

the planting of trees in all suitable places on Table Mountain, and the protection of the corpses that still remain around the springs in the Hout's Bay valley.

III. ON THE ANATOMY AND HABITS OF SOUTH AFRICAN SNAKES.—By HERBERT W. OAKLEY.

[Read May 31st, 1882.]

One of the reasons that induced me to prepare a paper on the Anatomy and Habits of some of the Poisonous and Non-poisonous Snakes of South Africa, and how to distinguish a venomous from a non-venomous snake, was caused by occasional remarks I have from time to time overheard of the remarkable dread in which nearly all snakes are held ; of extraordinary powers attributed to them in attacking man ; in protecting their offspring ; and in their partiality for food of which Nature never intended them to partake. Every one is familiar with the story, which it is quite popular to believe, of the Puff-Adder striking backwards ; some people even believing that it can spring backwards upwards of eight feet. The Cobra I have been assured has been seen to spring forwards twenty feet. And the black Mamba of Natal is said to put its tail in its mouth and roll after one like a hoop. The Adder is reported to defend its young by allowing them to run in and out of its mouth. And, on the other hand, the young of Puff-Adders are said to kill their parents on being born ; and in ancient times they were placed in a bag with a human parricide and drowned as the punishment of this great crime. The Schaap-sticker we are assured kills sheep. But the commonest of all stories is that snakes are so fond of milk that they suck cows, and the native women ; and are brought irresistibly out of their haunts or holes if a saucer of milk is placed near the entrance.

To show with what superstition and ignorance snakes have been and are now somewhat regarded in various parts of the world, I may point out that Tylor in his work on Primitive Culture says in speaking of animal worship that Serpent-worship unfortunately fell years ago into the hands of speculative writers, who mixed it up with occult philosophies, Druidical mysteries, and that portentous nonsense called "the Arkite Symbolism," till now sober students hear the very name of ophiolatry with a shiver. Yet it is in itself a rational and instructive subject of inquiry, especially notable for its width of range in mythology and religion. We may set out among the lower races, with such accounts as those of the Red Indian's reverence to the rattlesnake, as grandfather and king of snakes, as a divine protector able to give fair winds or to cause tempests ; or of the worship of great snakes among the tribes of Peru before they received the religion of the Incas, as to whom an old author says : They adore the demon when he presents himself to them in the figure of some beast or serpent, and talks with them. Thenceforth such examples of direct ophiolatry may be traced on into

classic and barbaric Europe ; the great serpent which defended the citadel of Athens and enjoyed its monthly honey-cakes ; the Roman genius Loci appearing in the form of a snake ; the old Prussian serpent-worship and offering of food to the household snakes ; the golden viper adored by the Lombards, till Barbatus got it in his hands and the goldsmiths made it into paten and chalice. To this day, Europe has not forgotten in nursery tales the snake that comes with its golden crown and drinks milk out of the child's porringer ; the house-snake, tame and kindly but seldom seen, that cares for the cows and the children and gives omens of a death in the family ; the pair of household snakes which have a mystic connexion of life and death with the husband and housewife themselves. Serpent-worship, apparently of the directest sort, was prominent in the indigenous religions of Southern Asia. It now even appears to have maintained no mean place in early Indian Buddhism, for the sculptures of the Sanchi tope show scenes of adoration of the five-headed snake-deity in his temple, performed by a race of serpent-worshippers, figuratively represented with snakes growing from their shoulders, and whose raja himself was a five-headed snake arching hood-wise over his head. Here, moreover, the totem-theory comes into contact with ophiolatry. The Sanskrit name of the snake "naga" becomes also the accepted designation of its adorers, and thus mythological interpretation has to reduce to reasonable sense legends of serpent-races who turn out to be simply serpent-worshippers, tribes who have from the divine reptiles at once their generic name of Nāgas, and with it their imagined ancestral descent from serpents. In different ways, these Nāga tribes of South Asia are on the one hand analogues of the snake Indians of America, and on the other of the Ophiogenes or serpent-race of the Troad, kindred of the vipers whose bite they could cure by touch, and descendants of an ancient hero transformed into a snake.

Serpents hold a prominent place in the religions of the world, as the incarnations, shrines, or symbols of high deities. Such were the rattle-snake worshipped in the Natchez temple of the Sun, and the snake belonging in name and figure to the Aztec deity Quetzalcoatl ; the snake as worshipped still by the slave coast negro, not for itself but for its indwelling deity ; the snake kept and fed with milk in the temple of the old Slavonic god Potrimpos ; the serpent-symbol of the healing deity Asklepios, who abode in or manifested himself through the huge tame snakes kept in his temples ; and lastly, the Phœnician serpent with its tail in its mouth, symbol of the world and of the Heaven-God Taaut, in its original meaning probably a mythic world-snake like the Scandinavian Midgard-worm, but in the changed fancy of later ages adapted into an emblem of eternity. It scarcely seems proved that savage races, in all their mystic contemplations of the serpent, ever developed out of their own minds the idea, to us so familiar, of adopting it as a personification of evil. In ancient times, we may ascribe this character perhaps to the monster whose well-known form is to be seen on the mummy-cases, the Apophis serpent of the Egyptian Hades, and it unequivocally belongs to the wicked serpent of the Zarathustrians,

Aji Dahaka, a figure which bears so remarkable a relation to that of the Semitic serpent of Eden, which may possibly stand in historical connexion with it. A wondrous blending of the ancient rites of ophiolatry with mystic conceptions of gnosticism appears in the cultus which tradition (in truth or slander) declares the semi-Christian sect of Ophites to have rendered to their tame snake, enticing it out of its chest to coil round the sacramental bread, and worshipping it as representing the great King from Heaven who in the beginning gave to the man and woman the knowledge of the mysteries.

In the nineteenth century, when the anatomy and habits of snakes are tolerably well known to science, surely it is high time to give up fallacies which existed in days when myths originated, unfortunately leaving impressions on the minds of many generations, thanks to tradition, a peculiar symbolical architecture, and ignorance of Natural History, and I trust that in the course of this paper I may be able to show you that many of the popular stories and beliefs, some of which I have briefly related, are utterly erroneous and quite at variance with common sense. Also that I may make clear to you why many snakes supposed to be noxious are harmless, how really few species of venomous snakes exist in South Africa, and how that even these are not nearly to be so dreaded as they appear to be at present. In order, however, to make myself understood I must call your attention to a little of the anatomy of serpents, especially to the skull and teeth.

In a paper of this kind I can but glance slightly at the skull of snakes, and will therefore briefly remark that the cranium is made up of a number of bones having their homologues in the skull of mammals. Those which enter into the structure of the maxillary and mandibular arches are of importance in distinguishing the venomous from the non-venomous snakes, and I will therefore give a short description of them.

The bones composing the upper jaw and palate, as also the mandibles, are very movable, those of the mandibles hanging loosely from the tympanic bones, and which are united in front by ligament. The mastoid bones are also movable and are articulated with the tympanic, giving great distensibility to the mouth, which can not only be opened vertically but transversely, and each lateral half has independent and separate motion necessary for swallowing large objects.

The most important bones, as bearing on the difference between the poisonous and non-poisonous snakes, and which I must call to your notice, are, viz : the maxillary, the palatine, the pterygoid, the ecto-ptyergoid, and the mastoid. In a typical venomous snake, such as the puff-adder, the maxillary bone is reduced to a mere wedge, giving support only to the poison fangs. Now there is but one fang in each maxilla actually in use and which is ankylosed firmly, it is covered by a fold or capsule of mucous membrane in which it is ensheathed. In this membrane are several reserve fangs, the puff-adder has five in different stages of growth, and which lie loose until one of them is required by the loss of the actual fang. The succeeding one then becomes ankylosed to the maxillary bone, and communicates with the duct of the poison gland.

I must point out that the fang itself has no power of independent erectibility, the erection taking place mainly through the medium of the articulation of the maxillary bone with the ecto-pterygoid, which is elongated in proportion to the reduction of the former, that its hinge-like motion enables the snake to depress or erect the fang at will. In a harmless snake the maxillary bone is, in comparison to a venomous one, much elongated and carries numerous recurved teeth more or less firmly fixed; in the majority of non-venomous snakes these teeth are nearly all of equal length, but there is a tendency for one or two of the last teeth to become somewhat longer. In the Boom-slang (*Bucephalus Capensis*), the Schaap-sticker (*Psammophylax rombeatus*), and the so called Night-adder (*Leptoderia rufescens*) they are remarkably lengthened and not only so but grooved, and there are also usually several reserve teeth folded in a sheath of mucous membrane as in poisonous snakes; these teeth are, however, not connected with any duct of a special poison gland, so that snakes possessing them could not use them as a means of defence or aggression. They must therefore be looked upon as performing another function, such as retaining in their mouth some creature they are actually proceeding to swallow; and it may not be improbable they instil into the wound they inflict some acrid saliva which may help to render death more quick in its occurrence.

There is no poisonous snake that I am aware of that has the poisonous fang situated anywhere else than in the anterior part of the maxillary bone.

The poison fangs of snakes are of two kinds, one, as in the colubrine poisonous snakes, having a simple open groove along its anterior surface which conveys the poison from the duct of the poison gland to nearly the apex of the tooth; and the other, as in viperine snakes, having a groove which is closed nearly the whole length of the fang, making it appear to be perforated, and hence venomous snakes are placed in two classes; the first with grooved teeth, the *Proteroglyphia*, they being the poisonous Colubrine snakes, which in their general configuration resemble harmless snakes, and the second with canaliculated teeth, the *Solenoglyphia*, or viperine snakes, and which are easily recognised by their large triangular head, thick body and very short tail, and having the scales on the skin keeled.

An easy way of understanding the structure of a fang having a closed poison-canal is to imagine that the crown of a simple tooth has been somewhat flattened, and that its edges have been bent forwards and cemented together, thereby forming a conical shaped hollow open at both ends. The beginning of the flattening and its inflection around the canal begins close above the base, and the joining of the inflected margins proceeds along the anterior and convex side of the recurved fang; the hollow therefore for conveying the poison is in front of the pulp-cavity. The aperture of the canal is oblique, and its outlet nearly at the apex of the fang is a mere furrow.

As Prof. Owen points out, and which I have proved from practical observation to be correct, the duct which conveys the poison, although it runs through the centre of a great part of the tooth, is really on the

outside of the tooth, the canal in which it is lodged and protected being formed by a longitudinal inflection of the dentinal walls of the pulp-cavity. This inflection commences a little beyond the base of the tooth, where its nature is readily appreciated, as the poison-duct there rests in a slight groove or longitudinal indentation on the convex side of the fang ; as it proceeds it sinks deeper into the substance of the tooth, and the sides of the groove meet and seem to coalesce, so that the trace of the inflected fold ceases to be perceptible to the naked eye, and the fang appears to be perforated by the duct of the poison gland.

It follows from the position of the poison-canal that the transverse section of the tooth varies in form in different parts of the tooth : at the base it is oblong, with a large pulp-cavity of a corresponding form, with an entering notch at the anterior surface, farther on the transverse section presents the form of a horseshoe, and the pulp-cavity that of a crescent, the horns of which extend into the sides of the deep cavity of the poison-canal ; a little beyond this part the section of the tooth itself is crescentic, with the horns obtuse and in contact, so as to circumscribe the poison-canal ; and along the whole of the middle four-sixths of the tooth, the section shows the dentition of the fang enclosing the poison-canal, and having its own centre a pulp-canal in the form of a crescentic fissure, situated close to the concave border of the inflected surface of the tooth. The pulp-cavity disappears, and the poison-canal again resumes the form of a groove near the apex of the fang, and terminates on the anterior surface in an elongated fissure.

Having briefly pointed out the structure of the skull and teeth and the difference between poisonous and non-poisonous snakes, I must now turn to the habits of these reptiles and endeavour to show how many of the stories about them which are in circulation are quite fallacious.

With regard to the parent adder swallowing its young in order to protect them from danger, the best evidence I think I can bring to bear against such an unlikely proceeding is, that there is no special adaptation in the internal anatomy of this snake for such an event to take place, that no instance has ever yet occurred, where young vipers have been born in captivity, of their escaping in case of danger down their mothers' throats, and there is no authentic instance of any one having seen such an occurrence take place where these reptiles have been in a wild state. If the viper had a special cavity for protecting its offspring, as is the case in the pouches of the kangaroo and other marsupials, and if they would obligingly avail themselves of such a protection by going in and out of their mothers' mouths as the young kangaroos do that are born in the Zoological Gardens, where they may be seen hopping in and out of their mothers' pouches, we might believe in the story that has been handed down from generation to generation. But until some peculiar adaptation in the anatomy of the adder has been found for the special protection of its young, and until it has been actually demonstrated that they do go in and out of their mothers' mouths, I think we may do well to disbelieve it. Instances are common of one snake swallowing another, the Hamadryad snake of India especially, but they do it not to protect their weaker brothers but to make a meal of them.

Referring again to the popular idea of the puff-adder striking backwards, there is nothing in its anatomy that would render such an occurrence likely but quite the reverse. No one that I have consulted who is conversant with the habits of this snake has ever seen such an event take place, neither is there any recorded authentic instance of it. For my own part I have seen and captured numerous puff-adders and have kept them alive in captivity, and although I have tried every possible means, while they were yet at large and in captivity, to make them strike backwards, they have refused to do so, always either striking forwards or sideways; and I therefore have come to the conclusion that they prefer to stick to the dictates of Nature rather than to try any acrobatic performance.

No doubt all here this evening are familiar with the story that snakes, more especially the cobra and ringhals, are able to eject poison from their mouths to a considerable distance. Now no one could until recently have been less disinclined to place any belief in the snake's power to do so than myself; but lately I have had the opportunity of actually seeing a gummy liquid like office gum exuding directly from the anterior opening of the poison-canal of the fangs of a puff adder, when it was much irritated. It occurred under these circumstances: I caught a puff-adder alive and held it in my hand round the throat, when it erected its fangs and again lowered them as in the action of biting. I saw liquid exude from the fangs immediately from the opening of the poison-canal and from no other part, which fell into the lower jaw.

On Wednesday last I caught a ringhals. It occurred thus: as I was proceeding with my gun along the Flats at Rondebosch accompanied by my brother, I saw a snake with expanded hood glide almost between my legs and disappear in a hole two or three yards in advance of me. I watched by the hole while my brother went for a spade, and when he returned we set to work digging the reptile out. I had taken but two turns with the spade when I saw the ringhals, and had just time to hold him down with the spade about two or three inches from the point of his tail, when his head and body appeared on the other side of the spade, or rather between the back of the spade and myself; he immediately reared himself up, spread his hood widely and struck at me, ejecting with great precision and with a smothered hiss some liquid which glistened in the bright sunshine like crystal. I saw the fluid coming and threw my head backward, but some of it reached my chin and some fell on my coat. This fluid must have been ejected at last three feet. Soon after he spied my brother and greeted him with the same compliment, the fluid falling on his hand. Having at last with some difficulty captured the ringhals alive, we took him home and placed him in a box with a glass top, where he again struck towards us repeatedly and each time ejected on the glass a clear fluid. I have no doubt whatever that the liquid ejected was mainly saliva, but I see no reason whatever to suppose that a poisonous snake of the nature of a cobra or ringhals when greatly irritated cannot eject with its saliva some of the poison that exudes from the poison-canal, and falls, as I have before stated in speaking of the puff-adder, into the lower lip.

I can but affirm positively that a liquid does exude from the poison-

canal of the fang of a snake when it erects them and when the fang does not actually come in contact with any object, and I state emphatically that the ringhals at least can eject some fluid, whether saliva alone or saliva mixed with poison, to a distance of three feet if not more. The question is, can the liquid ejected do any harm.

Dr. J. Fayrer in his work on the venomous snakes of India, speaking of the poison of snakes, writes :—" But there is no doubt, I believe, that notwithstanding all that has been said to the contrary, it is capable of absorption through the numerous membranes with which it is brought into contact, though with less dangerous effects than when it is introduced into the blood. In certain experiments in which the poison of the cobra was placed on the conjunctiva of dogs, the symptoms of poisoning were rapidly and strongly, though not in all cases fatally, developed. . . The poison may be diluted with water, or even ammonia or alcohol, without destroying its deadly properties. It may be kept for months or years, dried between slips of glass, and still retain its virulence. It is capable of absorption through delicate membranes, and therefore it cannot safely be applied to any mucous surfaces, though no doubt its virulence is much diminished in the endosmosis. It kills when introduced into the stomach, when put into the eye, or when applied to the peritoneum."

Perhaps Mr. Fisk can give an instance of a snake causing inflammation to the eye by ejecting something from its mouth.

The power poisonous snakes have of exuding poison from the fang without actual contact with an object, and of ejecting saliva beyond the lips, was known to Sir Andrew Smith, an authority on South African snakes, but he appears to doubt that it can be ejected anything like three feet. This is what he says. In speaking of the Ringhals (*Sepedon hæmachates*) he remarks, viz :—"The aborigines, as well as the colonists, reckon this to be the most courageous of all the South African snakes, and they highly dread the power of its poison. When in confinement, and irritated, it evinces great ferocity, it opens its mouth so as to be in readiness to seize on any object that may approach within its reach, and while open the poisonous fluid is to be seen distilling in drops from the fangs, which are on such occasions always raised to the proper position for performing their functions. During such periods of excitement it often ejects, by some means, a portion of the fluid to a distance from its mouth ; and the inhabitants even affirm that it is able to cast it more than several feet, and that in doing so it generally attempts to lodge it in the eyes of men or animals. Elsewhere he says : I shall take occasion to remark more at length upon this reputed power, which he does in speaking of the South African cobra (*Naia haje*). This he says " is known throughout the Cape Colony by the name of *Spuugh-slang*, and is so called from the power it is supposed to possess of ejecting its poison to a distance. All the cobras of South Africa distil poison from the points of their fangs when they are much irritated, and are able to eject a portion of it beyond the mouth by a forcible expiration, but that any greater power than that is possessed by this snake I am not disposed to believe ; nevertheless the contrary is strongly maintained both by the European and native inhabitants. Both

of these affirm that the snake in question is able to cast its poison to a distance of several feet, especially if the wind be blowing so as to favour its object ; and that it often projects it into the eyes of unwelcome intruders, and thereby occasions a degree of inflammation which not uncommonly terminates in loss of sight.

The oil of tobacco has a remarkable effect on snakes. If a little is placed in the mouth of a snake, in a few minutes it becomes perfectly rigid, as if the muscular tissue was drawn up in lumps somewhat resembling a crooked and knotted stick ; but if rubbed it gradually relaxes, and appears none the worse for the dose. This may explain the story of the Indian snake charmer being able to turn a snake into a stick ; this feat is performed by spitting into the snake's mouth, then placing the hand on its head until the reptile becomes stiffened ; the effect produced is in all probability caused by opium or some other narcotic being introduced with the saliva. They then rub the snake between their hands, restoring it again to its usual animation. Of snakes having a partiality for milk I cannot say that I at all believe the truth of it. I do not mean to say that a snake in its wild state may not drink milk if it can possibly gain access to it, from a pan or other vessel ; or that in captivity it may not be brought to drink it freely. A sea-gull will occasionally eat grain in a cornfield when times are hard, and even bread and milk when in captivity, and I have seen an oyster-catcher, a bird that in its wild state lives on molluscs and small fish, eat grain in company with fowls, and take bread and milk from a bowl. But that a snake can suck a cow I am perfectly sure is not only most improbable but utterly impossible. Most quadrupeds have nearly as great a dread of snakes as man himself ; and it is utterly unworthy a moment's consideration to suppose that a cow (as I have heard it stated and by those who ought to know better) would allow a snake to climb its leg and quietly go on grazing while the snake was taking its fill. The arrangement of the teeth, lips and tongue of a snake render it practicably impossible that it could perform the feat of milking cows or any other mammal. We may as well believe in fairy rings, the "sea-serpent," spirit rapping or any other nonsense.

The poisonous snakes of South Africa number only twelve species, they are as follows, viz :—

A. Colubrine venomous snakes, with grooved fangs in front.

Fam : Elapidæ.

Naja haje, L. (The Cobra)

Cyrtophis scutatus, Sm. (Hab. Kafirland and Natal.)

Elaps hygiæ, Merr. (Houseband of Cape Colonists.)

Dendraspis angusticeps, Sm. (The Mamba) 10ft. 5in. to 11ft.

Atractaspis irregularis, * Rein.

Fam : Hydridæ.

Pelamias bicolor, Daud. (Black-backed pelamis.)

Hab. Cape Seas.

* The fangs of this snake are so long and the mouth so small as to render it very doubtful whether they could be used except to retain anything that was being swallowed from escaping. It inhabits the Eastern districts of Cape Colony.

I have brought an example of this snake caught at Kalk Bay to show you, for although it is unlike the poisonous snakes we are most familiar with, and has a comparatively small fang, yet it is a very poisonous snake according to Dr. Fayrer. Sea snakes sometimes get on board ship, having been pulled up with lines or nets; and there are several instances on record of men having been bitten and death being the result.

B. Viperine snakes, with perforated or canaliculated poison fangs in front

Fam : Viperidæ.

Crotho arietans, Gray. (The Puff-Adder.)

„ *atropos*, Linn. (The Berg-Adder.)

„ *inornata*, Sm. (The Plain Berg-Adder.)

„ *cornuta*, Sm. (The Horned Adder.)

Sepedon hæmachates, Merr. (The Ringhals.)

Causus rhombeatus, Wag. (The Causus.)

In conclusion I may state that no South African snakes, so far as my observation goes, during four years over a large portion of the Colony and Basutoland, are able to spring off the ground, neither can I find any recorded authentic instance of any South African snake having been seen to do so. Also that snakes unless much provoked, except perhaps on exceedingly rare occasions, will never attack man, but on the contrary will make good their escape as fast as they possibly can.

IV. ELEMENTS OF THE GREAT COMET 1882 (*b*).—By W. H. FINLAY, B.A., F.R.A.S., and W. L. ELKIN Ph.D.

[Abstract of Paper read October 25th, 1882.]

$$\begin{array}{lcl} \tau = \text{Sept. } 17^{\text{h}} 22^{\text{m}} 42^{\text{s}} & \text{Greenwich mean time} & \\ \omega = 69^{\circ} 32' 8'' & & \\ \Omega = 345^{\circ} 59' 35'' & & \\ \iota = 141^{\circ} 58' 59'' & \left. \begin{array}{l} \text{Referred to the mean equinox} \\ 1882.0 \end{array} \right\} & \\ \log q = 7.888881 & & \end{array}$$

These elements are founded on two meridian observations on Sept. 17, 22, and extra-meridian ones on Sept. 28. The observations are corrected for aberration and parallax from approximate elements previously derived. They represent the middle place almost exactly, and give for the distance of the comet from the centre of the sun at the moment when we saw it disappear at the limb on the afternoon of Sept. 17

963".2

which is only 5". 5 in excess of the tabular value of the sun's semi-diameter.

Attention was called to the great similarity of the above elements to those of the comets of 1843 and 1880, but the authors were of opinion that these comets were not returns of the same comet but that they all were undoubtedly members of one family.