AN ACCOUNT OF SOME RESEARCHES INTO THE NATURE AND ACTION OF SNAKE VENOM.*

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III.

ON ACQUIRED IMMUNITY AGAINST SNAKE VENOM POSSESSED BY INDIAN SNAKE CHARMERS, BY MONGOOSES, AND BY CERTAIN OTHER ANIMALS.

In February, 1899, I was deputed by the Government of India to meet Professor Fraser in Bombay, and to confer with him on the best lines for the prosecution of snake venom research in India. The work which forms the subject of the present paper was then suggested to me by the Edinburgh pioneer of venom research, and I desire to preface my article with an acknowledgment of the timely help I received from him. The first step was to ascertain the extent of the reputed immunity enjoyed by the Indian mongoose and by certain other animals. The appended tables will show this portion of the work at length. Thanks to the courteous co-operation of the collector of Coimbatore, a number of mongooses were obtained, and several series of experiments were undertaken with a view to discover how much cobra venom per kilo. of body weight could be injected without causing death. The venom was in nearly every case dissolved at such a strength that 1 c cm. of solution contained 1 mg. of the poison. The injections were made into the animals' thighs with all antiseptic precautions. The results obtained are set forth in Tables A and B. In the former are massed together several series of experiments, conducted in the hills, and, therefore, in a climate which was colder than that to which the animals are accustomed, they were, with but few exceptions, in good health when operated on.

Table B sets forth the results of a set of experiments conducted in the plains, but the reliability of the results is marred by two factors, namely: (1) That the animals had been some time in captivity before I used them; and (2) that on my return to the hills I was obliged to take them up with me from a hot dry climate into cold driving rain; such a change is most trying to any constitution, and these little animals feel it acutely. I do not hesitate to attribute the deaths of the third and fourth animals in Table B to climatic influences, for I have little doubt that they would have survived had it been possible to leave them in their natural climate. I am also persuaded that the lower lethal doses which proved fatal to the animals in this table as compared with those in the previous one are to be explained by the fact that captivity had told on the health of the whole batch.

Bearing the above considerations in mind, we may now review the whole mass of experiments included in the two tables. From such a survey it would appear that a dose of 0.006 gram. of cobra venom per kilo. of body weight is likely to

prove fatal to a mongoose, but that, given a healthy, active animal, much larger doses than this can be borne. It is indeed remarkable that animals should have survived doses of 0.01 gram, and 0.015 gram per kilo. of body weight. If we compare these results with those obtained by using the same stock of venom on rabbits, we find that the mongoose takes from 10 to 25 times as much cobra venom per kilo. of body weight to kill him as the rodent does. M. Calmette gives a somewhat lower estimate than mine in his most interesting work *Le Venin des Serpents*. He performed only three experiments, and found that while four times the lethal dose per kilo. of rabbit failed to make a mongoose sick, six times that dose caused two days' illness, and eight times the dose killed in twelve hours. I would particularly invite attention to the rapidity with which death ensued in this case as compared with my own results.

A very important point to remember is that the mongooses with which Professor Calmette experimented had been obtained by him from Guadeloupe, where he states that

venomous snakes are unknown; they had been imported into that island 25 years before from Barbados, with a view to the destruction of the rats there.

If immunity against venom is to any extent an inherited characteristic of these foes of the snake, it seems likely that the above-mentioned fact has a very important and interesting bearing on the question of our relative estimates of the immunity the mongoose possesses, for my specimens came from Coimbatore (a district in the Madras Presidency), which is well known as a happy hunting ground for venomous snakes of several kinds, and especially of the cobra.

Now, the mongoose was introduced into Barbados from India subsequently to the year 1882,¹ in order that it might destroy the rats, which had proved a dangerous pest to the sugar-cane industry; assuming Professor Calmette's statement to be correct, the importation of the mongoose into Guadeloupe must have followed very close on its advent into the Barbados, so that for practical purposes we may assume that the Indian mongoose was imported direct into the former island. It

must now be clear that the specimens of this little carnivore, with which M. Calmette experimented, had not been away from contact with poisonous snakes much more than 25 years. We are thus led to the interesting conclusion that the introduction of the mongoose into a country in which venomous snakes are unknown has resulted, within so short a period as a quarter of a century, in a very appreciable reduction of the animal's resistance to snake venom. This fact points strongly to the further conclusion that the immunity is an acquired one, and inasmuch as the acquired characteristic has been so rapidly and easily diminished, it would appear likely that it must be maintained from generation to generation. Be it remembered that a quarter of a century probably means about 50 generations.

An important factor in discussing the protection enjoyed by the mongoose is the nature of its diet, for it is almost exclusively carnivorous in the wild state, though in captivity it will eat fruit and vegetables readily. Professor Fraser has shown reason to believe that the habitual ingestion of animal food increases the resistance of even a herbivorous animal to

Snake charmer at work.

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snake venom; it therefore seems advisable to compare the mongoose with a carnivorous animal, and a ready type is found in the dog. According to M. Calmette, it takes 0.006 gram of cobra venom to kill a dog weighing 7 kilos. in twelve hours, while the same quantity of venom will kill 12 kilos. of rabbit in three hours; roughly, we may say that, according to this estimate, the resistance of the dog is double that of the rabbit. A reference to Table C will show my results with Indian pariah dogs; these, compared with my previously published results with rabbits, confirm the relative resistances of the two animals as laid down by the French savant. It will be noticed that, while our relative results agree, the absolute amount of venom used by me was higher than that used by Professor Calmette; this is doubtless due to my poison being from a weaker stock than his, it being well known that the strength of cobra venom varies according to the time of year in which it is collected, and according to other influences which it would be beside the point to discuss here.

Taking the rabbit as a unit, we are now in a position to draw up a table of the relative resistances to cobra venom exhibited by the dog and mongoose. We may state these roughly thus: Rabbit 1, dog about 2, mongoose from 10 to 25. It is not contended that these figures are mathematically correct, but they are believed to be as close approximations to the truth as it is possible to attain, when dealing with calculations into which that very variable factor "the personal equation" enters. One thing at least is quite clear, that we must look beyond the mongoose's food if we wish to find an adequate explanation of the source of its partial immunity to snake poison.

In order to obtain light on the subject, I have closely watched fights between wild mongooses and untamed cobras, and have also been at pains to collect reliable information on the subject from others who have witnessed similar combats. The first thing that strikes a spectator in these contests is the absolute indifference the mongoose exhibits in the presence of a snake, even after it has had one or two skirmishes with the reptile; the cobra, on the contrary, is "all there;" it raises its hood, follows every movement of the mammal, and hisses almost without interruption. As a rule, both animals evince a strong desire to avoid a fight, but there is the greatest difference between the casual conduct of the mongoose and the lively terror exhibited by the cobra. It would, however, be a great mistake to suppose that the former animal for a moment forgets the presence of a dangerous foe, for it will dart out of the way of a sudden stroke with a combined agility and aplomb that are astonishing. When the little carnivore finds that it cannot get away, it seems suddenly to catch sight of the reptile; it then approaches slowly and stealthily, watching every movement its adversary makes, and never allowing its eyes to leave the snake's head; now begins the "open phase" of the fight, in which the cobra's lunges are either evaded by swift backward springs, or "countered" by a sudden dash forward which results in the mongoose seizing the snake's head in its open jaws. The rapidity of this latter manoeuvre is almost incredible, unless one has witnessed it.

A very noticeable point is that the mongoose always makes

for the snake's head; I have never seen it attempt any other grip, and very often one finds the jaws of the two animals interlocked. It then looks as if the mongoose must certainly be severely bitten; but that this is not the case is often shown by the result of the fight. There is something in the grip which prevents the cobra from injecting any great amount of venom. In one case I found that the snake's fangs had been snapped off short by the carnivore's teeth, and in several instances I satisfied myself that these bladed teeth had transfixed the venom sacs, doubtless giving free exit to their contents, and rendering them useless, thus putting the poison apparatus *hors de combat*. There would seem to be but little doubt that under such circumstances venom must have found its way into the mongoose's mouth and so down its throat. This is an important point to which I shall revert later on. Such a grip as I have described may be only momentarily held, in which case open sparring is resumed, or the mongoose may hold on, bull-dog fashion, till the snake succumbs. It is a gruesome sight to see the two animals rolling over and

over in a merciless death grip, the snake writhing with pain while it enfolds the little mammal in its coils, the mongoose maintaining its hold with a courage that only death can damp.

There is one point I have passed over and to which I desire to return. It is the question of the frequency with which the cobra "gets home" in the earlier stages of the fight. To a casual on-looker the snake often appears to get its blow in; but a careful watch will show that as a rule it misses stroke after stroke. Even when it does succeed in striking its little foe, the agility of the latter is such that it bounds out of the way before any appreciable amount of venom can have been injected. To my mind the only chance the snake gets of injecting a full dose of poison is in the interlocking grip, when for some reason the mongoose has not succeeded in catching its adversary's head with its accustomed knack. At the same time, I do not mean to assert that the mongoose never gets a fatal bite whilst skirmishing, though I think that such an event must be uncommon.

The mongoose possesses a weapon of defence that deserves especial mention, in its long bristly hair; when attacking a cobra every hair stands on end, so that the little animal appears to be double its real size, or more; the natural result of this is that the snake is largely misled as to the true size of target available, and many a desperate lunge is wasted on the harmless "outer" of the mammal's thick coat, instead of scoring a "bull's-eye" on the lithe spare body. Many observers have laid stress on the idea that the mongoose's coat is too thick for the cobra to be able to get through it, and they have also called attention to the toughness of its skin. I attach no importance to either of these factors, which at the very most are only subsidiary items; no one who has watched the force of a cobra's lunge can seriously think them anything more; as for the skin of the mongoose it is no tougher than that of a dog, indeed it is not so tough, and one speaks after having used a hypodermic needle many times on both species of animals. The real functions of the outstanding hair are in my opinion (1) to mislead the snake as to the available size of target; and (2) to terrify its foe by means very comparable to those it itself uses in erecting its hood.

Snake charmer at work.

After watching a number of such fights as have been described above I feel justified in drawing the following conclusions: (a) That during the open phase of a fight a mongoose is likely occasionally to receive incomplete bites, in which only very small quantities of venom are injected into its body; (b) that when the mammal seizes the snake's head in its mouth and drives its bladed teeth through the poison sacs the escaping poison must often pass down its throat and be swallowed; (c) that in both of these ways it is likely that a gradual immunising process takes place, a process which is kept up through successive generations so long as the animals are in constant contact with poisonous snakes, but whose effect dies away should the mongoose be transported to a country in which the *Thanatophidia* are distinguished by their absence. The question that will naturally be asked is, "On what evidence do you base your view that the consumption of venom by the mouth leads to the establishment of immunity or of partial immunity?" My reply to this is that though I am not prepared at the present moment to bring forward positive proof in favour of the view that some degree of immunity can be established by feeding animals on venom, a view which is associated with no less a name than Professor Fraser's, yet I hope before long to publish some evidence tending in that direction. It is a matter which requires both time and patience, as the immunity cannot be produced in a short time. It would be previous to say more at present.

That the mongoose owes its many narrow escapes to its agility as much as to its partial immunity may be gathered from the fact that many Anglo-Indians possess dogs which make a point of killing every snake they see. A case in point may be quoted: A gentleman recently retired from the Madras Railway gave me the following description of two dogs he owned for many years: "These dogs never lost a chance of attacking a snake either singly or the pair together; if they spied a snake on the verandah chicks they would whine and dance about till it was shaken down to them; they would never attack a cobra or any other snake as long as it stood up to face them, but the moment the serpent lowered its head and endeavoured to escape they would rush in, seize it by the back, and shake it so violently that the reptile had not a chance of retaliating, and was dead before one could have believed it possible; if the first grip was not a good one they would fling the snake away and again follow it up when it tried once more to escape; between them they killed very many dozens of snakes of all kinds, including many cobras; one of them at last ventured once too often, and met his death from the bite of a cobra he was worrying." Such instances are not uncommon, and they go far to prove that a quick resolute animal, unendowed with any peculiar resistance to snake venom, can hold its own with even as deadly a foe as the cobra, though the risks must always be very great.

Nor is the dog the only domestic animal which goes out of its way to attack snakes. Mr. Gray of Coonoor, an ardent naturalist and a most trustworthy and careful observer, informs me that he knew of a cat which used often to bring in specimens of the poisonous hill vipers. Another gentleman, on whose word I can rely, told me that he had a cat which used to tackle cobras; on one occasion, hearing his child shrieking with laughter, he went into a bathroom, and there discovered the cat engaging a cobra; she was sitting in front of the reptile in a boxing attitude; every time the snake lunged the cat struck the blow to one side with her paw; when the cobra made an effort to escape, and lowered its head for the purpose, the cat seized the opportunity to rush in with a bite that brought the unfortunate reptile to the defensive again, and so on till the snake was wearied out. Other trustworthy persons have confirmed the accuracy of the above statements from their own experience.

Guinea fowl and peafowl have the reputation of keeping a compound free of snakes, though with what amount of truth I am unable to say. A native who has given me much assistance in my work on snake venom assures me that he has seen a peacock kill a large cobra, and that on opening peafowl he has often found snakes in the alimentary canal. He adds that he has also seen guinea fowl catch and eat young cobras or other young snakes. He is a reliable man, and he asserts that such facts are well known to natives, being matters of common experience. I cannot confirm his statements by any

personal or other European evidence, but I am inclined to believe him. In this connection the following contribution from a correspondent stationed at Munzerabad is interesting: "February 7th, 1900.—Three weeks ago I saw a common grey kite attack and slaughter a Russel viper, which it afterwards carried away. The bird hovered and fluttered around, half in the air, half on the ground, striking the snake with beak and wing. I do not think the bird was touched."

TABLE A.—Experiments Undertaken to Ascertain the Lethal Dose of Cobra Venom for the Mongoose (*Herpestes Mungo*).

Serial No.	Weight in Kilos.	Dose per Kilo.	Remarks.
*VII	1.274	0.0025 gram	Never seemed unwell beyond what the cold in the hills would account for. Recovered.
*VIII	0.821	0.0050 "	Did not seem to feel the injection, and apparently recovered: it died four days later, 6/10/99, at 2 P.M. It was very doubtful whether the venom caused death.
*IX	0.793	0.0075 "	Died in 5 hours 45 minutes. This animal had been sent up from the plains in the same cage as a female and another large male, and it was noticed before injection that he had been badly bitten. The test was scarcely a fair one.
*X	0.5667	0.0100 "	A lively and vicious young female; never seemed any the worse for the injection. Seemed to feel it but little for the first 3 days, but died on the fifth day. Death possibly due to chill.
LXIX	1.1477	0.0100 "	Died in 21 hours 55 minutes. Recovered with but little disturbance.
LXX	1.1902	0.0125 "	Seemed to feel it but little the day of injection, sickened on the next, and died 3½ hours after injection.
LXXI	0.7467	0.0150 "	Seemed all right for some hours after the injection, but was dead in 2½ hours.
LXXII	1.24687	0.0175 "	Died in about 12 to 15 hours; found dead and cold in the early morning.
XXIV	0.65173	0.0200 "	Did not sicken the same evening, but was dead in 23 hours.
LXXIII	0.73677	0.0200 "	Did not sicken that evening, but was dead in 22 hours 55 minutes.
LXXIV	0.5667	0.0225 "	

N.B.—In the experiments marked with an asterisk (*) the poison was dissolved at such a strength that there was 0.0001 gram of poison in each c.cm. of solution. In all the other experiments the strength was such that in each c.cm. of solution there was 0.001 gram of poison.

TABLE B.—A Further Series of Experiments Designed to Ascertain the Lethal Dose of Cobra Poison for the Mongoose, undertaken on November 11th, 1899.

Weight in Kilos.	Dose per Kilo.	Remarks.
1.289	0.002 gram	Recovered.
1.8143	0.003 "	Recovered.
1.474	0.004 "	Died on the sixth day, and 2 days after removal from the dry heat of the plains to the severe cold damp of the hills; death is attributable to this change of climate, which mongooses feel severely.
1.417	0.005 "	Died on the eighth day; here again there was but little doubt that death was due to the change of climate.
0.680	0.006 "	Died 67 hours after the injection, but had seemed quite well for the first 24 hours.
0.907	0.007 "	Sickened in a few hours and died in 29 hours.
0.822	0.008 "	Seemed well the morning after injection, but died in a little under 44 hours.
0.652	0.009 "	Seemed well the morning after injection, but died in 60 hours.
0.8788	0.010 "	Died in 40 hours.
0.8505	0.011 "	Sickened soon and was dead in 22 hours.
0.6237	0.012 "	Sickened speedily and was dead in 19½ hours.

There is a common belief amongst natives that Indian pigs eat snakes and that they are to some extent protected from cobra bites. Lieutenant-Colonel O'Hara informs me that he has watched a sounder of wild pig trample a cobra to death with the greatest deliberation. Professor Calmette, too, evidently believed that pigs possess some measure of protection, though he was unable to work the matter out. A reference to Table D will show that the idea is not altogether devoid of foundation,

TABLE C.—*Series of Experiments Designed to Ascertain the Lethal Dose of Cobra Venom for Pariah Dogs.*

Weight of Dog in Kilos.	Dose of Venom per Kilo.	Result.
9.5	0.00075 gr'm	Very ill, for 2 days, then slowly recovered.
14.5	0.00100 "	Died in 27 hours.
9.5	0.00125 "	Died in 7½ hours.
11.78	0.00150 "	Died in 4½ hours.

TABLE D.—*Series of Experiments Designed to Ascertain the Lethal Dose of Cobra Venom for Indian Pigs.*

Weight in Kilos.	Dose of Venom per Kilo.	Result.
15.4	0.00075 gr'm	Seemed a little ill for 2 days and then recovered.
20.4	0.00100 "	Died in four days.
25.84	0.00125 "	Died in 40 hours.
19.72	0.00150 "	Died in between 12 and 17 hours.

The pigs used were the common village pigs, well known as the scavengers of Indian hamlets.

TABLE E.—*An Extract from a Series of Experiments showing the Lethal Dose of Cobra Venom for Fowls.*

Weight of Fowl in Kilos.	Dose of Venom per Kilo.	Result.
0.836	0.0010 gram	Sick for one day; recovered.
0.878	0.0015 "	Died in 50½ hours.
0.836	0.0020 "	Died in under 15 hours.

TABLE F.—*Two Experiments designed to Ascertain the Lethal Dose of Cobra Venom for Guinea-fowls.*

Weight of Fowl in Kilos.	Dose of Venom per Kilo.	Result.
1.353	0.0015 gram	The bird hardly seemed to suffer at all, and was certainly quite well a few days later, except for a threatening of sloughing at the seat of injection.
1.289	0.0020 "	Was very sick on the third day, with paralysis of the legs and wings; died 80 hours after the injection; wound sloughing at time of death.

NOTE.—Though the series is very incomplete, it seems clear that these birds do not present any well-marked resistance to the venom of the cobra. A common fowl to which I gave 0.003 gram of cobra venom died in six hours and a half. Captain Gabbett has kindly undertaken to work this matter out more in detail later on.

TABLE G.—*Two Experiments with Peafowl, designed to Ascertain whether these Birds are to any extent Protected against the Venom of the Cobra.*

Weight of Fowl in Kilos.	Dose of Venom per Kilo.	Result.
2.0757	0.0025 gram	Died in 5 hours.
2.1400	0.0035 "	Died in 2 hours.

These experiments were kindly performed for me by Captain Gabbett, I.M.S., of Salem, with a carefully-weighed specimen of venom sent him by me. Captain Gabbett calls attention to the fact that the usual method of weighing a fowl with its feathers is unfair to the peafowl, owing to the fact that the relatively large amount of plumage it possesses increases its apparent weight, and therefore raises its dose of venom.

for although a dose of 0.001 gram per kilo of body weight proved fatal to both pigs and dogs, whilst 0.00075 gram per kilo failed to kill either animal, yet the duration of life was distinctly greater in the pig. The same evidence of increased resistance may be traced where higher doses of venom were given. I incline therefore to the view that the pig possesses a slightly greater degree of resistance to venom than the dog does, even when the dose is graded according to kilos of body weight, and to this one must add that the former animal is much larger and possesses a very much tougher skin; indeed, it is a difficult matter to force a hypodermic needle through a pig's skin, even after selecting its softest spot.

Before closing this subject I would invite attention to Tables E and F. From the former we learn that the guinea-fowl possesses a slightly greater degree of protection than the common fowl. Calmette has explained the resistance of the latter to venom as being due to its reserve air-sacs.

Comments on Table F will be found in a footnote to it.

DOES THE INDIAN SNAKE CHARMER POSSESS ANY DEGREE OF IMMUNITY FROM THE EFFECTS OF THE BITES OF POISONOUS SNAKES?

In order to answer the above question, I have been at considerable pains to collect information from a variety of different sources. As the outcome of these inquiries, I have been led to the following conclusions:

1. The snakemen of Southern India trust as a rule to valueless vegetable drugs or mixtures of drugs. With but few exceptions, they know absolutely nothing of prophylactic inoculations, or of any other measures beneath which a substratum of scientific reasoning can be traced.

2. A few exceptional charmers, here and there, swallow venom or rub it into their limbs, but without any definite ideas as to why they do so. All that one can elicit by inquiry is the reply "It is a custom," and to the Eastern mind this explanation is all-satisfying. It is possible, but I think very unlikely, that these men conceal their knowledge. On this point the evidence of my assistant, Dr. Pinto, is most valuable, as he knows the caste well, and speaks their language fluently. He expresses himself as convinced that the men he deals with for snakes are really ignorant of any method of protection against snakebite. Captain Giffard, who has devoted a good deal of his consideration to such subjects, gives me the following interesting information in a recent letter: "The head snakeman" of Chingleput, "who died of a cobra bite as he was bringing a snake to me, was well known to eat cobra poison whenever he killed a cobra; he was employed killing snakes, was supposed to be invulnerable, and had a reputation for snakebite curing, by means of medicines administered to his patients by the mouth (some sort of vegetable medicines). The other men hereabout do not eat poison, but rub it on their arms."

3. A surprisingly large number of snakemen appear to lose their lives in the pursuit of their vocation. Within the last year Captain Giffard and Dr. Pinto have each reported a death among the men they employ to assist them in collecting venom with a view to help me in my experiment. It would be easy to multiply instances, but space does not permit this being done; suffice it to say that a number of the fatal cases among these men occur while the victim is under the influence of liquor, and that no room can be left for doubt that the South Indian snake charmer is not highly immunised against venom. On the other hand, it is but fair to quote an extract from a letter received by the writer from Major Lloyd, of the 19th Madras Infantry, a gentleman who spends much of his spare time in studying the ways of venomous snakes. He writes: "Colonel Watson and I saw a snake charmer bitten by a cobra in Behrampore. The cobra was a fresh one he had recently caught, and its poison bag was intact; he was bitten on the forefinger knuckle, where it joins the hand, and I saw blood on the wound.....The man laughed, and at once produced several pills, of which he swallowed two, rubbed in another over the bite, and went on with his performance." Major Lloyd describes how he kept a close watch on the cobra, and as soon as the performance was over made the charmer close the snake's jaws on a fowl's leg, with fatal results to the bird in ten minutes. It seems possible that this man had succeeded in attaining some measure of immunity. I have met with snakemen who showed me scars

which they asserted were the results of bites by cobras; there was no proof forthcoming as to the correctness of their statements.

4. Many of the men who deal in poisonous snakes undoubtedly take early means to secure themselves against a bite by breaking off the poison fangs. There are two well recognised means of doing this: one is to seize the snake close behind the head, and force open the jaws with a bit of stick, which is then passed behind the fangs and drawn forcibly forwards; the other is to throw a piece of rag tied on to a string to the cobra, and when it bites to twitch the rag with the impaled teeth out of the animal's mouth with a jerk. Lieutenant-Colonel O'Hara, I.M.S., tells me of a third protective method—namely, the production of an artificial internal fistula by tapping the poison sac through the mouth and far back with a sharp instrument. I have no experience of this practice. Professor Calmette, in his most interesting work *Le Venin des Serpents*, commits himself to a statement which lies outside my experience, when he says on p. 48, "Certains jongleurs exhibent des serpents auxquels ils ont pris soin d'arracher les croquets ou d'extirper les glandes....." The italics are my own, and refer to the statement to which I take exception; speaking from a large experience of Indian snakesmen and their ways, I have never met with a case in which there was any evidence that the glands had been extirpated, nor do I believe that these ignorant men would be capable of performing such an operation. On the other hand, one can unhesitatingly endorse Professor Calmette's assertion that many of the snakesmen carry on their performances with cobras whose venom apparatus is intact. This leads us naturally to our next conclusion, which we cannot do better than put in Professor Calmette's own words, which deserve a hearty endorsement.

5. "C'est grâce à une connaissance parfaite des habitudes et des mouvements du reptile qu'ils (the snakesmen) évitent presque toujours d'être mordus." This was the conclusion I had arrived at before I had the pleasure of seeing Dr. Calmette's paper, but I cannot go so far as to say with the French observer: "Il ne paraît donc pas qu'ils sachent se donner l'immunité contre le venin par un procédé quelconque." The comparative immunity amongst snake charmers is undoubtedly due to the fact that these men understand the cobra well, and are, therefore, seldom bitten. You will never see a snakesman make a sudden movement when dealing with a cobra; every action is slow and deliberate, and often pervaded with a sense of rhythm; there is a consciousness of power over the reptile that appears to mesmerise it. I have seen a charmer sit on the ground in the characteristic position of the East, within easy striking distance of a cobra, and, without touching the animal, mesmerise it till it followed mechanically every movement of his swaying knee the while that the man's attention was drawn elsewhere. The photographs on p. 217 and p. 218, taken by the writer and unfortunately damaged by climate, illustrate, better than any words can, to one who has not watched a charmer at work the extraordinary power these men exercise. It will be observed that in both cases the man's eyes have left the cobras and are fixed in rapt attention on the camera.

A gentleman who handles poisonous snakes freely, and who does not hesitate to thrust his naked hand into a box containing a number of cobras, gives this advice to those who wish to follow his hazardous example: "Never be afraid of the snakes, never make a sudden move, and you are quite safe." It is, however, quite a different matter when one comes to deal with Russel vipers; they are sluggish, uncertain-tempered snakes, which do not rise to strike but spring out from their coil with a suddenness and rapidity which are appalling. I had a very narrow escape whilst experimenting some years ago with a Russel viper, with a view to ascertain its maximum height of strike; the viper, which was lying on the ground, suddenly shot out, like the crack of a whip, aiming its blow not at the guinea-pig tied to a stick which I was offering it as a bait, but at my leg. Now remembering the character of this viper, it is noteworthy that one never sees the ordinary snake charmer with one in his possession; indeed one has the greatest difficulty in persuading snakesmen to catch and bring specimens of the daboia; they know well that their blandishments are thrown away on this snake, charm they never so wisely.

We may sum up our conclusions in a very few words:

1. The snakesmen of South India are certainly ignorant of any method of producing in themselves a highly-developed condition of immunity.

2. Some few of them appear to practise the swallowing of venom, or the inunction of venom into their limbs, but it is doubtful if they do so with any well-defined object. It is possible that they thus obtain some degree of immunisation.

3. They confine themselves almost exclusively to the cobra, and escape harm by their intimate knowledge of the methods of handling this snake.

It only remains for me to express my sense of indebtedness to the many who have helped me in this work. Though they are too numerous to mention individually, there are three names I must not omit, namely, those of Captain Giffard and Captain Gabbett, of the I.M.S., and of Mr. Charles Gray of Coonoor.

REFERENCE.

¹ Vide Lydekker's *Royal Natural History*.

A CASE BEARING UPON THE PATHOLOGY OF ACROMEGALY.

By PERCY G. LODGE, L.S.A.,

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E. M., a man, aged 22 years, complained about January, 1898, of stiffness of the right knee when going out to work. At first this wore off during the day, but shortly became constant. The case was placed in my hands in May. At this time the knee was much swollen, the cutaneous veins were enlarged on the inner side and front, the limb was held in the position of slight flexion, and could only be moved with considerable pain. The great degree of enlargement was due to the tibia in the popliteal space. About this time he was seen by Mr. Teale, of Leeds. From the earliest appearance of symptoms to this time about twelve months had elapsed.

At the beginning of June, 1898, I explored by means of a trephining operation the medullary tissue of the head of the tibia. This proceeding established the presence of considerable subperiosteal thickening. No pus or signs of abscess could be found. Mr. Teale, after mature consideration of all the points of the case, advised amputation. His father thought that he would like further advice before so severe a measure was carried out. Mr. Mayo Robson saw him a day or two after, and confirmed Mr. Teale's opinion.

On July 21st we performed amputation by Mr. Teale's method at the Eldon Mount Nursing Home. We began by making a preliminary incision into one of the nodular masses around the hamstrings. Mr. Teale at once decided that the mischief was malignant; indeed, the tissues were semi-fluid from degeneration, softening, and hæmorrhage. It was thought that the form was probably round-celled sarcoma arising from the periosteum an opinion, which was afterwards confirmed by means of the microscope, and by a careful examination of the removed limb. The course of the case after operation was quite uneventful, the flaps healed by first intention, and caused me no serious anxiety.

He returned home three weeks later, and from that date began rapidly to improve in health and strength. Two months after he could get about the farm by the aid of a crutch, and seemed to all appearance quite recovered; indeed, he obtained an artificial limb and was beginning to use it. Although the amputation was through the lower third of the femur, a good square flap was formed from the tissues in front of the knee-joint, the excellent result of the Teale's amputation quite justified the procedure. About nine months after his return home his hands began to enlarge, and there was a similar enlargement in the other knee to that from which he had first suffered. He was under the care of his local doctor at this time. I saw him about the middle of June, 1899; his hands were then enormous, symmetrical, and possessed very little mobility. The fingers were sausage-like; the nails were unaltered, but the skin presented a moist bluish appearance. His mind also was clouded towards the end. His weight, too, had much diminished, and from this time he became steadily worse, and died on August 28th, 1899.