THE
LAND-MARKS
OF
SNAKE-POISON LITERATURE

BY
VINCENT RICHARDS, F.R.C.S. &c.

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OF

SNAKE-POISON LITERATURE

BEING

A REVIEW

OF THE MORE IMPORTANT RESEARCHES

INTO THE

NATURE OF SNAKE-POISONS.

BY

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To

DR. S. WEIR MITCHELL,

PHYSICIAN AND PHYSIOLOGIST,

POET AND NOVELIST,

AND THE PIONEER OF MODERN INVESTIGATIONS

INTO THE NATURE OF SNAKE-POISONS;

THIS LITTLE WORK IS RESPECTFULLY DEDICATED

BY THE AUTHOR.

PREFACE.

THE main objects of the publication of this sketch, which in part originally appeared in separate papers, are to assist future investigators in discovering what has already been done to throw light upon the difficult subject of which it treats, so that their time may not be wasted in useless investigations; and to prevent an unnecessary and reckless sacrifice of animal life. Experiments performed upon the lower animals, either in ignorance of what has already been accomplished, or out of mere scientific curiosity, are alike inexcusable. But, unfortunately, owing to the want of some such little work as this, investigators have sometimes unconsciously travelled over the same ground, only to prove that which had already been placed beyond doubt. An old friend once remarked to the author that he thought the conduct of these researches was a useless expenditure of time and labour, for, said he, "*Contra vim mortis non herbulâ crescit in hortis.*" But if we are to interpret this old saw as meaning that all scientific enquiries directed towards the prevention of death are worth-

less, and to accept it in principle, then we must either admit the truth of the tenets of the "peculiar people," or abandon ourselves to the ignorant superstitions or impostures of self-constituted "faith-healers,"—neither of which consequences, he is assured, would commend itself either to an intelligent and enlightened people, or to the learned friend of

THE AUTHOR.

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CHAPTER I.

Snakes most commonly met with in India—Distinguishing features of poisonous snakes—The Horn-Snake—Rattle of the Rattlesnake—Habits of snakes—How to feed them—Fascination, a myth—Wonderful snake stories—Propagation—Peculiar odour of snakes—Two-headed snakes—The bite, a very complex act—Causes of an ineffectual bite—Collection of Venom—Snake-wallah's superstition about killing—Training and charming of snakes—Manipulation of snakes—Supposed love for Music—The Holy-men of the Soonderbunds—The Panseurs of St. Lucia—The fer de lance—Indian Snake-charmers—Snakes used for criminal purposes.

AS a prelude to the more critical portions of my theme, some observations upon snakes and their habits may be interesting and instructive. Much of what I have to say is, of course, not

original, but rather a *rèchauffage* of the materials which practical acquaintance with the subject has enabled me to gather, collate, and estimate the value of. We learn from the pages of Sir Joseph Fayrer's magnificent work, "The Thanatophia of India," that of the twenty-one families of Indian Ophidia, only four are venomous, namely, the Elapidæ and Hydrophidæ(sea-snakes) constituting the colubrine sub-order; and the Veperidæ and Crotalidæ (pit-vipers) forming the viperine sub-order. Of the colubrine snakes, the Cobra, Ophiophagus or Hamadryad, Krait (Bungarus Cœruleus), and the Bungarus Fasciatus; and of the viperine snakes, the Daboia Russelli are the most commonly met with, and the most
Cobra. destructive of human life.* The Cobra is found all over Hindustan, and is too well known to need description. The different species vary considerably in their markings on the hood, and

* In the course of an analysis of the snake-bite returns received from Bengal, Behar, Orissa, Assam, and Cachar, in 1873-74, I found that the *cobra* was credited with having caused the injury in 1660 cases, the *krait* in 166, the *daboia* in 205, and unknown and innocent snakes in 2129 cases.

in their colour. I have had in my possession specimens of all kinds—from a dead-black to a yellowish-white, and even salmon colour. Nearly all cobras have a single or double ocellus upon the hood; the former, marked, are termed by the natives *Keuntiah* and the latter *Gokurah*. The *Gokurah* is the snake usually selected by snake-charmers for their *tamashas*, because its movements are slower and more under control than those of the *Keuntiah*. The latter is fond of water, and its habitat is the jungle or paddy-fields; the former is not particularly partial to water, and it is to be found usually amongst old buildings or heaps of rubbish. I have never seen a cobra exceeding six feet in length, though I have had hundreds in my possession. The Ophiophagus, Hamadryad, or *Sunkerchor* of the natives, is the largest of all Indian venomous snakes, is hooded like the cobra, and lives in damp jungly places. This snake also is a favorite with the snake-charmers, because of the facility with which it is handled, and its formidable appearance. It grows the length of fourteen feet or more, is very powerful, and is said to be aggressive. It is certainly more aggressive than any other snake with which I am acquainted, but Dr. Wall and

Ophiophagus.

I found little more difficulty in manipulating a large fresh specimen, than in handling a fresh *Keuntiah Cobra*. Indeed, the latter, from its extreme activity and restlessness when first captured, is in my opinion, a more dangerous creature to manipulate. The Ophiophagus feeds, as its name implies, on other snakes, but it is doubtful whether they constitute its ordinary food; it, no doubt, accommodates its taste to the supply, and takes anything that falls in its way. The *Krait*—*Bungarus Cæruleus*—as generally seen, is about three feet long, but it grows to the length of four feet. It is either steel-blue black or brown, striped white. I believe the colour depends upon the age of the snake, the darker one being older, as I have never yet seen a very large *brown* creature. It is easily recognized by the colour, *and the single row of hexagonal scales running along the centre of its back.* Very serious consequences have sometimes resulted from the innocent snake *Lycodon Aulicus* having been mistaken for it, though there is really little resemblance between the two. The row of hexagonal scales is of course, wanting, and it is lighter in colour. The fangs of the *Krait* are much smaller than those of the *Cobra*. The

Krait.

Lycodon.

Bungarus Fasciatus (*Raj Samp* of the natives) is triangular-shaped, and has a prominent back, along which runs—as in the only other snake, the *Krait*—a row of hexagonal scales. It has alternate bands of blue and yellow running across its body. I have seen one six feet long, though much smaller ones are usually met with. The natives of Eastern Bengal believe that this snake has two heads. The Daboia Russelli—*Shiah Chunder*, *Chundra Bora*, and *Ulubora* of the natives of Bengal, and the *Tic Polonga* of Ceylon—is usually found about four feet long. It has a triangular-shaped head and a distinct neck; its body is robust and its tail thin; its body has a grey or chocolate-coloured ground with black white-edged rings, some round, and others somewhat oval, and not unlike the markings on a Paisley shawl. The fangs are larger than those of any other Indian snake. It is believed that these snakes are common in Bengal, but much correspondence, and the offer of rather large rewards for live creatures, have brought me only one miserable specimen during the whole year.* I think, however, that they must

Bungarus Fasciatus.

Daboia.

* Since writing the above, three good specimens have been sent from Midnapore.

be rather numerous in the Twenty-four Per-
Hydrophidæ. gunnahs. The Hydrophidæ (sea snakes) are all poisonous, and may be at once recognized by their head-scales, and their peculiarities of conformation which are adapted to their aquatic mode of life. The head is small, the body robust, and the tail flattened vertically, whence they are able to swim with rapidity and grace—indeed, "to outswim the fish." I have found their poison very virulent; quantity for quantity perhaps even more deadly than that of the cobra. The species of the Hydrophidæ—the
Platurus. Platurus—differs from the rest in its general formation, and in having large ventral *scutæ*, which indicate its power of progression on land. Besides the before-mentioned there are other poisonous snakes in India, such as the *Xenure-*
Echis, &c. *laps*, the *Callophis*, and the *Echis Carinata*, the bite of which is said not to be fatal to man. But Sir Joseph Fayrer doubts the accuracy of the statement in reference to the last named, the poison of which he found to be fatal to a fowl, in two minutes, and to a dog, in four hours.
Crotalidæ. We have also certain of the *Crotalidæ*—or pit vipers—which are distinguished by the broad triangular head, short thick body, and the pit,

which is situated between the eye and nostril in the loreal region. The *Trimeresuri*, the most important genus, are distinctly marked in vivid colours, and differ considerably in colour, and are said to adapt themselves to the localities in which they live—the dark ones being found on the ground, and the green ones amongst the foliage of trees or shrubs. Of the *Crotalidæ* the *Halys* has a caudal-appendage in the form of a horny spine. I am not aware whether the tail in question is of evil repute, but I read in Miss Hopley's very entertaining book on snakes:— "Of the horn-snake," says Lawson, "I never "saw but two that I remembered. 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 said by those who 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 o'clock in the afternoon was dead and the leaves dead and

Trimeresuri.

Halys.

Horn-snake.

withered. Doubtless, be how it will, they are very venomous." Nevertheless, this snake no more poisons with its tail than does the rattlesnake. Mr. Lawson's work was dedicated, "To His Excellency, William Lord Craven, Palatine; the Most Noble Henry, Duke of Beaufort; the Right Honourable 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 Lordships' feet, having nothing to recommend them but truth, a gift which every author may be master of if he will." I have in my possession a rattlesnake's rattle, which was sent to me by Dr. Mitchell; it is a fair specimen, about two inches long, and when shaken makes a noise similar to that made by the shaking of a "dry bean-pod." When I showed this to a friend, he exclaimed, "What, is that all! I thought the thing made a noise like a policeman's rattle;" and so, I imagine, do many of my readers. A very fine specimen of a rattle is figured in Miss Hopley's work. As regards the habits of snakes Dr. S. Weir Mitchell, the distinguished American physician and physiologist, tells us that he had an opportunity of observing the habits of the *Crotalus durissus*

Rattle of the rattlesnake.

Habits of the rattlesnake.

when in captivity for a period of two years. The rattlesnake of the Northern States of America, when at liberty, sometimes lives in the company of its fellows, but more frequently alone. In this particular it resembles our Indian snakes; though it is worthy of note, that if a collection of snakes is kept as nearly as possible in their natural state, where snakes are at all common, they will undoubtedly attract other snakes. Rattlesnakes, we are told, show no hostility towards one another, even when ten to thirty-five are kept in a box together, and even when fresh snakes were dropped upon those in captivity, no attempt was made to annoy the new-comers. This is also the case with most Indian snakes, especially vipers. But I have kept sixty to seventy cobras in a pit together, and they very often, on the slightest provocation, began to fight in a most savage and curious fashion. On being provoked, several commenced to hiss fiercely, and some would raise themselves up, expand their hoods, and begin a vigorous attack in all directions, and after making several ineffectual darts,—for they are by no means so skilful at taking aim as is generally believed—two would catch each other by the mouth, rapidly entwine them-

Habits of cobra.

selves as it were, and after wriggling and struggling about in this state for some time, relax their hold. Then one would be seen gliding away, vanquished, to the corner of the cage, while the triumphant one raised to its full balancing height, hissed out its challenge for a renewal of the combat. In what consisted of getting the worst of it, I could never discover, as neither of the combatants ever seemed any the worse for the fight; nor can I understand why one snake dreads another if no danger is involved.* The head is almost invariably the point of attack, though less injury could be inflicted by the fangs there, than in several parts of the body. Snakes are singularly inactive in their habits. Even in warm weather, when they are the least sluggish, they will lie together in a knotted mass, only occasionally changing their position, and then relapsing into

* Weir Mitchell says, he is convinced that the poison of the Crotalus can kill itself when hypodermically injected. Fayrer did not think that the poison of the cobra was poisonous to itself. The question, apparently so easy to decide, is really a very difficult one, as the snake sometimes dies very rapidly in captivity. I came to the conclusion, after numerous experiments, that one species of snake could kill another.

perfect rest. The sluggish movements and the perilous rapidity of the dart of vipers when molested, are dangerously deceptive. The mode of attack of these snakes and all other non-hooded venomous ones, is in wonderful contrast to that of the hooded-snakes, whose every movement may be almost invariably anticipated by an expert manipulator; hence the facility with which they are handled by so-called snake-charmers. Snakes when kept in captivity usually refuse food; cobras, however, sometimes consume it readily. Weir Mitchell, finding the food supplied so frequently unconsumed, adopted the plan of feeding such of the snakes as seemed feeble and badly nourished with milk and insects in the following manner:— "The snake was secured, and the lower jaw held in the grasp of a pair of forceps, while a funnel with a long stem was thrust down the æsophagus. Into this, insects such as flies and grasshoppers were pushed, or milk poured in proper quantity." I have had to feed a large Ophiophagus, by pushing pieces of meat down its throat with a stick— an operation not altogether pleasant for either the operator or the reptile. One of my little boys had a pet snake, *Chrysopelea Ornata* (golden tree-snake), which he fed with

Mode of attack.

Feeding of snakes.

milk out of a saucer. He held the snake near the head, and put the saucer to it, when it readily drank the milk and in comparatively large quantities at a time. Miss Hopley says, "We of late so often see it said of any particular snakes 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. Lealy's really valuable work, published so lately as 1870, should still retain the assertion that snakes have never been *seen* to drink. Mr. Frank Buckland saw his *Coronella* drink frequently, though she ate nothing; and as the discovery of this interesting lady and her brood, born in London in 1862, 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." As regards the shedding of the skin, Miss Hopley, who has several times witnessed the process, describes how the snakes crawl out of their skins. Weir Mitchell thus describes it: "My snakes lost their integu-

Periodical Sloughing of skin.

ments at different periods during the summer. In all cases the old skin became very dark as the new one formed beneath it. If, at this time, the snakes were denied access to water, the skin came off in patches. When water was freely supplied, they entered it eagerly at this period, and not only drank of it, but lay in it for hours together. Under these circumstances, the skin was shed entire—the first gap appearing at the mouth or near it. Through this opening the serpent walked its way, and the skin reverting, was turned inside out, as it crawled forth in its new and distinctly marked outer covering: when the old skin was very loose, the snake's motions were often awkward for a time. It is said to be blind during this period, which is probably true to some extent, since the outer layer of the cornea is shed with the skin, and there must obviously be a time when the old corneal layer lies upon the new formation. It is also said that the fangs are lost at the same time as the skin. In some instances this was observed to be the case; but whether or not it is a constant occurrence, I am unable to say from personal observation." Sir Joseph Fayrer and I have observed that the *cobra* when in captivity sheds its skin about once

a month, even in the winter months, and is certainly blind at this time; but the fangs are not invariably shed synchronously with the shedding of the skin. I have seen the sloughed skin entire from head to tail together with the corneal layer intact. In captivity, however, when the reptile has been deprived of water, the skin has been shed in patches, which came off easily when the snake was handled. In a state of nature, I doubt very much whether the casting of the skin takes place nearly so frequently as when the reptiles are in captivity. I have occasionally observed that birds line their nests with the sloughed skins of snakes. As to the power of snakes to fascinate small animals, Weir Mitchell remarks:—"After such numerous and long-continued opportunities of observation, it might be supposed that I should be prepared to speak authoritatively as to the still disputed power of the snake to fascinate small animals. If the former exist at all, it is probable that it would only be made use of when the serpent required its aid to secure food." He does not appear to think that it exists; nor do I, for the same reasons. He says "I have very often put animals, such as birds, pigeons, guineapigs, mice and dogs into the cage

Power of fascination said to be possessed by snakes.

with a rattlesnake. They commonly exhibited no terror after their recovery from alarm at being handled and dropped into a box. The smaller birds were usually some time in becoming composed, and fluttered about in the large cage, until they were fatigued, when they soon become amusingly familiar with the snakes, and were seldom molested, even when caged with six or eight large *Crotali*. The mice which were similarly situtated lived on terms of easy intimacy with the snakes, sitting on their heads, moving round on their gliding coils, undisturbed and unconscious of danger." Recently I put two rats into a cage containing forty cobras, all possessing more or less venom. On their first introduction to the snakes, their appetites appeared to be considerably affected, as they refused all food and were evidently much perplexed by the novelty of their position. "Fascination" failed to overcome the contempt which familiarity is said to breed, for in a short time the rats recovered their usual spirits, and caused considerable commotion amongst the cobras by running all over their heads and bodies. The snakes resented this familiarity in their own peculiar and stupid fashion by darting at each other

and at imaginary foes. Occasionally, however, one of the intruders would receive attention, but easily avoided the attack. The rats lived and partook of food in the cage for ten or twelve days, when one after the other they were found dead—victims, no doubt, of misplaced confidence. Apropos of "fascination," Dr. Nicholson says, in his interesting little work, "We have but little knowledge of the habits of snakes when at liberty, owing to the difficulties attending the observation of such animals in tropical climates; vigilant and patient, they mostly remain during the day in a state of repose, seeking their prey at those hours when most animals have relaxed from their usual watchfulness and are at rest for the night. Whether ground or tree-snakes, they remain patiently in the same attitude until their prey approaches, then gently gliding over the short distance which intervenes, they pounce on the unsuspecting victim.* The approach is so often imperceptible that, doubtless, a certain amount of curiosity must often fix the attention of animals on perceiving the snake for two or three seconds before they become aware of their danger; but of fascination, as it is called, there appears to be none.

* Much as a lizard attacks an insect.

"There are several explanations of the stories in which snakes are supposed to have fascinated their victims—'Fascination then,' says Miss Hopley, '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 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.'" Miss Hopley's explanation.

The following amusing story appears in Pepys's Diary under entry February 4th 1661-2. "To Westminister Hall, when it was full terme. Here all the morning, and at noon to my Lord Crewe's, where one Mr. Templer (an ingenious man, and a person of honor he seems to be) dined; and discoursing of the nature of serpents, he told us some in the waste places of Lancashire do grew to great bigness, and do feed upon larks which they take thus:—They observe when the lark 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 is conceived, they do inject poison upon the bird; for the bird do suddenly come down again in its course of a circle, and A marvellous snake.

falls directly into the mouth of the serpent, which is very strange."*

Propagation. Dr. Nicholson tells us that the young of snakes are produced once a year; the period between the impregnation of the female and the birth of her young is uncertain, but it would appear to be from four to five months. In the majority of snakes the eggs are exuded after about three months' gestation, the development of the embryo taking place in the period between laying and hatching; most snakes are, therefore, oviparous. Some of them retain the eggs until maturity more or less perfect. Originally all venomous snakes were called vipers, under the

* Scarcely more strange than that which follows. Pepys continues—"He is a great traveller, and speaking of the tarantula, he says that all the harvest long (about which times they are most busy,) there are fiddlers go up and down the fields everywhere, in expectation of being hired by those that are stung." Many marvellous stories are told by "great travellers." It would appear "that travelling" not only expands the mind, but also the imagination, or possibly the gullibility of the traveller. Chateaubriand, another great traveller, says of a certain snake—which by the way is perfectly innocent—"He hisses like a mountain eagle and bellows like a bull!" Du Chaillu tells stories that almost take one's breath away.

idea that the class was distinguished by its viviparous habit. As a fact, however, though most of the viperine snakes and many nameless snakes are so, the venomous Colubrine snakes, such as the cobra and ophiophages are oviparous. All sea-snakes, and nearly all the fresh-water snakes, are viviparous, and many tree-snakes are ovo-viviparous. Nicholson says that "the cobra at Bangalore is impregnated about January; the eggs are hatched in May, and up to the beginning of June, as many as nineteen young will be found in a brood." In Bengal, however, impregnation takes place in April or May, and the eggs are hatched in September. I possessed a brood of forty vipers (Daboias).

Odour of snakes.

Regarding the disagreeable odour which snakes sometimes have, Weir Mitchell says—"When a rattlesnake is roughly handled, specially about the lower half of its length, a very heavy and decided animal odour is left upon the hands of the observer. If the snake be violently treated, causing it to throw itself into abrupt contortions, then streams of a yellow or dark brown fluid are ejected to the distance of two or three feet. This fluid appears to come from glands alongside of the cloaca. Its odour

is extremely disagreeable, and it is irritant when it enters the eye, although not otherwise injurious." I have, while handling Indian snakes, experienced this disagreeable qualification of theirs. Chateaubriand appears to have met with a far more disagreeable snake in the States of America. He says—"When approached it becomes flat, appears of different colours, 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!" A terrible snake this, if the story only were true!

A terrible snake.

I am sometimes asked, in all seriousness, whether there are such creatures in existence as two-headed snakes; and a gentleman once gave me a description of one which he declared that he had seen in the jungles in Australia, where he said such snakes were common. After so positive a statement I did not, of course, venture to suggest that he was mistaken. I should only have got for an answer, "But I tell you I have seen them." Two-headed snakes certainly have existed and do exist. The *Amphisbæna*, for

Two-headed snake.

example, existed in the imagination of the ancients, and the *do morkhka samp* exists in the imagination of the natives of India.* There are, however, monstrosities of the kind, as there are of other animals, in some museums. One *lusus naturæ* is, or was, certainly to be seen in the museum of the Royal College of Surgeons of England. A moment's reflection would convince even the most credulous that such creatures could not possibly exist. What embarrassment would arise in the event of a disagreement between the two heads as to the direction in which food should be sought for!—a decided exception to the rule that "two heads are better than one." Miss Hopley tells us that "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 at 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

* Nicholson says—"The double-headed snake is manufactured by snake-jugglers and exhibited to the credulous European or Indian."

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 ..... We must note one other of the family of burrowing snakes which, from the very earliest ages, have been suppositiously endowed with two heads. Its name, *Amphisbœna*, or double walker (going both ways), however, is well merited, because like *Typhlops*, it can progress either way, forwards or backwards, with equal facility..... Of this harmless and useful reptile Pliny seriously wrote: 'The *Amplisbœna* 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!" One cannot help thinking that Pliny must have met at least one of the human species whose "mouth was too little for the discharge of all his venom," but it is doubtful whether he credited him with possessing too much head.

The bite, a very complex act.

The manner in which functions of the various parts concerned combine to effect a poisonous bite is certainly remarkable. The act, apparently simple in itself, consists really of a serious of complex acts following rapidly one upon an-

other, in ordered sequence, to effect a certain end; and as Dr. Weir Mitchell says, "The physician may learn from their study how he may be deceived as to the occurrence of poisoned wounds, and how the snake which appears to strike, may really fail in its object, even though seeming to have inflicted a wound," and then he gives the details of the manner in which the reptile inflicts an effectual bite. "At the instant, and while in motion, the jaws are separated widely, and the head is bent somewhat back upon the first cervical bones, so as to bring the point of the fang into a favourable position to penetrate the opposing flesh. Owing to the backward curve of the tooth, this, of necessity, involves the opening of the jaws to such an extent, that an observer, standing above the snake, can see the white mucous membrane of the mouth as the blow is given. . . . . Consentaneously with the forward thrust of the body, and with the opening of the mouth, the spheno-pterygoids act from their firm cranial attachments to draw forward the pterygoid plate, and thus through its attachment to the maxillary, to erect the fang . . . . . As the spheno-pterygoid acts, the submaxillary bone rocks

forward upon its lachrymal articulation, when the motion reaches its limit, and is checked by the ligament which I have described, the supporting lachrymal bone in turn yields to the power applied through the maxillary bone.

"These movements elevate a little the muzzle of the snake, so as to give to the snake a very singular expression during the act of striking. Their more obvious and important result is the elevation of the fang, which rising, thursts off from its convexity the cloak-like vagina-dentis, so that it gathers in loose folds at its base.

The bite described.

"As the unsheathed tooth penetrates the flesh of the victim, a series of movements occur, which must be contemporaneous, or nearly so. The body of the snake still resting in coil, makes, as it were, an anchor, while the muscles of the neck contracting, draw upon the head so violently, that when a small animal is the prey, it is often dragged back by the effort here described. If now the head and fang remain passive, the pull upon the head would withdraw the fang too soon, but at this moment, the head is probably stayed in its position by the muscles below or in front of the spine; while the ptergoideus externus and

spheno-palatine, acting upon the fang through their respective insertions into the posterior apophysis of the submaxillary bone, and the inside of the palate bone, draw its point violently backward, so as to drive it more deeply into the flesh. At this instant occur a third series of motions, which result in the further deepening of the wound, and in the injection of the poison."

The lower jaw is closed upon the bitten part or member. Where the surface struck is flat and large, this action will have but slight influence. Where the jaw shuts on a small limb or member, the consequent effects will be far more likely to prove serious, since the power thus to shut the mouth materially aids the purpose of the blow. . . . . The first two muscles tend simply to shut the mouth; the anterior temporal, however, is so folded about the poison-gland, that while it draws up the lower jaw, it simultaneously compresses two-thirds of the body of the poison-gland. This force is so applied as to squeeze the fluids out of the upper and back parts of the gland and drive them forward into the duct. The anterior lower angle of the gland, as well as a portion of the duct, is subjected to similar pressure at the same

instant, owing to the flat tendinous insertion of a part of the external pterygoid upon the parts in question. It will thus be observed, that the same muscular acts which deepen the wound, fix the prey and inject the venom through the duct and into the tissues penetrated by the tooth. Now, in the case of the cobra, the act is still more complicated by the preliminary expansion of the hood, and the greater distance of the strike.

It would, of course, be anticipated, in such an elaborate sequence of movements as those above described, that in the event of the failure of one of the essential motions, the ultimate essential of the whole would be materially interfered with, and an imperfect or ineffectual bite would be the result.

Causes of the infliction of an ineffectual bite.

The causes of an ineffectual bite, when the snake is poisonous and in full vigour, are:—

1*st.*—Miscalculation of distance.

2*nd.*—The object being too near, the blow is lost, and the fang does not enter the part attacked.

3*rd.*—Insufficient elevation of the fangs which are driven back by the force of the forward impulse.

4th.—When the fang enters, and from the quick starting of the animal injured, or from other cause, it is withdrawn so soon, that a large portion of the venom is thrown harmless upon the surface near the wound.

5th.—When from the nature of the part struck the snake is unable to close its jaws upon the parts.

There are other causes of an ineffectual bite referable to the snake itself.

1st.—Its gland may contain little or no venom (*a*) from recent exhaustion, (*b*) from impeded secretion through sickness.

2nd.—The efficient fangs may have been shed or lost.

Here I may note that fangs are renewed.

Collection of snake-poison.

When snake-poison is required for immediate experimental purposes or for collection, it is absolutely necessary either to handle the reptiles yourself, or to have them manipulated under your own supervision. In the former case, to ensure accuracy of observation, and in the latter, to obtain a supply of the genuine article. The specimens supplied by *samp-wallahs* are

dirty and unreliable, though high prices are often given.* On one occasion, through an obliging correspondent, I was supplied with a large quantity of supposed poison, which subsequently was found to be "gum," which the poison much resembles. On another I bought what appeared to be the genuine article, and it proved to be strychnine and gum mixed.

Fontana obtained the poison of the viper by killing the animal, and compressing the poison glands, which are situated behind the eyes, until the fluid exuded through the ducts. Barnett and others chloroformed the animal, and then exerted pressure on the glands. Prince Bonaparte made the snake bite upon soft substance which imbibed venom readily, and from which it could be easily removed by water.

Weir Mitchell's method of collecting snake-poison.

Dr. S. Weir Mitchell's method is here described: In moving snakes, it is customary to employ long-handled tongs or forceps, which are apt to pinch and otherwise injure them. I have been in the habit of using for this purpose a bar of wood, four feet long, and cut off at the end, so as to present a slightly roughened surface one and a half inches square; on one side of the end a piece of soft and pliant leather strap was nailed

* I have paid as much as five rupees for one grain of snake-poison.

securely. This strap was then carried across the end of the bar, and through a flat staple upon the side opposite to that on which the strap was fastened ; a stout cord attached to the strap above the staple, was held in the operator's hand. To use this simple instrument, the strap was drawn down, so as to form a loop, which was easily slipped over the head of a snake, and then tightened by drawing on the cord. Where it was desirable merely to secure the venom, the loop was slipped over the head and drawn closely around the neck.

Thus prepared, the snake was placed on the table and retained by an assistant, while the operator obtained the venom. When it was desirable to have an animal bitten without placing it in the cage, the loop was carried to the middle of the snake's body, and it was thus allowed movement enough to enable it to draw back and strike. It is unnecessary to add that during these manipulations, the utmost caution is necessary to avoid accident.

As it is sometimes essential to detain the snake on the table for some time without being forced to employ a person to guard it, I devised a little apparatus which, although imperfect, answered my ends well enough. A box about four inches square and thirty-six inches long was divided lengthwise, and arranged with hinges so as to close readily. The two sections were deeply grooved, so that where the sides of the box met, the grooves formed a tube large enough to receive the body of a serpent five feet in length. The large length of the box was fitted with a sliding door which could be secured by a wooden wedge driven in behind it. The lower edge of the door

was made concave, and a piece of leather was tacked across the concavity, designed to press on the snake's neck and secure without injuring it.

To employ this arrangement, the box was closed and the door raised, a cord having been previously run through the central tube. This cord bore on its extremity a loop which was thrown over the tail of the snake, and carried up between three and four inches. To effect this manœuvre, I was usually obliged to hold the snake down with a long stick notched at the end. The serpent being thus noosed, the loop was tightened, and an assistant tilted the box over the cage and rapidly drew the snake backwards into the tube, while a second person standing in front guided the snake with a long rod.

As soon as the tail appeared at the small end of the box, it was secured by the assistant, and the looped string which held it was wound around a nail. At this instant the head sometimes retreated into the box. After waiting a moment, it usually re-appeared again, and was then seized with a pair of long forceps, and held, while the door was pushed down on the neck and made fast with the wedge. When the snake was small, it sometimes contrived to turn around in the box before the tail emerged and thus reverse its desired position. This occurence twice exposed the operator to great danger; it was finally provided against by the aid of a large cork, which was strung upon the cord and was used to close the small end of the tube when the snake was of a size to make it possible for it to turn in the tube. When the snake was thus properly

imprisoned, it could be placed on the table and studied to great advantage, while it was still able to bite with sufficient vigor. At various times I have employed all the methods of procuring venom, which I have enumerated at the commencement of this note. I have finally laid aside all but the plan of stupefying the snake by chloroform. This is accomplished by seizing the snake about the middle with the looped staff, and placing it on the table. An assistant then controls the head and neck, by confining the latter with a notched stick, while with the other hand he slips over the head a glass vessel about two inches wide, and containing at the closed end a sponge soaked in chloroform, The snake breathes for a time with only a few inches of lung, which lie in front of the stick, but as it becomes more insensible, the pressure of the stick is removed, and the strap of the staff loosened. About twenty minutes are required to complete the process. If it is then found that the lower jaw hangs relaxed when opened, the neck is seized firmly, the fangs caught on a saucer edge, and the glands stripped from behind, forwards, by pressure with the thumb and forefinger. The venom usually escapes alongside of the fang, from under the mucous cloak. To secure all of the available venom, it is best to wash the fang and the vagina-dentis with the aid of a little water and a pipette; but one objection can be urged against this method. One snake in every four died within from two to five days, and this after apparent recovery from the effects of the chloroform. It is not impossible that too severe a compression of the venom

glands may produce rupture of its substance and consequent blood poisoning. This, however, is but conjecture; and I have not further examined the subject experimentally.

Our method of collecting venom.

The method adopted by us in India, though perhaps more dangerous, is infinitely more simple and efficacious. The reptile is caught by the tail, and the end of a walking-stick is then placed upon the head, pressing it not too forcibly against the ground or floor. When secured, the tail is handed over to an assistant, or it may be let go, and with the hand the snake is seized just behind the stick, which is then removed. Care is, of course, required that the fingers do not slip, as they sometimes will, more particularly when the animal is shedding its skin, and that the animal is not held so tightly as to injure it. *Samp-wallahs* hold the tail of the snake between the toes of the left foot. Expert manipulators do not require to use any stick, especially for cobras, but at once place the fingers upon the neck and then grasp it. To remove the poison the creature is made to bite through a strip of plantain leaf placed transversely around a mussel shell, the concavity of which is turned upwards. The fangs pierce the

leaf, and the poison flows freely through the fangs into the shell. An extra quantity of poison is obtained by exerting pressure upon the glands. The snakes do not always bite readily, but some times require a good deal of irritating; sometimes only one fang penetrates, and it is then necessary to make the snake bite again, in which there is generally some difficulty. The venom is then removed and poured into watch-glasses, to be dried and bottled off for use as occasion arises. Poison thus dried will retain its power for years. I have experimented with some fifteen years old, and I found that it had lost none of its virulence.

The Cow-milking snake.

Natives tell many extraordinary stories about snakes; amongst others, that a snake called the *Dhnarash* milks cows. The belief that snakes have the power to suck is not confined to natives. A gentleman told me of a story he heard from another to the effect, that a lady who was suckling her infant one night, woke up and found a snake sucking at the other breast. Suction cannot, however, be accomplished without the aid of lips and a broad tongue, both of which are absent in the snake. This story, like many others, is a myth.

Superstition against killing snakes.

There is a well-known superstition prevailing amongst the natives of India to the effect that, when a person is bitten by a snake, the snake should be protected from injury: it is believed that if the reptile is killed, the bitten person will surely die. I have reported such a case in Sir Joseph Fayrer's "Thanatophidia." Again, *sampwallahs* will never kill a snake, for fear their power over the creature should be destroyed. It is singular to find that such a belief exists also amongst the Caribs. Captain Pim, in his entertaining book, "Dottings on the Roadside," says—"On another occasion I saw a smaller but no less deadly member of the same species; it was on the banks of the San Juan, in the hands of my faithful Simon (a Carib), who had just landed from my canoe to make a fire and cook our breakfast. Simon allowed the creature to coil round him, and commenced talking to it in his musical language, holding the head close to his face. Presently he put it gently on the ground, when it slowly made its way into the adjacent undergrowth. I gave Simon a good blowing up for letting the brute escape, but he told me that he was a snake-doctor, and that had he inflicted the slightest injury on it, his influence would have been at an end for ever."

Training and charming of snakes.

It is thought that the snake-charmers train or charm their so-called performing snakes so as to make them do certain acts at the will of the "charmers." Now, this is not the case. By the training of a mammal, such as a horse for instance—the animal is made to do certain acts, it may be, foreign to its usual behaviour, or even its nature, at the will of the trainer, and in the process the animal's intelligence is appealed to. But in the case of the cobra (and in that of performing birds in a lesser degree) the manipulator anticipates the natural behaviour of the reptile under certain conditions, which alone he has command over. And he is the best "charmer" who is the most intimately conversant with the movements of the creatures under varying conditions. For example, I say, this cobra which is now balancing itself before me, shall turn to the right, raise itself higher, turn to the front again, suddenly dart, and after rebalancing itself, put its head down upon the table. To make the snake accomplish this, I wave my right hand very gently and turn it to the right, raise it towards the head of the snake; then bring it to the front, and wave it at first very gently, then rapidly, and suddenly bring my hand down in

front of the snake, which now strikes. I then smartly extend my arm above, so that when the snake rebalances itself, the palm of my hand nearly touches its head, and lastly, I bring my hand down gently towards the table. *

Manipulation of snakes.

Since the foregoing was written, I have read the following amusing account of snake manipulation by Dr. Nicholson. "To take a snake out of the box, when he is not sufficiently domesticated to be taken up with the hand, lift his body with a hooked stick, and, as his tail glides over, take hold of it and deposit him on the floor or in a spare box. If you wish to tame the snake, he must be taken out daily, and gradually accustomed to being handled; if you could per-

* I had several little birds, *Mooniahs*, and I found that they would go through the following performance by themselves. On taking one on to an index finger, and putting the other index finger before it, the bird would step or hop from one to the other as often as I changed them, if I just touched its breast. If I wanted the bird to fly for a short distance, I brought the disengaged finger sharply up to its breast, and at the same time I lowered the engaged finger. If I removed one finger and held the bird some distance from the cage, it would fly from my finger into the cage. Nearly every bird would go through this performance.

suade him to drink milk," (which you can do by dropping it on to his head) "the offer of it would become a great inducement to good behaviour. A cobra must always be taken out daily and gradually tired out of his wildness, but in the intervals of his performances he should be left alone and not worried. There is very little danger about handling this snake: nerve is all that is required. I have very little of it myself, and can never handle venomous snakes with confidence. I have often envied the nerve of a friend in Rangoon, who emboldened by the possession of a fancied antidote in case of accident, handles cobras with perfect freedom; he puts his hand into a narrow-mouthed basket containing several cobras, and picks out the one he wants without the slightest objection on the part of the snake beyond the usual hard swearing. When the cobra is on the floor, he squats down before him and brings him to attention, if he is making tracks, by a smart smack on the back; then by a side to side movement of the knees or gently moving in front of him a piece of chalk or a rolled-up handkerchief held in the left hand, he can be kept steady for a long time, following your movements." (The hand

alone answers the purpose equally well if you are at all experienced.) "If your attention relaxes, he comes down and backs away; catch hold of him by the tail or smack him on the back, and he will come to attention again. Keep him occupied with an object in front of him, and you may do anything to him; place your right hand above his head, and you can bring him flat to the ground, but without any attempt at resistance. After he has stood up some time, it is easy to provoke a strike; this, however, is rarely done viciously, and the injury inflicted is generally confined to his own nose. Most captured cobras have their noses barked raw from frequent hits against hard substances." As for the snake's supposed love for music, I have certainly not noticed it. As Dr. Nicholson remarks, the country music played by snake-charmers during the cobra's performance is quite superfluous, and from the very imperfect condition of the auditory apparatus, it is highly probable that it has very little appreciation of sound. It has been said that when a large number of remedies are to be found for any particular disease, that disease is either very easy, or impossible, to cure. There is probably no

Supposed love for music.

disease—not even excepting cholera—for which such a multitude of remedies are in existence, as for snake-poisoning, or more correctly speaking for snake-bite, for the two are by no means synonymous. The thousands of antidotes are almost all of a secret nature, very few being known and having professional sanction. Every district in India has its own *samp-wallahs*, and each *samp-wallah* is the happy possessor of an antidote and a *mantra* to assist it. Whether these men believe in the efficacy of their remedies I am not quite sure, but I have never yet seen the man who was willing to submit his remedy to a crucial test in his own person even for a consideration. The excuse has always been that he might forget his *mantra* at a critical moment. This reminds me of a curious story which was told to me some time ago. It appears that before the Mahomedan wood-cutters will go into a fresh patch of jungle in the Soonderbunds, they send a holy man (strange to say, a Hindoo) to the place to propitiate the wild animals. He erects a small *maichan* in which he stops for the night, if he is not eaten in the meantime. If all goes well, and the *jogi* is untouched, it is assumed that the jungle may be safely

The holy men of the Soonderbunds.

worked. Occasionally it happens that a hungry brute refuses to be propitiated in any but a natural manner, and it eats the *jogi*. When the wood-cutters are asked to explain why the holy man has been eaten notwithstanding his *mantras*, they say that he must either have had a very indifferent character, which was probably true, or he *had forgotten his mantras when attacked by the tiger*. I cannot vouch for the accuracy of this story, but *se non é vero, é ben trovato*. I have, however, seen at several different parts of the Soonderbunds *maichans* which were said to have been occupied by *jogis*. From time to time "infallible cures," "certain antidotes," and "never-known-to-fail remedies" are sent to me from all parts of the world to be submitted to the crucial test of experiment, always with the same result—utter failure. Many of them come accompanied by certificates of infallibility, and not a few with the intimation that the sender would be happy to disclose the secret, on the Government sending him the reward which is supposed to have been offered. I have experimented with "antidotes" sent from Brazil, the United States of America, Australia, Africa, and all over India; and in many instances the direc-

tions for the administration and application of the antidotes were amusingly absurd. For extraordinary cures of *snake-bite*, the *Panseurs* (snake-doctors) of St. Lucia certainly excell all others. The Government of India, observing in the Immigration Report of St. Lucia for the year 1879, that reference was made to the successful treatment of snake-bite, asked for further information on the subject. And the result is a most extraordinary contribution to snake-poisoning literature. All of the contributors, *with the exception of the medical officer*, appear to be quite satisfied that the *panseurs* are really able to cure snake-poisoning. One gentleman remarks, however, that "It is my impression that when the bite is inflicted by a large vigorous serpent in such a manner that the venom is deposited within a blood-vessel or deep in the tissues, or, as sometimes happens, in the trunk, death is inevitable." He makes the extraordinary statement that he believes that the bite of the "Fer de Lance" is more fatal to whites than to the black or coloured people. The medical officer after pointing out some of the conditions under which the snake may not have inflicted an effectual bite, remarks, "It is important to bear the above in

The panseurs of St. Lucia.

mind when we hear many persons boasting (some of them, no doubt, honestly) of their success with, and their ability to cure, serpent-bites."

"There are *many remedies* (italics mine) believed by the inhabitants to be efficacious; some kept a secret, some used locally, others internally, and some both local and internal, while passes are made and words used by the professional snake-bite curers, which no doubt are useful with the class on whom they are practised, on the principle of the 'influence of mind over matter.' The preparations consist of a heterogenous collection, chiefly of various herbs steeped in rum. These must be gathered on a certain day (generally a Friday, and at a certain phase of the moon." The *recipes* are reported to be obtained from old Africans.

"The St. Lucia Almanac of 1852 gives 'six modes of treatment.' Many of these seem absurd, and one positively dangerous from the amount of arsenic it contains. Mention is made of the guaco * having been re-introduced by Governor Darling from Venezuela, and 'that it

* The Milkania guaco has had many advocates, amongst them, Andrieux in 1849, Vargas 1798, and others.

now luxuriates in the garden of every gentleman in the Island.' I believe it has again become extinct!" Note in the above extract that the "panseurs" assist their antidotes with "passes" and "words": the *jharro* and *mantras*. Also that they have *many remedies*, notwithstanding that guaco, (the great remedy) has become extinct. The medical officer winds up his letter with the following paragraph:—

The remedies used by panseurs.

"The treatment adopted by some of these serpent-doctors, can only be described as 'lynch law,' and I believe often gives rise to mortification of the bitten part. Others practise by more gentle means, inflicting no injury. A powder named Theriaque † is in great repute. This consists of a forago of seventy-two different ingredients, the flesh of the viper being one *; each drachm of the powder contains a little more than a grain of opium, and to the soothing effect of this drug is to be ascribed such influence for good as the powder may have. Rum and ammonia are largely used in all the nostrums, and are probably the only efficacious constituents." The marvel is that

† Advocated by Arctæus in 1772.

* A very ancient remedy.

any person so treated ever recovers from the effects of the treatment. We find mentioned no fewer than four articles which have a reputation in India, namely, arsenic (as given in the Tanjore pill), opium (opium eaters are supposed to be proof against snake-poison), alcohol, and ammonia. Over stimulation in a case of snake-poisoning can only expedite the absorption of the poison, which, it should be our aim to prevent being taken up into the general circulation. Ammonia, like alcohol, is only a stimulant—not an antidote. Hence, in a true case of poisoning it is not only useless but hurtful. But to return to the "panseurs" of St. Lucia. One gentleman writes:—"I cannot state with certainty what is *generally* the exact course of treatment observed, 'panseurs' evincing a disinclination to give definite information on the subject. In almost every instance they have acquired the knowledge from Africans who have charged heavily for transmitting it. Fathers have bequeathed the information thus obtained to their sons, so that a family for many generations have been acknowledged as professional 'panseurs'; consequently a knowledge of the kind, which, as a rule, is a source of pecuniary

A great secret divulged.

advantage to the 'serpent-doctor,' is cautiously and jealously guarded by every member of the faculty." Two 'panseurs,' however, hearing that information was required by Her Majesty's Government, "loyally elected to be exceptions to the rule," and so we are afforded information as to the composition of two of these marvellous cures, and according to the "panseurs," nothing could be more successful, seeing that one man has had sixty-two cases, and lost only one patient; while the other had two hundred and fifty, and he too lost only one patient, and that one died not from the effects of the bite, but "from being too much frightened." Here are the prescriptions:—Take of each of the following herbs, viz.—Zebe Giante. En haut bois, confied Cayé, Petit Fongére. Zebe á Couresse, Zebe Dahi, Zebe á Colete, Chadron, Beni, Soumatié, Zimoron, Treffe, Charhentier, Zebe astro, Jarpanyai, and Balier doux, pound the same in a mortar, add thereto ¾oz. of alkali, ½oz. of laudanum, put all in a quart bottle full of very strong spirits, shake and mix well, administer internally half a wine-glass-full according to condition and constitution of patient. Dress the wound twice a day and oftener, if necessary, with the same preparation."

"*1st—Dose.*

1 Gr. powdered Peruvian bark.

1 Gr. emetic.

3 Drops spirits of hartshorne.

2nd Tison.

1 handful Bois mal estomac leaves, coco figæ, small piece raisin, citron small piece.

3rd Cataplasm.

Pied Poulli, a handful of Moron, ditto fevilles, Pistaches l'Ecorce, Quina bois pilled, 1 Corce d'ail or garlic, 9 grains preserve guinié, un morceau de gingerbre or ginger un cuillier pourd á fusil, un morceau de tieff. (A singular jargou of French and English.)

4th.

"After applying the above stated, then cut the bite to run out the poison.

Then a small tumbler containing some rum, light fire to the rum, and apply upside down on the bites, called vantouse." (This is a rough form of "cupping" but both that and suction utterly fail to "draw out" a single drop of venom, for the simple reason that it is rapidly diffused, and becomes intimately amalgamated with the products of the specific local inflammation).

5th Vomiting.

To make the patient vomit, take some leaves of quina bois, boil in one quarter of water, to be reduced to three tea-cups.

6th Friction.

After 4 days 1° savon Francais, 1° Chandelle mole, 2 spoonsful of white rum, melt together on fire, and rub part very hot." (This could do only harm in a true case of snake-poisoning.)

7th to avoid pains.

Take one leaf smoking tobacco (or merely) apply above, friction of No. 6 on the inside part, pass it on fire and apply over the part for 3 or 4 days, then wash the part with some hot water, and the patient is radically cured." Mirabile dictu.

By the way, there is internal evidence that the above prescriptions are certainly not amongst those which have been obtained "at great cost" from the Africans. Where did these Africans learn to make "laudanum" and "spirits of hartshorne?"

The old, old story of the mangoose.

The old, old story of the mangoose is introduced to shew that there certainly must be an antidote in existence. In fact, all the old, dead, buried, and disintegrated *post hoc ergo propter hoc* arguments are exhumed and patched together to do duty as veritable and convincing proofs. A man is bitten, therefore by a poisonous snake. The snake was poisonous, therefore the man is poisoned. The man is poisoned, therefore he will

die. An antidote is administerd to the bitten individual, the individual does not die, therefore, the antidote cured him. A "M. de Lanbenque's" method of treatment is mentioned. While there is nothing new in it, there is much that is ludicrous. The method includes the old treatment of the application and administration of oil, which was declared useless nearly two hundred years ago, (*vide* Chapter II.) The absurd advice is given to keep the patient roused by every means. If it were a case of real poisoning nothing would keep the patient roused. Far from rousing the patient it is good practice to keep him as quiet as possible, so that the absorption of the poison—which you desire to keep out of the general system—may be retarded as much as possible. The wonderful snake-doctors of St. Lucia, like many other snake-doctors, evidently owe much of their fame and reputation to the non-identification of the snake, and the timidity of the people. Dr. Shadling says (as quoted by Miss Hopley) "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." After all, the "*Fer de lance*" *Trigon-*

The Fer de lance.

ocephalus lanceolatus—is not nearly so formidable as most of our Indian poisonous snakes, notwithstanding the infamous character which has been given to it by the people of St. Lucia. A very interesting note is given in Sir Joseph Fayrer's "Thanatophidia," on the snake-charmers of Bengal, from the pen of Dr. Rajendralala Mitra. "In Bengal we have four different classes of men who deal in snakes. The first, and by far the most expert among them, is the *Mal*, a low-caste Hindu, who earns his livelihood by catching and exhibiting snakes and selling simples in the bazaar" [in more ways than one] "but never professes witchcraft, jugglery, or the healing art. Many of this class are certainly very poor, and have to lead a vagrant life, but I have never heard that they are much given to thieving. In the North-Western Provinces they are replaced by *Modaris*, a few of whom occasionally come to Calcutta to ply their vocation. I have never had an opportunity of studying them carefully, and cannot, therefore, say anything about them. Apparently, however, they seem to have been confounded with the *Bediyahs*, or gipsies of Bengal. The latter are jugglers, bear and monkey dancers, sellers of simples, fortune-tellers,

Indian snake-charmers.

reputed adepts at curing rheumatisn, gout, tooth-ache, and other complaints; professors of witch-craft, experts in cupping, applying moxas and actual cautery, as well as snake-charmers. In fact, they take to whatever comes in their way to protect themselves from being taken up by the police as thieves, for thieves they are of the most inveterate type. Some time ago I put a few notes together about them. . . . . .

"As snake-charmers these people are by no means successful or noted. They differ from the *Mal* in taking their women to join them in their profession, which the Mals never do. I have never seen a Mal woman. The *Sanyis* are known in Bengal by the name of *tubri-wallahs*. I am not aware of where their head-quarters are, but there is no doubt they come to Bengal from the North-West. They are always dressed in yellow clothes and a large turban, and have a double pipe mounted on a gourd shell—the *tubri*—with the music of which they pretend to charm and draw out snakes from holes and cracks, not un-often from the bedding in the houses of the per-sons who employ them. For this purpose they carry about several snakes on their persons hid-den under the folds of their flowing garments;

but openly they shew only a few or none. As professed vagrants they may purloin whatever falls in their way, but they are by no means notorious as thieves. They may be seen everywhere in the North-West, and I believe (though I cannot speak from personal knowledge) also in Southern India. I have met with notices of them in old Sanskrit books, and it is probable that, as a class, they have existed in India from a very early age. Their pipe is peculiar to them; it is never used by the *Mals*, the *Modaris*, and the *Bediyas* for charming snakes, nor by any of the Indian races for musical entertainment." Most of these snake-charmers, especially the *tubriwallahs*, are very fond of alcohol, particularly brandy; the more fiery the better. The crime of homicide by snake-bite, we are told by Chevers, was rather a full history from very ancient times. Snakes were employed also for purposes of war. Hannibal and Antiochus defeated the Romans in a novel action by throwing earthen pots filled with the reptiles into their ships. In Paradin's "Chronique de Savoye" it is mentioned that a Saracen ship was taken, in which were snakes in cages, which were intended to be thrown among the Christians in their camp. He gives other

Snakes used for criminal purposes.

instances of the practice. The following curious mention of the crime of using snakes as homicidal instruments, made in both ancient Hindu and Mahommedan law, is referred to by Dr. Chevers:—

Hindu and Mahommedan law regarding.

"If a man by violence throws into another person's house a snake or any other animal of that kind, whose bite or sting is mortal, this is *snakish, i. e.* violence. The magistrate shall fine him five hundred puns of cowries, and make him throw away the snake with his own hand." (Halhed's Code of Gentoo laws, pp. 262, 263.) It was enacted in the ancient Mahommedan law that "If a person bring another into his house, and put a wild beast into the room with him and shut the door upon them, and the beast kill the man, neither *hisas* nor *diyat* is incurred. And it is the same if a snake or scorpion be put into the house with a man, or, if they were there before, and sting him to death. But, if the sufferer be a child, the price of blood is payable." Dr. Chevers mentions that some of Sir Thomas Roe's suite were present at an execution by snake-bite, ordered by the Mogul. It must have been a horrible spectacle judging from the account of the execution.

CHAPTER II.

Francesco Redi—The viper as a symbol of Divine power—The Psylli and Marsi—Poisoned arrows—Dr. Richard Mead, his theory and microscopic examination of the viper's venom—Various antidotes—The bite of the rattlesnake a cure for elephantiasis—Felix Fontana's researches—Discovery of the poison-gland—Tricks of old viper-catchers of Europe—Schlegel—Fontana's criticisms: De Buffon—Fontana appeals to posterity—Fontana's theories—M. Sage on ammonia—Quantity of viper venom shed at one bite—Effects of viper-poison on the blood—Fontana refutes the ammonia theory—Dr. Patrick Russell's experiments—The mangoose—A fight between the cobra and mangoose—Mr. Boag recommends ammonia—Mr. Boag's theory – Suction, &c.—Artificial respiration—Mr. John Williams and his cases—Dr. Macrae and Mr. Breton—Dr. Butler recommends opium—Recurrent symptoms after snake-bite—Livingstone's case—Snakestone—Davy's researches—Fayrer and Brunton's theory.

Francesco Redi.

MORE than two hundred years have elapsed since Francesco Redi— "a man of the widest knowledge and most versatile abilities, distinguished alike as scholar, poet, physician, and naturalist" (Huxley) "and the originator of the doctrine of Biogenesis—first gave to Europe the result of his investigations into the nature of the venom of the viper. Previous to his time the grossest ignorance prevailed not only regarding the nature of the poison, but even as to the organ by which the snake inflicted its deadly injuries. It is true this great man did little more than correct the principal fallacies which prevailed; still, he it was who first directed men's minds to the subject, and collected by patient enquiry, the crude material which Fontana, a century later, moulded into something like definite shape.

Physiology has, thanks to Chemistry and Mechanical Art, made rapid progress. For example, the theory of "*omne vivum ex ovo*" which was only very roughly demonstrated by Redi, is now demonstrated (and by many considered *positively* proved by the most elaborate processes. What was in Redi's time a rough outline is now a well-filled-in picture, not quite

complete in all its details, but a picture nevertheless; and the microscope has been the principal means by which the theory has been, and is still being, sifted to the most minute particular.

The viper, the symbol of divine power.

From time immemorial the viper has been the symbol of divine power, not only in Asia and Europe but in other parts of the world. It was as sacred to the Egyptians and Arabians as it is now to the Indian snake-charmer, and a man who could manipulate the reptile or was bitten without injury was honored as a god. We have an instance of this in the history of St. Paul, who, after being shipwrecked off the island of Malta, was received by the "barbarous people" of the island, and while lighting a fire was attacked by a viper, which he shook off into the fire, whereupon "the people said that he was a god." The Psylli, an ancient nation of Africa, and the Marsi, in Italy, were supposed to be able to resist the fatal effect of the poison of the viper, and the most marvellous stories are related of them, but, as in the case of our Indian snake-charmers, there was evidently some trick at the bottom of their supposed immunity from the ill effects of the poison.

The Psylli and Marsi.

Some supposed that the viper would not touch them, and it was said that this was made a test of the legitimacy of their children. I have observed, in the previous chapter, that nothing will induce a snake-charmer to kill a cobra, especially if he happens to have been bitten by it. It is recorded that the king of Calicut actually had huts built in which snakes might take shelter during the rains, and that the punishment awarded to any one who harmed these reptiles was death.

The sheltering of snakes.

Non-venomous snakes, the emblem of health.

While the venomous snake was made the symbol of divine power, the non-venomous snake was made the emblem of health, possibly on account of its shedding its skin every month. The venom has been used for many purposes, especially for those of war. The Scythians are said to have poisoned their arrows with the venom of the viper and human blood,* as the South American Indians did with the Wourara poison (this is supposed to contain snake-poison also); the Tartars are believed to use viper-venom in a similar way; and the Hottentots are known to

* I have in my possession some Fijian arrows which are said to have been rendered poisonous by being first plunged into the decomposing corpse of a human being, and then smeared with some vegetable poison.

use cobra-poison for the same purpose. It is more than probable, also, that many savage hill tribes of India apply cobra-poison to their spears and arrows.

Poisoned arrows and spears.

One of the most celebrated of those men, who have spent much of their time enquiring into the subject of snake-poisoning was Dr. Richard Mead,* the King's physician. In 1702, he published an account of his investigations, which is pregnant with interest. The

Dr. Richard Mead.

* "Dr. Richard Mead was an eminent English physician, born at Stepney in 1625. At sixteen years of age he was sent to Utrecht, where he studied three years under the celebrated Grævius, and then choosing the profession of physic, he went to Leyden and attended the lectures of Pitcairn and Hermann. Having visited Padua in 1695, he took his degree of doctor of philosophy and physic, and returning home, he settled at Stepney and practised physic with great success.

In 1703, Dr. Mead was elected a member of the Royal Society, of which Sir Isaac Newton was then President. The same year he was elected physician to St. Thomas's Hospital, and was also employed by the Surgeons to read anatomical lectures in their hall. In 1707 his Paduan diploma for Doctor of Physic was confirmed by the University of Oxford; and on the death of Dr. Radcliff, Mead enjoyed the most extensive practice of any physi-

Mead's theory.

introduction to the essay is somewhat mystical, and contains not a few unsubstantial hypotheses, but this fact in no way detracts from the value of the more practical portion of the work. Previous to the year 1700, the subject had engrossed the attention of Monsieur Charas and the Abbé Francesco Redi; the latter especially

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cian of his day. In 1727 he was made physician to George II. whom he had served in that capacity whilst he was Prince of Wales. During almost half a century he was at the head of his profession, and he was admired no less as a man than as a physician. His reputation, not only as a physician but as a scholar, was so universally established that he corresponded with the principal literati in Europe. This great physician, naturalist and antiquary died on the 16th of February 1754." (Vide Cyclopœdia Britannica).

Anecdotes of Mead.

The following anecdote is told of Mead. Woodward, the Professor of Physic at the Gresham College, having offered some insult to Mead, so infuriated him, that he drew his sword and ordered Woodward to defend himself—"The duel terminated in Mead's favour, as far as martial prowess was concerned, for he disarmed Woodward and ordered him to beg for his life.

'Never, till I am your patient,' answered Woodward, happily." (Vide "Doctors and Patients.")

For an interesting account of Dr. Mead, vide "A Book about Doctors," by J. Cordy Jeaffreson.

being very enthusiastic in the matter. The theory which Mead adopted was that "venomous animals, when they bite or sting, inflict a wound and instil into it a drop of liquor which infects the fluid of the nerves, and by this means inflames the membranes," etc. In fact, he thought that the poison did not act through the blood, but directly through the nervous system. It is owing to his having enunciated this theory that we find no mention of a ligature having been used before Kempfer recommended, and Fontana adopted, it. Regarding his theory, Mead says, "these experiments" (scanty and unsatisfactory to a degree) "upon the viper poison and the blood are a sufficient confirmation of what has been advanced in the introduction that the nervous liquor only is affected by this venom." After giving the symptoms, the severity of which, he states, depends on the climate, the season of the year, the greater or less rage of the viper, the size of the reptile and animal bitten, and the depth of the wound, he proceeds to explain why snakes live so long without food. On this point he observes, "owing to the length of time the process of digestion takes, and to the fact that the blood of the snake is a grosser

Severity of symptoms depends upon meterological and other conditions.

or more viscid fluid than that of most other animals, so that there is very little expense of it by transpiration, it is able to go without food for five or six months." Sir J. Fayrer kept a *Daboia* for one year without food or water, and it was vigorous, as regards its power to kill, up to the last. I have had one in my possession for seven months, and it has not partaken of either food or water during the whole time.

Mead's microscopic examination of snake-venom.

Mead's microscopic examination of snake-poison is most curious. He examined it in the following manner: "I have oftentimes, by holding a viper advantageously, and enraging it till it stuck out its teeth, made it bite upon somewhat solid so as to void its poison," which having put under the microscope, he proceeded to examine. "Upon first sight," he remarks, "I could see nothing but a parcel of small salts nimbly floating in the liquor; but in a very short time the appearance was changed and these saline particles were now shot out, as it were, into crystals of an incredible tenuity and sharpness, with something like knots here and there, from which they seemed to proceed, so that the whole texture did, in a manner, represent a spider's net, though infinitely finer and more minute; and yet so rigid were

these pellucid *spiculæ*, or darts, that they remained unaltered upon my glass for several months." What Mead really saw was nothing more nor less than the drying of the poison..

Source from which venom is derived.

One would have imagined that the source from which the position was derived could not have been very difficult to decide. It appears, however, to have been otherwise, for Mead tells us that he performed an experiment "with a view to the controversy between Redi in Italy and Charas in France." The former affirmed that "the venom of the viper lay in the yellow liquor of the gums." The latter, in opposition to this theory, espoused a notion, advanced first by Von Helmont, and "placed it altogether in the enraged spirits of the creature, calling this yellow liquor a pure innocent saliva," and citing experiments in proof of his theory. But, as Mead very rightly observes, "there is a great deal of difference in the success of the same experiments when faithfully and judiciouly made, and when they are cautiously and timorously managed, lest they should overthrow a darling hypothesis." Redi's conclusions were confirmed by Monsieur du Verney and Drs. Areskine and Mead.

Viper fat as an antidote.

The treatment recommended by Mead is suction of the wound, an emetic with oil and warm water, and *Axungia Viperinæ* or viper's fat. He did not believe in external management, "since it cannot prevent the sudden communication of the poison to the nerve." The following case in which suction of the wound was had recourse to, is well worth citing:—

"A man was bit on one of his fingers by a rattlesnake, just then brought over from Virginia. He immediately put his finger into his mouth and sucked the wound. His underlip and tongue were presently swelled to a great degree; he faltered in his speech, and in some measure lost his senses. He then drank a large quantity of oil" [a reputed antidote] "and warm water upon it, by which he vomited plentifully. A live pigeon was cut in two and applied to the finger. Two hours after this the flesh, about the wound was cut out and the part burnt with a hot iron, and the arm embrocated with warm oil. The man recovered."

Warm oil as a remedy.

The application of warm oil in cases of snake-bite appears to have enjoyed a great reputation in England, but the Physicians of the Royal Aca-

demy of Paris, after investigating the subject, pronounced the treatment ineffectual "any further than it might be a fomentation to the tumefied part." Mead attaches the greatest value to the *Axungia Viperinæ* or viper's fat, which was said to have been the remedy used by the English viper-catchers, from whom after a great deal of trouble, Mead obtained the secret. He gives two experiments with a view of proving its efficacy, but both are vague and unsatisfactory. He indulges in a very wild theory to account for the efficacy of the treatment. The "cordial remedies" recommended are "Confect Ralegh and the salt of vipers, or, in want of this, ammonia." It is believed by many, even in the present day, that the viper has about it the antidote to its own poison, and it was suggested to Sir Joseph Fayrer, by an American gentleman who found

Confect Ralegh and Ammonia.

*Since writing the above the following has come under my observation: "It is a common belief in many parts of South America— a country as besotted in superstitious observances and customs as Spain is—that the bite of the rattlesnake acts as a cure for elephantiasis. In one sense it may be said to be a specific for the disease, as all who have tried the remedy have died within a few hours of the experiment. The following case appears to have acted as a rude shock to the believers in the effi-

Tincture of spirit and crushed cobra recommended.

"that crushed centipede and spirit when applied to the part always cured the injury done by a centipede," that a tincture of spirit and cobra should be tried in cobra-bite.† The flesh of viper dressed as eels, was strongly recommended by Galen as a remedy for elephantiasis* (leprosy), and it is said that the flesh of the cobra was prescribed in Bengal for wasting diseases, and the

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cacy of the poison of the crotalus horridus. José Machada, aged fifty years, originally a fine athletic man, had been laid up in the hospital of Rio de Janeiro for four years with elephantiasis in a form which obstinately resisted all treatment. The disease extended all over his body, producing such loathsome disfigurement that the unfortunate man eventually resolved to embrace the alternative of subjecting his hand to the fang of the deadly snake. Accompanied by his medical attendants (a circumstance that will strike European practitioners with profound surprise), who had taken the precaution to secure a declaration in which the patient affirmed that he acted entirely of his own free-will and against their advice—the unfortunate man proceeded to a house in which a rattlesnake was kept caged. He put his hand to it and grasped the animal firmly, which immediately buried its fangs in his fingers, without, however, causing him any sensation of pain; a result no doubt, due to the disor-

The bite of the rattlesnake, a cure for elephantiasis.

† This treatment was put to the test, and, of course, failed.

physicians of Italy and France very commonly prescribed the broth and jelly of viper's flesh for the same uses. It appears also to have been given in England, for Mead observes "the patient ought to eat frequently of viper jelly, or rather as the ancient manner was to boil vipers and eat them like fish; or if the food will not go down (though really very good and delicious fare, to make use, at least, of wine in which dried vipers have been digested six or seven days in a gentle heat." This was actually an acknowledged preparation of the London Pharmacopœia. About the middle of the seventeenth century, physicians were in the habit of prescribing compounds which would scarcely be relished by patients in the present day. Charles II.'s physician in ordinary, Dr. Thomas

Viper-jelly.

Balsam of bats.

ganized condition of his tissues. This occurred at 11-50 a.m. In less than an hour the hand had swollen, and his sight had become dim, while the pulse increased in frequency. Soon there supervened acute pains, and the respiration became laboured, with hœmorrhages and excessive evacuation of urine. During the progress of the symptoms, little medical interference was attempted on the first day. He was given aqua ardente, the common spirit of the country, and made from the fermented juice of the sugarcane. He died next day at 11-30."—(Lancet, April 18th 1874.)

Sherley, recommended what he termed "Balsam of Bats" as a remedy for hypochondria; it was composed of "adders, bats, sucking-whelps, earth-worms, hog's greese, the marrow of a stag, and the thigh-bone of an ox." One would scarcely have thought that such a mixture was calculated to give one an appetite. (*Vide* "A Book about Doctors.") The Santhals, Dhangars, Burmese, and many natives of India partake of snakes as food.

Snakes as food.

Felix Fontana's researches.

For more than half a century the subject of snake-poisoning appears to have received little attention, but in 1776, Felix Fontana, naturalist to his Royal Highness the Grand Duke of Tuscany, and a very able man, published his researches. While it is true that Francesco Redi and Richard Mead were the pioneers of the subject, the value of their researches was nothing as compared with that of Fontana's. He wrote a most elaborate work setting forth the results of his numerous experiments. He performed "more than six thousand experiments, employed upwards of three thousand vipers and had bit more than four thousand animals."

Discovery of the poison-gland.

After entering into some anatomical questions regarding the fangs and the situation of the

poison-gland, he informs us that Mead, and after him, Dr. James, asserted that the true reservoir of the poison was the sheath which covered the fangs, but he very clearly shows the position of the poison "vesicle" which is found above and behind the fang. He asserts that the poison of the viper is not a poison to itself, and in this statement he is confirmed by more recent authorities.* Arguing from the fact "that certain substances are known to be poisonous to certain animals, whilst far from being hurtful to some others," he thought that the venom of the viper may not be a poison to all animals. "He made several experiments with a view of determining the point, and came to the conclusion that the poison was perfectly harmless to such cold-blooded animals as leeches, slugs, snails, and three kinds of innocent snakes. Regarding the effects of the poison on warm-blooded animals, he remarks, "I am not afraid to advance, that the venom of the viper is a poison to all warm-blooded animals." "There is not," he says, "a warm blood animal in all Italy that can withstand the effects of the poison."

The venom of the viper not poisonous to cold-blooded animals.

* As has been previously pointed out, Weir Mitchell is doubtful whether the rattlesnake cannot poison itself.

In the latter assertion recent authorities will concur, but certainly not in the former. An innocent snake succumbs to the poison of a venomous one as certainly as does a dog, though not so rapidly, by reason of its anatomical conformation.

Redi's viper-catcher Jacques.

A curious tale is told by Fontana, when discussing the taste of the venom. It appears that Redi had a viper-catcher named Jacques who boasted that he could swallow spoonfuls of the venom of the viper, and Redi declared that he had been seen to do so; he does not, however, assert that he was ever a witness to the fact. With all due deference to the memory of the late M. Jacques, one cannot place implicit confidence in his statements since he belonged to a class of men as celebrated for their tricks as the snake-charmers of Bengal. Very few people in India have not heard of an instance in which a snake-charmer has offered to let himself be bitten by one of his snakes, in order to demonstrate the value of a certain antidote he possesses; the snakes in all such cases have had the poison-gland removed previously, so that although wounds are caused if the animal bites, no poison can be injected. The old viper-catchers of Europe were in the habit of stop-

Tricks of old viper-catchers of Europe.

ping up the passage and hole in the poison fang with wax, from a similar motive. Some such deception was, no doubt, practised by the Psylli and Marsi, to whom I have previously alluded.

Fontana did not believe that the poison was absorbed by mucous membranes.* Schlegel, in his "Essai sur la Physionomie des Serpens," refers to the question. It has almost universally been held that the poison of snakes may be taken internally without any ill effects following, but Dr. Fayrer's experiments prove beyond doubt that the poison is not only absorbed, but sometimes proves fatal. I have made several experiments with a view to clearing up this point. I found that the poison kills if taken in large doses on an empty stomach. Schlegel says:—"*Appliqué sur la langue il produit des sensations semblables à celles produites par la graisse; on peut même, suivant Fontana, le prendre l'intérieur, sans que se déclarent les moindres conséquences facheuses, cette observation cependant a été récemment contredite par les expériences que le Docteur Hering a faites à Surinam sur la nature du venin d'un crotale muet. Ce voyageur, prenant à di-*

Schlegel's theory as to the poisonous nature of venom when taken internally.

* He subsequently altered his opinion, as was pointed out to me by a kindly critic in the *Pioneer*.

fferentes reprises des doses diverses de ce poison mélé avec de l'eau, en ressentait les effets pendant huit jours et plus; ils se manifestaient par des douleurs dans le larynx et dans d'autres parties du corps, par une sécrétion multipliée de mucus dans les membranes du nez et de l'œsophage, par une diarrhée fréquente accompagnée de douleurs dans le rectum, etc.; à ces symptomes s'en joignaient plusieurs autres assez curieux, dûs à l'influence que ce poison aurait, selon M. Hering, sur les facultés morales." Mead maintained, on perfectly insufficient grounds, that the poison would not kill if taken internally; firstly, because human saliva was an antidote; secondly, that if it should pass into the stomach and intestines, "the balsam of the bile will be an antidote there, powerful enough to overcome its force." Dr. Mead quotes Galen in support of his statement that the poison is inert when taken into the stomach, and further refers to Lucan, who introduces Cato when marching the remains of Pompey's army through Africa, very wisely telling the soldiers almost choked with thirst, yet afraid to drink of a spring they came to, because full of serpents—

"*Noxia serpentum est admisto sanguine pestis.*

Morsu virus habent, et fatum dente minantur
Pocula morte carent."

Fontana's criticisms. Fontana's criticisms of the different theories then advocated are instructive, and occasionally amusing. The first reviewed is the spontaneous-coagulation-of-the-blood theory, which he disposes of by asserting that the blood is sometimes found fluid, which was a sufficient bar to the acceptation of the theory. Strangely enough, however, this appears to be the theory which he attempted to establish in after years, though the objection which he here advanced still held good and was a sufficient refutation of it.* He

Melloni's theory. * Fontana is not singular in having advanced a theory that was incompatible with facts which he had previously demonstrated by experiments. Melloni, in his latter days, advocated a theory entirely opposed to results he obtained practically in former years. Miller says, "A consideration of the preceding facts led Melloni to expect that by a combination of screens which allow light of a given colour to pass, radiant heat may be arrested; and, in fact, he thus effected an apparent separation of light from heat. By transmitting the solar rays, first through a glass vessel filled with water which arrests the less refrangible rays, and then through a plate of a peculiar green glass tinged by means of oxide of copper, which stops the more refrangible rays, a greenish beam was obtained, which was concentrated

next deals with the hypothesis that the poison causes death by universal inflammation. He contended that *post mortem* appearances did not indicate anything of the kind. With reference to Mead's theory, he denies that any salts are to be found in snake-poison, and holds that what Mead saw under the microscope must have been a "kind of skin from the mouth of the snake" (*epithelium*) "which he himself occasionally observed." The celebrated De Buffon, on the other hand, maintained that the

De Buffon—Foreshadowing of the germ theory.

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by lenses, and furnished a greenish light of great intensity, but yet produced no perceptible heating action when it was allowed to fall upon the face of a sensitive thermoscope. A similar separation of light and heat seems to be effected in nature, in the light reflected by the moon. Melloni concentrated the rays of the moon by means of an excellent lens of a metre in diameter, and obtained a brilliant focus of light of one centimetre in diameter, the intensity of which consequently was nearly ten thousand times greater than that of the diffused light of the moon ; upon directing this focus of light upon the face of a very sensitive thermomultiplier, only an extremely feeble indication of heat was obtained." Miller adds in a foot-note, "Notwithstanding these results, Melloni maintained during the latter days of his life the identity of the agent which produces light and heat."

"salts" observed by Mead were "animalcules," on which the activity of the venom, as well as other active poisons, depends. This looks like something approximating to a belief in the germ theory of disease. Fontana, of course, flatly contradicts De Buffon and insists that nothing of the kind exists, a fact of which he satisfied himself by frequent and repeated experiments. He appeals to posterity in the following strong and forcible terms:—"How many are there who judge after others! We may include in this number all those who are not capable of immediately consulting nature; who prefer hypothesis to fact, and eloquence to truth; a severe and candid posterity will, without doubt, be astonished to find that there have been philosophers and naturalists in the eighteenth century, who, even in the most important particulars, have ventured to substitute conjecture to experiment, notwithstanding that the latter would have been made with as much ease, as it would have been decisive." Fontana, if alive, would be grieved to find that the world has not yet improved so much as he expected. What was a grievance in his day is equally a disgrace in the nineteenth century.

Appeal to posterity.

Fontana's theory of the destruction of muscular irritability.

Fontana at first originated the theory that death was caused by the direct destruction of the irritability of the muscles; his reasons for abandoning this theory will be referred to subsequently. He was of opinion that opium acted in a similar manner. He disputed the fact that snake-poison in any way acted on the nervous system, but even, supposing him "to be of another opinion, his discovery of the proximate cause of death would lose no part of its importance, for whether the poison operates immediately on the nervous fluid, or on the muscular fibres, it is not less true that it kills by depriving the animal of all motion, and the muscles of the power of contracting." He maintained that the irritability of the muscular fibres was destroyed, not only during life; but after death.

M. Sage on ammonia as an antidote.

In the year 1777, M. Sage, of the Academy of Sciences at Paris, published a pamphlet on advantages of the volatile alkali (ammonia) as an antidote in cases of snake-poisoning which was first recommended to the faculty by Jussieu. This mode of treatment appears to have been founded on Mead's theory that the active principle of the venom was an acid salt. Fontana had already condemned the treatment, but he

again performed a number of experiments before Dr. Troja, Member of the Royal Academy of Naples, and M. Jean Fabroni of Florence, and attached to the Cabinet of Natural History of the grand Duke of Tuscany. After performing numerous experiments he again condemned the ammonia as useless, if not positively hurtful. The sentiments he then expressed may safely be repeated here. He observes, "I place the greatest importance on repeated experiments for I know of what weight the prejudice for a favourite hypothesis, and the authority of a celebrated writer are." It is more difficult to uproot error, than to establish truth, especially when the scientific reputation of an "authority" is at stake; every man may err, but more especially he who has some pet theory either to defend or to establish.

Fontana disputes the position.

Fontana was under the impression that the skin was the principal agent in the absorption of the poison, that is to say, the cut edges of the skin. This is, however, erroneous; the poison is absorbed while lying in the areolar tissue, and frequently, as in the bite of the *daboia*, the poison is injected into the muscles. Fontana declares, notwithstanding his former

The skin, the principal agent in the absorption of the poison.

Fontana wrongly concludes that the conjunctiva does not absorb venom.

theory, that in the event of the poison being injected directly into a muscle, it is never fatal. The experiments he cites to prove this are full of fallacies. Fontana made several experiments on various parts of the body, and came to the mistaken opinion that the conjunctiva does not absorb the poison. Sir J. Fayrer has demonstrated, and I have also observed, that the poison is not only absorbed, but is frequently fatal. He took a great deal of trouble to prove that the venom of the Viper was neutral. Mead first, and Dr. James, Cantor, Laidlay, and Dr. Harlan subsequently, asserted that the poison was acid: Fontana, Russell, and Schlegel, on the contrary, declared it was neutral. The fact is, as I have found by numerous experiments, that the fresh poisen is acid, and that which has been kept for a few hours is usually neutral.

Dispute as to the acidity of the venom.

Quantity of venom shed at one bite.

Although the measures taken by Fontana to ascertain the quantity of poison that must be injected to kill, were clumsy, owing to the want of appliances, the results obtained by him pretty nearly correspond with those obtained by me. His deductions, however, are somewhat wide of the mark. He found that the thousandth part of a grain of viper's venom would kill a sparrow,

and, taking this as a basis of calculation, he concluded that not less than twelve grains would kill an ox, and two and a half grains a man. As a fact, three grains are fatal to an ox, and one grain to one grain and a half would, I believe, be sufficient to kill a man, though six grains are sometimes shed at one bite of a cobra. I do not think that the poison of the larger vipers and that of the Colubrine snakes, differ much in strength, quantity for quantity; the difference, if any, would, of course, be in favour of that of the Colubrine snakes.

While the average amount of poison possessed by a cobra is about two and a half to three grains, though it may be either more or less, the average amount possessed by many other snakes is not more than half a grain, sufficient to prove fatal to a child, and to give rise to serious, though, perhaps, not fatal, symptoms in a man. Here, then, we have one of the reasons of the favourable reputation of so many useless remedies.

The only fair test of an antidote.

It must now be acknowledged that the only fair test of any antidote to snake-poisoning in

the lower animals is the employment of the dried poison in the smallest fatal dose, whereby plenty of time is afforded the remedy to manifest its effects.

The following are Fontana's deductions regarding the physiological action of the poison, and they are well worthy of notice.

Fontana's views as to the physiological action of venom.

First, he asserts, that the poison has no direct action upon the nerves—that they neither are affected, nor are they the vehicle by which any change is wrought in the animal. On the other hand, it is proved, that the blood is the medium by which the body is affected. He, however, considered that the changes were on the blood alone, and that death was the result of its spontaneous coagulation. This theory is opposed to facts, as he himself states in the first part of his work. The heart, he says, is the last affected. This is certainly true, for the fact has been clearly demonstrated by more recent investigations.

He modifies his theory.

He modifies his theory regarding the effect of the poison on muscular irritability, and states: "I did not know when I wrote the first part of this work that the venom of the viper has no

action on the nerves, and that, when it is introduced into the blood, it kills an animal in a few instants. It is not that in effect the irritability is not diminished in the animal that has been bit, and that it is not even destroyed in a little time, but this is rather an effect than a cause, and is a consequence of the change caused in the blood by the venom rather than an effect of the venom on the muscular fibres."

Effects of viper venom on the blood.

There is an undoubted change in the blood (if only mechanical by the presence of the venom), but this change is certainly not spontaneous coagulation. On the contrary, the blood is generally found fluid.* And although the venom may not act on an exposed sciatic nerve, because it is not capable of absorbing the position, still it is quite different when the fluid on which this nerve depends for its vitality, is radically altered. Moreover, Fontana's experiments on the spinal cord seem to indicate that the poison certainly has some direct action on the nerve-centres, and from experiments made by Fayrer and Brunton, they were of opinion that, on the one hand, the poison acts through the blood on the great nerve-centres, peripheries,

* This subject is dealt with more fully further on.

and even the muscles themselves, leading to paralysis of the muscles of respiration, etc., and consequent death by asphyxia; and on the other hand, through the blood on the heart, causing it to cease to act in systole* these different results being dependent on the quantity of poison injected, and the manner of its injection.

Fontana on the intravenous injection of ammonia.

The treatment that has enjoyed such a reputation in Australia, and which is generally believed to have originated with Dr. Halford, was in great repute in Italy nearly a century ago, as the following extract from a letter† from Fontana to M. Gibelin will show:—

"It is very true that our Italian journals report cures by *ammonia injected into the veins of persons bitten by the vipers:* and it is also true that these cases partake of the marvellous, and almost of the miraculous. It appears, moreover, that certain individuals have had great pleasure in assuring the public that a true specific against the poison has been discovered, that which I had sought in vain for many years, and which with philosophical candour I had declared

* There appear to be very good grounds for doubting whether cobra-poison ever acts on the heart in this way.

† *Medical Times and Gazette*, August 23rd, 1873.

the inutility of searching for. I must confess that it did not occur to me that I should find a remedy in Medicinâ Infusoria." Fontana made some experiments and found the treatment unsuccessful.

Dr Patrick Russell's experiments.

The subject of snake-poisoning attracted the attention of Dr. Patrick Russell in 1796. His book, which was published by the Court of Directors of the East India Company, contains drawings and descriptions of several snakes, venomous and non-venomous, but principally of the latter. Dr. Russell performed a number of experiments with kraits, cobras, daboias, and the Trimeresurus virid, but there is little of importance to notice. He brought the famous Tanjore pill very prominently before the public, but it does not appear that he placed much faith in its efficacy. He does not seem to have been very favorably impressed by the knowledge of the subject possessed by the members of his profession. He says : "It was matter of surprise as well as of regret, to find so little known on the medical history of serpents in a country where much might have been reasonably expected. Numbers of stories, it is true, were to be met with, of the fatal effects, as well as of singular cures of venomous bites. But such were in general related from

Dr. Russell reads his brother professionals a lesson.

memory; the progress of the disease and succession of symptoms, had either not been attended to or were indistinctly recollected; the same story told at different times was found to vary in material circumstances, and the marvellous too often found place in the narrative. It is, therefore, to be wished that the medical gentlemen in India would in future bestow more attention on this subject than appears to have been done hitherto.* Besides the Tanjore pill Dr. Russell recommends either immediate amputation or the ligature.

e mangoose loses his reputation.

An impression prevails that the mangoose is proof against the poison of the cobra, but Fayrer has shown that this animal succumbs to the bite of a cobra as certainly as does any other animal. The mangoose, if left to itself to attack a snake, will invariably come off the victor, but if pushed on to the snake to make them fight, will probably be fatally bitten, as is recorded in a case by Russell.

A mangoose was made to approach a "katuka rekula poda"—Daboia—and was accidently forced

* Medical men do not even now know as much as they ought as regards snakes. It is within my own knowledge that a poor wretch lost his life by amputation for the bite of an innocent snake.

too near when the snake bit it on the shoulder, upon which "it seized the snake by the neck and held fast for fifteen seconds, the snake all the while wreathing round the mangoose's limbs. The instant they were separated, the mangoose fell down on its side as if dead." It died in two hours and a quarter, and the snake in eight hours.

I have not seen it recorded that the mangoose gnaws out the fangs of the snake, but it is a fact, and has been witnessed by several gentlemen. *

The Mangoose and Cobra—a fight.

A mangoose was let loose in a room with a cobra. The latter was gliding about the room, when the mangoose went cautiously up to it, and slightly touched it with its nose ; the snake hissed gently, lifted its head, but still went gliding on. The mangoose again followed as if determined to make the snake lift its head, for the mangoose is far too wise to attack the snake while its head is on the ground. The snake at once turned round, balanced itself to strike and began hissing; it darted two or three times, the little mangoose just stepping on one side to avoid the blow, its eyes fixed intently on the enemy, its nose pointed and nostrils expanded, and hair

* This has since been confirmed by Wall.

bristling, watching for an opportunity to make a rush and seize the snake. This skirmishing went on for some time; the snake at last made a dart, but before it could recover itself was seized by the back of the neck by the mangoose, which immediately proceeded to *gnaw out the fangs on both sides.* It then gave the snake two or three shakes and let it go, again returning to the attack when the snake lifted its head, and so on until the snake was nearly killed. As I have before observed, this was witnessed by several gentlemen to whom I afterwards showed the wounds caused by the gnawing out of the fangs. This was witnessed twice afterwards.

Russell is in error in stating that all cobra-poison is exactly alike in appearance. The spectacled cobra which lives in dry places has viscid amber-coloured poison, while the keuntiah cobra, which is generally found in paddy fields, has a light-colored watery poison.

Mr. Boag advocates Fontana's treatment.

In the year 1799, we find Mr. Boag not only advocating the Abbé Fontana's treatment of snake-poisoning by the administration of nitrate of silver and nitric acid baths, but attempting to establish a theory whereby to account for the efficacy of the treatment. After telling us it

would be an endless and unprofitable task to enumerate all the remedies that have from time to time been recommended, he details several which he considers the most worthy of notice. Amongst these he mentions human saliva which, "as we are informed by Seneca and the elder Pliny," enjoyed considerable reputation as a remedy in viper-bite. He also refers to the snake-root recommended in both India and America. Ammonia which had been in great repute had apparently lost ground, as it was then pretty generally aknowledged that it possessed no specific power, its only action being to stimulate the heart and vascular system to a more vigorous action, and, moreover, this stimulation was only temporary. These views thoroughly coincide with those of more recent authorities who have had experience in the matter. Arsenic is condemned as producing very violent results, and, therefore, being liable to cause death. The only cases in which Mr. Boag considered it might be employed were the more desperate ones. Mercury is spoken of as deserving of trial, as "much good might be anticipated from its use," though it should be given in a more convenient form than was then prescribed.

Ammonia had lost ground.

Mr. Boag's theory.

Mr. Boag's theory was that the venom subtracted the oxygen of the blood, so leading to death, and he founds this theory on four arguments as he terms them; with some of which, however, it is difficult to concur. These four arguments are:—

1*st.*—"Man, and other warm-blooded animals, exposed to an atmosphere deprived of oxygen, quickly expire. The poison of a serpent, when introduced into the blood, also causes death, but carried into circulation by a wound, and in very small quantity, its operation is comparatively slow and gradual."

2*nd.*—"The appearances on dissection in both cases are very similar, the blood becomes of a darker colour, and coagulates about the heart and large vessels, the irritability of the fibres is nearly in the same degree destroyed, and the body has a strong tendency, in both instances, to putrescency."

3*rd.*—"Dr. Mead mixed the venom of the viper, and healthy blood together out of the body, and he did not perceive that it produced any change in its appearance; this arose from his mixing a small quantity of the venom with a large

quantity of the blood, but if two or three drops of venom be mixed with forty or fifty drops of blood, it immediately loses its vermilion colour, becomes black, and incapable of coagulation."

4th.—"It is a very remarkable circumstance that the poison of the serpent has most power over those animals whose blood is the warmest, and the action of whose heart is the most lively; while, on the contrary, it is not a poison to the snake itself, nor in general to cold-blooded animals. The reason appears to be this; cold-blooded animals do not require a large quantity of oxygen to preserve them in health, this is evident from the conformation of their heart, and respiratory organs, as already mentioned."

Therefore, as I have before pointed out, Mr. Boag concludes that death from snake-bite simply arises from the abstraction of the oxygen from the blood.

The first argument requires no special notice, but the second contains inaccuracies; the blood may or may not coagulate in cases of snake-poisoning, and it certainly does not generally coagulate about the heart and larger vessels, nor is there usually, in my experience, any par-

ticular tendency to rapid putrefaction in snake-poisoning;* not that I attach much value to the fact, nor do I believe that *general* decomposition is particularly rapid after death from suffocation. It is true that blood remains fluid if mixed with a large quantity of snake-poison, but it must be remembered that in the human body the relative dilution is not three to fifty, but perhaps two to nine thousand six hundred. The question of the condition of the blood as regards fluidity is not, however, of much importance except from a medico-legal point of view. It is remarkable fact that while the blood of a dog poisoned by venom coagulates after death, that of a human being remains permanently fluid.

Mr. Boag's theory criticised.

The fourth argument is most remarkable. Mr. Boag observes that a poisonous snake is protected from the effects of its own poison, by its physical conformation, which enables the animal to live with a very small amount of oxygen. Unfortunately for this argument, however, venomous and non-venomous snakes do not differ anatomically, and yet the venom of the former will kill the latter. Mr. Boag

* I am aware that a few cases have been reported.

is also in error in stating that the poison is not generally fatal to cold-blooded animals. Although its action is, of course, somewhat slower, it is none the less fatal. I would not be understood to mean that de-oxidation of the blood to some extent is not a result of snake-poisoning—I believe it is—but that it is not the cause of death.

The treatment Mr. Boag recommends is interesting. The principle is the speedy oxygenation of the system, and the means to this end are the following :—

Suction.

"External treatment," which may be divided into local and general; first, suction of the wound as recommended by Celsus. This measure should not be omitted, though Mr. Boag does not think it is very successful. Mr. Boag evidently believed with Celsus that this proceeding can be adopted with perfect safety to the operator; but that it is not so, has been proved by Fayrer and others; undoubtedly, the risk is slight, but still it exists.

Ligature and Scarification.

The next measures are the ligature and scarification of the wound, which should then be washed with a weak solution of lunar caustic

and water, a warm bath acidulated with nitric acid just sufficiently to irritate the skin. This bath should be continued at intervals. And lastly, the administration of nitrate of silver in half-grain doses, and "a more highly oxygenated atmosphere might be breathed by means of a pneumatic apparatus adapted for the purpose, as recommended by Dr. Beddoes."†

Artificial respiration.

Curiously enough, after recommending the above, Mr. Boag made some experiments, every one unsuccessful. And yet we find him stating that "I am of opinion that the method of cure mentioned in the foregoing essay is most rational, and the most likely to succeed in preventing death, as well as the other bad consequences which sometimes follow the bite of a serpent that is not mortal."

It is difficult to understand on what grounds Mr. Boag comes to a conclusion so directly opposed to the result of his experiments.

In 1801, the ammonia treatment again found an advocate in Mr. John Williams. He evidently was a staunch believer in its efficacy, as he observes: "The following statement of facts

Mr. John Williams advocates ammonia.

† Artificial respiration (*vide* Chapter III.)

relative to the cure of persons bitten by snakes, selected from a number of cases which have come within my own knowledge, requires no prefatory introduction, as it points out the means of obtaining the greatest self-gratification the human mind is capable of experiencing, that of the preservation of the life of a fellow creature, and snatching him from the jaws of death, by a method which every person is capable of availing himself of." Professor Halford could not have written in a more laudatory tone of the system of treatment he has so persistently advocated. As no system of treatment is complete without a theory, Mr. Williams stirs one up from the depths of his imagination, which, though somewhat weak and obscure, is still a theory. He observes that, "as the poison diffuses itself over the body by the returning venous blood, "as proved by the effects of a ligature placed between the wound and heart, destroying the irritability and rendering the system paralytic, it is probable that volatile caustic alkali, in resisting the disease of the poison, does not act so much as a specific in destroying its quality, as by counteracting the effect on the system, by stimulating the fibres,

Mr. Williams' theory.

and preserving that irritability which it tends to destroy."

In other words, the ammonia does not act chemically upon the poison, but it counteracts its effects physiologically. What these effects are, and how the ammonia counteracts them, Mr. Williams does not inform us.

He then gives seven cases, of which only one terminated fatally.

Mr. Williams' cases.

The first case was only a supposed case of snake-bite. The second was that of "an old woman of the Brahman caste, who was bitten between the thumb and finger, by a cobra." She became "speechless and convulsed, with locked jaws, and a profuse discharge of saliva running from the mouth." Mr. Williams gave her two drachms of "volatile caustic alkali spirit, when she evidently got better" and "perfectly recovered in about half an hour. The Brahman of the house would not allow the snake to be killed."†

The third case is not deserving of notice.

The fourth case is the following:—"In July 1784, the wife of a servant of mine was bitten by

† This superstition has already been referred to.

a cobra di capello on the outside of the little toe of her right foot. In a few minutes she became convulsed, particularly about the jaws and throat, with continued gnashing of the teeth. She at first complained of a numbness extending from the wound upwards, but no ligature was applied to the limb. About sixty drops of the volatile caustic alkali spirit were given to her in water, by forcing open her mouth which was strongly convulsed: in about seven minutes the dose was repeated, when the convulsions left her, and in three more she became sensible and spoke to those who attended her. A few drops of spirit had also been applied to the wound. The snake was killed and brought to me, which proved to be a cobra di capello."

The other cases are equally wonderful, except the last, which terminated fatally!

Dr Macrae again advocates the ammonia treatment.

The administration of ammonia was again advocated in 1809, by Dr. Macrae, who was himself bitten by a cobra; he took "thirteen spoonfuls of the ammonia."

In 1825, Mr. Breton performed a series of experiments with the cobra, daboia, and bungarus fasciatus, and arrived at the following conclusions:—

Firstly.—"Although the effect of the venom of a serpent may be for several hours very evident, an animal is capable, without any remedy whatever, of surviving its action; for the day after being bitten, the dog remained several hours apparently in a dying state, but in the course of the following day recovered perfectly."

Secondly.—"After the first or second emission of the poison, it becomes too weak to destroy even a whelp three parts grown."

Mr. Breton's experiments.

Here Mr. Breton has mistaken the quantity for the quality; it is not that the poison is *too weak*, but the quantity *too small*. But we have instances on record in which several dogs have been killed in succession by one cobra, and a case is cited by Dr. Chevers, in which three men died, and one became much affected by the bites of one krait.

Thirdly.—"An innoxious snake can be killed by the venom of a poisonous snake."

Fourthly.—"Rabbits and pigeons are killed in two or three minutes, and full-grown dogs in fifteen or twenty."

Fifthly.—"A poisonous snake is unsusceptible of the poison of another snake."

Mr. Breton was evidently a very careful observer.

Dr. Butter recommends opium as an antidote.

Vol. II. of the "Medical and Physical Transactions of the Calcutta Society," contains an article "On the treatment of persons bitten by venomous snakes," by Donald Butter, Esq., M.D. The author had such faith in his mode of treatment that he reprinted his paper and circulated it gratis. After referring briefly to the essays by Messrs. Williams and Boag, he says: "As I thought it probable that some of my professional brethren, who have had opportunities of seeing such cases, might have been in the habit of employing a more active treatment, I endeavoured, in a letter printed in the Calcutta *John Bull* of the 20th October 1823, to draw their attention to the general advantage which would arise from a publication of the results of their practice." To the letter there appears to have been little response by the medical profession. Dr. Butter recommends the administration of opium, brandy, and sulphuric æther, and this treatment is founded on the hypothesis that the heart and arterial system are principally affected. It will be seen hereafter that this theory is altogether untenable, and that the main action of the venom of the cobra is upon the respiratory centres. This plan of treatment appears to have been advo-

cated by Mr. Latta. Dr. Butter, besides recommending extreme caution, also speaks favourably of the use of the ligature, dry-cupping, and suction of the wound. I have tested the efficacy of this treatment on the lower animals, but found it as unsuccessful as Fontana did nearly a hundred years ago. Dr. Butter admits that the species of snake "was ascertained in one or two instances only," but *supposes* they were cobras. The following case, quoted by Dr. Butter, is interesting, but some of the symptoms, so far as they are described, appear to be more the result of the treatment than the effects of snake-poisoning.

The case is as follows:—

Dr. Butter's supposed cases of snake-poisoning.

"*April* 22*nd*, 1825.—Soobhan Khan, *Sipahee*, 6th Company, Goruckhpore Light Infantry, aged about 18 years. About 55 minutes after midnight bitten in the left instep and shin by a snake, *supposed* (the italics are mine) from its size to be a cobra de capello, at one o'clock five minutes A.M., and when brought to me, was speechless and insensible, but had the power of moving his legs. Ligature instantly applied, and R. Opii drachm one, with brandy ounce one, and spirit menth. pip.

ten minims, administered; pulse hardly perceptible either in the heart or arteries; surface cold, made to walk about between two men. At 1-10 minutes, heat and circulation returning. At 1-15 minutes, syncope. Gave a second dose as above, soon after which circulation again returned, and at 1-20 minutes he was perfectly well, and described very clearly the manner in which the accident happened. He now walked about unassisted; and at 1-35 minutes, half an hour after he took the first dose, I removed the ligature as I had been in the habit of doing when the patients had completely recovered. At 1-40 minutes he suddenly fainted; ligature was instantly re-applied, and a third dose, as above, given, and the wounds well washed with hot water. Circulation still continuing very weak, with foaming at the mouth, occasional syncope, and convulsive twitches of the arms; at 1-45 minutes a fourth, and at 2 A.M. a fifth dose, all in the above proportions, were given; after which he rapidly recovered from all symptoms of collapse, but still complained of giddiness, which I now ascribed to the medicines, as his pulse was full and regular" (evidently the man was becoming intoxicated). "His wounds were again well washed with hot

water, and at about 3 A.M. he became slightly delirious" (intoxicated ?) "his imagination being haunted with the idea of a snake coming to attack him." This youth took five hundred minims of tincture of opium. Dr. Butter concludes by stating that he gave the man three ounces of Epsom salts. As far as one can judge from the description, I must admit that this case is as unlike a genuine case of snake-poisoning as any I have ever seen or read. Dr. Butter, after trial, condemns Mr. Williams' treatment, the administration of ammonia, which was said by him never to fail, as being sound in principle, but unsuccessful in practice. While it is true that the natives of India suppose that opium-eaters are more proof against snake-poison than other people, there can be no doubt, from recent experiments carried on in the most systematic manner, that the drug is useless in cases of snake-poisoning.

Recurrence of pain in bitten part.

A curious effect is said sometimes to follow the bite of a snake:—"In 1855 Mr. Souberran published the case of a gentleman who, having been bitten by a viper in the year 1849, asserted that he still experienced *attacks of rather severe pain in the arm bitten*, with sensations of lassi-

tude and malaise, these *symptoms recurring every year in the month of April,* and lasting a month."

Dr. Demeurat relates the following instance of a similar occurrence:—" A woman was bitten by a viper in the right forearm, on the 28th May 1824. She suffered at the time from nausea and vomiting, headache and chilliness. The arm also became swollen, and a dark red patch, covered by a large bleb, formed at the spot which was bitten. This affection extended across the forearm, and a large quantity of serosity exuded daily from the furrows between the bullœ. Beneath the raised epidermis was a thick false membrane. After eighteen months this membrane became black and dry, and the woman tore it off in one piece. The skin beneath was red, but soon recovered its healthy appearance. This was in November 1826. The next year, on May the 28th, the eruption returned, and continued till November. These *phenomena repeat themselves each year, commencing about the same day.*" Dr. Demeurat does not say that he, himself, witnessed the phenomena. (" Year Book of Medicine and Surgery," 1863.)

Recurrence of peculiar signs after viper-bite.

This annual recurrence of symptoms does not appear to be confined to cases of snake-bite, as

Livingstone's case.

Livingstone ("Missionary Travels and Researches in South Africa") mentions a case of the bite of a lion, in which it occurred. Livingstone says, after describing a fight with a lion, in which he took the most prominent part, "a wound from this animal's teeth resembles a gunshot wound; it is generally followed by a great deal of sloughing and discharge, and pains are felt in the part periodically ever afterwards. I had on a tartan jacket on the occasion, and I believe that it wiped off all the virus from the teeth that pierced the flesh, for my two companions in this affray have both suffered from the peculiar pains, while I have escaped with only the inconvenience of a false joint in my limb. The man whose shoulder was wounded, showed me *his wound actually burst forth afresh on the same month of the following year.* This curious point deserves the attention of inquirers."

Snake-stones.

The famous snake-stone has long been in repute in Asia, but it was never credited with any efficacy in cases of viper-bite in Europe. In 1662, some specimens were taken from India by three Franciscan friars and deposited in the museum of the Grand Duke of Tuscany, where they came under the notice of Redi. It was believed that

the stone was found in the head of a snake. Taverini and Kempfer, however, considered it to be an artificial fabrication. Dr. Alexander Stuart stated (1749-50) that it was made of the burnt bones of the small buffalo. Captain Herbert says he obtained one from the people of Jowalins, who said it was found with detritus in the valley of the Satlej. Calculi taken from the stomach and intestines of different animals are sometimes used as snake-stones. There are, no doubt, many kinds, all equally useless.*

Dr. Davy's researches.

Dr. Davy, in 1839, published an account of some experiments he performed with some of the poisonous snakes of Ceylon (" *Physiological and Anatomical Researches*"); and in his " conclusions and general remarks" points out that

Snake-stones.

* Dr. Davy truly says :—"Too often, medicines have got into repute as antidotes from being given in slight cases in which recovery would have taken place without medical treatment,—beneficial changes that were due merely to the preservative powers of the constitution. The reputation that many Indian medicines, and especially that snake-stones have acquired, affords striking proof of the preceding remarks : of three different kinds of these stones which I have examined, one consisted of partially burnt bone, another of chalk, and the third principally of average matter ; this last resembled a

"the principal seat of the diseased action is the lungs," but he appeared to think that this action is confined to cases of viper snake-bite. He believed that the virus of colubrine-snakes acts primarily and principally on the blood and muscles, tending to coagulate the former and convulse and paralyze the latter. He was erroneously of opinion that the bite of the daboia is generally more dangerous than that of the cobra.

In 1874 I wrote:—

"At no period has the subject of snake-poisoning received so much attention as it has during the past eight or ten years. Drs. Fayrer and Shortt in India, Dr. Weir Mitchell in America, Dr. Halford in Australia, and Dr. Brunton—in conjunction with Dr. Fayrer—in England, have all been labouring in the hope of finding that which has baffled the ingenuity of ages, and

bezoar. All of them (excepting the first, possessed of a slight absorbent power) were quite inert, and incapable of having any effect, exclusive of that which they might produce, as superstitious medicines, on the imagination of a patient." The first kind of stone referred to by Dr. Davy was manufactured by the monks of Manilla, who carried on a lucrative trade in them with Indian merchants.

which, if found, would be an inestimable boon to mankind. Although no antidote has been discovered, much good work has lately been done as regards the physiological action of the poison, and if there be in existence a remedy, the more intimately we become acquainted with the *modus operandi* of snake-poison, the more likely are our efforts to be crowned with success.

Fayrer and Brunton's theory.

"According to Drs. Fayrer and Brunton, who lately read an exhaustive paper on the subject before the Royal Society, the poison may kill in either of four ways: *

"*Firstly.*—By tetanizing the heart, and so stopping the circulation of the blood.

"*Secondly.*—By paralyzing the muscles of respiration, and so giving rise to asphyxia.

"*Thirdly.*—By a combination of the two former conditions.

"*Fourthly.*—By giving rise to *septicæmia.*

"It is much to be regretted that some experimenters have so unwisely advocated, and in the strongest terms, a certain treatment which

* Afterwards modified, as will be learnt subsequently.

has not stood the test of an impartial investigation; and it seems difficult to understand, granting them honesty of purpose and common-sense, how they could have arrived at conclusions so diametrically opposed to facts.

"I am not at liberty to enter more fully into an account of the theories, &c., of the more recent experimenters, as I should be anticipating the report of the Commission appointed by Government, of which I am a member. I hope, however, that this humble attempt to put into a concise form all the available literature of the subject, will be a means of saving future investigators from falling into the very common error of advocating and expounding exploded theories, and perpetuating exposed fallacies."

CHAPTER III.

The researches of Brunton and Fayrer, and Weir Mitchell—The Indian Snake-poison Commission—Artificial respiration—Experiments with Australian snakes—Mr. Pedler's analysis—Cunningham and Lewis's microscopic examination—Chevers on the effects of venom on the blood—Dr. A. J. Wall's investigations—Symptoms of cobra-poisoning resemble those of glosso-laryngeal paralysis—Daboia-poisoning, symptoms of; compared with those of cobra-poisoning—Wall on the venom of the rattlesnake.

The researches of Brunton and Fayrer, and Weir Mitchell.

THE researches are now brought down to the time when Fayrer and Brunton were presenting their valuable series of papers, on the physiological action of snake-venoms, to the Royal Society of England. Dr. Weir Mitchell, of Philadelphia, had already finished and published his elaborate essay on the venom of the rattlesnake. It

would be impossible to do justice to those researches within the space at my command, but I will indicate their main features and results.

Constitutional and other effects of cobra-poisoning and daboia-poisoning compared.

Brunton and Fayrer considered there was little difference between the constitutional symptoms of daboia-poisoning and cobra-poisoning. The principal difference was said to be the more extensive local injury inflicted by the bite of the daboia. Sir Joseph Fayrer must have subsequently modified his views in this matter, as will be seen hereafter.

Effects of re-agents, &c.

As regards the effects of re-agents, &c., on the action of the venom, Brunton and Fayrer say it is not destroyed, and is scarcely impaired by

Drying.

drying. This had already been conclusively proved by Weir Mitchell and others. The local action of the venom is, however, altered by the process, the specific inflammation being much less

Dilution.

extensive. Dilution has no effect in lessening the activity of the venom, except so far as it retards absorption.

Alcohol.

They further held that an alcoholic extract possesses similar properties to the poison itself. I have since shewn, and been confirmed by Wall, that that is an error. The poisonous elements of

the venom are not soluble in absolute alcohol. Weir Mitchell confirms my view as regards the venom of the rattlesnake.

Liq. potassæ and liq. ammoniæ.

Brunton and Fayrer held that admixture with liq. ammoniæ and liq. potassæ did not alter the effects of the poison. Sir Joseph Fayrer subsequently altered his opinion (I think erroneously) as regards the effects of the admixture with liq. potassæ. I performed several experiments to elucidate this point, in connection with the permanganate of potash question.

Effects of the venom on the muscles.

Weir Mitchell states that quivering of the muscles is due to the direct influence of the venom of the crotalus upon the ultimate sarcous elements. No quivering of the kind has been noticed by Brunton, Fayrer, Wall, or myself. He further observes that muscular irritability is lost sooner than usual in crotalus-poisoning. The same has been observed with regard to cobra-poisoning, by Brunton and Fayrer. Nevertheless, muscular irritability after death from snake-poisoning does occasionally exist for some time.

Ultimate effects of venom on the muscles.

Dr. Mitchell says that in every instance venom softened muscle in proportion to the length of time during which it remained in contact with it.

The wounded muscle became almost diffluent, and assumed a dark color and somewhat jelly-like appearance. The same change has been noticed by Brunton and Fayrer in some cases of cobra-poisoning. It is in daboia-bite, however, that it is more particularly observed. According to Weir Mitchell, in most of the cases of acute poisoning, the rhythm and force of the heart became affected before the respiration was suspended, and the organ continued to pulsate more or less perfectly for some time after all voluntary and reflex motion had ceased. The constant arterial pressure undergoes a rapid and singular diminution. "It is proper to add that, in some instances of death, in rabbits, for example, artificial respiration failed almost totally to sustain the cardiac power, but even in these the heart remained irritable to direct stimulus, and there was, consequently, no such thorough paralysis of the sarcous elements as is seen in some other poisoning." Fayrer and Brunton point out that in cobra-poisoning, in what may be called sub-acute cases, the fatal issue is not to be attributed to any failure of the circulatory apparatus, since the heart often continues to beat for some considerable time after all reflex action has ceased.

Effects on the heart.

The Indian Snake Commission give many examples of this, and shew conclusively that the action of the poison upon the heart is commensurate with the amount of poison absorbed. Thus, when the animals operated on were bitten, the average time from the bite to the commencement of artificial respiration, was forty-two minutes, and from the commencement of artificial respiration to the period of death, ten hours forty-one minutes. When half the quantity of virus ordinarily ejected was hypodermically injected into an animal, the average time from the injection to the commencement of artificial respiration, was one hour ten minutes, and from this to death, seventeen hours forty-four minutes. Again, when only half a grain of cobra-poison was hypodermically injected, the time from injection to commencement of artificial respiration, was two hours forty-five minutes, and from that period to death, twenty-six hours eighteen minutes; and lastly, when $\frac{1}{4}$ of a grain was injected, the time from injection to artificial respiration was four hours two minutes; and from the commencement of artificial respiration to death, thirty-seven hours fifty minutes. According to Brunton and Fayrer cases do occur in which the heart is principally

affected,—when an overwhelming dose of poison is injected into the areolar tissue or directly into a vein. The heart then is said to stop in systole. This is, however, very questionable.

Action of venom on the capillary system.

There is either a distinct difference in the action of the venom of the crotalus and that of the cobra, or some error of observation, since the observations of Mitchell and those of Brunton and Fayrer exhibit a material discrepancy. While Mitchell states that no increase of pressure followed the introduction of venom into the system, therefore it exerts no marked influence in contracting the capillaries, an experiment made by Fayrer and Brunton shews that the pressure did rise considerably, on the injection of the poison into a vein; and they remark—"The fact that the blood-pressure sank slowly and did not fall below 30 even after the heart had almost entirely ceased shows that the arterioles were much contracted." In Mitchell's experiment the difference fell in three minutes from 16 mm. to 4 mm. representing a diminution of 10 mm. five minutes after the infliction of the bite of the snake.

Action of venom upon intestinal movement.

Weir Mitchell found that the motions of the intestinal canal were in no way affected. This assertion applies equally in cases of cobra-bite.

Indeed, Brunton and Fayrer affirm that they are quickened. I have constantly observed this fact in the course of the conduct of my experiments. Weir Mitchell examined the cilia from the mucous membrane of the throat of a frog; their activity appeared to be undisturbed in both acute and chronic poisoning. Brunton and Fayrer found that their activity was generally, though not invariably, arrested by cobra-poison.

Action of venom on ciliary movement.

The poison has no direct influence on the nerves, as was proved by the application of venom to the exposed sciatic nerve.

Action of viper-venom on the nervous system.

Dr. Weir Mitchell states that in crotalus-poisoning the loss of nervous power commences in the nerve centres, but whether the sensory nerves are or are not affected, is difficult to determine. The motor nerves are not affected. In cobra-poisoning Fayrer and Brunton assert that the grey matter of the spinal column is paralyzed, but that the white sensory columns remain intact; further, that while the motor nerves are sometimes unaffected, they are often completely paralyzed, or at least are so far deadened that they no longer transmit to the muscles (such as those of respiration) the ordi-

Action of venom upon the sensory and motor nerves, and upon the nerve centres.

nary stimuli from the medulla, though they are capable of transmitting stronger impulses; as exemplified by the convulsions which occur when the medulla is greatly stimulated by the increasing venosity of the blood. Many interesting examples of this will be found in the Indian Snake Commission's Report. Brunton and Fayrer believe the sensory nerves to be little, if at all, affected. The sensory ganglia are not affected until the last. (See the chapter dealing with Halford's treatment in snake-poisoning.)

Effects of venom upon the calorifacient functions.

Dr. Weir Mitchell invariably noticed a gradual fall of temperature, except when death was very rapid. The experiments made by the Indian Snake Commission show a fall of temperature occasionally, but not invariably.

Effects of venom on the blood.

Weir Mitchell found that the longer death is delayed, the more apt is the blood to become incoagulable. "So diffluent was it in some cases," that he "poured it from glass to glass like water, and kept it thus until it decomposed completely. In other cases the heart contained a few loose and very weak clots, and in others again, only rare shreds of coagulum were met with." Before I had read Weir Mitchell's excellent monogram,

I came to the conclusion—in which the Snake-Commission concurred,—that the fluidity of the blood is dependent upon, and in direct proportion to, the amount of venom taken into the circulation.

Dr. Mitchell, in common with all observers but Dr. Halford, could find no particular abnormality in the blood corpuscles, or in the blood's appearance under the microscope.† He arrived at the following conclusions :—

"1st.—That on animals which survive the poisoning for a time, the blood is so altered as to render the fibrin incoagulable.

"2nd.—Experiments in and out of the body have given proof that the change is gradual, and that the absence of coagulation is not due to checked formation of fibrin, but to alterations produced by the action of the venom in that fibrin which already exists in the circulating blood.

"3rd.—The influence thus exerted is of a putrefactive nature, and imitates in a few hours the ordinary results of days of change. It is

† Brunton and Fayrer found the blood corpuscles crenated in one case, but they believed that it was due to rapid evaporation.

probably even more rapid within the body, on account of the higher temperature of the economy.

"4th.—The altered blood retains its power to absorb gases, and thus to change its own color.

"5th.—The blood-corpuscles are unaffected in acute poisoning by crotalus venom, and are rarely and doubtfully altered in the most prolonged cases which result fatally.

"6th.—The contents of the blood-globule of the guinea-pig can be made to crystallize as is usual after other modes of death."

Altered relations between the blood and tissues.

In respect to rattlesnake-poisoning, Weir Mitchell informs us that among the most constant and most curious lesions in the case of secondary poisoning are the ecchymoses which are found on and in the viscera of the chest and belly; most frequently affecting the intestinal canal, they may and do occur in any cavity and on any organ.

These ecchymoses are not so extensively met with in cobra-poisoning, but they are to be found in viper-poisoning, and in a minor degree in krait-poisoning. Weir Mitchell thus sums up regarding acute cases:—

Causation of death.

"1st.—That the heart becomes enfeebled soon after the bite, which is due to the direct influence of the venom on the organ, and not to the precedent loss of the respiratory function. The heart, however, notwithstanding this loss of power, continues to beat after respiration has ceased, and its tissues remain for a time irritable.

"2nd.—Artificial respiration lengthens the life of the heart, but does not sustain it so long as when the animal has died by woorara or decapitation.

"3rd.—That in the frog the heart-acts continue after respiration has ceased, and sometimes survive until the sensory nerves and the nerve centres are dead, the motor nerves alone remaining irritable.

"4th.—That in warm-blood animals respiration ceases, owing to paralysis of the nerve centres.

"5th.—That the sensory nerves, and the centres of nerve power in the medulla spinalis and medulla oblongata, lose their vitality before the efferent or motor nerves become affected.

"6th.—That the muscular system retains its irritability in the cold-blood animals acutely poisoned, for a considerable time after death."

The cause of death in chronic or secondary poisoning Weir Mitchell says, "may, with propriety, then be referred to the incipient putrefactive changes which affect the blood, as well as to the continued influence of the agencies which first act to depress the heart's action, and destroy nerve function."

The Indian Snake-poison Commission.

We have now arrived at the time when the Indian Snake-poison Commission (of which Dr. Ewart was President, and Dr. Mackenzie and I Members) issued their report in the latter part of the year. The object of the appointment of the Commission is thus described in the report:—"From experiments made in London with the dried poison of the Naga, Tripudians (cobra), Drs. Fayrer and Lauder Brunton were led to infer that artificial respiration, applied to animals or human beings, poisoned by any of the *Thanatophidia of India*, might prove successful in prolonging or saving life.* Dr. Fayrer states, in a letter, dated 29th November 1872, to Her Majesty's Secretary of State for India, that 'since my re-

Object of the appointment.

* Artifical respiration was first recommended by Dr. Beddoes (vide Chapter II.) It was tried also by Dr. Weir Mitchell.

turn to London, I have, in conjunction with Dr. Lauder Brunton, been making further investigations into the subject of snake-poisoning, especially with a view of ascertaining if there be any means of saving life, and, though I cannot say that the desirable object of research has been attained, I am satisfied that the results of certain experiments are interesting and important, as they point in that direction. I have recorded an opinion, derived from a long and elaborate series of experiments, that none of the so-called antidotes possess the virtues or powers attributed to them; but in the experiments recently made, it is ascertained beyond a doubt that the life of an animal poisoned by the cobra-virus, may be prolonged for many hours by artificial respiration, and it is, therefore, possible that, if respiration be artificially continued for a sufficient length of time, life may be altogether preserved. In experiments performed upon the fowl and rabbit, after the most complete development of the physiological action of the poison, amounting to total paralysis and convulsions, conditions which immediately precede death, the convulsions, ceased, and in one case the heart was kept beating vigorously for about nine hours (and probably

then failed from imperfect respiration carried on in the cold)—a result never before attained by any means that I am aware of!'" I had kept a dog alive for nearly twenty-four hours by artificial respiration. The results obtained by artificial respiration in animals subject to the action of the curara, wourali poison, were calculated to encourage Dr. Fayrer to hope that similar treatment might possibly succeed in restoring to health animals almost dead from snake-poisoning. He remarked, "There is apparently a strong analogy between the action of the cobra-virus, and that of the curara poison of South America. It has been ascertained that an animal poisoned by this agent may, after apparent death for many hours, be restored, if artificial respiration be carefully and continuously applied for a sufficient length of time, the temperature of the animal being at the same time sustained at blood-heat by artificial warmth. Curara, it is believed, kills by paralysing the peripheral distribution of the motor nerves, thus inducing asphyxia by involving the muscles of respiration in general paralysis. If, however, the heart's action can be sustained by artificial respiration during a sufficient length of time, to allow of

elimination of the poison through the excretory organs, (for whilst the heart acts they continue to perform their functions) the paralysed muscles regain their power, and life is slowly, but certainly restored. I am not prepared to assert that the cobra-poison kills in exactly the same way as carara; I am inclined to believe that it does not; but still analogy in the results of experiments support, or, perhaps, rather suggest the idea that, if artificial respiration be sustained in a case of cobra-poisoning, and life be thus artificially supported for a sufficient length of time, it might be for days; elimination of the poison may occur, and recovery may result." Sir Joseph Fayrer was, however, by no means sanguine of the success of the treatment. This was the procedure adopted by the Commission. After poisoning the animal, a dog, either directly by the bite of a cobra, or by the hypodermic injection of the virus, when convulsions, general paralysis, and cessation of respiration, were fully developed, a canula was quickly inserted into the trachea. In the external end of the canula about a foot of India-rubber tubing was attached; and into the free extremity of this, the nozzle of the bellows was fitted. The canula,

Sir Joseph Fayrer's letter.

Mode of performing artificial respiration.

tubing, and bellows specially constructed for the purpose of avoiding clogging with mucus—were all connected and ready for use before the performance of the operation of tracheotomy was ever attempted. This was a necessary precaution, inasmuch as valuable time would have been lost, had the connexions between the different parts of the apparatus been always made after the trachea had been opened. Care was taken to see that the channels, through which the respiration was to be carried on artificially were clean and patent. To the canula was also attached a supplementary side tube, provided with a stop-cock, to admit of the escape of respired air, whenever it was found it was not being rapidly enough discharged by the side of the tube, through the mouth. The elastic recoil of the lungs and atmospheric pressure were generally sufficient to accomplish the act of expiration. Whenever these were deemed inadequate to empty the lungs, the opening of this stop-cock, and compression of the chest with the hands, were employed to secure efficient expiration, whilst the pumping in of air was in no way interrupted for a single instant. As regards the effects of artificial respiration on animals bitten

by snakes, the Commission remark: "Death from snake-poisoning is preceded by general muscular paralysis, induced by interference with the actions of the spinal cord, medulla oblongata, and it may be the central ganglia of the encephalon; convulsions; unconsciousness, and absolute cessation of respiration. The rythmic action of the heart continues for about three or four minutes longer. In these experiments the time selected for the commencement of artificial respiration in the manner already indicated was the exact period when the breathing had ceased, and about three or four minutes prior to the stoppage of the beating of the heart. . . . The average lapse of time between the infliction of the bite, and the cessation of the respiratory process, was only *forty-two minutes*, the maximum and minimum having been *one hour and ten minutes, and twenty-five minutes* respectively" without artificial respiration. A cobra does, however, sometimes kill in a much shorter time. "The powerful influence of artificial respiration in supporting and prolonging life is well illustrated . . . . Life was thus prolonged on an average *ten hours and forty-one minutes*, the maximum having reached *seventeen hours and*

Effects of artificial respiration.

six minutes and the minimum *three hours and ten minutes.*

The Commission continued the experiments with decreasing doses of cobra-poison hypodermically injected; at last with the following result, when only $\frac{1}{4}$th of a grain of the poison was injected. It took *four hours and two minutes* until artificial respiration was resorted to. In four minutes more, in the absence of this system, this animal's heart would have ceased to beat and somatic death been complete. But by its steady application, life was extended to *forty-one hours and fifty-two minutes.*

And the Commission thus sum up the result of the trial of artificial respiration:—" The power of artificial respiration in supporting the respiratory process; in maintaining the action of the heart, and the circulation of the blood to all parts of the body; in effecting the arterialization of the blood; in sustaining the life of the secreting and excreting organs, and that of the organic system of nerves; and in, probably, keeping up an imperfect form of nutrition of the tissues to which arterialized blood is supplied in abundance, for periods of time varying, to a

great extent, according to the quantity of poison introduced into the system through the absorbent channels of the body, is therefore placed beyond all question.

"But its influence in saving life, even when very small quantities of the poison have found entrance into the juices, is extremely problematical. It occurred to us that there might be hope of preserving life if the method were employed in conjunction with certain drugs. And though that hope was, from our previous experience of the mortal nature of the poison over animal life, very faint, we resolved to try artificial respiration with the exhibition of medicines, and in a few instances with the transfusion of blood from a healthy dog into dogs poisoned with the virus of the cobra." But the Commission found that the exhibition of drugs in no way improved the chances of prolonging or preserving the lives of the animals experimented upon. The Commission performed nearly *two hundred* experiments on dogs, and as many of them occupied both day and night, and I personally conducted every one of them, I am in a position to say that the strain upon the experimenter was sometimes exceedingly great. After

Artificial respiration combined with the exhibition of drugs, etc.

being up for three hours I have remained in the experimenting room watching the dog experimented on for forty-six consecutive hours—without sleep and without leaving the room. This vigilance was absolutely necessary as a half minute's cessation of the artificial respiration operations, on the part of the men, would have been fatal to the experiment in hand, and would have necessitated the conduct of a fresh experiment. Add to the number of hours, a close room, the peculiar Stench of pariah dogs, and plenty of mosquitoes, and you may realize one's discomfort while the experiment lasted, and the state of fatigue afterwards. As regards the quantity of cobra-poison required to kill, the Commission found that the tenth of a grain killed a dog weighing 18 lbs., in eleven hours and thirty minutes. One-twentieth of a grain injected beneath the skin of a dog, weighing 26 lbs., produced drowsiness and vomiting, but the animal recovered. The *thirty-second* part of a grain injected into the peritoneal cavity of a dog weighing 12 lbs., produced all the symptoms of cobra-poisoning, and eventually killed it in about fifty hours.

Tediousness of the experiments.

Fatal doses of poison.

These results shew not only how fearfully subtle is cobra-poison, but how a favourable

termination, after the manifestation of serious symptoms, may be attributed to the effects of the administration of reputed antidotes. The Commission obtained some poisonous snakes from Australia—the *Pseudechis porphyriacus*, or black snake, and the *Hoplocephalus curtus*, the tiger snake. Both these snakes somewhat resemble the Indian cobra, but their fangs are smaller and they probably secrete less poison, and are not so deadly. With the poison of these snakes the Commission tested the efficacy of the ammonia treatment advocated by Halford, but like Fontana, Fayrer, Hilson, and myself, in regard to Indian snake-poisoning, they found it useless. This decision was subsequently agreed with by the Melbourne Medical Society.* The Report contains also a report of the analysis of cobra-poison by Mr. Alexander Pedler, F. C. S. As regards Mr. Pedler's analysis the Commission observe :—

Experiments with Australian Snakes.

Ammonia.

"So far as we are aware, this is the first time that absolutely fresh cobra-poison has been submitted to ultimate analysis." It will be observed,

* As belief in this system of treatment has not yet quite died out, and as I am convinced it is most pernicious, I have dealt fully with the subject further on.

Mr. Pedler on cobra-venom.

from a reference to the following tables, that the substance isolated and analyzed by Mr. Pedler is more nearly allied to albumen than that submitted to examination by Dr. Armstrong. F. R. S. The reason of this discrepancy may possibly be found to exist in the fact that the poison investigated by the former gentleman was fresh and pure, whilst that analyzed by the latter was already in a state of decomposition before it was analyzed :

	ARMSTRONG.	PEDLER.	
	Crude poison (decomposing.)	Pure and fresh poison.	Albumen.
Carbon ...	43·55	52·87	53·4
Nitrogen ...	43·30	17·58	15·8
Hydrogen ...	.....	7·51	7·1
Sulphur ...	.....	not ascertained	1·8
Oxygen ...	.....	Ditto.	22·0

"It is quite impossible," says Mr. Pedler, "to draw any deductions as to the nature of the poison. It is more than possible that the poison is a mixture of albuminous principles with some specific poison. Blyth claims to have isolated a crystal-

line principle. He says: "the poison has been examined by several chemists, but until of late years with a negative result. The writer was the first to isolate, in 1876, a crystalline principle which appears to be the sole active ingredient; the yellow granules were dissolved in water, the albumen which the venom so copiously contains coagulated by alcohol, and separated by infiltration; the alcohol was then driven off at a gentle heat, the liquid concentrated to a small bulk, and precipitated with basic acetate of lead. The precipitate was separated, washed, and decomposed in the usual way by S. H2., and on removing the lead sulphide, crystals having toxic properties were obtained." Gautier declared that he found an alkaloid in cobra-poison resembling a ptomaine. But considerable advances in the chemical analysis of the venoms have lately been made, and will hereafter receive attention. It is said that cobra-poison is the most powerful animal poison in existence, but after my experience with the ptomaine, which is generated in the bowels of persons suffering from cholera,*

* There is a marked resemblance, in some respects, between the symptoms of *cholera* ptomaine poisoning and cobra-poisoning.

I am inclined to doubt that statement, though, quantity for quantity, it may, of course, be so. Cunningham and Lewis made a careful microscopic examination of cobra-poison and of the blood of the poisoned animals, but with negative results. Dr. Wolfenden, late professor of Physiology at the Charing Cross Medical School, says, however, "I have for some time been making experiments upon the blood of many animals. I cannot consent to the generally received opinion that cobra-venom exerts no influence upon blood. My investigations, which will shortly be published, have convinced me that cobra-venom decolorises, by driving out the hæmoglobin, a large proportion of the discs, and breaks up a large number of the white discs, completely filling the plasm with minute granules. The bacterial forms, which are present in such large numbers, in cobra-venom, I do not think have anything to do with the activity of the venom. When recovery takes place from poisoning, with a dose of the poison insufficient to kill, it is not improbable that a condition of blood-poisoning may supervene, secondarily, as in one of the cases I have quoted." Neither Wall nor I have ever witnessed a condition of blood-poisoning

Cunningham and Lewis's microscopic examination of venom, etc.

Wolfenden's experiments.

after the injection of fresh venom. Recovery, when it does occur, is always rapid and complete: not so in viper-poisoning.

Effects of venom on the blood.

The question of the fluidity or otherwise of the blood in persons poisoned by snake-venom is of some importance, medico-legally. At page 376 of Dr. Norman Chevers's important work on medico-legal jurisprudence will be found the following footnote :—"The reporter in the *Lancet* says the blood was altogether dark, alkaline fluid (this was thirty hours after death, in the month of October), and it emitted a peculiar sour and sickly smell, quite different from the odour commonly known to pervade the dead-house.* This is quite contrary to Indian experience. The blood drawn from an animal which has just died from cobra-poison always coagulates firmly. The blood of animals killed by Russell's viper does not coagulate." Now this statement, coming from so high an authority, is likely to mislead. The conditions under which the blood remains fluid, and under which it coagulates, are thus described by the Indian Snake Commission :—

Dr. Chevers's view erroneous.

* This is the report of a case in which a man was bitten by a cobra at the Zoological Gardens, London.

Circumstances under which blood remains fluid after death.

The blood appears to remain fluid after death under the circumstances noted below:—

1*st.* When a large quantity of the cobra-poison has been directly injected into the circulation, as for example into an artery or a vein.

2*nd.* In cases where animals or human beings have been poisoned by the bite of vipers, such as the Russell's viper.

3*rd.* In all cases of snake-bite, whether from the poisonous colubrine or viperine genera, in the human subject.

The blood undergoes either partial or complete coagulation under the following conditions:—

1*st.* When a small quantity only of the cobra-poison has been injected into a vein or an artery.

2*nd.* In cases where the lower animals have been bitten by the cobra.

Why the admixture of a large and quickly fatal injection of the cobra-virus into the circulation of animals should produce comparatively permanent fluidity of the blood, or interfere with its ordinary coagulability soon after removal from the body, or after death, and why the injection of a smaller and more slowly fatal quantity should interpose no obstacle to its speedy coagulation,

are questions extremely difficult to account for or explain. We can only state the fact that in the one case coagulation occurs speedily, and in the other, this coagulation is retarded or altogether prevented by some cause at present unknown. I gave it as my opinion that the larger the quantity of the poison absorbed the nearer to fluidity will the blood be found after death; that is to say, the fluidity of the blood is entirely dependent upon, and is in direct proportion to, the amount of the poison taken into the circulation. The fact of the blood remaining fluid in the case of man being bitten by a cobra and coagulating in the case of an effective cobra-bite in the lower animals, can probably be accounted for in this way. The poison is, no doubt, absorbed in the human subject in a large quantity before death supervenes, consequently the proportion of poison to blood is greater than in the lower animals. Whether this be the true solution of the matter, I, of course, cannot positively assert, but, at any rate, it appears to me to be a rational explanation of the problem.

Wall's investigations.

In 1883 Dr. Wall published the results of his investigations, which I think were commenced in 1875, and his contribution to the literature

is certainly one of the most important ever published, though it must be remembered that, unlike most of his predecessors, he had a mass of important scientific material at hand to assist and direct him in his researches, which he undoubtedly conducted with much ability, care, and scientific exactness, as his little work amply testifies. "The inquiry," says Wall, "that naturally presents itself first in considering the subject of snake-poisoning is—How does snake-poison kill? and what are the changes it effects in the animal system? And, as a consequence of this—Is there only one poison, or are there several? Upon the answers to these questions depend both the certain recognition of snake-poisoning when it comes under observation, and the indications that must serve as guides to us in the treatment of it." And on these lines Dr. Wall conducts his enquiry. After explaining the effects of cobra-poison on animals of different classes, he shews that the symptoms in man are peculiar, owing to the difference in the organization of his nervous system. He draws special attention to the pain and to the local specific inflammation, upon which the pain depends. Intense mental shock in snake-bite may render the

Symptoms of cobra-poisoning in man.

victim insensible to pain, at least for a time. The characteristic local condition he considers to be of the utmost practical importance. Externally there may be scarcely a sign on the skin to mark the spot where the snake inflicted its bite: or possibly, one or two small punctures, or even a scratch may be found, especially if the part bitten be the fingers.* It may even happen that the part is slightly swollen or discolored. But whatever may be the condition of the external aspect, there will be found a distinct change in the parts beneath. Dr. Wall fully describes the appearances that are found beneath the true skin. Briefly stated, the areolar tissue will be found to resemble red-currant jelly in appearance, or if a large quantity of venom has not been injected, there will be only a pinkish

* When manipulating a large Daboia, some time since, to extract its poison, I found that on one side two fully formed fangs were unsheathed. Now, supposing this snake had effectively bitten a person, we should have found three distinct fang-marks at the bitten part. Not the slightest reliance is to be placed in the appearance of the scratches or punctures, though very much stress has been laid upon them as a means of diagnosing the bite of a venomous snake.

The local effects of a snake-bite described.

effusion. "This local hyperæmia," says Wall, "is the first indication that we obtain that snake-poison has really entered the system." True, but while admitting that it is of value as a diagnostic sign of a poisonous bite, I must observe that it is no certain indication of the injection into the tissues of a fatal dose of poison. Very extensive local mischief has been observed to have occurred in cases which have terminated in recovery. The practical importance, therefore, of this appearance seems to be somewhat limited. As regards the characteristic symptoms of cobra-poisoning in man they are thus described by Wall. A feeling of intoxication appears to be the first constitutional effect of the poison. It is very generally complained of but not universally so, as it would require some intelligence on the victim's part to mention it. The next symptom is loss of power in the legs—at first staggering, then inability to support the legs—due to progressive upward paralysis of the spinal-cord, and at last complete paraplegia. At this time there is scarcely any loss of power in the arms, which may remain completely under the influence of the will. The next symptoms are very characteristic. The patient loses power of speech, of

swallowing, of moving the lips; the tongue becomes motionless and hangs out of the mouth, and the saliva, which is secreted in large quantities, runs down the face, the patient being equally unable to swallow it or eject it. "It is singular," says Dr. Wall, "that the striking resemblance of these symptoms to the disease known as glosso-laryngeal paralysis has not been previously noticed. Now, the preponderance of medical opinion attributes this disease to lesion of certain tracts of the medulla." Dr. Wall confirms the views of his predecessors when he remarks that "it is evident that cobra-poison has a special affinity for acting on the respiratory centre, and those ganglia allied to it in the medulla oblongata which are in connection with the vagus, the spinal accessory, and the hypoglossal nerves, and that it is directly to this destructive action that we have to attribute death in most cases of cobra-poisoning.

Resemblance of the symptoms of cobra-poisoning to those of glosso-laryngeal paralysis.

Sir Joseph Fayrer first pointed out this fact, and he was confirmed in his opinion by Brunton and the Indian Commission. The respiration becomes slower and slower until the victim dies suffocated. Wall does not believe that cobra-

Poison does not kill by paralyzing the heart, but sometimes immediately stops the action of the respiratory centre.

poison ever kills by tetanizing the heart, as was supposed by Fayrer and Brunton, and I think there are grounds for believing that he is correct in his view. In very rapid cases of poisoning, instead of the gradual extinction of the function of the cerebro-spinal centres, the poison, he says, appears to act almost immediately by stopping the action of the respiratory centre. He fully describes and illustrates by stethometric charts the effects of cobra-poison upon the respiration. Briefly stated they are: slight quickening, with increase of the excursus, followed by rapidly increasing retardation, with a certain amount of lessening of the excursus—the latter being less affected than the former; sudden and abrupt inspiration, followed by an equally sudden expiration, until the respiratory effort is entirely abolished, and after a pause the convulsions of asphyxia terminate life. Cobra-poison exercises little influence upon the circulation and temperature,† nor has it any particular effect upon the

† If Wolfenden is correct in his analysis, it must be found that there is relatively little albumen-venom in cobra-poison, since he states that this element of the poison produces a striking fall of temperature.

higher sensorium. * This fact has been noticed over and over again, and is of some importance diagnostically. The pupil of the eye also is unaffected. On secretion, generally, the poison has great effect; nearly all secreting tissues being affected by it, especially lachrymation, and even more so, salivation, marked and constant. The whole alimentary track pours out mucous. The larynx and trachea become almost occluded by frothy mucous. I have already pointed out that Dr. Wolfenden cannot accept the generally received opinion that cobra-poison effects no great change in the blood, and on this point Wall says, "that there is no great change in the blood is evident from the fact, that when an animal has survived the same symptoms, produced by cobra-poison, it is found to be quite well and to suffer no further inconvenience from blood-poisoning or other causes." It is just possible that when extensive sloughing occurs at the bitten part, septicæmia may occur, but this can scarcely be attributed primarily to the cobra-venom, or be regarded as a physiological effect of the venom.

Wolfenden cannot accept the generally accepted opinion that the venom of the cobra has no effect on the blood.

* These two facts alone are sufficient to distinguish cobra-poisoning from alcoholic poisoning, in which there is a rapid fall of temperature and stupor or coma.

Before leaving the subject of cobra-poisoning, I may state that Sir Joseph Fayrer and Dr. Lauder Brunton, in their valuable series of papers on the subject, maintain that though the greater part of the nervous system is affected, yet the terminations of the motor nerves suffer especially, and in a very marked manner. Dr. Wall, on the other hand, is of opinion that there is no need to suppose a special effect of the poison on the peripheries of the motor nerves. As regards the daboia-poison, Dr. Wall says, that the preliminary and local effects of the bite of a Daboia Russelli resemble those of the cobra, only that the consequent pain and inflammation are much more acute. The first constitutional symptom of daboia-poisoning is convulsions, which may vary in degree from those producing slight muscular twitching, to those which produce almost instant death. These primary convulsions depend upon the amount of poison injected, and the relative size and strength of the animal affected. Birds are most easily affected, and next to them the *Lacentilia* mammals also are very easily affected by the convulsion-producing properties of the poison. On the other hand, amphibia only exhibit symptoms of general paralysis. Wall draws at-

Daboia-poison.

The primary convulsions of daboia-poisoning.

tention to a curious fact, *viz.*, that by heating a solution of daboia-poison to 100° C. it loses completely the power of producing primary convulsions, even in birds, which under other circumstances it is difficult to poison without their occurrence. This may, perhaps, be accounted for by some alteration in the albumen-venom being affected by heat; though it is true, Dr. Wolfenden says, that albumen-venom is not destroyed by heat (95°5), it may, however, be altered. This is a point which requires elucidation. In daboia-poisoning there are three forms in which death occurs. Firstly, from the primary convulsions. Secondly, from advancing paralysis. Says Dr. Wall, "the respiration and pulse become greatly accelerated, and there is gradual loss of power in all the limbs, vomiting may occur, sanious discharges issue from the rectum and other parts, the pupils are usually widely dilated, and the respiration becomes less and less, and may cease with or without convulsions." These secondary convulsions are simply the expression of carbonic acid poisoning. The third form of death from daboia-poisoning is altogether unlike anything observed in cobra-poisoning. It occurs in those cases in which insufficient poison has been injected to

Three forms of death in daboia-poisoning.

Secondary convulsions.

cause death in the above mentioned forms. It is, indeed, death from blood-poisoning. "The animal has very few nervous symptoms, very likely none at all, but on the second day he appears ill, refuses food, has diarrhœa, his urine contains albumen, and he may linger on in this state for days, dying exhausted, or some acute complication may supervene, causing death rapidly. It may be an ædematous condition of the lungs or a hæmorrhagic condition of the system generally that proves fatal. Hœmorrhages may take place from lungs, stomach, rectum, kidneys, and even skin. Sir Joseph Fayrer, in a paper on the nature of snake-poison, which he read recently before the Medical Society of London, of which he is President, says—"In 1868 I described the action of cobra and daboia venom in the case of two horses bitten by these snakes. I also pointed out the peculiar action of daboia-venom in causing early convulsions. In some the convulsions are more marked, and in others death is preceded by a more decided state of lethargy . . . . Dr. Wall gives a more complete exposition of the varying effects, and shews them to be greater than I supposed." Dr. Wall summarises the

Fayrer had drawn attention to the primary convulsion of daboia-poisoning in 1868.

difference in the action of cobra and daboia venom as follows :—

Cobra-poisoning and daboia-poisoning contrasted.

Cobra-Poison.	Daboia-Poison.
1. The regular course is slowly advancing general paralysis coming on after an interval without symptoms, with especial paralysis of the lips, tongue, larynx and pharynx, and complete destruction of the respiratory function. Death is often attended by convulsions, which depend on asphyxia.	I. Commences its action by producing violent general convulsions, which often terminate fatally, or may be followed immediately by paralysis and death, or may also be recovered from paralysis and death following later. The paralysis is general, and lasts a considerable time after respiration is extinguished. No special paralysis of lips, tongue, larynx and pharynx.
2. Very quickly destroys respiration. After slight acceleration there is slowing, and excursus is lessened.	2. At first quickens the respiration very much more than cobra-poison does, and the lessening of the excursus and the retardation of the respiratory movements do not occur so soon.

Cobra-Poison—*(Contd.)*	Daboia-Poison—*(Contd.)*
3. Kills birds and reptiles only after paralysis.	3. Invariably kills birds and reptiles at once in convulsions.
4. Doubtful if it affects the pupil. Salivation constant.	4. Pupil always widely dilated. Salivation very rarely met with.
5. Effect on the blood slight. After recovery from nervous symptoms, no symptoms of blood-poisoning observed.	5. Effects on the blood very great. Sanious discharges the rule. Albumenuria is constant. After recovery from the nervous symptoms, the patient has to go through a period of blood-poisoning, perhaps not less dangerous than the primary symptoms.

Wall's opinion as to the venom of the rattlesnake.

Dr. Wall says as regards the rattlesnake-bite—"In its main features the crotalus resembles the Indian viper in its effects, the chief difference being that the primary convulsions are very much less frequently seen." Crotalus poison is decidedly less dangerous than either that of the Indian cobra or that of the Australian hoplocephalus, and probably even than that of the daboia.

CHAPTER IV.

Lacerda's investigations—Advocates the use of Permanganate of Potash—My experiments and conclusions on the use of Permanganate of Potash in snake-poisoning—Sir Joseph Fayrer's opinion—Liq. Potassæ in snake-bite—What can be done in snake-bite—Weir Mitchell and Reichart's recent researches into the physiological chemistry of venoms—Wolfenden's investigations into the chemistry of snake-venoms—The intra-venous injection of ammonia in snake-poisoning: the evidence in its favour critically examined—The treatment condemned by the Victoria Medical Society.

Lacerda.

We are told by an American Reviewer (Mr. Robert Fletcher) that, "Dr. J. B. de Lacerda, Director of the Physiological Laboratory of the National Museum of Rio Janeiro, has been, during the last ten years, experimenting with the venom of Brazilian snakes, especially with that of bothrops jararacassu, a serpent which closely resembles its congener, the North American crotalus, in the intensity of action of its venom. During that time, he has made several communications to the French Academy of Sciences."

Lacerda discovers figured ferments in the venom.

In 1872 Lacerda announced that he had discovered "figured ferments in the venom of serpents. He placed a drop of rattlesnake-venom under the microscope, and saw the production of spores take place. The spores increased by scission and by internal nuclei. This has not been confirmed by further experiments." On this subject, however, Dr. de Lacerda writes to Sir Joseph Fayrer, as President of the Medical Society, "I beg leave to protest against an opinion attributed to me by some of your colleagues, but which I have never sustained. I refer to the opinion that attributes to Bacteria the effects of the poison. I have weighty reasons for considering such an hypothesis is entirely false. I recognized, indeed, by means of repeated and careful observations, that the venom contains micrococcus in great numbers, and I made a communication on this subject some three years ago to the Academy of Sciences of Paris. These corpuscles, however, exist in the venom in an accidental manner, as also in the human saliva, and play no important part in the effects of the poison.*

* Wolfenden says: "The bacterial forms, which are present in such large numbers in cobra-venom, I do not think have anything to do with its activity."

This last acts as a chemical agent, producing a rapid alteration in the molecular composition of the albumenia, which enters into the formation of almost all animal tissues. On the blood, given certain conditions, its effects are very rapid, almost instantaneous; the same happens with the nervous and other elements, whose functions are disturbed immediately that the venom comes in contact with them. Now, such immediate action can never be attributed to bacteria. You see, therefore, that this unsustainable theory cannot be invoked in endeavouring to explain the neutralising effects of permanganate of potash."

Effects of snake-poison upon the blood, according to Lacerda.

As regards the effect of the poison on the blood, Lacerda is said to have found that—"The blood of a poisoned animal presented the following phenomena: the red corpuscles began by presenting little shining points, which increased until the globule broke down, and was replaced by numerous ovoid corpuscles, very brilliant, and possessed of oscillatory movements.* The blood obtained from animals which had died from serpent-venom, when injected into others hypodermically, invariably produced death in a few hours."

* *Vide* Wolfenden's observations on the same subject.

Lacerda recommends the permanganate of potash in snake-bite.

"But," says Mr. Fletcher, "the most interesting of Lacerda's discoveries was reported to the French Academy of Sciences, in September 1881. After proving the inefficiency of various supposed antidotes, such as perchloride of iron, borax, tannin, and other substances, he found that the permanganate of potassium produced very remarkable results. He obtained his supply of poison by forcing the *bothrops* (the more deadly variety) to bite cotton-wool, and the venom which poured out upon it was dissolved in eight to ten grammes of distilled water. A syringe full of this solution was injected into the cellular tissue of the thigh or groin of a dog. In from one to two minutes after, the same quantity of a filtered one *per cent.* solution of permanganate of potassium was injected. The dogs, examined the next day, exhibited no evidence of injury except a trifling local irritation at the point of injection, nevertheless, this same solution of venom, injected into the tissues without the counter poison, produced great swelling, abscesses and extensive loss of substance."

But to quote again from Lacerda's letter to Sir Joseph Fayrer :—

Lacerda's letter to Sir Joseph Fayrer.

"Passing now to the essential point of the discussion that took place in the Medical Society, I will give, in a few words, how I comprehend, and how I judge, that the efficacious effect of permanganate of potash should be comprehended. You yourself, by experiments made in 1869, recognized that permanganate of potash, mixed with the venom, took from it its noxious properties. Certain conditions of the experiments led you, however, to deny the efficacy of this chemical agent in the cases in which the venom had been inoculated in the tissues. As you know, however, I have demonstrated by numerous experiments and innumerable clinical facts, that the neutralisation takes place even in the midst of the tissues, which makes this substance a chemical antidote of great value. The permanganate of potash acts upon the venom, destroying it in two ways; first, as a powerful oxidising agent, second, by the potash, that forms the base of the salt, passing a current of nascent oxygen through a concentrated solution of the venom, which loses entirely its noxious properties. This experiment, which I have repeated many times, gave me always the same result. Let us suppose, now then, an individual is bitten. If injections are made in the

place of the bite from five to ten minutes after the inoculation of the venom, this is promptly neutralized *in situ,* and the individual runs no further danger. A great number of facts have been observed like this in Brazil. If aid is given late, hours after the bite, when the tumefaction of the wounded part is very pronounced, and the phenomena that indicate the entrance of the venom into the circulation have already declared themselves, injections, repeated in various parts of the wounded members, parting from the wounds made by the fangs of the reptile, still give very good results. Nor is it difficult to explain the good results in this case. The venom, as I have said, acts first locally, and only enters the general circulation, after the lapse of a certain time, and by portions. The permanganate of potash, meeting in the tissues with the venom, which is little by little diffusing itself, neutralises it in the various points where it has been diffused, and thus stops the source of supply. The entrance of new and successive portions of the venom into the general circulation being thus impeded, the organism takes charge of the elimination of what has already been introduced, and which was insufficient to compromise the life of the individual."

My attention is drawn to the subject by an article in the *Englishman*.

My attention having been drawn to the subject by a notice in the *Englishman*, I performed nearly one hundred experiments with a view to settling the matter as regards cobra-poison, and the conclusions I arrived at are noted below. It is to be remarked that the poison experimented with by Lacerda was that of the *bothrops*, a snake not nearly so venomous as the *cobra*. My conclusions were:—

The conclusions drawn from my experiments.

I. That in dogs no appreciable symptoms of cobra-poisoning followed the hypodermic or intravenous injection of a watery solution of from two to seven centigrammes of cobra-poison when previously mixed with from one to three decigrammes of permanganate of potash, though under ordinary circumstances such quantities hypodermically injected are more than sufficient to produce fatal results.

II. That when similar quantities of a watery solution of cobra-poison were hypodermically injected into dogs, and were followed, either immediately or after an interval of four minutes (the longest interval I have yet sufficiently tested), by the hypodermic injection into the same part of a watery solution of permanganate of potash (one to six decigrammes) no appreciable symptoms of cobra-poisoning resulted.

III. That when glycerine was used, instead of water, to dissolve the dried cobra-poison, the permanganate of potash appeared to have no power over the virulence of the virus.

IV. That after the development of symptoms of cobra-poisoning, the injection of permanganate of potash, whether hypodermic or intravenous, or both, failed to exercise any influence upon the symptoms.

V. That permanganate of potash possesses no prophylactic properties, since death followed the hypodermic injection of three and a half centigrammes of cobra-poison in watery solution in the case of a dog which had been hypodermically injected a few hours previously with 8 decigrammes of the agent in solution.

VI. That it would appear to be absolutely necessary that the permanganate to be efficacious should come into actual contact with the cobra-poison.

VII. That although no symptoms of cobra-poisoning followed the injection of cobra-poison and permanganate of potash, sloughing of the part injected sometimes followed.

VIII. That up to the present time it has never been experimentally shewn that any agent has either the power to neutralise the cobra-poison lying in the tissues, or to prevent death when four minutes had elapsed from the time of injection of the poison to that of treatment.

IX. That if permanganate of potash has such power to destroy so subtle a poison as that of the cobra, it is probable that the hypodermic injection of the agent, in the bite of a rabid animal, would destroy the virus which causes that terrible disease—Hydrophobia.

Sir Joseph Fayrer's opinion of the power of the permanganate of potash.

And I have certainly seen no reason to modify or alter my opinions. Sir Joseph Fayrer's opinion as to the power of the permanganate may be gathered from the following extract from his address to the Medical Society of London:—"In a pamphlet *(Experiments on permanganate of potash, and its use in snake-poisoning,* dated 1882, Richards says:—A solution of five *per cent.* of permanganate of potash is able to neutralise the poison," and recommends that this 'should be injected into the bitten part after a ligature has been applied; it is less likely to cause sloughing of the tissues than any other agent which could neutralise the venom.' In his letter dated July 22nd, 1882, he says, 'It is, in my experience, the best local application we possess. It is not a physiological antidote, but a chemical one, and is utterly powerless to effect any influence on the lethal action of snake-poison' (meaning constitutional action.) He is of opinion 'that whenever opportunity offers, the injection of permanganate of potash should be resorted to, assuming that a ligature has been applied (where it can be applied at all) within five minutes from the bite. In the average run of cases, the permanganate will certainly destroy

the poison lying beyond the ligatured part, if it come in contact with it; but as Wall pointed out, the difficulty of insuring its contact with the poison is so great as to render it practically unreliable. I agree with Richards that, so far as it goes, it is a good local application, and as such ought to be used, or in its absence, tannic acid or liquor potassæ might be resorted to with the same object, but as a constitutional remedy, as a physiological antidote, it is powerless, like all others that have been tried and failed to do good. Dr. Lacerda himself, although he attributes the highest value to it as a chemical antidote, both as a powerful oxidising agent, and by the action of the potash, says, 'as to the idea of finding a physiological antidote for snake-poisoning, I entirely agree with you that it is a Utopia.' Although I found that liquor potassæ practically answered the same purpose as permanganate of potash, it did not decompose the venom, but merely destroyed the tissues in which the venom was lying, thereby preventing its absorption; and it was subsequently discharged with the slough. This was proved by the fact that when the venom and liq. potassæ were mixed and injected subcutaneously, no con-

My conclusions as to the power of liquor potassæ.

stitutional effect followed; but if the same mixture was diluted with water and injected into a vein, or into the peritoneal cavity of an animal, symptoms of cobra-poisoning were soon manifest and the animal died. Now, as to what really can be done in snake-bite, I am afraid very little: the first and most important indication is, to prevent the absorption of the venom into the general circulation. The ligature, excision, and application or injection of a solution of permanganate of potash—5 *per cent.*—are the means to that end.* If the poison gains access to the general system, then positively nothing can be done. It is usual to recommend artificial respiration, and the exhibition of stimulants in moderation; but I fear they are really of very little use.† Imme-

What can be done in snake-bite.

* I have recently had an opportunity of seeing the Wyeth Compressed Permanganate of Potash Tablets, prepared by Messrs. Burroughs, Wellcome and Co., and consider them a very excellent and particularly handy form. They are quite reliable. Four of the one-grain tablets added to a dram and a half of clear water will effectually neutralise snake-venom when brought in contact with it.

† Stimulants given to excess can do only harm—(vide observations regarding treatment by the intravenous injection of ammonia.)

diate amputation of the part would, of course, possibly save life, as might the ligature, &c. as before recommended. It is somewhat humiliating to have to confess that practically, so far as the *treatment of snake-poisoning* is concerned, we are nearly as helpless as our forefathers were two centuries ago. Unfortunately, our helplessness is not confined to the cure of snake-poisoning, for there are several diseases in existence which baffle the skill and knowledge of the wisest and most learned of our profession. It is, however, some satisfaction to those who have spent the best part of their lives in conducting these disheartening investigations, to think that their work may, in some measure, serve as landmarks for the guidance, not only of future enquirers, engaged in the particular field which has been their special study, but of those who may be called upon to investigate the nature of any of the other animal poisons, which is at present shrouded in profound mystery."

We come now to the subject of the most recent researches into the physiological chemistry of the venoms.

Weir Mitchell and Reichart's recent researches into the physiological chemistry of venoms.

In April 1883, Drs. S. Weir Mitchell and Edward T. Reichart of Philadelphia, published a preliminary report on the chemistry of the venom

of serpents, which as they observe, represented only a part of an elaborate study of the poisons of all their own genera of serpents. They expressed a hope that their study might include that of a number of foreign genera. "Our researches," they observe, "have of late been rewarded by so remarkable a discovery in toxicology, that it has been thought well to announce it here rather than to await their completion. We have, therefore, selected from our notes such material as seems to us of interest from its novelty."

Effects of drying the venoms.

They remark, that in drying the venoms of the *rattlesnake* and *moccasin*, there is a loss of nearly seventy-five *per cent.* This estimate agrees with the loss as regards cobra-venom. They point out, as a singular fact, that the venoms above-mentioned could be subjected to the boiling temperature of water (except the venom of the *Crotalus adamanteus*) without a complete destruction of their poisonous power; but with a noticeable alteration of their physiological properties. In the case of the *Crotalus adamanteus* or *diamond-back rattlesnake*, the toxicity of the venom is destroyed at a temperature below 80° C. (176° F.) It will be recollected that Wall found that the convulsion-producing pro-

Effects of boiling.

perties of daboia-venom was destroyed at a temperature of 100° C., though the venom still retained its poisonous power. As regards the intensity of the venoms, Drs. Weir Mitchell and Reichart express an opinion which corresponds with that I have already given. They say, "beyond a doubt, cobra-venom is the most intense in its poisonous power, the venom of the copperhead next, then the moccasin and rattlesnake." The most important part of their paper is that in which they describe the chemical analysis of the venoms. They succeeded in isolating three proteids, *viz.* :—

Venom—Peptone
„ Globulin
„ Albumin.

The first two they say are poisonous, and the last innocent. According to them the venom-peptone is a "putrefacient," and the venom-globulin, a much more fatal poison, which probably attacks the respiratory centres and destroys the power of the blood to clot.

Wolfenden's investigation into the chemistry of snake-poison

In the September number of the *Indian Medical Gazette* will be found an important paper which I had the privilege to communicate,

from the pen of Dr. R. Norris Wolfenden, late lecturer on physiology at the Charing-Cross Hospital, London.

After paying a well-merited compliment to Dr. Wall, Dr. Wolfenden says, "Weir Mitchell and Reichart, in America, have for some time past been engaged in investigating this subject (of the chemistry of snake-poisons), and they have examined the venom of a number of snakes, chiefly American. They are now completing their investigations, which will shortly be published by the Smithsonian Institute. One or two papers have appeared in America, already, from their pen. Though I have been trying for a considerable time to get these papers, I have hitherto been unsuccessful, and I am consequently in ignorance of the scope and character of their investigations. I think it right to say this before mentioning my own experiments, because it gives to my work that independent character that it properly possesses. It is only since I began my investigations into these animal poisons, that I have become acquainted with Weir Mitchell and Reichart's work, through a short contribution made to the *Lancet* of last year, in which the former gentleman stated some results of their joint work.

This had resulted in the separation from snake-venoms of their proteid poisons, the one like a globulin, attacking respiratory centres, and preventing coagulum; a second resembling albumin, and being probably innocuous; a third like peptone, and being a "putrefactive poison." With some of these results I agree, but not with all. Dr. Wolfenden sums up the results of his investigations, but he remarks that they must not yet be regarded as complete. He says there are two poisonous elements in cobra-venom, viz.—

1. Cobra globulin-venom,
2. Cobra albumin,"

and that they probably exist in different proportions in different secretions. What other albumins are present, are not of the importance these two are. The globulin-venom poisons the respiratory centre, producing no paralysis of muscle; the cobra-albumin venom does not affect the respiratory centre, but produces marked and progressive motor paralysis. Wolfenden points out further that "globulin-venom is slower in its action than the albumin-venom, and a longer period often elapses after the injection, before symptoms supervene and terminate life. The globulin is very deadly, and when once the symptoms

have supervened, asphyxia rapidly ends the existence of the animal." There is a rather extraordinary difference of opinion between Mitchell and Reichart on the one hand, and Wolfenden on the other.* Perhaps, an idea of the difference will be best conveyed by a statement such as this:

Different results arrived at by Weir Mitchell and Reichart on the one hand, and Wolfenden on the other.

	Proteids.	Weir Mitchell and Reichart.	Wolfenden.
Cobra poison	Peptone	Poisonous: putrefacient.	None present.
	Globulin	Attacks respiratory centre, and destroys power of coagulation of blood.	Attacks respiratory centre. Very powerful.
	Albumin	Innocent ...	Less powerful. Produces motor paralysis.

* It is only bare justice to Drs. Weir Mitchell and Reichart, whose valuable work has extended over some years, to state that the researches which they have yet published were considered by them only preliminary, and that some of their statements might have to be modified or even, perhaps, withdrawn. *Original* researches are, of course, liable to error in some particulars, and if error there be, Dr. Mitchell will, I am sure, be the first to acknowledge it.

In noticing these researches the editor of the *Indian Medical Gazette* remarks: "To trust to dialysis alone, in the attempt to separate the different proteids of snake-poison, is calculated to give most unsatisfactory results. Even a crystalline salt, which is readily dialysable, requires a period of several days for complete extraction by dialysis. It would be practically impossible to altogether extract a peptone, if, indeed, such is really present, in this way. Besides, in dialysing albuminous fluids, decomposition must occur, and not only may an active proteid thus lose its activity, but poisonous decomposition products, which did not exist in the original venom, may be formed in this way, and being readily dialysable, they will contaminate the crystalloid proteids. The products which Dr. Mitchell experimented with were obtained in this objectionable manner." Wolfenden adopted a recognized mode of precise chemical analysis so that his proteids were presumably of a fairly pure nature. Notwithstanding the very great importance of these contributions, I cannot help believing that the active principles of snake-poisons are rather of the nature of animal alkaloids, having an affinity for albumin and globulin.

Dr. Wolfenden has not yet accounted for the specific inflammation which occurs locally, on the injection of snake-venom—especially daboia-venom. Does the venom-globulin act also as a "putrefactive agent," and, if so, how? The editor of the *Indian Medical Gazette* winds up his excellent article thus—"The important recent additions to our knowledge of snake-venom, and the increasing perfection of experimental methods, render the attainment of solid results much more easy and probable at the present time than hitherto. The time has now undoubtedly arrived for the institution of a fresh Commission to re-investigate a subject of such admittedly vital importance." I doubt, however, whether a Commission is the best machinery for the working out of these questions. If one man, who is thoroughly conversant with all the recent methods of analysis, took up the subject, the results would be more satisfactory. And no better one in India could be found for the purpose than the *Editor of the Indian Medical Gazette*, Dr. Waddell. An investigator here has the advantage of being able to obtain a very large quantity of fresh cobra-venom, without which no analysis, so far as cobra-venom is concerned, can

Dr. Waddell suggests the appointment of a commission

be considered absolutely satisfactory; but at the same time, investigations should, of course, be continued by that able physiologist, Dr. Wolfenden, who has done so much in the study of animal poisons, and Drs. Weir Mitchell and Reichart, who have already spent so much time, labour, and money in snake-poison investigations, and who are the pioneers of these recent researches.

The intravenous injection of ammonia in snake-poisoning.

I have already referred briefly to the subject of the intravenous injection of ammonia in snake-bite, but as the treatment is still to be found recommended in the pages of some of our standard works, I will deal more fully with the question, and shew on what slender grounds its reputation was based and maintained. We have seen that, although originality of the procedure was claimed by Dr. Halford of Melbourne, as a fact it had been tried and condemned by Fontana. The grounds on which Dr. Halford was led to recommend the treatment were six experiments on the lower animals; and the confirmatory evidence of its success was to be found later on in a number of cases which were published in the Australian newspapers. In order to arrive at a just conclusion as to the merits of the advocated treatment, it is necessary to

Halford's experiments.

examine and estimate the value of these experiments and cases. As to the experiments:—

Experiments critically examined.

Experiment 1.—A dog, not weighed, was inoculated in several places with rattle-snake poison sent from America. Neither the age nor the quantity of poison inoculated, nor the mode of inoculation resorted to, is mentioned. Twenty-four hours after the inoculation of the poison, the dog was motionless, "the heart's action could only occasionally be felt; then it was of the feeblest; and the general opinion was that the dog was dying." Ten minims of ammonia were injected. Half an hour afterwards, ten minims more were injected. "From this time he gradually recovered, taking a little food in two or three hours." There is no doubt that this animal was poisoned, but certainly not necessarily fatally so, as Dr. Halford most unwarrantably concludes. I cannot demonstrate this more forcibly than by quoting a case described by Dr. S. Weir Mitchell—a much more serious one.

Note that in Dr. S. Weir Mitchell's case the symptoms of poisoning were very grave and rapidly manifest. Says Dr. Mitchell:—"The next case, and the last of this kind, I have placed alone; because it has especial value as showing

Dr. Mitchell's case of snake-poisoning ending in recovery.

how exceedingly grave may be the signs of poisoning, and yet how rapidly and complete may be the rally and escape. Experiment.—A small brown terrier was struck twice on the fore-leg and shoulder by a large snake which I held in the loop as usual. Within ten minutes the dog vomited, urinated, and passed solid fæces. All this time he whined a good deal, and finally at the fifteenth minute lay down on his side, breathing in jerks and twitching in almost every muscle. No fremitus could be seen at the wound, owing, perhaps, to the swelling, which was great, and might easily have concealed it from view. An hour after being bitten, the dog had a slight convulsion and vomited again. Meanwhile I could scarcely feel the heart heat, and the respirations were long and laboured. On leaving the animal late in the evening, and about seven hours after he was hurt, he was lying on the floor, scarcely breathing, and nearly pulseless. He had passed liquid and very dark stools, and some water." His sensorium even at this period, seemed to be unaffected. He was found perfectly well the next morning, except, of course, of the wounds caused by the bites. This experiment will be found

described at page 71 of Dr. Weir Mitchell's "Essay on Snake-Poison," which Dr. Halford informs us he had "studied with the greatest pleasure and profit," and yet he can assure us, by way of remark to his experiment above-mentioned, that "it seems clear that the ammonia obviated the tendency to death." Experiment 2.—A dog was bitten by a tiger-snake—vomiting, purging, and staggering occurred throughout the day. The next morning the dog was found "lying down apparently at the point of death, totally paralyzed, but sensible." Then, three more, and again five minims of ammonia were injected, but still the animal did not immediately get up and walk—as we shall presently see was the result in Dr. Halford's "cases"—it merely "seemed improved, and the breathing fuller." And it even remained in the same state the whole of the next day and the day after that; although ten more minims of ammonia were injected. It did not immediately recover, and was not reported well until eight days after the bite. There are several worse cases on record, in which recovery occurred, and we find, after the description of this experiment, the word "recovery," which is not quite synonymous with "cured." Experiment 3.—

Dr. Halford's conclusions unwarranted.

A small dog was inoculated with the contents—quantity not ascertained—of one poison-gland of a tiger-snake; twenty-five minutes after, vomiting and staggering came on; ten minims of ammonia were injected; but again, strangely enough, the influence of the poison did not seem to be "quite overcome," until seventy minutes afterwards when the vomiting ceased immediately." "It, moreover, ate a meal five hours and twenty minutes after it had been inoculated." The fourth and fifth experiments are similar, but the sixth terminated fatally from a *bite*. The Indian Commission record a case in which a dog was bitten by an Australian tiger-snake; it was a great deal salivated, and vomited, but it recovered. There are a number of cases on record shewing how seriously affected from snake-poison the animal many become, and yet recover without being submitted to any treatment. I have seen an animal in convulsions over night, and apparently quite well in the morning. There is an absolute want of precision in the conduct of Dr. Halford's experiments. In no instance was the quantity of poison which was injected ascertained. That *some* poison was injected is clear, but it is equally clear that the quantity was very

Some of the fallacies exposed.

small, sufficient to produce symptoms of poisoning which lasted over days (in some instances), but not enough to cause death. It is also absolutely certain that the ammonia did not in any way cut short the attack (so to speak) of snake-poisoning, as Dr. Halford and his friends insisted it does in the case of human beings so seriously affected as to be in a state of *profound coma* from snake-poisoning. Is not Dr. Mitchell's case, in which the dog recovered after a bite without treatment, of a much more serious character than any of the above-mentioned five cases? Great importance having been attached to Professor Halford's cases, I ventured in the columns of a Melbourne paper to analyse them, and I think I proved that symptoms of alcoholism were mistaken for those of snake-poisoning. One of Dr. Halford's champions wrote thus:—"I will not suppose for one moment that a large proportion of our rural surgeons are such a set of incapables as our Indian friends imply—unable to distinguish between drunkenness and snake-bite." Now there is really nothing very remarkable or incapable in their "rural surgeons" having confounded the two, for while real cases of snake-poisoning are comparatively exceedingly rare

Symptoms of drunkenness and of snake-poison confounded.

in Australia, there are many cases of supposed snake-poisoning, which are immediately converted into cases of alcoholism by the pernicious practice of administering an unlimited quantity of alcohol, under the mistaken idea that excessive stimulation is the remedy. This gentleman went on to point out to the members of the Melbourne Medical Society that whereas there are "profound coma" and dilatation of the pupils in snake-poisoning, "there are giddiness, helplessness, heavy sleep, *pupils contracted,* in alcoholism. It is here observed that he diagnoses the one from the other by the *profound coma* and *dilatation of the pupil* on the one hand, and the *heavy sleep* and *contraction of the pupil* on the other. Now let us see what Dr. R. S. Taylor says on the subject of *alcoholism.* "There is *confusion of thought,* with inability to stand or walk, a tottering gait and giddiness followed by *stupor* and *coma* (italics mine) * * * * the *pupils are dilated and fixed.* Diluted alcohol commonly produces a stage of excitement before stupor, while, in the action of concentrated alcohol, there may be *profound coma* in a few minutes." We will now examine Dr. Halford's cases—of real and sup-

Mistaken ideas as to the effect of alcohol.

posed poisoning, and contrast them with cases of cobra-poisoning and alcoholism. For this purpose, I place the analyses in juxtaposition :—

Dr. Halford's cases.

SYMPTOMS OF SNAKE-POISONING IN DR. HALFORD'S FATAL CASES.

No. 18.—Very drowsy but easily aroused, and able to answer questions very sensibly ;* * *quite sensible, now and again talking voluntarily to his mother. Died.

No. 24.—The reporter says:—"When I first saw him he had no drowsiness, and could walk about and talk naturally." Subsequently his jaws were fixed, and he could not articulate properly, * * pupils intensely dilated, and conjunctivæ insensible to touch. Hearing, however, appeared perfect. Died.

No. 41.—"He appeared stupid, and had partial paralysis of the tongue and eyes, but no loss of sensation." When the reporter last saw him, he answered rationally. Five hours afterwards he was dead.

SYMPTOMS OF SUPPOSED SNAKE-POISONING, IN WHICH ALCOHOL HAD BEEN ADMINISTERED : DR. HALFORD'S CASES.

Real cases of snake-poisoning compared with cases of alcoholism, supposed to be those of snake-poisoning.

Case No. 1.—"Stage of stupor * * * could not rouse him * * Pulse 56; * * progressed well with the exception of violent vomiting for twelve hours afterwards." Recovery.

No 2.—"Sluggish dilated pupils" * * * "symptoms of coma." Recovery.

No. 5.—"Complete state of stupor, from which I could with difficulty only partially arouse him." Recovery.

No. 6.—"The patient was comatose ; pupils dilated ; head sunk on chest ; pulse low and weak." Recovery.

No. 7.—"The boy was in a state of stupor." Recovery.

SYMPTOMS OF COBRA-POISONING FROM CASES QUOTED BY INDIAN SNAKE-POISON COMMISSION.

Case 1.—"He was unable to answer questions (owing to paralysis of the tongue), but appeared to be quite conscious." Died.

Case 2.—"The pupils were slightly dilated, and they contracted slowly when a candle was brought near them. He was unable to speak, but appeared to be quite conscious, and waved his hand in the native fashion to indicate his dissent when told that the injection of ammonia was about to be repeated. * * * * * * * The sense of hearing remained intact almost to the last. Vision did not seem to be impaired; but from his losing the power of speech so soon, it was impossible to determinate this point." Died.

No. 11.—"She fell down and became unconscious." Recovery.

No. 16.—She was in a comatose state, the pupils were dilated and insensible to light; the pulse was scarcely to be felt at the wrist." Recovery.

No. 22.—"I found him perfectly insensible. Pupils dilated." Recovery.

No. 23.—"She was lethargic and insensible." Recovery.

No. 26.—"Perfectly comatose, and pupils contracted, and, adds the reporter, "in two hours the comatose symptoms were so great that I was rather alarmed; at the same time it was a sleep which any medical man who did not know of the 'bite, would have said to be drunken.'" Recovery. How significant these remarks are!

Case 3.—Nothing definite stated, but one may infer that he was sensible as he had first complained of smarting about the bitten part, and half-an-hour afterwards was continually "putting the right hand to his mouth." No doubt owing to the feeling of suffocation, and to remove the frothy mucus which filled the mouth. Died.

Case 4.—From my snake-bite report, reported by Dr. Odevaine, 13th Regt. B. N. I.: "He was unable to walk or articulate though his mental faculties were clear." Died.

Case 5.—From Dr. S. Weir Mitchell's cases of rattle-snake-bite convulsion: mind generally clear up to death.

No. 27.—"Suddenly dropped from a chair into the arms of a bye-stander, completely comatose." Recovery.

No. 35.—"Patient insensible, eyes bloodshot, suffused with tears—the pupils somewhat dilated." Recovery.

True symptoms of alcoholic poisoning resembling cases of snake-poisoning as described by Dr. Halford's reporters (that is of the recovery cases.)

SYMPTOMS OF ALCOHOLIC POISONING, AFTER DRS. TAYLOR AND TANNER.—In general the symptoms produced by alcohol come on in the course of a few minutes. There is confusion of thought, a tottering gait and giddiness, followed by *stupor* and *coma*; should the patient recover from this stage, vomiting supervenes.

The insensibility produced by alcohol may not come on until a certain period, and then suddenly. Dr. Christison met with an instance in which a person fell suddenly into a deep stupor (vide Nos. 11 and 27 in the above column): "Pupils

Blyth on alcoholism.

dilated and fixed * * * * There is sometimes *profound coma* (Dr. Taylor). This is what Blyth says upon the subject:—"Symptoms.—In the case of rapid poisoning by a large dose of alcohol, which alone concerns as the preliminary and too familiar excitement of the drunkard, may be hardly observable; but the second stage, that of depression, rapidly sets in; the unhappy victim sinks down to the ground helpless, the face pale, the eyes injected and staring, *the pupils dilated, acting sluggishly* to light, and the skin remarkably cold."

The inevitable conclusion after comparison.

Compare these symptoms with those given by the gentlemen who undertook to champion Dr. Halford's cause. Also with those of the cases of supposed snake-poisoning in which alcohol—sometimes in enormous doses—had been administered, and you must inevitably arrive at the conclusion that cases of drunkenness were being treated, and not cases of snake-poisoning. It is invariably stated in the fatal cases that the higher sensorium has remained unaffected, while in the cases of recovery, *stupor* and *coma* were never absent. I endeavoured, as forcibly as possible, to bring home to those gentlemen who were advocating this line of treatment

that the dangers were really introduced by themselves—the real elements of danger were brandy and the syringe. That my efforts were to some extent crowned with success will be gathered from the following extracts from leading articles contained in the Melbourne *Daily Telegraph*, and from the fact that the Melbourne papers, which I have had an opportunity of perusing, through the kindness and courtesy of Dr. Lloyd of that city, are absolutely silent now on the wonderful cures effected by Dr. Halford's method of treatment; though there are still many who refuse to be convinced of the utter worthlessness, not to say positive danger, of such a line of treatment. In my opinion every person who resorts to it should be punishable for malpraxis.

My efforts against the treatment being resorted somewhat successful.

"The Medical Society of Victoria is to be congratulated upon the decision it took on Wednesday evening, to subject the ammonia treatment of snake-bites to a conclusive test, thus rejecting the advice given by the journals who 'write up' Professor Halford, to treat the challenge of the Indian Commission with contempt. This, the favourite mode of dealing with subjects by people who are completely upset, is out of place here, and our medical men have taken the one course open to them to vindicate their *bona fides*. It is also right, as the Medical Society has determined, that the experi-

What the "Daily Telegraph" of Melbourne said.

ment should be conducted by an independent body, and not by Professor Halford; and this as Dr. M'Crea says, without any disrespect being implied towards that gentleman * * * * * * * As to the funds with which the Medical Society propose to supply themselves we certainly think they might be contributed by the State. The Assembly voted £500 this year to Professor Halford to enable him to continue his researches, and if that item is allowed to lapse, it can be re-voted to the more National committee."

And subsequently:—

"'Trifling with human life' is the dictum of Dr. M'Crea on the ammonia treatment in snake-bite. The conclusion is one that we stated to the profession five years ago, and it is satisfactory at last to find that truth is prevailing. The members of the medical profession in Victoria are so deeply committed to the ammonia treatment that it is not to be expected that all of them could go round at once, but the public will notice that the men who have tried the experiments for themselves are one by one changing sides. Dr. Girdlestone has arrived at the truth, so has Dr. M'Crea. Dr. Webb's name has to be mentioned, and so has that of Dr. Blair. It may seem dogmatic to speak of the anti-ammonia cause as the truth, but on the other hand it is ridiculous to suppose that all human experience is to be set aside in favour of Professor Halford, and we challenge that gentleman now, as before, to shew one set of experiments, apart from his own, in which the verdict has not been that ammonia hastens

death. * * * * * * Dr. M'Crea and Dr. Girdlestone, and, indeed, all experimenters, appear to see clearly enough now the point which has been so long insisted upon, that it is the quantity of the poison dose upon which everything depends. If anything short of a fatal dose is given, the patient recovers, and he recovers with far more certainty if he is let alone than if he is drenched with ammonia. * * * The results obtained by the Medical Society of Victoria are strongly corroborative of this result, and we must be excused for repeating what some of them are. Two small dogs were poisoned with half a grain of virus, and were then afforded such chance of existence as the ammonia treatment gives. The one, weighing 17 lbs., lived two hours and forty minutes: the other, weighing 20½ lbs., lived three hours and fifty-three minutes; the average of the two being three hours and seventeen minutes. A still smaller animal, weighing only 10 lbs., received the same half-grain dose of poison, and, considering his size, this victim should have died in a still shorter time than the others, but he was left alone, and he absolutely lived five hours and forty-six minutes, or more than twice as long as the dog that most nearly resembled him in size, and who received the benefit of the antidote. Again, witness the two dogs into which one grain was injected—one weighing 54 lbs. died under the ammonia treatment in twelve minutes; his smaller brother, weighing 41 lbs., who was left alone, lived two hours and thirty minutes, or ten times as long as the dog under the antidote. With the dogs who were bitten by snakes, and who were

respectively subjected to the ammonia treatment and left alone, the results obtained are equally emphatic. Four such victims were treated by ammonia injection, and lived from two hours and eighteen minutes the longest period, to nineteen minutes the shortest, the average being one hour and twenty-seven minutes. Eight dogs were bitten and left to struggle against the poison, and lived from sixty-six hours and forty-eight minutes (the longest time) to fifty-two minutes (the shortest), the average being twelve hours and twenty-seven minutes or nine times as long as their fellow sufferers who were taken in hand by the experimenters for cure. In the face of these facts it is not possible to deny the accuracy of the statement made by Fontana in the eighteenth century, and echoed by Mr. Vincent Richards in the nineteenth, that to inject ammonia is simply to do one's best to make sure of death."

And yet, as I have said, we still find this method of treatment receiving the countenance of some writers of standard works.

APPENDIX.

Dr. R. Norris-Wolfenden has been conducting further researches into the chemical nature of cobra-venom, in the University College, London, and has demonstrated beyond doubt, I think, the proteid nature of the venom. So far, he is in accord with Weir Mitchell and Reichart; but he still holds that if peptone be present, it is only in traces and purely accidental, and is certainly not a noxious element of the venom.

He entirely disposes of the supposition that the venom owes its properties either to an alkaloid, as suggested by Gautier, or to a non-proteid body, as held by Blyth. He made examinations of cobra-venom by the Stass Otto method—the most reliable yet known—but failed to find the slightest trace of an alkaloid, either fixed or volatile. And in this particular, he confirms the conclusions of Professor Wolcott Gibbs, who made an investigation in this connexion at the request of Weir Mitchell.

On dialysing cobra-venom, and treating the dialysates after Blyth's method,* Wolfenden found

* Vide page 127.

no trace of a "cobric acid" leaving crystals such as that gentleman has described, though it is true that the dialysates are usually faintly acid, but of a non-toxic nature.

Apart from the antecedent improbabilities of the power of the venom being due to the presence of micro-organisms, as shewn by the rapidity of the poisoning, the phenomena of heat action and chemical action, Wolfenden found that there is nothing in cobra-venom which will grow under conditions favourable for bacteria.

He to some extent modifies his former conclusions—for which, however, finality was not claimed—as to the toxic elements of the venom. He now points out that there are three, viz:—

1. Globulin.
2. Serum Albumin.
3. Acid Albumin.

And one non-toxic proteid in some specimens, viz:—Peptone.*

As regards the physiological action of the toxic proteids, he is of opinion that the serum-

* Vide page 158.

albumin kills by an ascending paralysis without that implication of the respiratory system, so characteristic of the globulin, and—as he now says—in a lesser degree of the acid albumin.

It will be observed that these researches have reference to cobra-venom—an analysis of viper-venom being still wanting.

Now, if Wolfenden is correct in his deductions as to the destructive physiological action of these proteids, we ought to find that the main factors in the production of the phenomena of viper-poisoning are the albumins. Until we have before us an account of the analysis of viper-venom, a few points of considerable importance must still remain in obscurity. For example, what occasions the primary convulsions of daboia poisoning? What is the cause of the difference in the intensity of the local effects of cobra and daboia venoms? How is the subsequent blood-poisoning in the case of daboia-bite accounted for, when it is almost, if not quite, absent in cobra-poisoning?

I do not for a moment wish it to be understood that I underestimate the value of these

important researches into the chemical nature of snake-venoms, which must, of course, from the difficulties of the enquiry and the comparatively inadequate supply of the venoms, be slowly progressive, but I am constrained to admit there are yet some very material questions which remain unanswered. Some of the more important are these:—globulins and the albumins are innocuous; how then do the venom-globulins and venom-albumins differ from them? Whence do the latter obtain their subtle toxic properties? There must be a *plus* to the proteids. What is its nature?

There are several good workers in the field—Wolfenden, Warden, Waddell, besides Weir Mitchell and Reichart, the originators of the "new departure," and it may be confidently hoped that in the near future this recondite subject will be satisfactorily elucidated. But then comes the all-important question, Where shall we find the antidote? Wolfenden says, we must look for that amongst the compounds which will oxidise the venom proteids alone. Potassium permanganate fails to counteract the lethal effects of the venom, even when injected into the circulatory system, because it oxidises

not only those substances, but the proteids of the blood.

I regret that this notice should have to appear as an appendix, but as Dr. Wolfenden's essay—intended for publication in the *Indian Medical Gazette*—has only just reached me, it could not appear in the body of the work. I am sorry also that I should be compelled to issue the book without a notice of the important investigations which are now being completed in America by Weir Mitchell and Reichart.

It is to be hoped that some competent physiological chemist will take up the subject in Australia, in reference to the poisons of the snakes to be found in that colony.