovered.

And assuredly the remedies are generally so severe as to be in themselves sufficiently terrifying. 'No time for reflection;' 'no mercy must be shown,' declares Sir Joseph Fayrer, in describing the incredible rapidity with which the venom inoculates the blood 'in a moment of time.' Where a deep wound has been inflicted by a highly venomous snake on a small animal, death has been known to occur in a few seconds, especially if the bite were on a large vein or an artery. Therefore if the bite be on a limb, to tie a ligature is the first thing to be done. A thong of leather, a tape, a string, a cord, a garment torn in shreds, anything that can be caught up, must at once be tied round the limb. Every instant of delay increases the danger. Incredible force must be used to tighten the ligature, which even with a tourniquet or a stick to twist the cord to the utmost is scarcely sufficient to completely stop the circulation in the fleshy part of a limb. So tight as to cut into the flesh is frequently necessary. In the case of a dog whose hind leg had been bitten, such amazing force was required, in one of Fayrer's experiments, that with the strength of a pair of hands it was almost impossible to tighten the ligature sufficiently to effect complete strangulation. In another of his experiments a chicken had a ligature tightened round its thigh 'with the greatest amount of tension that a man's hand could exert.' The poor chicken (already half dead with terror and pain, as one must conjecture) was then bitten below the ligature by a cobra, but in spite of the thorough strangulation of the limb, the fowl showed signs of poison in twenty-three minutes, and in three-quarters of an hour was dead. These two among other cases are cited to show that the mere tying of a tape or a pocket handkerchief round a bitten limb is of very little use, provided it is not drawn tight enough to almost cut into the flesh. Yet this is only the first step; for if assistants are at hand, let them tie a second or even a third such ligature above and below the bite when possible, while whoever is best able to operate must scarify the wound by cutting it across deeply, or by immediately cupping, letting it bleed freely; 'better still,' says Sir Joseph, 'cut it out deeply and quickly.' In the case of a finger or a toe, 'amputate instantly; for if once the venom is absorbed into the system, there is but the slenderest chance of life.' If the wound be in a fleshy part, force a red-hot iron to the very bottom of it, and burn it out to the depth of half an inch, or when excised fill it with gunpowder and explode that, or force a live coal into it, or burn it out with carbolic or nitric acid! Agonizing though the remedies be, they are inevitable, should the bite be inflicted by one of the larger and deadlier snakes in a part where absorption is rapid. 'Do not relax the ligament till the part be cold and livid,' adds Fayrer.

Nor, when we look at the effects of a bite, can we wonder at the severity of the remedies.

'Vomiting black fluid,' 'bleeding at every orifice of the body,' are among the horrible sufferings at the time; an injured constitution and hideous sores likely to break out afresh periodically in various parts, may be some of the after consequences should the patient recover.

As the effect of the bite is depressing, the system must be kept up with strong stimulants. Food is of little use, because the functions are too feeble to digest it. But great faith is placed in stimulants. Hence the popularity of ammonia, which is quickly diffusible. The venom exhausts the vital forces; therefore, excepting in the local surgical treatment, all the best remedies are volatile and alcoholic stimulants. Ammonia in the form of *eau de luce* has long been approved, both taken internally and rubbed into the wound. Professor Halford's plan of subcutaneously injecting it has been very successful in some cases of Australian snake-bites, and the popularity of this mode has been seen in the large number of hypodermic syringes purchased by persons in the bush. But the use of these requires surgical skill; and awkward attempts by the laity have produced wounds which have been prejudicial to the originator; for though it is said that some attempts of this kind were made by Fontana about one hundred years ago, Halford could not have been aware of that, since he claims to be the first who ventured to throw ammonia directly into the blood. 'Previously to my experiments in 1868,' he says, 'it had never been thought possible to throw ten or twenty minims of the strongest liquid ammonia directly into the veins without killing the man on the spot.'[1] He first tried it on animals, and finding it successful, at length ventured this 'mode of treatment' with human beings; since which other doctors in Australia have also practised it. Still he does not claim for it infallibility, though giving some cases in which the action of ammonia on the blood and on the heart's action produced rapid recovery in persons apparently dying.

Any technical explanation must not be attempted by me; but those who are interested in this subject will find Prof. Halford's own accounts in the *Medical Times* for 1873 and

[1] *Medical Times*, 1873, vol. ii. p. 90.

ensuing years, also in his paper 'On the Condition of the Blood from Snake-bite,' 1867.

In India similar kinds of experiments were not attended with success; leading to the conclusion that the Indian snakes were more deadly than those in Australia. Climate, latitude, season, and many other circumstances affect the virulence of snakes, as we may here repeat. The 'Brown' or 'Tiger snake' (*Hoplocephalus curtus*), the 'Black snake' (*Pseudechis porphyriacus*), *Hoplocephalus superbus*, and some other of the larger venomous kinds *within the tropics* are thought to be equal in virulence to the Indian ones of the same bulk in the same season. Many of them erect themselves and distend their necks like the *najas*.

And now for a few words about the most popular and perhaps most attainable of all remedies—alcohol! No wonder the backwoodsman resorts to this, which without any chopping off of fingers or toes, or personal pyrotechnics, or other local tortures, deadens his sensibilities, renders him unconscious of suffering, and sends him into a happy obliviousness of danger. It is not a refined mode of treatment, nor one that presents many opportunities of exhibiting professional skill; and it is no doubt somewhat derogatory to admit that to become dead drunk is an effective victory against snake venom! Other old and inelegant remedies we hear of as practised by the Bushmen of South Africa, and savage tribes elsewhere, but revolting in the hands of refined practitioners. Deference to science and loyalty to the profession demand some more elaborate means. Yet the efficacy of whisky or brandy is admitted by all, and the pioneer who has not a doctor within miles of him has his demijohn of whisky at hand.

During a sojourn in Iowa some years ago, when wild and uncleared lands formed the 'streets' of the town in which I was staying—Lyons on the Mississippi river, and as lovely a spot as artists and botanists can wish to revel in—it was by no means an infrequent occurrence to hear of rattlesnake bites. 'What was done to the man?' 'Is he alive?' were questions naturally asked.

'He drank a quart of raw whisky, and got dead drunk.'

Generally a quart had the desired effect—that is, of causing intoxication. Persons unused to intoxicants might be affected by a less quantity, but so violent is the combat between venom and whisky that a large dose must be swallowed before any effects at all are produced. In the southern and hotter States it was similarly used. Indeed, a planter himself told me that Sambo would sometimes prick his hand or foot with a thorn, and crying out 'Rattlesnake!' fall into well-assumed agonies, in his preference for a spirituous somniferousness to cotton-picking. But when the fraud was detected and less enticing remedies were adopted, rattlesnake or copperhead bites became less frequent. I heard of a man in Nevada, George Terhune, a teamster (I give his name, having every reason to believe the truth of the story), who was bitten in the hand by a rattlesnake while stooping to reach some water out of a spring. The man was alone and far away from human habitations. It was an instinctive and momentary business to first kill the snake; then rushing to his waggon, he drew the bung from a keg of whisky and took a large draught of the contents. After swallowing as much as he could, he took some tobacco from his pocket, saturated that with whisky, and applied this poultice to his hand. He then proceeded with his team, drinking whisky at intervals until he reached a dwelling, when he removed the poultice and found that the wound had turned green. Applying another of the same kind, he resumed his journey and his potent doses, reaching his destination next day 'as sober as a judge,' having imbibed enough 'fire-water' to intoxicate a dozen men with no *crotalus* venom in their veins. The quantity sometimes swallowed under such circumstances is utterly incredible.

Professor Halford describes a case of snake-bite near Melbourne, in which two bottles of brandy were drunk without any symptoms of intoxication; and another of a girl of fourteen, who, when bitten by an Australian snake, drank three bottles without being intoxicated! She recovered. 'Alcohol has powerful attractions for oxygen,' writes Professor Halford, on the theory that the venom has produced foreign cells in the blood, 'so that if alcohol engage the oxygen absorbed by the poison, the cells perish and recovery ensues.' Others among the ablest experimentalists similarly recognise the efficacy of alcohol. Dr. Shortt of Madras says: 'Bring the patient under the influence of intoxication as speedily as possible. Make him drunk, and keep him drunk, until the virus is overcome.' Dr. Weir Mitchel found that delicate women and young children under the influence of snake poison could take 'quarts of brandy without injury, and almost without effect.' One man brought to him—a man of temperate habits—took one quart of brandy and half a pint of whisky, which 'only slightly intoxicated him for about four hours.' Another man bitten in the throat was cured at the end of twenty-four hours, during which time he had had two quarts of whisky in one night, and renewed as the pulse fell, besides red pepper and other stimulants.[1]

In South Africa, too, the alcoholic remedies seem to be successfully adopted, so far as we may judge by occasional reports of them which find their way into print. In the *Field* of January 14th, 1882, a Mr. Walter Nightingale records that a boy of fifteen, bitten by a puff adder, drank two bottles of brandy before it had any effect; and a little girl two years old, bitten in the hand by a 'horned viper' (which might have been a *Lophophrys* or *Vipera nasicornis*), had administered to her brandy and milk in occasional doses without any visible effects, until a whole bottle of brandy had been thus swallowed! The child recovered; and the force of the argument seemed to rest on the astounding quantity of strong spirit that could be taken to overcome the venom without producing intoxication. Under ordinary circumstances, a wine-glassful of brandy would have made either of those children tipsy, yet the infant of two years did not reel under a whole bottleful, and the boy of fifteen under two bottles full—a quantity that would have killed many outright.

Yet whisky is not an 'antidote' chemically, any more than is ammonia, or tobacco, or artificial respiration, which latter has been tried with success by Drs. Vincent Richards and Lauder Bruton. So rapidly destructive to every vital function is snake venom, that anything that will keep life going until the poison is eliminated is desirable; and what would themselves be poisons in other cases here act only as

[1] *Smithsonian Contributions.* Washington, D.C., 1860.

counterfoils. 'A septic of astounding virulence,' Weir Mitchel has proved *crotalus* venom to be; and the scientific experimentalists on the Oriental thanatophidia confirm his words as regard the *najas* and vipers of their own regions. A subtle, malignant, mysterious fluid, to which all animal life succumbs. Even vegetables are affected by it, as Mitchel proved. Inoculated with it, they looked dead next day as if scathed by lightning. So those old writers on Virginian serpents might not have been so far wrong after all, so far as the injurious effect of venom on a young tree; only they made a slight mistake in supposing that the 'thorny tail' inflicted the mischief (p. 174).

It is not within the compass of this work to attempt to describe in detail the many remedies which from time to time have enjoyed a short-lived popularity; such as 'snake stones,' the 'Tangore pill,' and other preparations. Conventions have within the last twenty years been held in India, in Australia, in America, and London; and Commissioners from among our most distinguished M.D.'s have been appointed to investigate all the reputed 'antidotes' and popular remedies that could be got together. The names of Dr. Ewart, Dr. Lauder Bruton, and Dr. Vincent Richards of the Indian Medical Department, as associated with artificial respiration, must be familiar to many. Dr. Shortt, of Madras, claims originality in the use of potash, *liq. potassæ*, which both by the mouth and by injection has been attended with success. He has recorded several cures by *liq. pot.*, 'not as miraculous, but as rational.' He affirms that it has the property of neutralizing the venom, and that brandy expedites it by carrying it rapidly through the system. Potash or soda plentifully applied to the wound is a popular remedy also among the border pioneers of America, who, on the theory that venom is of an acid nature, make frequent use of alkalis. The child of a gentleman whom I knew in Virginia was bitten on the foot by a rattlesnake ; his whole body quickly exhibited the symptoms of the poison. But the father was so confident of the success of his own domestic treatment that he did not even send for a doctor. '*Salcratus*' (used in cookery) was bound upon the bitten spot, and the child was dosed with apple brandy until stupefied. Next day he was well.

From all the 'recoveries' above quoted, it may be said that the bites could not have been very deep, or that the snakes could not have been very virulent ; and in the many hundreds of experiments tried in India and elsewhere, the doctors have arrived at similar conclusions. *A full charge of venom injected directly into the veins, should no remedy be attempted, is almost certain to be fatal.* Within half an hour a man might die from a vigorous *crotalus*, *fer de lance*, or large *claps*.

It is important to impress this on the reader, lest from the cures above cited, I appear to argue that snake-bite is not so serious an affair after all. Notwithstanding that the South American Indians, in the midst of the most deadly of the *Crotalidæ*, do fly confidently to their *guaco* and their traditional remedies, they know so well when there is no chance of recovery that they attempt no cures whatever. Travellers tell us they lay themselves down to die when bitten by certain snakes ; probably they know that, from the position of the bite, or the accidental lack of essential remedies, there is no hope for them. They are said to resign hope when bitten by the little Peruvian viper (*Echis ocellata*), in the very heart of the tropics, and as deadly as the little *echis* of India. In every case the symptoms point to the exhaustion of the nerve centres, and the rapid decomposition of the blood.

The venom appears to be an indestructible fluid. Toxically it remains unaltered whether boiled or frozen, or mixed with the strongest corrosives. Diluted in water, alcohol, or blood, it is still equally injurious. The blood of an animal killed by a bite, if injected into the veins of another animal, kills that one also; and the blood of the second one killed is similarly fatal to a third, and the third to the fourth, and so on through a series of animals. Also so small a quantity is fatal where no remedies are attempted, that a venomous serpent can kill six or eight animals one after another; each one, bitten in succession, succumbing more slowly, it is true, but still dying at last. Fayrer found that no less than nine creatures could thus be affected by one cobra. A dog, a pigeon, and seven fowls were bitten one after the other: the dog, first bitten and receiving the largest injection of venom, died in thirty-three minutes; a fowl, next bitten, in three minutes; the third, in ten minutes; the fourth bitten, in eleven; the fifth, in seventeen minutes; but the ninth bitten, a fowl, when the poison gland was exhausted, recovered after a time. And the same effect is seen in much larger animals than fowls. Fayrer also tells of four men bitten in succession by one cobra, only the last one bitten receiving treatment, and recovering slowly after many days. The facts prove the fatal confidence placed in snake-charmers, if further proofs be needed. The four men, on payment of money, were to be taught the 'spells,' *müntras*, etc., and, as they hoped, to be endowed with curative powers. The professional 'snake men' bullied them into playing with a cobra and irritating it, with the promise that no harm should follow, even if they were bitten, which one of them very soon was, falling senseless immediately, and dying within an hour. Not warned by the utter failure of 'charms' to restore their comrade, the other three permitted themselves to be bitten. The strongest charge of venom having been expended in the first bite, the man next bitten did not fail so rapidly, the third still more slowly, but both died the next day. When the fourth was bitten, the police were informed of what was going on, and they carried him off to the hospital, and the charmers to prison. Thus is the death-rate swelled.

Though the venom may be swallowed with impunity by a thoroughly healthy person, there is always danger of its being absorbed through the delicate membranes of the throat and stomach. In cases of sore throat, injured gums or lips, or internal maladies, the risk would be great, of course. Animals killed by the venom are constantly eaten, Fayrer states; and that the hungry natives eagerly carried off the fowls upon which he had experimented. Since those celebrated experiments at Florence by the 'Florentine Philosopher,' Redi, and those other 'Knowing Physicians' above two hundred years ago, the venom has been swallowed by many. The great point of discussion then was to ascertain the source of the 'Mischiefs;' whether they arose in the gall or the 'Juyce of the Bag at the root of the Master Teeth;' and Redi tasted both the Gall and the 'Spittle from the Bag' in order to test this great question, and found 'the Gall sharp and the Spittle flat.' As the learned physicians of the nineteenth century have been again trying effects, so did those 'Knowing Physicians' work out similar problems in 1670, no doubt suggesting many things that have subsequently been solved and perfected. One Francini was hard to convince that only a tooth and not a demoniacal spirit inflicted the injury; whereupon, to convince that unbeliever, they thrust a thorn and a pin into the breast of a fowl, which betrayed no ill effects; but a splinter of wood covered with 'Spittle from the Bag' killed a pigeon as quickly as the 'Master Tooth.' They showed, also, that a dissevered head was able to bite, and its 'Biting is as dangerous as when the Viper is entire.' They proved other things, too numerous to recount; and particularly, that venom was not injurious in a healthy stomach, the question from which we have strayed to Florence.

Lately we have been led to think that it is something more than harmless. Through the researches of Professors Selmi, Lacerda, Gautier, and others, we learn that from the powerful peptic properties of the venom it may become a valuable medicine. I think I am correct in stating that a Dr. C. Hering of Philadelphia, when practising in British Guiana some forty years ago, introduced the venom of our celebrated Curucucu (*Lachesis mutus*) into medicine; and that since then, serpent venoms have held an important place in the Homœopathic Pharmacopeia. Already we have hinted at the digestive properties of venom to the serpents themselves, that neither masticate nor take exercise otherwise to promote digestion; and there are those among us who, not lacking energy so much as time, and whose busy brains permit them but little leisure for either exercise or the unhurried meal, may be glad by and by to resort to a poison pill to cure the 'dyspepsia' they thus bring upon themselves. Our American cousins will hail with joy such a discovery. Perhaps even now they are anticipating a prize medal at the next Great International Exhibition, for a newly-invented 'Extract of Bushmaster' as the infallible remedy. *American Bothropine.*—'One drop of this extract in a wine-glassful of water taken immediately after dinner ensures that meal being swallowed in three minutes with impunity.' Would not this deserve a gold medal in these days when one man tries to do the work of three?

Drs. Lacerda and Netto of Brazil have proved that crotaline venom acts as a solvent on hard-boiled egg and other albuminous substances,—that it can, as it were, digest living tissues; and Dr. Stradling thinks that this solvent or disintegrating power will in some measure account for the intense local severity of a venomous snake-bite, 'so disproportionately wide-spread to the tiny punctures made by the needle-like tooth.'

The excision of the fang does not check the function of the poison gland any more than the extraction of a tooth will check the salivary secretions in a human mouth, because (as was described in the chapter on 'Dentition') there are other fangs coming forward and requiring similar supplies.

One great value in experimental snake-bites by subcutaneous injection is knowing which specific venom, or how much of it, produces certain effects. But there is this to be said with regard to the creatures operated upon, that the restraint, terror, and pain necessarily inflicted before the venom is injected, must do a great deal towards rendering that victim predisposed to succumb under ever so small a dose; and in some cases 6, 8, or 10 drops of venom have been injected. If terror and timidity act so strongly on a nervous human subject, they must act similarly on such feeble, frightened creatures as fowls, rabbits, and guinea-pigs, that are held, strapped down, and tortured by ligaments and lancets.

Human beings may take courage in reflecting that in some of the experiments under which animals have died, *in spite of immediate remedies*, a far larger dose of venom has been injected than could possibly pass through the fang in one normal bite. The virulence of the venom in ever so minute a quantity has been proved sadly enough; yet the possibility and hope of recovery are also evident.

'As prevention is better than cure,' those who run risk in the tropics can guard against bites by wearing thick coverings to their feet and ankles in the way of gaiters, leather boots; and denser materials for clothing, in preference to those which the finely-pointed fangs can easily penetrate. The cloth or leather may then receive the principal charge of venom. Silk as a lining is good, and has the advantage of coolness. Anything rather than bare feet. Then supplies of ammonia, tobacco, carbolic acid, and strong tape are easily portable, and plenty of good whisky, if the bearer can courageously *keep it for emergencies.*

The mongoose of classic reputation must have a passing mention; though it is now pretty well understood that this little animal owes its safety to its own bravery and adroitness, more than to any supposititious herb to which it flies. Not but what instinct may induce it to eat of the plants nature provides to animals as to men, and as a cat eats grass when nature dictates a necessity for physic. The mongoose has been known to die of snake-bite like other bitten animals, though it certainly succumbs more slowly than many. Vitality is stronger in some animals than in others. A rat is hard to kill; and a cat will resist the poison as long as a dog of three times its size. Then if mongooses feed on venomous snakes, they may enjoy in themselves a sort of protective or prophylactic security. Their long fur is also protective, leaving but few vulnerable points; and their strong vitality enables them to escape and probably overcome the bite if slight, or to hide away and die unseen.

The question of immunity from bites suggests yet one other point on which some uncertainty exists, viz. Do snakes die of their own bites? Dr. E. Nicholson only shall be quoted here, because I shall be able to introduce some cases from personal observation in the ensuing chapter, concluding this with just one foreign example which may be relied upon. 'According to my experience,' says Nicholson, 'the poison of venomous snakes affects not only harmless ones, but also venomous snakes of other genera.' My own opinion is that they can kill not only other snakes, but even themselves if the charge of venom be strong enough. What has occasionally been seen in print of 'snakes committing suicide,' is, I think, only from an instinct in the serpent to strike at what injured it *where* injured. It feels a sudden pain and turns to avenge the injury, striking itself on the spot where the pain directs. A case was recorded in a paper of a cobra having been struck by a bullet, and instantly twisting round to bite itself on the spot, and presently dying; and this was called 'snake suicide.' It died in part perhaps from the bullet, and partly from its own venom, which injected in anger would be powerful. Several similar cases have come to my notice, where snakes have thus attacked themselves when the instinct has been evidently to strike the *cause of pain.*

In vol. xxii. of *Nature*, p. 40, the case recorded by Mr. S. H. Wintle from Tasmania will, I think, bear this explanation. He pinned a 'black snake' (probably *Pseudechis porphyriacus*) to the ground with a forked stick by the middle of the body; instantly coiling round the stick, the angry snake turned and buried its fangs in itself, making the part wet with viscid slime. Hardly had it done this than the coils relaxed; a perceptible quiver ran through its body; in a few moments more it lay extended and motionless, open mouthed and gasping, and in three minutes was dead. Mr. Wintle examined the snake after death, and found the body 'bloodless,' as though the poison had destroyed the colouring matter. He tried the blood on a mouse, which died in five minutes; and on a lizard, which died in fourteen minutes.

If the saliva of an angrily-excited human being or a dog be more injurious at one time than another, how much more so that of a venomous serpent. The flow would be greater, the character more noxious. It seems therefore a mere question of power or virulence, the greater over the less. In some cases one serpent might kill another, in other cases not.

CHAPTER XXX.

NOTES FROM THE ZOOLOGICAL GARDENS.

ARRANGING the following examples, not so much in chronological sequence as in elucidation of special facts, I will first give some cases of venomous serpents killing themselves and each other. My notes began in 1872, after the interest so strongly awakened in Cheyne Walk, Chelsea, when those tame snakes were fed to gratify our curiosity (see Introduction).

Holland was then the keeper at the Reptile House of the London Zoological Society's Gardens, and had occupied this place upwards of twenty years, gathering much experience and knowledge of reptilian habits. Incidents known to him, when not witnessed by myself, may therefore be received as trustworthy.

On Sunday, July 20th, 1873, a 'River Jack' (*Vipera rhinoceros*), from West Africa, really did kill itself, though the act can scarcely be called intentional 'suicide.' It was from dashing its head against its cage either in anger or pain. Holland was of opinion that it had been severely bitten by one of the others of the same kind in the cage at the time; for he had known snakes to die from bites in this way, sometimes from their own bites. On one occasion three Puff adders (*Vipera arietans*) all died through quarrelling and biting each other. One of the three survived ten days, the others dying sooner.

One day in April 1873 or 1874, on going to the Gardens, I was informed that a water viper (*Cenchris piscivorus*) had been found in the tank in its cage, presenting a very unusual appearance, and enormously swelled. On going his rounds that morning, the keeper observed it, and touching it with his iron rod, he discovered that it was quite dead. He said these vipers frequently quarrel, biting each other and causing this great inflation of the body, as if blown out by wind. The vitality of this species is very strong. From such bites the inflation is sometimes only temporary, and they recover, but not always. One of them lived a long while with a broken back. It was endeavouring to escape by the sliding door, which was raised while the keeper was making some arrangements. The movements of the reptile were so swift that Holland was obliged to suddenly drop the slide; and though he succeeded in partly pushing back the snake, it got caught and was jammed under it, completely dislocating its spine. But it did not appear to suffer very much, he said, and entirely recovered from the injury.

Some 'viperine snakes' (named from their aspect, but not really venomous) not only bit each other, but killed and swallowed each other.

Several cases of cobras injuring each other and themselves are on record at the Gardens. On one occasion a cobra got loose, and, as may be supposed, created considerable terror. While being caught, it turned and bit itself, burying its fangs in its own flesh. I could not learn exactly the spot where it wounded itself; but it was no doubt where the hooked rod, or the snake tongs, had been offendingly applied.

A couple of cobras were presented by Sir Joseph Fayrer. One of them bit the other repeatedly, and in so many places that it was 'torn to pieces,' in the language of the keeper. 'The body was all over sores.' Notwithstanding this, it was several weeks dying. This painful spectacle did not fall under my own observation, happily, but there is no reason to doubt the occurrence.

Next to the rattlesnakes few are more nervously timid than cobras; only, while the former displays fear by a shrinking retreat, a cobra is aggressive, inasmuch as it raises itself with a threatening aspect and distended hood. It is on account of their extreme timidity that the cobras' cages are screened with painted glass at the lower part, or the reptiles, in aiming at offending spectators, would be continually dashing their heads against the front, to their own detriment. In this manner snakes wound themselves very seriously, producing various mouth diseases.

Before writing another word of what, as a student, I have witnessed at the Gardens, I must here affirm that any distressful occurrences are not related to gratify a morbid curiosity in those who read only to be amused, but to enable other students to acquire a better insight into ophidian habits and physiology, and as a duty which I have set myself to accomplish—a duty which has cost much moral courage to carry out, and which demands, as I now discover, an equal amount of moral courage to commit to writing. A good deal is painful, if not revolting; therefore I would commend the perusal of this chapter only to those who, as naturalists, wish to be informed on these subjects.

'Lip fungus,' gum boils, canker, and abscesses are among the mouth diseases to which snakes in confinement are subject, and for these, very delicate surgical operations have sometimes to be performed,—'very delicate' often, by reason of the dangerous character of the patient, and in consideration for the operator as much as for the sufferer. The keepers have sometimes to lance the gums, sometimes to wash the sores! One very venomous patient was so covered with sores that the keeper's only resource was to throw the lotion all over the reptile.

'Why not let the odious serpent die, or kill it at once?' some will exclaim. Well, in the first place, many snakes cost large sums of money to purchase; secondly, humanity as well as economy demands that their sufferings should be allayed wherever possible. And in return, they frequently reward such care by recovering and entertaining the visitors, climbing with renewed vigour about their cages.

On the other hand, so tenacious of life are some snakes, that they might survive as disgusting objects a long while—not in a state to be exhibited at all, but only to be an additional care and trouble to those whose duty it is to attend to them. One very astonishing instance of tenacity of life must be introduced. It was in a rattlesnake which would not feed, and must have greatly suffered in some way, whether physically or from nervous terror cannot be determined; but the reptile struck its head so repeatedly against the side of its cage, that, in the keeper's words, 'it completely smashed it.' At last it died, its head one mass of putrid sores; and in that state it had sustained life for many months. It had eaten nothing for ten months.

It must be owing to the excessive and nervous timidity of snakes, that some of them reject food for so long a time during the first months of their captivity. I think for even more than two years snakes have been known to fast, and to recover their appetite afterwards. So strong a disinclination for food do cobras show, when first brought that it is of no use whatever to put mice into their cages. Now and then, if no one is near them, they will partake of a mouse or a sparrow, but never until they become somewhat reconciled to their surroundings.

Almost equally alarmed and irreconciled was the Hamadryad, which is closely allied to the cobras. When first brought to the Gardens in the spring of 1875, he did little else than suspiciously watch for some weeks. With his head elevated in front of the glass, and his hood expanded, he made a dash whenever any one approached or stopped to look at him, and ate nothing for many days. Within a year these fears gradually subsided, and he became so tame as to watch for the keeper instead of for supposed enemies, raising himself to the roof of his cage, and remaining close to the little trap-door at the top, awaiting the snake which, as he had already learned, made its appearance through there for dinner. Much caution is requisite in feeding him; for though he does not now display spite or anger, once let his head find egress through that little trap-door when raised, he, one of the most venomous snakes in existence, would be through in a moment, creating a stampede indeed among the visitors, to say nothing of danger both to them and to himself. He well recognised a change of guardianship when poor Holland was compelled from ill-health to resign his place; and not even yet, in spite of the kindest treatment, will he trust his present keeper as he trusted Holland. During the interregnum and frequent change of attendants, his nerves were tried in a manner that he has been slow to recover.

The Hamadryad's appointed diet is one ring snake per week; but 'Ophi,' as we now call him, is occasionally required—and with no sacrifice of his principles either—to eat an extra snake to satisfy the curiosity of some distinguished visitor. Sometimes, too, colubers are plentiful, and two small ones are not too much for his ten or twelve feet of appetite. This splendid serpent has rewarded care by remaining in perfect health, and growing several feet. He was between eight and nine feet long when he came, and is now not far short of twelve, and proportionately larger in circumference. Sometimes during winter, when ring snakes are scarce, 'Ophio' is compelled to fast; for, as related p. 62, he is not to be tempted with other food. During the first year of his residence in the Gardens, the supply was good, and he ate no less than eighty-two fellow-creatures before the winter was well over. Towards spring, however, the supply ran short, and only two more remained for him. He had now fasted two entire weeks, and looked hungry and eager. The keeper offered him a guinea-pig, at which he took great offence, spreading his hood and hissing angrily for a long while. Eggs he declined, also a lizard and a rat, in great disgust. In India the Ophiophagi are said to feed on lizards and fish occasionally, but *our* Ophiophagus preferred to fast. At last one of the two ring snakes was produced, and Ophio was to be regaled. It was the 31st of March 1876, and he had been a denizen of the Gardens just one year. My note-book informs me that it was a lovely, soft spring day, and that Ophio was quite lively. He had rejected frogs on his own account, but in the uncertainty of more ring snakes arriving, he was now decoyed into eating half a dozen. Holland contrived that the snake destined for his dinner should answer the purpose of a feast, and had allowed it to eat as many frogs as it chose. Like the poor wretch who, doomed to the gallows, is permitted to fare sumptuously the last morning of his life, the ring snake ate three frogs, by which the Ophiophagus was to derive chief benefit; he, all unconscious of the cause of his victim's unusual plumpness, swallowing him speedily.

Soon after this Ophio doffed his winter coat entire, and having again fasted for ten days, was at once rewarded by the last remaining ring snake in a similarly plethoric condition, namely, with three more frogs inside him. Now and then during the winter months the scarcity of ring snakes has compelled the sacrifice of some far rarer colubers to Ophio's cannibal tastes. And yet each year we hear of hundreds of ring snakes being ruthlessly killed in country districts, while at great cost and trouble others are purchased or brought from the Continent for the Hamadryad's sustenance. Lord Lilford, one of the Ophidarium's best patrons, sometimes sends presents of game in the shape of ring snakes to the Hamadryad.

While watching this snake-eater over his dinner, one is struck with the remarkable tenacity of life exhibited in the victim, or the slow action of the venom if poisoned in the first grasp. The Ophiophagus seizes it anywhere, that is, at whichever part happens to come first, and then, after holding it quietly for a time, works his jaws up to the head in the usual hand-over-hand, or 'jaw-after-jaw' fashion, invariably swallowing the snake head first. On one occasion when I watched attentively, Ophio, having seized a ring snake by the middle, held it doggedly still for one quarter of an hour, while the lesser snake did its very best to work its way out of the jaws, and also to fetter his captor by twirling itself over his head and coiling round his neck. This continued while Ophio, with his head and neck raised, remained motionless, and after the quarter of an hour commenced to work his jaws up towards the head of the ring snake, which, as more and more of its own body was free for action, twirled itself about, and at length coiled its tail round the bit of branch nailed into the cage.

Persistently, like a sailor making his vessel fast to the windlass, the ring snake lashed as much of himself as was free round the branch a foot off, and so pulled and pulled till he looked in danger of severing himself in two. Meanwhile Ophio, slowly but surely advancing, caused its head and neck to disappear, grasping tightly with his venomous jaws, as if he would say, 'We'll see who is master.' It was a close tussle, so firmly did the little coluber retain his hold on the 'tree;' but as the upper part of him was gradually drawn into those unrelaxing jaws, he by degrees gave way, and by and by was gone.

Not far short of an hour was occupied in this meal, during which the victim showed no signs of being poisoned, nor were his coils round the stump relaxed in the slightest degree, till Ophio reached the tail. The ring snake is not a constrictor, yet he thus tied himself round the tree by the coils of his tail.

One more singular case of tenacity of life must be recorded. A ring snake had been caught in the usual way, and the usual struggle ensued between captor and captive. Coluber, with its head tightly gripped in the jaws of his enemy, had still all the rest of himself at liberty and in full activity, and after wriggling a violent protest, he coiled what was left of himself so closely round the neck of his persecutor that the latter made little or no progress with his dinner for a time. He seemed to be deliberating how to proceed next, and asking, 'What is the meaning of this?' then shook his head, lowered it to the shingle, and tried to rub off the coils. The only result thus achieved was that the extreme end of coluber's tail was loosened for a moment, but only to coil afresh round Ophio's jaws, which nevertheless slowly and surely advanced.

For nearly an hour the progress was very slow; but when the ring snake was all swallowed except a few inches of tail, these became so tight a muzzle that Ophio in turn was the victim. Shaking his head and vainly endeavouring to free his jaws of this muzzle, a minute or two elapsed, during which he seemed to suffer some discomfort, when suddenly his mouth opened widely, and out crawled Natrix, apparently none the worse for this temporary entombment. He had turned round when two or three feet from daylight, and come back to see the world once more. But it so happened that Ophio closed his jaws in time over the few inches of tail which still remained between them. Nor did he once relax his grasp of this, but quickly and patiently began to work his way up to the head and recommence his meal, and this time with better success. An hour and a quarter I watched, nor was any evidence of poison seen, so as to reduce the powers of the bitten snake; for bitten it must have been in those prolonged and forcible grasps.

In these conflicts one could but observe a dogged stupidity on the part of the venomous snake, who, had he but brought coils to his aid, might have simplified matters so easily. The little Heterodons and even the Lacertines often assist themselves with coils in managing their prey, though not themselves constrictors; but the venomous ones have not the slightest notion of helping themselves in this way, as if confident that in time their venom would do its work. In self-protection, however, we have seen that a rattlesnake can coil, p. 394.

This Ophiophagus has caused to vanish, on an average, not far short of a hundred snakes per annum since his arrival in England, say seven hundred in all. In his native haunts, actively moving and climbing amidst plenty of other snakes, one might multiply the consumption by at least three, and give to the Hamadryads the credit of assisting Government in exterminating snakes to the extent of 300 each per annum. These snakes, therefore, should be much prized by the Government snake-exterminators, and in reward for services rendered, have their own lives spared. They are not very common, nor very obtrusive; and we do not hear of so many deaths laid to their charge as to cobras and Bungari. So long as you do not molest their nests or their young, they get out of your way; but for all that, they might be turned to very good account as snake consumers.

So might some in Australia and in South America, and elsewhere; for although this especial Hamadryad usurps the name of 'Snake-eater,' there are Ophiophagi in many parts of the world. They are chiefly *Elapidæ*. Probably on account of the small head and slender form of these snakes, a fellow-creature is more convenient to swallow than an animal all joints and elbows, and fur-covered. Many snakes are also involuntarily or rather unintentionally cannibals, as in the case of the Tropidonoti, when two seize the same frog, or the python swallowing Geoptyas (p. 38). In such cases the swallower does not first seize his comrade with the intention of devouring him; but both having hold on a meal which neither chooses to relinquish, it is a mere question of which one first reaches the jaws of the other, and which pair of jaws happens to be most widely extended. A case is recorded in *Nature*, March 8th, 1877, of a Mr. L. Heiligbrodt in Texas capturing an unusually thick 'Water moccasin' (*Ancistrodon pugnax*), and on opening it finding a large 'Copperhead' (*Ancistrodon contortrix*), recently swallowed.

This was 'the only case on record,' for it is very unusual for the *Crotalidæ* to eat each other; and very probably, in this instance, the cause was a mutual meal. 'Moccasins' (*Tropidonoti*) at the Gardens sometimes have such a hard grip on each other as to fetch blood. I once saw two of these rearing themselves high in their scuffle for the unhappy frog of which both had equal hold. The keeper was obliged to administer corporeal reproof, which caused one of them to let go, when the other swallowed the frog almost at one gulp, as you might swallow an oyster. Nor do they invariably turn the frog round to swallow it head first. This is done if the frog is likely to escape. These so-called 'moccasins' are of a very pugnacious disposition. One of them once startled me by dashing at me through the glass, with such violence that I thought the glass would have been broken. I was doing nothing whatever to alarm it, and I knew the snakes quite well. But in that angry mood its aspect seemed so changed, that I asked the keeper if that were a new snake and a venomous one, which it certainly resembled at the moment. I may here mention that Professor Brown Goode (who presided over the 'American Science Convention on Snakes') once caught a *Tropidonotus fasciatus* in Florida, which was so like the 'dreaded moccasin' (*Ancistrodon piscivorus*), that not until he had examined the mouth and found it was harmless could he identify it. These *Tropidonoti* have been known to take raw meat occasionally; so has the Xenodon, and so has a rattlesnake at the Gardens. Indeed, of one of these the keeper said, 'It will eat any dead thing;' and he found it convenient sometimes to give it a rat or a guinea-pig which a neighbouring snake had killed by poisoning, but not eaten. The Crotalus in such cases imbibed some foreign venom with his dinner. One Crotalus at the Gardens would eat only rats, others prefer guinea-pigs.

'Look at that rat!' exclaimed a lady to her friend, when the keeper gave the rattlesnake a good-sized guinea-pig.

'I think it must be a rabbit; it is too big for a rat,' returned the friend.

Before they could decide this zoological question, it lay dead. The rattlesnake struck it and left it. It gave one gasp, fell over, and in half a minute was dead. Another day a guinea-pig was six minutes dying, but on this occasion the rattlesnake had expended some of its venom in angrily striking the iron rod with which the keeper was moving something in the cage. When the guinea-pig seemed to be dead, the Crotalus, after eyeing and smelling it all over, that is, investigating it with its tongue as if to be assured, was about to take it, when the little animal had one slight spasm more, and the snake darted back its head and rapidly retreated. Watching them as I have done for years, I am still undecided whether excessive timidity or their low order of intelligence is paramount in the rattlesnakes. They are so slow and sluggish of movement, that those accustomed to them hold them in tolerable contempt. I have seen Holland watch his opportunity, open the cage, and put his hand in to snatch away a guinea-pig to give to another snake if the Crotalus did not want it.

'They always coil before striking,' is often said. They certainly take time to think about an attack and to make ready by having plenty of coils—slack rope, as it were—at their command, in order to reach their aim, the 'always coiling' not truly meaning that they wind themselves round and round as a sailor coils a rope, with their head in the middle. The 'coiling' has been thus described by persons with 'unscientific imaginations;' but having its head in the centre of such a coil, the snake would *not* easily reach its object. Often the coils are like those of 'Totsey' when taking her choice of a bird, having loose folds near the head, which is always *forward* in readiness for the attack.

Excellent opportunities of observing the relative venoms present themselves in zoological collections—not only the degrees of poison seen in the different serpents, but the effects produced by one serpent at different times. Of those species when in full vigour there is no doubt but that the South American rattlesnake (*Crotalus horridus*) is one of the most virulent. Sometimes this species will strike at a young rabbit or a guinea-pig, and death is almost instantaneous. One such instance was observed when a rattlesnake struck a guinea-pig on the head, the little animal falling as if shot, and in such a flash of time that Holland examined it to ascertain the cause, and 'its brains had turned quite green directly.'

'A new rattlesnake' was introduced in the autumn of 1873. Not new to science, but this, I regret to find, is all that my notebook records in heading some observations made September 26th of that year, 'a very warm day' for the season. A guinea-pig was put into the cage, when the snake (I *think* it was *Crotalus durissus*) approached its head closely and stealthily till quite near to the little animal, shrinking back at the slightest movement on the part of the guinea-pig, which sat staring and blinking in a corner. Each time the snake recoiled, even at a blink, it kept its eyes fixed in alarm on the piggy, who stupidly returned the gaze, not knowing what to make of the snake or of the people so close to him. By and by the snake, regaining courage, again ventured nearer, and again when nearly close started back at a slight movement of the guinea-pig. Three times a similar approach was made before the snake ventured to strike, betraying its extreme caution and timidity. As soon as struck, the guinea-pig was convulsed, and falling on its side was dead in three minutes.

Rats do not succumb to the poison nearly so quickly as rabbits, guinea-pigs, and birds.

Another guinea-pig struck by a rattlesnake immediately fell over on its side, and died, panting hard, in *about* three minutes. One could not discern the precise moment of its last gasp; but in this case there were no convulsive jerkings of the limbs.

The rattlesnakes always strike and then recede quickly, keeping a stealthy watch over their prey until it is perfectly still, often much longer. Puff adders and some others of the African vipers, on the contrary, retain their hold after biting. Cobras sometimes strike and retain their hold, and sometimes let the prey go and wait for it to die. On a small creature the effect of Puff-adder venom is instantaneous; and a remarkable difference is observable between the effect on a timid victim and on a rat. One of these adders ate a sparrow alive August 20, 1874, that is, struck and held it, swallowing it so quickly that it had not time to die. A sparrow is, however, a very small prey for so large a serpent. Another Puff adder, about to cast its coat, bit a guinea-pig, which was rapidly convulsed, as with spasms, accompanied by sharp jerkings of the limbs for nearly five minutes, when it became motionless. In this case the charge of venom might be feeble. In September of that year a Puff adder (I think the same as the last named) bit a rat, which at first ran about trying to escape, going close to the viper, as if unconscious of an enemy, and apparently unharmed during the first minute. Then it became aware of pain, and began to lash its tail, whisking it round and round in a frantic manner. Then one of its hind legs kicked out, probably the bitten limb, jerking violently for a time, and the rat lay helpless thus for about two minutes. In four minutes from the bite it gasped, and continued to gasp harder and harder for nearly three minutes more. It then bled at the mouth. The Puff adder then bit it again, when, after two or three more minutes, it leaped violently in convulsions from the effect of the second bite. The convulsions became gradually less; but fully twenty minutes elapsed, in spite of a double charge of venom, before the rat was dead. In all similar cases I noticed that rats were very tenacious of life. A guinea-pig has been killed in five seconds from the bite of a Puff adder.

On the same day, a 'nose-horned viper' (*Vipera nasicornis*) struck a rabbit, which immediately ran and started spasmodically, panting as if astonished and wondering what had hurt him. Then he leaped into the well at the back of the cage, but in that short moment was too feeble to crawl back again. He attempted to run, but sank quickly. Being out of sight, it was impossible to state the exact moment in which it died, but the whole was in less than two minutes. These vipers are no doubt intensely virulent. Another day one of them with a bad swelled face from abscess bit a guinea-pig, which in thirty seconds fell over on its side. It squeaked convulsively the moment it was bitten, and several times afterwards. It lay motionless for half a minute, appearing to be dead, but gave one slight start afterwards, and was perfectly still before three minutes expired.

In stating these periods of time decisively, it is by the watch. When I did not keep my watch in hand, I do not state the time so positively.

Between those larger African vipers, when all are in full vigour, there would appear to be not much difference in power of bite. A 'River Jack' (*Vipera rhinoceros*) struck a guinea-pig, holding it in his mouth till dead, which was in less than two minutes. Poor little piggy struggled convulsively the first few moments as if in pain; then only gasped as if labouring to breathe, but soon was insensible.

The poison of *Cenchris piscivorus*, though a much slighter snake, seems as potent as that of the rattlesnake. One of these struck a guinea-pig—the action being so swift that some of us who were attentively observing were not sure that the animal had been bitten at all, except from the instantaneous effects, the guinea-pig leaping frantically and dashing itself about for a few seconds; then it sank gasping heavily, and kicking convulsively, until in a few minutes life was extinct. Some of the creatures live ten minutes, others not ten seconds. I was glad to observe that in most cases insensibility rapidly overcame them. And without exception, it was observable that of the two—the snake or the destined food—the first named was by far the most alarmed, or 'charmed.' In the actions of the little creatures thrown into the cages, there was a fearless, unsuspicious freedom, when once they had recovered the surprise of finding themselves suddenly there instead of in a dark box. Rabbits hop about and over the snakes, and then sit up and clean themselves. Birds plume themselves and look about to see what they can pick up, perching upon the snake as if it were a log of wood. Rats run hither and thither to find something to eat, and then wash *their* faces. Many of the little animals run over the snakes, quite unconscious of their being live enemies, or force their noses under them, to the evident alarm and discomfort of the Ophidian, should he be disinclined to move. Sometimes, if faint and languid, and huddled together in a corner, it is because they—the victims—are oppressed with the closeness of the cage and the vitiated air, but quite apart from any 'spell' or magnetic influence. They may stare at the serpent that is staring at them, and as they stare in alarm at the people, but they have never seen a python, a puff adder, or a rattlesnake before in their lives, and have not the slightest idea that they are going to be eaten by one. And for this reason you so often see the startled and surprised look the moment of being struck. Thus far they have been unconscious of danger; and when a shock does come, it is incomprehensible, because instinct does not guide them under the circumstances.

On account of the excessive timidity of cobras, it is seldom that they can be observed when feeding, which is frequently in the night, or 'when no one is looking,' to repeat the keeper's words; but the little Indian viper (*Echis carinata*) should not be omitted in these notes, because there is difference of opinion regarding its virulence. Being one of the smallest vipers, only from sixteen to eighteen inches in length, one would argue extraordinary power from effects seen. A friend who had resided in India expressed great astonishment on hearing it said that a cobra was supposed to be more deadly than this one, known as the 'carpet viper' or the 'whip snake,' which, he said, could kill a man in a half-hour, and that he had seen men thus die. 'If a cobra bite you, you have at least four or five hours to live,' he said; 'but half an hour for the whip snake, and you are a dead man.' The individual brought to the Gardens in 1875 died the day after it gave birth to three young ones. While alive it ate nothing, and, as it was then thought, because it had not its natural food, Dr. Günther having discovered nothing but *scolopendræ* in the specimens which he had examined. Now it would be interesting to discover whether, as Aristotle affirmed, the bites of all venomous animals are more pernicious if they have devoured each other, or if snakes have devoured scorpions, and whether the toxic powers of the little Echis are aggravated by the venomous food it evidently prefers at home. 'In India is a certain little serpent for the bite of which alone the natives have no remedy,' said Aristotle; and one can scarcely err in deciding this to be the Echis, being not only the smallest venomous snake there, but the only viper, except Russell's viper, a much larger snake.

Only twice could I observe the toxic effects of the *Echis carinata* at present (1882) in the collection; both cases being in hot weather. It has so far conformed to circumstances in England, as to consent to dine on small white mice, failing scorpions. In the first case it struck the mouse savagely as soon as it was dropped into the cage, and the mouse died in less than two minutes. Echis approached it stealthily and timidly, but having at last got courage to seize it, ate it very quickly; and as the snake moved and dragged it, the mouse appeared to be quite stiff in that short time. On the second occasion, it bit a mouse on the leg, and it was five minutes dying. At first only the leg was paralyzed; then a spasm followed, and the mouse fell over and lay extended flat and still as if dead; but presently a spasmodic convulsion followed. It again appeared to be dead, and the little viper approached; but on a very slight spasm receded swiftly, not once taking its eyes off the mouse, which was dying slowly. The viper was at least five minutes swallowing this, and as if it did not much care about it. One must argue, therefore, that the charge of venom had been scantily expended, as the difference between this and the previous victim was remarkable. Echis poison has been seen to take instantaneous effect. The small *Vipera atropos* from the South African mountains is also astoundingly virulent. One in the collection in 1881 struck a mouse as soon as it arrived, and death occurred in fifty seconds by the watch. A large store of poison must have accumulated during its journey and since its previous meal.

One more African snake must be mentioned before I conclude the painful duty of describing the inevitable—though happily short—sufferings inflicted by venomous serpents.

Three young *Najas*, the well-known *Ring Halsschlange* of South Africa, were brought in the spring of, I think, 1877. They were very black and very shy, and for a long while one could see nothing more of them than three little heads in a row peeping out from under their blanket, and watching with their large round black eyes, but vanishing like a shot at your approach. 'They cut away the moment you go near them,' said the keeper. When they did give us an opportunity of looking at them, we found that one was quite black, and another was speckled with white; they erected their heads and distended their necks defiantly. Their eyes had a white rim round them, and were bright and undeniably beautiful, even though belonging to a venomous snake. Whether because they were young and inexperienced, or naturally stupid, I could not decide; but of all the snakes none ever went so awkwardly to work in feeding, or put their victims to such unnecessary torture, as did these ridiculous little *Najas*. The feeding observations were made in August, when they had grown considerably, and had become accustomed to their home. They seemed to bite the prey anywhere without much effect, sometimes retaining it in their mouth, and at other times beginning at once to eat it. One frog was ten minutes from the time it was struck until it was swallowed, and for no reason beyond the feeder's awkwardness. The little snake began at a hind leg, and not being able to get the frog into its mouth, put it down and began again at the side, but with no better result, the legs being in the way. Then he gave it up and let the frog go, and presently his comrade struck the half-dead thing and took five minutes to eat it. One might decide from this that frogs were not their natural food; but with very young sparrows the same mismanagement was observable. The bird was awkwardly bitten on the tip of the wing, and the snake held it helplessly for a quarter of an hour while the bird was struggling violently. Not getting good hold, the snake put it down and began again, so that the poor little sparrow was twenty minutes in being swallowed, gasping to the last, and evidently only very feebly poisoned. One of the Najas bit his companion, and held on for about ten minutes, and for no reason whatever that one could discern. In no other venomous snakes have I seen such prolonged suffering caused by such stupidity or bungling as in those young African 'Ring Hals.' Their fangs are, however, exceedingly short, as I found on examining a dead one, and this may account for the slow effect of them.

Three other heads were often seen in a row peeping out, but belonging to harmless 'glass snakes,' and there was intelligence in their looks; for they recognised the keeper, and advanced to the glass whenever he passed, asking for their dinner as plainly as little snakes could ask. A *Heterodon* exhibited equal intelligence when it was dinner-time, and sprang at the glass when he saw the keeper coming. Some of the pythons display intelligence too, on feeding days, but of quite an epicure form. One day in May 1876, on remarking that the pythons were disinclined to eat, Holland said 'they were waiting for young ducks,' only elderly birds being in their cage at the time. Even in summer they don't eat the old ducks so eagerly, because the large, hard quills annoy them. A bunch of these quills passes undigested. Hair or feathers in a desiccated mass pass through the snakes, and occasionally, when they are not in health, digestible but undigested substances too, also the beaks of the ducks.

Vegetable substances have been found in snakes, from which it has been argued that they sometimes eat vegetables. But it rather argues that they don't digest vegetables, which have probably been swallowed in the stomach of a rabbit or some other herbivorous animal that they have caught.

An indifference to food was noticeable in the snakes in ungenial weather. One cold, raw, foggy day in October 1873, a python caught a duck and partially coiled it, but so feebly that the bird, after passively submitting for a time, at last disengaged her feet and walked away to shake herself, and then turn and stare as if to discover what possibly had kept her there.

A similar disinclination to exert themselves was seen that same chilly day in the largest cage, where were three large pythons. One of them having killed a duck, could not get a satisfactory hold of its head, and let go repeatedly. Another held a duck, but not to crush it or hurt it; for it, like the one above named, only gazed deliberately around, and as if asking the meaning of its detention. A third duck was put into the den for the third python, who, however, only lazily stared at it and made no attempt to seize it; while the bird gazed in astonishment at the one in the embrace of the other snake, as if to inquire, 'What are you doing there?' Presently this duck also got away, and was again caught and only partially coiled. The python seemed too large and fat to constrict so small a thing as a duck. It was like tying up a pill-box with a rope. Some of the spectators expressed satisfaction that the duck was not more tightly coiled, and hoped it would succeed in getting away (the duck was not worth two shillings, the python could not be bought for twenty pounds), and were far more horrified when a vigorous constrictor caught and killed its prey in one flash, as when an extended watch-spring flies back to its original position. But a half-constricted creature does suffer, and happily this does not often occur, the chilly weather that day diminishing ophidian energy considerably. A gentleman, disappointed because they did not eat, and wishing to assign some reason for such unaccountable abstinence, remarked to his friend, 'I have an idea they sting themselves.'

Watching these gigantic ophidians on one of those half-wintry days, it happened that two of them were lazily gliding, partially hidden by their blanket, and with neither heads nor tails visible, so that the two bodies seemed as only one snake. Two youths stood watching and vainly endeavouring to calculate the numbers of feet or of yards which were entwined and entwisted in those moving coils. Portions and loops of two other pythons in the same cage were visible beyond the rug, but only one head of all the four snakes was to be seen; and to distinguish to which of the gliding, shining curves that head belonged, was impossible. 'It seems to me that snake's such a length that he doesn't know the other part belongs to him,' remarked one boy to his friend.

'I don't think he knows where it is,' returned the other boy sympathetically.

Not a little are the keepers sometimes tried in replying to the inquiries of visitors desirous of improving their minds. Let me repeat one or two conversations overheard on those Fridays.

'Is that duck put in there for the snake to eat?' asked a respectably dressed man of the keeper on one of those autumnal days, when a duck sat pluming itself as if settling itself for the evening.

'Yes, sir,' replied the keeper.

'Will he swallow it whole?'

'Yes, sir.'

'Choke him! I should think?'

'No, sir; no—it won't choke him.'

The man studied the duck, and studied the size of the python's head and throat for some time. The duck apparently going to rest, but not quite reconciled at so many persons intruding upon her, the man looked disappointed, and again began:

'Now is that duck charmed, sitting there?'

'I should think, sir, she was not at all charmed with the prospect,' sedately replied Holland.

'Does that duck *know* it's going to be eaten?' then inquired the man after fresh scrutiny.

'No, sir,' returned the keeper with the utmost gravity.

'That snake don't seem to be hungry,' then said the disappointed observer.

'No, sir. He'll eat well enough next Friday. He's going to change his skin.'

'Oh!' said the man to a boy by his side, satisfied, though still rather puzzled, 'that snake's going to change his skin next Friday.'

Though there are always on an average fifty snakes in the Reptile House, and on an average each casts its coat three times a year, the visitors are for the most part much mystified about this phenomenon. A snake that had just completed a new toilet had a portion of the old slough still adhering to its tail, when a boy drew attention to it, saying, 'Papa, that snake is all ragged and torn on its tail.'

'Yes, my dear, it is casting its tail.' Papa must have been reading Aristotle, who wrote: 'Tails, also, of serpents and lizards when cut off are reproduced.' With regard to the reproduction of their eyes, Aristotle spake more cautiously. 'It is reported that the eyes of serpents, if dug out, will be reproduced.' But, on the contrary, the eyes of snakes are easily injured, and *not* easily healed; snakes are therefore frequently seen partially blind. As need scarcely be said, only lizards 'reproduce' a tail that has been accidentally abridged; and the repair is after all only a boneless one. The truncated member gradually heals, and by and by a short point is again formed, but can always be recognised as a repaired, and not the original, tail; and as far as I have been able to observe, viz. for three or four months, no bone was reproduced. Probably also a snake's tail might heal in the same way, and to a casual observer appear quite perfect; but the anatomical structure in either case would not, I imagine, be restored.

That boy was not far wrong when he said he thought the python did not know which was its own tail. At all events, it is not endowed with much external sensation, as one might judge by the way in which the rats and guinea-pigs take liberties with it. This must be owing to the thickness of the cuticle, because, as we have seen in the constricting snakes, there is keen muscular sensibility in the tail. I may cite an instance of each case. One day a young rabbit caught hold of a small python with its teeth and held firmly on. The reptile was moving across the cage, and did not appear to feel any hindrance. Indeed, being much the stronger of the two, the persistent bunny was compelled to hop along at the same pace, still holding on by its teeth. But presently, from the position of the snake, the rabbit was obliged to let go, when it next caught hold of the tip of the python's tail, and again holding tight, hopped after the retreating reptile as if enjoying the joke. In this case I do not think the snake was conscious of the insult, as perhaps the rabbit had hold of the skin only.

On the other occasion a guinea-pig was biting a coiled and passive constrictor, *Python sebæ.* The snake wished to be quiet, but piggy got among its coils and worried it, hopping over it and biting its tail. The python on this, moving only the end of its tail, pushed away the guinea-pig, which soon returned to the attack. The snake again gave the little animal a caudal hint that his fidgeting was annoying; but as the guinea-pig did not take the hint, and still nibbled and teased the snake, the latter with two coils of the tail put an end to the annoyance, not once turning its head, but just tucking up its persecutor in the end of its tail as you might tuck up a parcel under your arm. The python was not hungry, and took no more notice of the offender, though thus effectually punishing the offence with the last two feet of its practical tail. Could we suppose such a quality as muscular intelligence, we might think the tails of those constricting snakes were surely endowed with it. As in other instances already described in chaps. xi. and xii., the eyes took no part in directing the movements of the snake; the whole nine or ten feet of the animal remaining passively coiled, while only the extremity of the tail exerted itself. When reptiles are in a partially torpid condition, their sensations are slow; when hibernating, they are reduced to a minimum. At such times, the creatures being half dead, they may be maimed or injured without any apparent effect. Rats have been known to attack and nibble snakes under these circumstances, and even to eat bits out of them, the snakes being at the time unconscious of injury, though possibly dying from the after effects.

A good deal of very interesting matter might be added on the economics of the reptilian *ménage*, the mode of ventilating and warming it, the cost of its larder, and the best means of preserving the health of the inmates. There are, besides, some incidental experiences not devoid of sensationalism in connection with snake guardianship, but my own herpetological experience does not extend beyond the keeping of pet lizards, including blind-worms. I may add a word, however, in reply to some often-heard lamentations of disappointed spectators who object to the coverlets, after sometimes waiting in vain to see the snakes emerge from beneath them.

'Those horrid blankets! Why not give the snakes moss or hay in their cages? or turf and sand and dead leaves? Much more natural for them than those woollen rugs.'

I, too, may have echoed such plaints until a better comprehension of ophidian nature showed the wisdom of what is certainly a somewhat disappointing arrangement. And those who have honoured these pages with a patient perusal, and discovered the nervous timidity and sensitiveness of these reptiles, their proneness to reject or to disgorge their food, to injure themselves or each other when molested, not to mention the danger of meddling with the venomous kinds and the easy escape of the swifter snakes, will admit the importance of providing them with such retreat and shelter as can be most speedily arranged, and which will secure the least annoyance to the terrified serpents while the keepers are doing their best to preserve order and cleanliness.

The allusion to lizards tempts me to add a word or two on the exceptional species which has lately become an inmate of our Zoological Gardens. There are certain features in it so much in common with viperine snakes, that I may be pardoned for dragging a lizard into these pages. I allude to the Heloderm (*Heloderma horridum*) from Mexico, presented to the Zoological Society in July 1882 by Sir John Lubbock. Its advent was an event in reptilian annals; and being surrounded by a halo of curiosity, it claims a passing notice. We have been at some pains to exonerate saurians from the evil character which our ancestors were apt to give them; but suddenly —and to the surprise of even some herpetological authorities—there comes a lizard that with one grip of his jaws caused a frog to fall dead in a moment, and a guinea-pig in three minutes, the symptoms appearing to be the same as those produced by deadly snakes. The Heloderm is 'said' to be furnished with poison glands in both jaws! But until a dead specimen has been further examined and described, the signification of 'poison gland' must be restricted. Its teeth—many and strong—are grooved with a deep furrow; its salivary glands are largely developed; and under excitement a thick, acrid secretion flows abundantly from its jaws. Yet so far as present observations enable us to form an opinion, the reptile does not use these formidable teeth to secure its prey, or even in feeding. It did not devour the victims of its bite, nor has it since killed any creature for the express purpose of eating it. Up to the date at which I write (Oct. 1882), eggs have formed its chief diet, varied by an occasional dead mouse. Now it certainly does not require deeply-grooved teeth and venomous saliva to bite raw eggs and dead mice. Nor does the noxious secretion flow continuously from its gums in repose, but abundantly so when irritated.

Though a stranger in England, this lizard was known more than two hundred years ago. Hernandez, in his *Nova Animalium Mexicanum*, published at Rome in 1651, described its bite as 'hurtful, but not deadly;' and that it was 'more dreadful in appearance than reality.' Its Mexican name, *Acaltetepon*, is (or was then) applied to all large and suspicious-looking lizards. *Scorpione* is its modern name. As *Heloderma horridum* was awarded plenty of space in the journals at the time of its arrival, full accounts of it will be found elsewhere; it is introduced here merely as one of the venomous reptiles that form the chief subjects of this chapter, and to trace its analogy with them. In its slow, stealthy movements there is the same striking contrast between the Heloderm and most other lizards, that there is between the deadly vipers and the active colubrine snakes; and the inquiry suggests itself, Can the venom elaborated in their system so act upon themselves as to produce this habitual lethargy? Drowsiness and coma are almost invariable effects of snake venom in the blood, and why is it that the deadly serpents are so constitutionally different from others?

The Heloderm has a round, heavy tail, of no service to it in swimming, and short, weak fingers, ill suited to climbing; and it passes its lethargic existence on the sandy plains of Mexico, manifesting in its actions, or rather in its inactivity and stealthiness, a conscious timidity and cowardice. Motionless for hours, with an impulse to retreat if molested, but attempting to bite if angered, its noxious saliva would seem to be rather protective than aggressive. It may have formidable enemies at home; and by all we see of it here, it does not use its teeth as a means of obtaining food. In this respect, therefore, it is an exception to deadly serpents, and cannot take its venom into its stomach as they do. And, again, the remarkable development of its tongue suggests a peculiarity of food. In lapping the egg, the action of it is apparently perfected by practice; the tongue is twisted, extended, twined under, then over, now used as a shovel, a scoop, or a broom, as occasion requires. It is the very reverse of what I noticed in some other lizards feebly lapping up an egg (see p. 71), for in a most expeditious manner does Heloderm cause its raw eggs to disappear.

A word *à propos* of its name *horridum*, supposed by many to refer to its objectionable qualities. Unfortunately the word 'horrid' has almost entirely lost its original signification and become mere slang in English. But when Wiegmann assigned it the name of *Heloderma horridum* in 1829, 'horrid' was understood according to its original meaning, from *horridus*, rough, rugged, etc.; and as this reptile has a remarkable skin, dotted over with little prominences, like knobs or warts (hence its generic name, *Heloderma*, warty skin), there can be but little doubt as to the intention of *horridum.* In a communication to *Knowledge* (Sept. 29), I ventured to call this the 'Warty-skinned Lizard,' in consequence of the confused accounts of it which have appeared in print. There are several other warty-skinned or 'tuberculous lizards.' The specific *horridus*, as applied to the South American Crotalus, also signified its terrible or dreadful character, and not the 'horrid' which spectators apply indiscriminately to snakes and their blankets.

With the rapid advance of ophiology comes the splendid new home for snakes which will shortly grace our Zoological Gardens; and in taking leave of my readers, I cannot offer them a kinder wish than that their visits there to *observe* the snakes will be productive to them of as much pleasure as has been mine to describe them.

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LIST OF ABBREVIATIONS.

Am., American ; Ass., Association ; Br., British ; co., cobra ; Con., Convention ; cons., constrictor ; cro., crotalus ; cy., cyclopædia ; C.M.Z.S., Corresponding Member of the Zoological Society ; F.Z., Fellow of the Zoological Society ; hist., history ; nat., natural ; N.Y., New York ; py., python ; Soc., Society ; s., snake ; ss., snakes ; ser., serpent ; v., viper ; vs., vipers ; U.S., United States ; z., zoological ; Z.G., Zoological Gardens ; Trans., Transactions ; Proc., Proceedings.

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