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VENOMOUS SNAKES. SOME CENTRAL AMERICAN RECORDS. INCIDENCE OF SNAKE-BITE ACCIDENTS[1]

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No general scientific effort had ever been made to determine the exact character of the snake population in Central America, with the exception of Costa Rica, until July, 1924. Therefore very little definite scientific knowledge of the species of snakes responsible for snake-bite accidents had been recorded. Brazil was apparently the only country in the tropics of the western hemisphere that had made significant progress in the study of its venomous snakes. A great stimulus was given the subject in 1924 by Dr. W. E. Deeks, General Manager of the United Fruit Company's Medical Department, and since then considerable progress has been made in a Central American snake census and in promoting the manufacture of antivenin.

During my service in his organization while at Tela, Honduras, C. A., a plan was launched for a snake census of the coastal plain in use by the fruit growers. Snake accidents had never been a subject of great importance in these plantations yet occasional tragic accidents did occur and we were not prepared to offer modern treatment nor did we have scientific information regarding the species of snakes responsible for the accident. Each country and even many localities in the same country use different local names for the poison snakes. The final result of our effort was a cooperative plan of investigation with Dr. Thomas Barbour of the Museum of Comparative Zoology at Harvard University. He was assisted by Dr. Afranio do Amaral of the Serum-Therapeutic Institute of Brazil, Mr. Arthur Loveridge of the British Museum and Prof. E. R. Dunn of Haverford College. These specialists in herpetology accepted the responsibility of making a scientific identification of all specimens collected. A fund was arranged so that a bounty could be paid for the head and a few inches of the neck from all snakes collected without regard to the size or species. These were then placed in tanks of 10 per cent formaldehyde solution which were supplied all farm centers. This stimulated the labor forces in all plantations to make a uniform collection of all the snakes they could find during their daytime working hours. Complete details of the progress of the United Fruit Company snake census in the various countries of Central America and Colombia can be found in the Annual Reports of the Medical Department for the years 1925 to 1930 inclusive. As a result of this work the Antivenin Institute of America was

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organized as a subdivision of the Mulford Biological Laboratories, Glenolden, Pa. to meet the problem of snake-bite in all its aspects. This organization is now under the direction of Sharp and Dohme of Philadelphia, Pa. Venom collections were made in the serpentarium at Tela, Honduras for the use of the Glenolden Laboratories in making antivenin.

In spite of the fact that Weir Mitchell built the foundation of our modern knowledge of snake venom in the period 1860 to 1886, and that Flexner and

TABLE 1

Panama's poison snake census by locations (January 1929 to September 1940)

LOCATIONS	TOTAL CATCH	POISON SNAKES	PER CENT POISON SNAKES
Province of Panama (Sabanas)	3,855	1,041	27.0
Province of Darien (Rio Tuira)	3,534	874	24.7
Provinces of Panama and Colon (Rio Chagres)	2,498	523	20.9
Province of Herrera (Rio Santa Maria)	1,272	216	16.9
Province of Chiriqui and Coiba Island	825	293	35.5
Province of Cocle (Rio Hato and Rio Grande)	186	14	7.5
Province of Veraguas (Rio Concepcion)	17	6	35.3
Total	12,187	2,967	24.3

TABLE 2

Panama's poison snakes by species and locations

SPECIES	PANAMA-SABANAS	TUIRA VALLEY	CHAGRES RIVER	SANTA MARIA RIVER	CHIRIQUI AND COIBA ISLAND	RIO HATO RIO GRANDE	RIO CONCEPCION	TOTAL
Fer de lance	94	729	123	4	236	0	0	1,186
Hog nosed vipers (2)	669	57	104	209	11	13	0	1,063
Tree vipers (3 species)	6	3	73	0	22	0	1	105
Goldman's viper	0	0	0	0	12	0	0	12
Timbo viper	0	1	0	0	0	0	0	1
Bushmaster	3	38	63	0	3	0	2	109
Coral snakes (6)	266	46	160	3	8	1	3	487
Sea snake	3	0	0	0	1	0	0	4
Total	1,041	874	523	216	293	14	6	2,967

Noguchi succeeding in preparing certain specific antivenins in 1902, we have not had, until quite recently, a constant source of specific antivenins for use against the dangerous species of snakes in Central America, the north coast of South America and the United States. Brazil cannot meet the demands outside its own country. The demand for antivenin in other countries of the western hemisphere has never been great enough to meet the cost of production and distribution. Amazing as it may seem, the greatest single new factor in the United States that has made it possible to manufacture antivenin on a commercial scale is the automobile. People now make vacation trips across the continent and this has led to a great stimulus in camping, hunting, fishing and

hiking on the part of people who never before have been *snake conscious*. The result has been a demand for antivenin and snake-bite advice.

Dr. Amaral's automobile trip through the United States in 1926 led him to estimate that there are annually, in the United States, more than 1,000 cases of snake-bite by poisonous species. He believes that the mortality rate in such accidents runs from 10 per cent in the northeast, middlewest and northwest, to 25 per cent in the southeast and 35 per cent in the southwest. The southwest

TABLE 3

Relative incidence of poison species in collection

POISON SPECIES	NUMBER CAUGHT	PER CENT OF TOTAL CATCH OF 12,187
Fer de lance	1,186	9.5
Hog nosed vipers (2)	1,063	8.7
Coral snakes (6)	487	3.99
Bushmaster	109	.89
Tree vipers (3)	105	.86
Goldman's viper	12	.098
Sea snake	4	.032
Timbo	1	.008
Total	2,967	24.3

TABLE 4

Collection made in plantations July, 1924 to October, 1925. Tela Railroad Company, United Fruit Company

POISON SPECIES	NUMBER CAUGHT	PER CENT OF TOTAL CATCH OF 3,109
Fer de lance	312	10.0
Coral snakes	207	6.6
Hog nosed vipers	12	0.4
Tree viper (horned palm viper)	10	0.3
Total	541	17.4

receives a vast number of outdoor enthusiasts. Other circumstances that operate in the same direction are as follows:

1. The clearing of land, contrary to the general opinion, is followed by a rapid increase in the number of snakes, provided that agricultural development follows. Such development provides shelter and food for rodent life and rodents are the chief diet of the vipers.

2. A primitive region is sparsely populated, if at all, while an agricultural region provides many exposures of man and domestic animals.

While Dr. Amaral was studying the snake problem in Texas, he was told that in a period of three years snake-bite was responsible for an annual loss of over one million dollars worth of cattle.

The Gorgas Memorial Laboratory started its participation in the snake census

in January, 1929. The same method of collection was used that had been in effect in the United Fruit Company and the same scientific staff made the identifications. We have done very little midland, mountain and Atlantic coast survey work except in the valley of the Chagres River which discharges on the Atlantic side of the isthmus. Our catches can be more easily presented by reference to tables 1 to 3.

During the progress of the snake census in Tela, Honduras, which I had the opportunity to supervise, a total of 3,438 specimens was shipped to Harvard University for identification. Reports were returned on 3,109 that were in satisfactory condition to study the head scales, sutures and teeth. The tabulated results are as shown in table 4.

NOMENCLATURE

The scientific and lay names of our poison snakes follow. Efforts to describe these snakes so that one can recognize them is quite beyond my ability. If one could offer true color pictures of the young and old snakes with new skins and with old skins ready to be shed, it would give many of us greatly desired assistance. However, without such help it requires experience covering a large amount of material in the field or in the museum.

Viperidae (*pit-vipers*)

Bothrops atrox is the commonest large poison snake found in our surveys. This snake is known in Martinique as the *fer-de-lance*, in Colombia and Panama as the *equis*, in Costa Rica and Nicaragua as the *terciopelo* and in Honduras and Guatemala as the *barba amarilla*. It has a dart shaped head (fer-de-lance), an x-like color pattern when viewed from above (equis), a plush covered head (terciopelo) and lemon colored scales under the head (barba amarilla). An adult is usually 5 to 6 feet in length; slender, dark in color with a light gray to lemon colored pattern in the form of triangles when viewed from the side but forms an x pattern when seen from above. In Honduras this snake not infrequently gave birth to litters varying from 60 to 70 in number, while in Panama the litters have averaged about 45. These young snakes at birth are from 10 to 13 inches in length and are active and dangerous. The *fer-de-lance* is the cause of nearly all of our serious snake-bite cases. It is very common in lowland plantations and is less common in a rocky, forested region up to two thousand feet. It is a ground snake although its young may glide up slanting vines and bushes.

Bothrops lansbergii and *Bothrops nasutus* are the small hog nosed vipers. The former is an inhabitant of the Pacific side and the latter of the Atlantic side of Panama. These snakes range from 12 to 18 inches in length and have a tipped up nose. They are dark in color and about as thick as one's middle finger. They have rhomboidal patterns over the back of a faint brick red color set in a general background of brown or black. They produce about 8 to 14 young. It is a ground snake and far more common in the sabanas than in the forest. It is less apt to strike than the *fer-de-lance* although a few serious cases have been due to its bite. The lay names used for it are: *hog-nosed-viper*, *patoca* and

tamaga. It usually lives on lizards and has never yet, in our experience, contained a rodent although in captivity they can be forced to take mice. During the earlier years of our census these snakes, from the Atlantic coast, were reported as *Bothrops brachystoma* but the name has been dropped in recent years.

Bothrops schlegelii is another small viper. It has a prehensile tail and lives in bushes or trees. It is usually about 10 to 14 inches in length. It may be olive green or butter yellow in color with powder shot specks of black. Some are almost black with a pinkish pattern over the back. The important mark of identification is the prehensile tail and the two or three scales above the eye which stand out as small horns or eyelashes. Their young usually number 6 to 10. A ground collection of snakes is not apt to reflect the true incidence of this snake. These are to be found when large labor forces are felling trees and bushes. It is common in cacao plantations. A wide variety of names have been applied to this snake: *horned palm viper, eyelash snake, bocaraca, toboba de pestanas, oropel* and *sleeping gough*. Its main diet seems to be small birds. We have only one instance of a snake-bite case due to this form and it struck the shoulder near the neck. The man recovered without specific treatment.

Bothrops lateralis and *Bothrops nigroviridis nigroviridis* are also tree or bush snakes with prehensile tails. They are about 18 to 30 inches long and are green in color. The first has light stripes along the side and the other has powder shot black specks scattered throughout the green background. We have too few of these specimens to offer much about them as medical hazards but they occur at high levels, four to six thousand feet elevation. All of ours were caught by trout fishermen in bushes along the banks of streams. They may be common at those levels but it would require tree and bush felling to learn their incidence.

Bothrops godmani is another small thick ground viper. It is thicker than the hog nosed viper and black in color and about 18 to 22 inches in length. We have a few specimens all taken at about four thousand feet elevation near the same trout stream where the tree vipers just described were found. Natives say that it seldom strikes a person and we have no record of such an accident. Lizards and mice have been found in them. No common name for it has been given us.

Bothrops nummifiera is another short thick ground viper being about 10 to 18 inches in length and thicker than one's thumb with a dart shaped head as large as that of a *fer-de-lance*. This snake produces litters of about 10 to 14 and they vary widely in color from brickish red to black. The pattern on this background fits over the back something like a saddle with stirrup straps hanging down the sides. The pattern is very dark and the scales are rough. It looks not very unlike a bushmaster except for its length. When it strikes, its short powerful body pulls away from the ground and this gives rise to the name *"jumping snake," timbo* and *mano de piedra*. We have taken but one in Panama but they have now been reported in Honduras in rocky elevated places of about one to three thousand feet. It is said to be a serious hazard. Rodents and lizards have been found in its tract.

Lachesis muta is our longest and heaviest viper, averaging about 7 feet in length. One of this length would weigh twice as much as a *fer-de-lance* of the

same length. It lays eggs, about 10 to 14 in number. It is usually found in high, rocky forested places like the mid-basin of the Chagres River. It is also found in the lowlands if rodent life is abundant. Rats have been found in all of those we have examined. Its local names are: *bushmaster*, *verrugosa*, *mapana* and *cascabela muta*. It is powerful but not as fast as the *fer-de-lance*. The general color of the snake is tan and the pattern is very black and fits over the back like a saddle. Its tail ends in a brown sharp spine that is not covered with scales. The scales are very high and over the back give it a warty appearance, hence the native name *verrugosa*. This snake has a low incidence because the eggs and young are more open to destruction by predatory life than the litter of the *fer-de-lance*. It is a serious hazard but one hears of an authentic case very seldom. Most of the snakes accompanying cases said to be due to it have been found to be the *fer-de-lance*.

Crotalus terrificus, the tropical rattlesnake or *cascabela* does not appear in our census but it occurs on either side of Panama, in Costa Rica and Colombia. It is alleged to be in the dry tablelands of the provinces of Chiriqui and Veraguas and we have received rattles but no snake from these regions. It prefers dry tableland or desert regions and we have done very little collecting in such areas because they are too thinly populated to conduct a census.

Elapidae

Micrurus nigrocinctus nigrocinctus is by far the most common coral snake in our census and it seems widely distributed over the Republic and at many levels from the sea coast to at least three thousand feet elevation. They are more abundant, however, at lower levels and in the sabanas. It is usually 10 to 20 inches in length and is a tricolor snake with annular bands of red, white and black. We have only three records of snake-bite by this species and they all occurred in the personnel of zoological gardens. It is capable of doing serious damage if it makes a successful strike but the three people we know who were bitten by it did not receive specific treatment yet they recovered. This snake has fixed short fangs farther back in the jaw than the vipers and it may strike without being able to set its fangs. It is a burrowing snake and we consider it of little importance since so few accidents have been caused by it. However, it cannot be handled with impunity for its venom is very much like that of the cobra.

Micrurus mipartitis is another local coral snake but it is comparatively rare. Its color scheme is represented by black and white annular bands without a red band. Some of them show some pink near the tail. We know of no accidents due to it.

Micrurus dissolencus dunni is another less common coral in our collection and has a tricolor annular band scheme.

Micrurus clarki is a new coral snake for this region and has been found in the Tuira valley of the province of Darien and about Madden Lake in the Chagres River basin. It is a tricolor snake with annular bands but the tip of each red scale is black and it has a white horseshoe shaped mark on the back of its head rather than a transverse white bar as in our common coral snake.

Micrurus nigrocinctus coibensis has been found, thus far, only on the island of Coiba. The common names for all coral snakes are: *coral snake, harlequin* and *gargantilla*. One species still under study from the Atlantic coast (San Blas) is about three feet long and as large as one's thumb. It was not collected by our organization.

The eye of the poison tricolor corals is pin-point in size while the nonpoison tricolor snakes have an eye as large as a pin-head.

Pelamydrus platurus is a sea snake that occasionally has been found stranded on the beach. It is a black snake with orange patterns on the side and belly. It has a flat tail like an eel. It is exceedingly abundant in Panama Bay at some seasons of the year. Although laboratory experiments with small animals indicate that it is a poison snake, we have never heard of anyone being bitten by it. Those we have opened contained shrimp and small fish.

Dr. E. R. Dunn has provided us with a list of poison snakes taken by other collectors in Panama that are not included in our surveys: they are as follows:

Viperidae: Bothrops montecelli. A single specimen has been recorded from Cana in the Darien Province.

Elapidae: Micrurus nigrocinctus mosquitensis. Five specimens recorded from Bocas del Toro on the Atlantic side.

Micrurus sp. Two from El Valle. Pacific slope.

Micrurus stewarti. A single specimen from the San Blas coast (Atlantic side).

Another *Micrurus* sp. is under study that is new to Panama. Five specimens were collected by us in 1940 in the banana plantations of the Chiriqui Land Company, a subsidiary organization of the United Fruit Company. This location borders the boundary line between Panama and Costa Rica on the Pacific side. The Gorgas Memorial Laboratory's collection of snakes includes 15 species of poison snakes for Panama: Viperidae, 9 and Elapidae 6.

In addition to these, other Panama collectors have recorded 2 Viperidae and 5 Elapidae or a total of seven. The total known record for Panama, therefore, is 22 species of poison snakes: Viperidae 11 and Elapidae 11. To this list must be added, for Central America, the tropical rattlesnake. Panama is known to have 109 snake forms and the Gorgas Memorial Laboratory census, which now includes 12,187 snakes, has collected 78 of the 109 forms. Fortunately for the Central American doctor, about 80 to 85 per cent of his poison snake-bite cases are bound to be the result of some species of *Bothrops* and if he is able to identify the bushmaster, rattlesnake and coral snake he can gamble with safety on the use of bothropic antivenin for all other cases. A specific antivenin is necessary for the tropical rattlesnake, the bushmaster and the coral snake.

Most people hold the idea that our tropical vipers can strike at much greater heights than it is possible for them to do. None of our snakes coil up into a high pile and then strike from that position as some North American rattlesnakes do. As a general rule they assume an S-like position on the ground with the head about two or three inches above the ground and the strike covers a distance of 6 to 10 inches. Of course, if the snake is on a log, stump, rock, bank or hanging in a bush, the bite may occur on any part of the body. Much information has been gained on this subject by watching snakes in a serpentarium. It is

possible for me to review 104 cases of snake-bite by poison species in regard to the anatomical location of the wound (see tables 5 and 6). These records are from the plantations of the United Fruit Company and since then I have received in Panama eight additional case records and all of the wounds in these cases were on the hands or feet.

Nearly all of these cases arrived for treatment many hours after the accident.

Snake-bite cases do not occur as often in our region as the incidence of poison snakes in our census might indicate and *serious cases resulting in death* are almost as rare as deaths caused by lightning. In all of the wide spread banana plantations of the United Fruit Company in Central America their medical records show 23 snake-bite accidents per 100,000 population per annum.

TABLE 5

Anatomical locations of 104 snake-bites

UPPER EXTREMITIES		LOWER EXTREMITIES	
Fingers	33	Toes	7
Hand	10	Foot	17
Wrist	5	Ankle	11
Forearm	5	Leg (below knee)	12
Shoulder (tree viper)	1	Thigh*	3
Total	54		50

* Bitten while in a squatting position.

TABLE 6

Morbidity and mortality

YEAR	NUMBER SNAKE-BITE CASES	DEATHS	TOTAL RATE
1927	19	1	5.26
1928	46	4	8.70
1929	39	2	5.13
Total	104	7	6.73

The reason that snake-bite accidents in Central America seldom kill is a natural one. Most all of our venomous snakes are nocturnal in their habits. Food is plentiful throughout the year so they are able any night to capture and swallow a rodent.

In doing this they discharge all of their venom that can be squeezed out of the glands into the rodent or other item of food. A snake that has recently killed and ingested its meal will require some time to secrete enough venom to fill the glands again. According to Dr. Amaral, it requires about two weeks for a snake's glands to regain their maximum capacity of venom and maximum degree of toxicity. We know, in our laboratory work, that it does not pay to strip a snake for its venom unless it has fasted for a period of about three weeks. Very

few people are abroad at night and therefore they escape chances of being bitten by a snake with full poison glands. Most snake-bite accidents that involve people, happen in the daytime and in the majority of cases the snake that causes the accident is full of food or it would have made its escape. When a snake swallows a rat or other animal it can not run well because the belly plates used in running are stretched so tightly over the "food ball" that they cannot function. They hide nearby until the meal digests and spreads out in the alimentary tract. Baby snakes are not always able to find a meal that they can swallow so they may be found active *after sunup* trying to find food. These little specimens can cause very serious cases. Most people bitten by poison snakes in our part of the world do not receive a fatal dose of venom because the snake's glands have not had time to secrete enough poison following its capture and ingestion of a rat or other animal.

Domestic stock at large on a range is, of course, exposed day and night to snake-bite. We are unable to secure accurate information on such cases for when animals die at great distances from headquarters the buzzards soon destroy all the evidence needed to diagnose a cause of death. We do infrequently hear of such cases in the horse and cow kept in pastures near range headquarters. I never yet have heard of an authentic case of snake-bite of a mule. They seem to know when they are near a snake and will not pass over or near it unless spurs are used and then they will jump over the spot. Most people in our region are forced to wear shoes or boots of some kind to protect themselves from thorny vines, trees and saw-edged grasses. This, at the same time, offers good snake-bite protection. Anyone who is well shod and gloved is well protected even in a bad snake region.

ADVICE IN SNAKE-BITE PROCEDURE

I have, personally, treated only five cases of *fer-de-lance* snake-bite. Three of them within a few minutes after the accidents and two of them 10 to 20 hours afterward. Most cases of serious snake-bite poisoning come to a hospital from 12 to 24 hours after the accident and this is far too late to expect much help from treatment with antivenin. Either they get well or die regardless of what is done for them other than the good effects of supportive treatment, rest in bed and prevention of secondary infections.

Practically all that is written on this subject relates to hospital practice and that always means many hours delay before admission for the treatment of a case and plenty of time for extensive absorption of venom. Crimmins and Jackson have recorded splendid procedures for the management of hospital cases but, after all, the place to institute important treatment is at *the time and place of the accident*. As a general rule snake-bite accidents occur at a great distance from medical assistance and those bitten know very little about snake identification. First aid packets are still of such a size and snake accidents so rare that labor forces, hunters, fishermen, explorers, etc. soon find that they want their pocket space for other things. People seldom wear coats in the tropics and the

pocket space is limited to the trousers, shirt and any bag they may carry. Twice since 1923 I have seen two cases that travelled a great distance to the hospital several hours after their accidents with ligatures in place and greatly swollen hands only to find that they were not the victims of snake-bite! They had been picking up piles of cut brush and grass and something hit them and left holes in the skin. In both instances pieces of palm thorns were broken off under the skin surface. These two instances are mentioned because many people are in a panic after such accidents and histories are unreliable.

First aid

(1) Alone or in a party the first step should be to kill and keep the snake responsible for the bite. This is usually easy to accomplish since it is very apt to be right nearby and unable to escape because of the "food ball" in its body that restricts locomotion. Simetimes young snakes, ten or twelve inches long, may be hard to find for they have a color that blends with the surroundings and are hard to see. They also, may be empty and able to run. It is very important to know what kind of snake did the biting. If the snake has a lump in its body then the patient did not receive a large amount of venom and the prognosis is good. If there is very little evidence of a "food ball" then the case must be considered serious.

(2) Apply a tourniquet (vine, weed, string or a piece of shirt) like a tight garter well above the knee or elbow whenever the bite is located below these levels. The tourniquet should be applied firmly enough to prevent the flow of blood in the veins, but not tightly enough to prevent the flow through the artery. In other words, tie it tightly enough to cause the limb to become blue but not white. The tourniquet should be released for a few seconds, at intervals of ten minutes, in order to prevent gangrene of the tissues below the level of the tourniquet. Tourniquets are not successful below the knee and elbow, because some vessels that lie between the bones are not effectively controlled. Some patients have been more seriously injured by too long and tight use of a tourniquet than by the toxic property of the venom itself. Just as soon as it is possible to apply the tourniquet or to have some one hold the leg or arm with both hands in place of a tourniquet one should begin the extraction of the venom. This is the most important step in first aid since one should immediately extract all that he possibly can, in order to avoid absorption and to leave as little as possible for the antivenin treatment to control. We advise hunters, campers, bosses of labor gangs, etc. to carry squares of very thin rubber dam that can be laid over the wound and sucked against with safety. The commonest thin rubber available is the condom. One of these when cut down one side and the ends cut off is large enough to make two squares. People are advised to carry half a dozen squares in a metal tube match case such as are used by boy scout troops. This has a spring top and the case is small and occupies very little room in a pocket. It will protect the rubber squares from punctures by thorns, barbed wire, etc. Even though one's gums are not good he can safely suck and press with the teeth at the same time in a wide manner about the wounds. We do not make incisions

at the site of wounds in cases subjected to immediate treatment following the accident. The channels made by the fangs are raw and absorb quickly and additional incisions increase the raw surfaces and thereby hasten absorption. Do vigorous sucking over the wounds for about five minutes, then wash the wounded area with water or any available safe solution.

(3) Administer antivenin subcutaneously and again repeat the sucking efforts over the wound. All large camps or labor centers should have this in their dispensary stock in a bad snake region.

(4) Keep the tourniquet in use for about an hour after the administration of the antivenin and then it may be removed. Send the patient and the snake to the hospital. It is important to have an accurate identification of the snake so that a proper antivenin may be used. If by the time the patient reaches the hospital, serious evidence of poisoning are present then more antivenin should be given and the treatment of Crimmins and Jackson should be instituted. In most cases, well applied first aid treatment is all the specific treatment that will be required. The rest of the treatment need only consist in treating the wound as you would any other form of an injury to prevent infection.

Two accidents have been seen where a fang punctured a vein. In such a case immediate intravenous injection of a specific antivenin is indicated. Any delay in treating such a case is almost sure to result in death. The dosage of a specific antivenin must be based entirely on the amount of venom injected rather than on the age and size of the individual. There is no way to estimate the amount of venom injected by the snake except roughly by noting whether the snake exhibits a lump or food ball in its body or by the progress of symptoms in the patient after good first aid has been applied. Snake-bite cases are usually sent to the hospital without first aid treatment other than an incorrectly applied tourniquet. If a large dose of venom has been injected they arrive far too late for the physician to have much chance to effect the course. Most physicians have so little chance to gain experience in a knowledge of snakes that they cannot identify the snake and there are some cases of snake-bite inflicted by non-poisonous species.

The fang of a viper is curved and channeled through its center but the hole through which the venom escapes is not in the tip end of the fang. It is an oval hole like the eye in an old fashioned sewing needle located on the front of the fang about one eighth of an inch above the points. When the snake strikes it pulls against the fang and this removes some of the tissue pressure along the front of the fang which assists in the escape of a few drops of venom. In striking a person the lower jaw of our vipers seldom leaves a mark as it would in the case of a rat during the capture and swallowing act. A rat would receive more venom, ordinarily, than a large animal struck on a flat surface because the jaws of the snake close tightly around it and this squeezes the glands. Making crucial incisions over the fang marks in the skin of a person does not reach the droplets of venom because they are deeper than the skin layer and are not directly beneath the skin wounds because the fang is curved. Any deep incisions are also apt to miss the droplets of venom and if they do pass through them they only

smear the venom on a new cut surface where it is rapidly absorbed. We prefer no incisions over the bites or at any level above unless the case is received sometime after the accident. We use the mouth or a $1\frac{1}{2}''$ glass funnel to which a rubber tube is attached to extract the venom through the channels made by the fangs. Most pocket kits are supplied with a syringe barrel that is not large enough. When it is placed over a fang mark and pressed downward hard enough to get action with the piston, the edge of the barrel squeezes shut the line of the fang wound at about its middle and therefore the droplets of venom are not removed for they cannot escape up the tract of the wound. When snake-bite wounds are over a bony prominence or between fingers and toes it is very difficult to extract the venom. We use glass tubing smoothed and compressed at the end and attached to a rubber tube. On a flat surface a funnel and tube work well and a clamp can be used on the tube so that when the skin is pulled up to a good level in the funnel the clamp can be screwed tightly on the tubing and the action held until it is desired to loosen the clamp.

Alcohol is contra-indicated in the treatment and permanganate solution cannot reach the droplets of venom beneath the skin although it could serve well as a solution to wash the skin where suction over the fang wounds has been performed. Hospital and dispensary records never correctly reflect the actual incidence of snake-bite accidents because most such victims find themselves at a great distance from medical help. Only the news of some of the tragic fatal accidents ever reach a record bureau.

Most physicians find themselves confronted with two important obstacles in their efforts to cope with the few snake-bite cases that they see during their professional life time: (1) The patient does not know what species bit him. (2) If by chance the snake was killed and brought in with the patient, the physician is very apt to be at a loss in his ability to identify it or to have immediate access to anyone in his neighborhood who can identify it. (3) Fortunately for Central American doctors, about 80 to 85 per cent of their snake-bite cases have been due to one of the forms of the *Bothrops* and antibothropic serum can be used on speculation. The tropical rattlesnake and the bushmaster requires a specific preparation. The coral snakes seldom bite and when they do they are very apt to fail in setting the fangs. Their fangs are fixed and well back in the upper jaw and cannot often succeed in puncturing the skin.

In all of the 12,187 snakes collected for us, none of the collectors were bitten. Such accidents happen when the victim does not see the snake and steps on it or right by it. Most natives carry a hooked stick about a yard long in one hand and a long machete in the other hand. They use the stick to put grass or bushes under a bending pressure that makes their machete stroke more effective in doing clearing work. They uncover any snakes present while being at a safe distance from a possible strike at their hands or feet. Well shod and gloved people who avoid night exposures in our region are safe from snake-bite. It is worth calling some attention to those who live in temporary camps in a snake region. We always denude the ground in the sheltered part of the camps where beds or cots are placed and in that portion used for the kitchen and food supplies.

In a short time after such a camp is occupied, the food supplies attract the field or forest rats and mice. These rodents are the chief diet of our vipers who come into the camp to capture them. If one gets out of his bed at night bare-footed and without a flashlight he takes a chance. Three such accidents are known to me. Not infrequently, one finds a shed snake skin on the ground floor that was not there when he retired. Again, I repeat that snake-bite accidents are rare even though about one out of four or five of the snakes collected is venomous. It has been my experience that snakes make their escape very promptly unless they have a "food ball" interfering with locomotion or they are cornered by your presence and must fight to defend themselves.

The snake problem affords more academic interest than a practical medical problem of great importance. Prompt attention to the extraction of venom from the wounds is the most important thing in the management of such accidents and without waiting to move the patient or to send for the doctor.

Large military operations involving day and night movements in the tropics should keep in mind the snake problem.

Both venom and antivenin are being studied with increasing interest in some centers for their probable therapeutic values in the treatment of certain diseases. This field may prove to be of greater importance than the use of antivenin for the treatment of snake-bite.

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