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SNAKEBITE MORTALITY IN THE WORLD

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SYNOPSIS

In examining the relative importance of snakebite mortality in different parts of the world, the authors review the information collected concerning both snakebite mortality and the species of snake incriminated. Available statistical data are known to be unreliable and at best can serve to provide only an approximate and highly conservative estimate of the relative magnitude of the snakebite problem. The sources of error inherent in the data are discussed, and estimates are made of the probable mortality from snakebite in various areas of the world.

INTRODUCTION

In 1935 the Inter-Governmental Conference of the League of Nations suggested that the Health Organisation of the League of Nations should study the question of standardization of antivenenes. Owing to the size of the problem, however, the Commission on Biological Standardization of the League decided to confine the study to the serum against venoms of European vipers only.[6] The interest in this problem was revived when the question arose as to whether snakebite mortality was of such worldwide importance as to require consideration by the World Health Organization. The answer depends upon a knowledge of the total number of deaths from snakebite in different parts of the world.

A study was therefore undertaken to determine the extent to which mortality from snakebite was really a world problem. Its value depends on the availability of reliable information not only on the number of deaths caused by snakebite in different parts of the world, but also on the prevalence of different kinds of poisonous snakes found in various countries.

It is well known that the registration of deaths from various causes is incomplete in many areas of the world, and that in some countries it is almost non-existent. Since deaths from snakebite occur generally in the so-called underdeveloped countries, and more so in the remote villages and

jungles, the chances of snakebite deaths being missed are perhaps even greater than for deaths occurring from several other causes. In many areas the only information available is that relating to cases treated in hospitals or dispensaries. Such cases are drawn from places sufficiently close to medical institutions and then only if the victim lives long enough to reach the hospital.

The recorded figures of snakebite deaths may therefore be regarded as under-estimates of the total fatality from this cause, the degree of under-recording varying from place to place.

Another difficulty in ascertaining the numbers of snakebite deaths is that in the *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death*,[12] adopted by many countries, no provision exists for a separate classification of snakebite deaths. These deaths are included in a broader group, namely, E927, in which are grouped all deaths from " accidents caused by bites and stings of venomous animals and insects ". This title therefore includes all deaths from bites and stings by venomous animals and insects such as :

Bite by :	Sting of :
centipede	bee
insect, venomous	insect
snake	scorpion
venomous animal	wasp

Prior to this classification, which was recommended in 1948, the international recommendation was that the countries should follow the *International List of Causes of Death* (Fifth Revision, 1938), in which, also, no separate provision existed for tabulating deaths from snakebite alone. In accordance with the 1938 revision of the International List, deaths from snakebite could fall either under Category 175 or under Category 194. Category 175 included deaths from agricultural and forestry accidents and was further subdivided as follows :

(*a*) accidents from farm machinery and vehicles (excluding road accidents);

(*b*) injuries by animals in farming, etc.;
ba. venomous animals;
bb. other animals;

(*c*) other agricultural and forestry accidents.

Thus, the detailed category " 175 ba " included deaths from snakebite as well as from other venomous animals, provided they occurred in connexion with agriculture or forestry.

Category 194 (" attack by venomous animals "), included deaths from snakebite as well as from other venomous animals, except those occurring in the course of agriculture and forestry (175 ba).

According to the classifications suggested for international use and adopted by a number of countries, it would have been impossible therefore to tabulate separately the deaths from snakebite. Fortunately, however, in several countries where poisonous snakes exist in appreciable numbers and snakebite deaths are not infrequent, provisions had been made by national authorities to further subdivide categories of the International List so as to show deaths from snakebite separately.

The statistical information assembled for the purpose of this study is therefore based on separate information on snakebite deaths as far as it could be obtained. For many countries in which, as already stated, snakebite mortality is not so great a problem and for which figures of deaths have been tabulated only under the broad headings, an attempt has been made to provide some estimate of the percentage which snakebite deaths constitute of the total deaths classified in the broader groups E927 (1948 Revision) or 175 or 194 (1938 Revision). This percentage is, of course, zero for countries in which it is known that poisonous snakes do not exist as, for instance, in Chile, the Republic of Ireland, New Zealand, etc. On the other hand, in a country infested with poisonous snakes, e.g., Thailand, this percentage is naturally high.

The incidence of snakebite mortality depends on the chance of a person being bitten by a poisonous snake, which naturally is related to the numbers of the prevalent poisonous species of snake and other factors contributing to the individual coming in contact with them. For instance, in areas where people walk bare-footed, the chance of being bitten by a snake may be assumed to be greater than in other regions, although equally infested with poisonous snakes, where people's limbs are well protected.

Some general information on the prevalence of poisonous snakes in different parts of the world was obtained by inquiries addressed to a number of individuals in different countries—in many cases through the Regional Offices of the World Health Organization—to supply whatever information could be obtained from various areas. Additional information incorporated in the study was collected from published literature on the subject.[3, 4, 9]

WORLD DISTRIBUTION OF POISONOUS SNAKES

Some 2,500 different kinds of snakes are known to exist in the world and they belong to 13 different families. Less than about 200 snakes are dangerous to man, and they are unequally distributed among four main families : the Elapidae; the Viperidae; the Crotalidae, every member of which is poisonous to a certain extent; and the Colubridae (to which nearly two-thirds of the known species of snakes belong), most of which are harmless, the only dangerous ones being some of the rear-fanged reptiles. There are two other families of poisonous snakes—the Hydridae

and the Amblycephalidae—but they are said to be " so unobtrusive in their habits that they rarely conflict with man ".[3]

Poisonous snakes are not generally found in extremely cold climates, although a very robust viper is known to be present in Scandinavia to within the Arctic Circle and to extend into Siberia. In North America, poisonous snakes are not known north of the southern borders of Canada. In contrast, poisonous snakes are abundant throughout the continent of Africa, and are also found in most parts of South America, with the exception of the high mountain tops and southern Patagonia.

Land-dwelling poisonous snakes are not found in the Polynesian islands. Madagascar and New Zealand are also free from these reptiles, despite the fact that very many dangerous species are present in neighbouring countries. Poisonous reptiles are also absent from the Azores, the Canary and Cape Verde Islands, and (with the exception of Martinique, St. Lucia, Tobago, and Trinidad) the West Indies. Thus, they do not occur in Haiti, Cuba, Jamaica, and Puerto Rico. They are also missing from Ireland, Iceland, the Orkneys, and the Shetlands.

The Elapidae, to which family the widespread and dangerous cobras of the Old World and the New World coral snakes belong, is represented in every continent except Europe. The true vipers of the Viperidae are found only in the Old World. The family Crotalidae is represented in the New World and Asia. The USA rattlesnake is a member of this family. Other crotalids are present in southeastern Asia and the East Indies; among these are some rear-fanged members of the family, but their venom is not lethal for man. The dangerous rear-fanged colubrids of Africa are seldom found outside that continent.

The sea snakes (family Hydridae) occur near the coasts of southern Asia and northern Australia. As a rule, they live near the shore and are not found far away from land. However, one species which may have crossed the Pacific Ocean has established itself on the west coast of Central America; it is also found on the eastern coast of Africa.

Further details of the distribution of poisonous snakes in individual continents and countries are given in the sections dealing separately with each area.

Africa

Africa has a wide variety of poisonous serpents, including terrestrial, aquatic, and arboreal species, and some kind of snake is found in almost every region of the continent. The barren deserts and snow-covered mountain peaks are, however, free from these reptiles.

Two kinds of spitting cobras occur, both of which are able to blow their venom into the face of an opponent from a distance of up to 12 feet (3.7 m). The ringhals or spitting snake (*Sepedon haemachates*) is common throughout South Africa. Another snake that sprays its venom is the

spitting or black-necked cobra (*Naja nigricollis*), which ranges from Upper Egypt to Angola and the Transvaal. The black cobra (*Naja melanoleuca*) is confined to the tropical regions; this snake does not spit its venom.

Naja haje (the Egyptian cobra) is the most widely distributed of the African cobras, and is found throughout North Africa, with the exception of the coastal region of Algeria. It is also particularly abundant in the countries bordering the Sahara Desert, and its range extends through East Africa to Natal. *Naja flava*, the Cape cobra, is present from Cape Colony to southern Tanganyika, and several other cobras are found in somewhat limited areas of Angola and West Africa. The water cobra is known in the Cameroons, the Belgian and French Congos, and Lake Tanganyika.

About 30 true vipers are present in Africa, and among these the puff-adder (*Bitis arietans*) is very widely distributed. It occurs from southern Morocco and the southern Sahara to the Cape of Good Hope, and is also found in Arabia. The venom of the puff-adder is very dangerous but, compared to that of the cobra, it is slow to take effect. The Cape puff-adder (*Bitis inornata*), a close relation of *B. arietans*, is found in the Cape region.

Causus rhombeatus, the night or Cape adder, ranges from the Nile over most of South Africa, and is particularly frequent in the Nairobi area. This reptile is reported to be rather timid in disposition, being slow to bite unless hurt or surprised. In addition, its venom is less toxic than that of many other vipers. The rhinoceros viper (*Bitis nasicornis*) is also a placid and inoffensive reptile, and while its poison may be even more dangerous than that of other species it is said that this snake bites only with much reluctance. The rhinoceros viper is found in the rain forests of the Belgian Congo, the Cameroons, the Gold Coast, Kenya, Nigeria, Portuguese Guinea, and Uganda.

The highly poisonous gaboon viper (*Bitis gabonica*) inhabits the deep forests of West Africa. This snake injects its venom, which is especially dangerous to man, very deeply with its long fangs, killing the victim almost instantaneously.

The horned adders (*Bitis cornuta* and *B. caudalis*) are also extremely dangerous, and will bite immediately at the bare feet of any person who happens to approach them. They are not found, however, outside the sandy areas of southern Africa. The venom of the berg adder (*Bitis atropos*), which inhabits the mountain ranges in South Africa, is highly toxic.

Two sand vipers (*Aspis cornuta* and *A. vipera*) are known in the Sahara; they are both extremely well suited for existence in dry desert sand. Another reptile which occurs in the sandy areas north of the equator is *Echis carinatus*, the carpet viper, and it is interesting that, while most of the poisonous snakes known in Africa are not found in other countries, this reptile is also present in Arabia, India, and Iran.

The African representative of the rear-fanged snakes of the family Colubridae is the boomslang. Several species of the extremely dangerous mambas are present in Africa, and they range from Ethiopia to the southern regions.

Systems for the registration of vital statistics have not yet been fully established over large areas in Africa. In many cases, therefore, the available information relates only to cases treated in hospitals or dispensaries. From these figures it is not possible to make any comparisons or even to judge the importance of the snakebite problem. But the data are set out merely to indicate whether or not deaths from snakebite do occur.

French Equatorial Africa

Annual figures for snakebite deaths recorded in hospitals in individual territories are given below.

Territory	*1947*	*1948*	*1949*	*1950*	*1951*
Middle Congo	6	8	15	14	23
Gabon	—	—	—	4	15
Oubangui Chari	—	—	—	6	37
Tchad	2	4	5	8	8

A large number of the snakebite deaths in this region are caused by *Dendroaspis jamesonii* and *Bitis arietans* (puff-adder). *B. arietans*, *B. gabonica*, and *Naja nigricollis* (spitting cobra) are found in the savanna zone; *B. nasicornis* lives in forest areas; and *Causus rhombeatus* is found near human dwellings.

One of the most dangerous reptiles in Gabon is the water cobra, *Boulengerina annulata*. Another snake present in this area is *Naja melanoleuca*, the black cobra, which also occurs in the Middle Congo.

French West Africa

Annual deaths from snakebite occurring among cases treated in hospitals in French West Africa during the period 1948-51 are shown below. In many cases complete information is not available.

Territory	*1948*	*1949*	*1950*	*1951*
Ivory Coast	2	2	16	4
Upper Volta	2	2	0	4
Dahomey	7	*	*	21
Sudan	*	5	*	5
Guinea	*	*	3	3
Niger	*	*	0	4
Senegal	*	*	*	3

* No data available.

Several species of poisonous reptiles are found in French West Africa. Those common to all the territories are the night viper, *Causus rhombeatus*, the rear-fanged *Dispholidus typus*, *Elapechis guentheri*, and *Naja nigricollis* (spitting cobra). *Naja haje* is found in Niger, Senegal, and the

Sudan; *N. goldii* in Dahomey and Ivory Coast; and *N. melanoleuca* in coastal areas. The vipers occurring in the forest regions of Dahomey, Guinea, and Ivory Coast are *Bitis nasicornis* and *B. gabonica*. The puff-adder (*B. arietans*) is also widely distributed.

Angola

The following tabulation shows figures of cases of snakebite and snake-bite deaths in Angola during the period 1947-51.

Year	*Number of*	
	cases	*deaths*
1947	40	2
1948	18	—
1949	17	—
1950	4	—
1951	9	—
Total . . .	88	2

The most prevalent poisonous snakes are the vipers : *Bitis arietans*, *B. gabonica*, and *Causus resimus*. The cobras are represented by *Naja nigricollis*, *N. anchietae*, and *Elapechis guentheri*. The mamba, *Dendroaspis angusticeps*, is also found in many localities.

Gold Coast

The total numbers of deaths from snakebite occurring among cases treated in Government, mission, and mine hospitals during the years 1949, 1950, 1951, and 1952 were 5, 5, 6, and 7 respectively.

It is known that a considerable number of cases do not attend hospitals and presumably the mortality among them is high.

Reliable information on the relative prevalence of different poisonous types of snakes is not available. In the northern parts, fatal bites are believed to be from *Echis carinatus*. The cobras (*Naja nigricollis*, *N. melanoleuca*, and *N. goldii*) are also quite common.

Egypt

Annual deaths from snakebite in Egypt for the years 1944-8 are given below :

Year	*Deaths*
1944	27
1945	22
1946	34
1947	41
1948	46
Total . . .	170

On the average, about 34 deaths from snakebite are recorded in Egypt annually, giving an annual death-rate for the country as a whole of 0.2 per 100,000 population.

Of the six or more venomous reptiles found in Egypt, *Naja haje*, the Egyptian cobra, is widely distributed. *Bitis arietans* is also frequent, and is present in both grassy and rocky areas. Three vipers are found in the desert : *Echis carinatus* (carpet viper), and *Cerastes cornutus* and *C. vipera* (small sand vipers). The spitting cobra, *N. nigricollis*, occurs in the south of the country.

Ethiopia

Figures for snakebite are not available, although it is reported that the number of cases of snakebite treated in provincial hospitals is not high. The most common venomous snakes in Ethiopia are : *Naja haje*, found in great number below 2,000 m (6,562 feet) altitude; *Bitis arietans*, found in great numbers all over the country below 2,000 m altitude (Danakil, Tigre, Sidamo); *Echis carinatus*, found in great number, especially in the Rift Valley from the Hawach River to Lake Rudolph, and also in Gondar region (Tana Lake) and Ambo, about 120 km (approximately 75 miles) west of Addis Ababa.

Libya

The number of snakebite cases officially registered during the last five years was about 6 to 8 each year.

The two kinds of snakes most frequently encountered in Libya are the sand vipers (*Aspis cerastes* and *A. vipera*) and the cobra (*Naja haje*) in the proportion of 6 to 1.

Portuguese Guinea

In 1952, six deaths from snakebite were recorded. Reporting by the indigenous population is incomplete.

The poisonous snakes commonly found are the spitting cobra (*Naja nigricollis*), the puff-adder (*Bitis arietans*), and the night adder (*Causus rhombeatus*). The boomslang (*Dispholidus typus*) and the mambas (*Dendroaspis viridis* and *D. jamesonii*) are also present.

Madagascar and the Comoro Archipelago

No poisonous snakes are reported from these islands.

Mauritius

No poisonous snakes are found in Mauritius.

Mozambique

Separate figures for snakebite are not available.

During the five-year period 1947-51 the total number of inpatients treated for attacks by venomous animals and insects (serpents and scorpions) was 331, of whom 7 died. In the same period, 3,038 cases of such attacks were treated as outpatients, among whom 7 deaths are known to have occurred.

The most important vipers are the puff-adder (*Bitis arietans*), the gaboon viper (*B. gabonica*), and the night adders (*Causus rhombeatus* and *C. resimus*). The dreaded mamba (*Dendroaspis angusticeps*), and the cobras (*Naja haje* and *N. nigricollis*) are also common. The sea snake (*Pelamydrus platurus*), which occurs in the coastal waters, has caused occasional fatalities among fishermen.

Nigeria

As in many other parts of Africa and elsewhere, the recorded figures relate to only those cases of snakebite which occur sufficiently close to a medical institution, and then only when the victim lives long enough to survive and seek treatment.

The northern region recorded 166 cases and 9 deaths from snakebite during the period 1947-52. The snakes most commonly concerned are : *Echis carinatus*, *Atractaspis aterrima* (black burrowing viper), particularly in Benue Province, and *Causus rhombeatus* (night adder). It is reported that the Johannesburg polyvalent antivenene is of little value in the treatment for bites by these species.

In the western region, nine snakebite cases (seven of which were fatal) were recorded during the years 1948-52. The species commonly concerned are *Bitis nasicornis* (horned puff-adder) and *Dendroaspis viridis* (green mamba). The other common species are *B. arietans* (puff-adder), *Naja nigricollis* (black-necked or spitting cobra), *N. melanoleuca* (black-lipped cobra), and *N. goldii* (black-bellied cobra).

Southern Rhodesia

During the period 1947-51, four deaths from snakebite were reported by the hospitals. The commonest venomous snakes are the boomslang (*Dispholidus typus*—a rear-fanged tree snake), the Cape adder, the Egyptian cobra, the puff-adder, and the banded cobra. The mamba is not common at high altitudes, but is found in " areas covered with dense vegetation in the vicinity of the rivers and the streams in the sub-tropical parts of the country".[9]

Seychelles

There are no poisonous snakes in Seychelles.

Sudan

Statistical data on deaths from snakebite in the Sudan are not available, although deaths from this cause are known to occur.

The common poisonous snakes found in all parts of the Sudan are *Naja haje* (Egyptian cobra), *N. nigricollis* (spitting cobra), *Causus rhombeatus* (demon night adder), *Bitis arietans* (puff-adder), *Atractaspis microlepidota* and *A. irregularis* (black burrowing vipers). In Equatoria, *N. melanoleuca* (black cobra), *Dendroaspis jamesonii*, *Causus lichtensteinii*, *Bitis gabonica*, and *B. nasicornis* are also found. *Echis carinatus* is found in north Sudan and *Cerastes cornutus* in central and southern Sudan.

Union of South Africa

Figures are available for only the European population in the Union of South Africa. Deaths from snakebite are included under Item 176 (" attack by venomous animals ") of the International List (1929 Revision). Annual figures are given below :

Year	*Number of deaths*
1934	15
1935	9
1936	13
1937	10
1938	10
Total . . .	57

For the European population, the annual death-rate per 100,000 for this classification group was 0.57.

During the years 1949, 1950, and 1951, the annual deaths were 14, 20, and 14, respectively.

Several species of poisonous reptiles are found in South Africa. Some have a somewhat restricted range, while others are present in all parts of the Union. The ringhals (*Sepedon haemachates*) belongs to the latter group although it is more frequent in the northern areas. Another widespread snake is the dangerous rear-fanged boomslang, *Dispholidus typus*, a tree snake with an extremely poisonous venom.

Naja haje and *N. anchietae* are encountered in the northern parts of Natal and Transvaal, and *N. flava* is present in Cape Province. Several vipers occur. They include *Bitis arietans*, which is found in many parts of the country; *B. atropos* and *B. inornata* in the south; and *B. caudalis* and *B. cornuta* in the south-west, from Namaqualand to the Cape.

Zanzibar

Poisonous snakes are relatively rare in Zanzibar, and during the last ten years there has been no recorded death from snakebite.

Other areas in Africa

Figures of inpatients and outpatients treated for snakebite in the hospitals of certain territories are shown below :

Year	British Somaliland		Gambia	
	cases	deaths	cases	deaths
1934	12	—	5	—
1935	8	—	3	—
1936	9	—	7	—
1937	17	—	5	—
1938	54	—	1	—

Year	Basutoland		Kenya		Swaziland	
	cases	deaths	cases	deaths	cases	deaths
1946	*	*	404	1	13	—
1947	11	—	433	—	7	—
1948	17	—	564	5	7	—
1949	13	—	515	5	15	—
1950	4	—	554	12	28	—
1951	34	—	*	*	29	—

* No data available

In Basutoland both cobras and puff-adders are relatively common venomous snakes. In Kenya, the two highly venomous snakes most frequently encountered are the puff-adder and the black-necked cobra. In the Protectorate of British Somaliland the principal snake is the carpet viper, *Echis carinatus*, which inhabits the sandy regions, although *Bitis arietans*, *Naja nigricollis*, and *N. haje* are also found.

The Americas

United States of America

Two families of poisonous snakes—namely, the Crotalidae and the Elapidae—are represented in the USA. The pit vipers (Crotalidae) are very abundant, and the presence of at least 35 different species and subspecies has been established. They include the true rattlesnakes, the pigmy rattlers, the massasauga, the copperhead, and the cottonmouth. The family Elapidae is represented by coral snakes, which are related to the African and Asian cobras.

At least one kind of poisonous snake is found in each of the 48 States, and many States have several species. However, the northern States have fewer poisonous reptiles than those in the south. For example, only two dangerous species are known in New England—the copperhead and the timber rattler; the former is not found north of central Massachusetts. The massasauga occurs in the upper Mississippi. The rattlesnakes present in the south-east are the canebrake, the Carolina pigmy, the dusky pigmy,

and the diamondback. The diamondback is found in wooded regions, particularly among the scrub palmetto of the Florida beaches.

Three species are responsible for approximately 95% of the deaths from snakebite; they are the water moccasin, the prairie rattlesnake, and the diamondback. It is reported, however, that a western diamondback causes twice as many deaths as its eastern relative.

Annual deaths due to poisoning by venomous animals in the USA during the period 1944-50 are shown below.

Year	*Number of deaths*
1944	78 [a]
1945	50 [a]
1946	62 [a]
1947	64 [a]
1948	40 [a]
1949	47 [b]
1950	51 [b]

[a] Classified under Item 194 of the International List, 1938 Revision
[b] Classified under Item E927 of the International Classification, 1948 Revision

It will be observed that even though figures for snakebite deaths are combined with those of deaths from other causes, the deaths are relatively few. However, considerable variation is noted between individual States when average annual rates per 100,000 population are calculated for each State for the period 1944-8. The highest rate found (0.50 per 100,000) is that for Arizona State, which is followed by those for New Mexico (0.30), Florida (0.19), Texas (0.18), Montana (0.17), Nevada (0.15), Arkansas (0.11), Tennessee (0.10), Mississippi (0.10), and Alabama (0.10). The rates for the remaining States are all lower than 0.10 per 100,000 population.

The relative importance of snakebite deaths included in this group for Arizona State is shown by the following comparison :

Distribution of deaths from attacks by venomous animals and insects in Arizona

Deaths from	*Period* 1929-36	1938-45	1946-8	*Total*
Snakebite (rattlesnake) . . .	8	6	1	15
Scorpion bite	30	30	4	64
Spider bite and other insects	6	5	2	13
Total . . .	44	41	7	92

Snakebite deaths in Arizona, therefore, constituted only about 16% of the total deaths included in the broad group of the International Classification.

If the same percentage is applied to the total for the entire country, we may presume that perhaps only about 10 to 20 deaths from snakebite occur each year in the USA.

Canada

Annual total deaths due to attacks by venomous animals during the years 1945-9 are shown below :

Year	*Number of deaths* *
1945	5
1946	1
1947	—
1948	2
1949	2
Total . . .	10

* Classified under Item 194 of the International List (1938 Revision)

These deaths were reported from the following six of the ten provinces in Canada : Ontario, Manitoba, Alberta, British Columbia, reporting two deaths each, and Prince Edward Island and Saskatchewan, one each. The average annual death-rate from all causes included in this group is only 0.02 per 100,000. This figure would be even lower if snakebite deaths alone were considered.

The rattlesnake (*Crotalus viridus*), and two other species have been found in southern Canada, but, as can be judged from the figures given, mortality from their bites is practically negligible.

Central and South America

Two of the most common South American coral snakes are extremely dangerous. One, *Micrurus frontalis*, ranges from southern Brazil to Argentina; the other, *Micrurus lemniscatus*, is found in Brazil and the Guianas. Many close relatives of the USA rattlesnakes (genus *Crotalus*) are present in South America, and one of the larger species (*Crotalus terrificus*) occurs from northern Venezuela to southern Brazil. It is, however, absent from the wet valley of the Amazon and the Chaco region of Argentina. This snake, which is the only representative of the genus present east of the Andes, differs from its northern relatives in that its venom has a largely neurotoxic action. It has many common names, and is known in Brazil as boicininga, boiquira, and maracaboia, but it is most often called cascabel.

A snake that has a highly toxic venom is the cantil (*Agkistrodon bilineatus*). It ranges from Central America to central Mexico, but is not found in great numbers.

The bushmaster (*Lachesis muta*), a characteristic South American reptile, occurs from Nicaragua through southern Central America to South America. It is also found, in company with the coral snake, on Trinidad and Tobago. One of the bushmaster's near relatives is the fer-

de-lance (*Bothrops atrox*), which is found on Martinique and St. Lucia. The effect of the poison of the fer-de-lance has been described as " dramatically sinister and rapid, the action being largely haemolytic ".[4] This reptile is also known from southern Mexico through Central America to northern South America, and is said to be " especially dangerous to laborers on sugar plantations, as it is attracted there in numbers by the rats which make their homes in such places ".[3]

Since most tropical countries have within their boundaries a great variety of poisonous reptiles, it is of particular interest that, except for the places mentioned above, the islands of the West Indies are entirely free from poisonous snakes.

Although the jumping viper (*Bothrops nummifer*) is found in most parts of Central America and in Mexico, this snake is not as dangerous as some of the other *Bothrops* species, since its venom is less toxic than most of its relatives. For example, the palm vipers, which also belong to this genus, are small in size (2 feet (60 cm)), yet their bites have been known to cause fatalities. The palm vipers occur in Mexico, and in Central and South America. The hognosed vipers (*Bothrops nasuta, B. lansbergii, B. ophryomegas*) are mostly found in Central America and southern Mexico, but two kinds are also known in northern South America.

A well-established pit viper in Brazil is Maximilian's viper (*Bothrops neuwiedii*), a snake that closely resembles the fer-de-lance. It also occurs in Argentina and northern Paraguay. Another highly toxic pit viper is *B. insularis* (island viper), which is found on " a small rocky island barely three-quarters of a mile [approximately 1 km] in extent lying 40 miles [64 km] southwest of the Bay of Santos ".[3] A third pit viper—*B. alternata*—is also abundant in the region, being present in Argentina, southern Brazil, Paraguay, and Uruguay.

The semi-poisonous tree snakes of the *Oxybelis* and *Pseudoboa* genera possess only small quantities of venom, and are therefore less dangerous to man than many of the other reptiles known in South America.

Pelamydrus platurus is found along the west coast of Central America and is common in the Gulf of Panama. This sea snake is said to be the only species that has crossed the Pacific Ocean from its original habitat in the coastal waters of Asia. It is believed that sea snakes never attack swimmers, since they are generally reluctant to bite. However, some sea serpents do possess a highly toxic venom, and deaths due to the bites of *Pelamydrus platurus* have been reported.

Argentina. No mortality statistics for recent years are available, although it is believed that snakebite constitutes a problem of real importance in the rural sections of certain regions of the country, the annual numbers of cases being estimated at several hundred. Cases have

been reported from the Provinces of Buenos Aires and Eva Perón (Territory of La Pampa) and from all the provinces and territories to the north. The " Carlos G. Malbran " Bacteriological Institute, at Buenos Aires, produces a trivalent serum against the venom of the following species, which are responsible for the majority of deaths. The numbers of specimens received for extraction of the venom during the years 1936-46 are given in parentheses :

Crotalus durissus terrificus (13,920); *Bothrops alternata* (13,892); *Bothrops neuwiedii meridionalis* (5,991).

Bothrops ammodytoides is present in lesser numbers than the two *Bothrops* species mentioned above. Although three species of the genus *Micrurus* (*M. lemniscatus*, *M. frontalis*, *M. corallinus*) are present in the country, accidents caused by these snakes are rarely observed.

Bolivia. Mortality statistics are available only for the group " attack by venomous animals ". The hospitals, clinics, and dispensaries of the Ministry of Public Health reported 99, 63, and 115 deaths from attacks by venomous animals during the years 1948, 1949, and 1950, respectively. The figures refer to Item 194 of the International List (1938 Revision). Several species of venomous snakes are present, especially at the lower altitudes and in the northeastern part of the country. The most widely distributed species are *Bothrops atrox* and *B. neuwiedii boliviana.*

Brazil. On the basis of the 1929 figures, it is estimated that there are 4,800 deaths from snakebite annually in Brazil. According to an indirect source, the number of annual deaths was estimated at about 2,000 in 1949. The Instituto Butantan in São Paulo prepares various monovalent and polyvalent antivenenes against the following species (numbers of specimens received during the years 1947 and 1948 are given in parentheses).

Crotalus terrificus (10,038); *Bothrops jararaca* (10,832); *B. alternata* (1,148); *B. jararacussu* (219); *B. atrox* (459); *B. neuwiedii* (899); *B. itapetiningae* (14); *B. cotiara* (748); *Micrurus corallinus* (116); *M. frontalis* (87); *M. lemniscatus* (20); *M. decoratus* (1); other venomous species (6).

The Institute also receives dried venom from private serpentaria. The Vital Brazil Institute in Niterói recorded 2,238 cases treated with specific sera from 1919 to 1942; of these 1,383 were men (36 deaths), 300 women (10 deaths), 324 children (15 deaths), and 231 animals (30 deaths). The genera of the snakes responsible were *Bothrops* (1,636 cases, 36 deaths); *Crotalus* (287 cases, 38 deaths); not specified (315 cases, 17 deaths).

The Instituto Butantan, São Paulo, has distributed serum for the treatment of snakebite since 1902, enclosing with each ampoule of serum a report form to be completed with details of the accident and returned to the Institute. During the 50-year period 1902-51, the Institute received directly, in this manner, reports of about 9,500 accidents caused by

venomous snakes and treated with serum. Some of the data included in the reports are shown in table I.

Most of these accidents occurred largely in southern Brazil, although the figures also include a small number of human cases reported from other countries.

TABLE I. DATA ON IMMUNE-SERA TREATMENT OF SNAKEBITES BY AGGRESSOR SPECIES OF SNAKE, ACCORDING TO REPORTS RECEIVED BY THE INSTITUTO BUTANTAN, SÃO PAULO, DURING THE PERIOD 1902-51

Species of snake	Human cases						Animals	
	men		women		children			
	number treated	deaths	number treated	deaths	number treated	deaths	number treated	deaths
Crotalus terrificus .	501	59	85	11	140	25	155	29
Lachesis muta . . .	15	1	1	0	2	0	2	0
Micrurus spp. . . .	11	0	5	0	0	0	0	0
Bothrops jararaca . .	2,443	15	601	7	949	11	494	16
Bothrops jararacussu	470	7	86	0	144	4	76	7
Bothrops alternata .	274	6	36	0	119	3	121	15
Bothrops neuwiedii .	195	2	42	0	73	0	31	2
Bothrops atrox . . .	78	1	13	0	31	0	12	3
Bothrops cotiara . .	67	1	26	0	25	0	19	0
Bothrops schlegelii .	3	1	0	0	0	0	0	0
Bothrops lansbergii .	1	0	0	0	0	0	0	0
Unknown,venomous	614	13	193	5	319	9	1,004	126
Total	4,672	106	1,088	23	1,802	52	1,914	198

The geographical distribution of the most important species of venomous snakes in Brazil may be summarized as follows :

Crotalus terrificus terrificus—distributed over the entire country, more abundant in the north-east and centre;

Lachesis muta—from the State of Rio de Janeiro to that of Amazonas, and northward to Central America;

Bothrops neuwiedii—all Brazil except the Amazon Valley, also found in Argentina, Bolivia, and Paraguay;

B. jararacussu—relatively common from the north-east to Argentina and Paraguay (littoral);

B. atrox—quite common from the State of São Paulo northward to North America;

B. jararaca—quite common from the State of Bahia to the south of Brazil, also found in the north of Argentina and in Paraguay;

B. alternata—from the state of Minas Gerais to the south of Brazil, also found in Argentina, Paraguay, and Uruguay;

B. cotiara—from the State of Minas Gerais to the south of Brazil;

B. bilineata—from the State of Rio de Janeiro to the north, also Bolivia, Ecuador, and Peru.

British Guiana. Deaths from bites by venomous animals (Item 194 of the International List, 1938 Revision) in British Guiana during the period 1944-8 are shown below :

Year	*Number of deaths*
1944	4
1945	—
1946	4
1947	5
1948	2
Total . . .	15

The average annual rate per 100,000 population is 0.80.

British Honduras. The Report of the Medical Department shows that inpatients treated for snakebite in the hospitals of the colony totalled 20 during the five-year period 1947-51. Three outpatients were treated for snakebite during the years 1949-51. No deaths were reported among the patients.

Chile. It is believed that there are no venomous snakes in Chile. The majority of deaths caused by venomous creatures are believed to be due to venomous spiders.

Colombia. Annual figures of deaths from injury by venomous animals in agriculture (Item 175 ba of the International List (1938 Revision)), as well as of deaths classified under Item 194 (attack by venomous animals, except in the course of agriculture and forestry) of the 1938 Revision, during the five-year period 1945-9 are given in the following tabulation :

Colombia. Deaths from attacks by venomous animals, 1945-9

Year	*Deaths classified under Item 175 ba*	*Deaths classified under Item 194*	*Total*
1945	21	149	170
1946	43	126	169
1947	40	93	133
1948	13	183	196
1949	20	133	153
Total . . .	137	684	821

For deaths recorded under both groups, the death-rate during the period 1945-9 was 1.56 per 100,000 population.

A great variety of poisonous snakes are known to be present in Colombia, the most common species and the one causing the largest number of deaths being *Bothrops atrox*. The Samper Martinez Institute at Bogotá prepares a polyvalent serum against *Crotalus terrificus* and the genus *Bothrops*.

Costa Rica. Annual figures of deaths from attacks by venomous animals (classified under Items 175 and 194 of the International List (1938 Revision)) for the years 1943-9 are shown below :

Costa Rica. Deaths from attacks by venomous animals, 1943-9

Year	*Deaths classified under Item 175*	*Deaths classified under Item 194*
1943	5	24
1944	4	13
1945	3	21
1946	*	*
1947	*	*
1948	2	9
1949	34	3

* No data available

As stated already, Category 175 also contains figures of accidents in agriculture and forestry arising from other causes, including those from farm machinery and vehicles. The average annual death-rate, calculated on the basis of figures shown under Item 194 alone, is found to be 1.93 per 100,000 population for the years 1943, 1944, 1945, 1948, and 1949.

Cuba. During the quinquennium 1944-8 only two deaths from attacks by venomous animals were recorded under Category 194 of the International List (1938 Revision). It is believed that there are no venomous snakes in Cuba, and that these two deaths may have been caused by other venomous animals or insects.

Dominican Republic. During the period 1943-7, 11 deaths due to attacks by venomous animals were recorded under the Categories 194 and 175 ba of the International List (1938 Revision). As the Dominican Republic is believed not to have any venomous snakes, these deaths may have all resulted from attacks by other venomous animals or insects.

Ecuador. Several species of venomous snakes are believed to be present in this country, especially in the western littoral and in the eastern jungle region, and they are probably the most important venomous animals found in Ecuador. From 1900 to 1946, 2,182 cases of snakebite were treated at the Luis Vernaza Hospital, Guayaquil; of these 87 were fatal.

Mortality data for snakebite for the country as a whole are not available.

El Salvador. Snakebite is believed to be relatively rare in El Salvador owing, perhaps, to the great reduction of the jungle area for agricultural development. Mortality data for snakebite are not available.

French Guiana. According to the Institut Pasteur, at Cayenne, venomous snakes are not abundant, at least in the more accessible regions. The species recently identified include *Lachesis muta.* Mortality figures for snakebite are not available.

Guatemala. Guatemala has a great variety of venomous snakes, especially at the lower altitudes, although *Crotalus durissus* has been found at 4,890 feet (approximately 1,500 m) above sea level. The most common species is *Bothrops atrox.*

Mortality figures for snakebite are not available.

Haiti. It is believed that there are no venomous snakes in Haiti.

Honduras. Mortality figures for snakebite are not available, but it is believed that cases of snakebite are infrequent, in spite of the large numbers of snakes. The most common venomous species is *Bothrops atrox.*

TABLE II. MEXICO: DEATHS CAUSED BY THE BITES OF VENOMOUS ANIMALS AND INSECTS IN 1940 AND 1941

Cause of death	Year	Region				
		North Pacific	North	Centre	Gulf	South Pacific
Snakebites . .	1940	4	39	39	40	35
	1941	4	44	60	55	56
Scorpion bites .	1940	144	58	945	—	480
	1941	158	57	980	3	612
Spider bites . .	1940	2	6	9	—	1
	1941	—	2	15	—	2
Other bites . .	1940	31	12	100	1	26
	1941	—	—	—	—	—

Mexico. Although data on deaths caused by venomous animals and insects are not available for recent years, the statistics for the years 1940 and 1941 given in table II are of interest.

In this table, the causes of death are classified according to Item 175 ba of the International List (1938 Revision). It is of interest to note that snakebites form only 9% of the total deaths resulting from attacks by venomous animals.

Nicaragua. Snakebites are not frequent. Mortality figures for snakebite are not available separately.

Panama. During the three-year period 1941-3, 150 deaths were recorded under Item 194 of the International List (1938 Revision). The proportion of deaths from snakebite falling in this category is not known. The Gorgas Hospital, Panama City, recorded 55 cases of snakebite in the years 1925-51; of these 7 were fatal. In 19 cases, the snakes were identified as follows : *Bothrops atrox*, 10; *B. lansbergii*, 3; *B. schlegelii*, 2; *Micrurus*, 2; *Lachesis muta*, 1; *Boa constrictor*, 1 (non-poisonous). According to the records of the United Fruit Company, for years previous to 1940 about 23 cases of snakebite, per 100,000 population, occurred on the banana plantations yearly, the great majority being caused by *Bothrops atrox*, which is attracted to the plantations by the presence of rats.

Paraguay. Mortality figures for snakebite in this country are not available. The greatest number of accidents are said to be caused by *Crotalus terrificus*, which is distributed in scant numbers throughout the country. *Bothrops alternata* and *B. neuwiedii* are also widely distributed, while *B. jararacassu* is found in the jungle regions. *Micrurus macgravi* is found in the fields and *M. corallinus* in the jungles of the Alto Paraná.

Peru. Separate figures for snakebite mortality are not available. Several species of venomous snake are present in various regions of the country. A species very similar to *Bothrops atrox*, *B. barnetti*, and two species of *Micrurus*, *M. tschudii olssoni* and *M. tschudii tschudii*, are said to be quite common in the northern desert region, but accidents are apparently infrequent. Species present in eastern Peru include *Lachesis muta*, *Bothrops atrox*, and *B. castelnaudi.*

Surinam. Venomous animals do not appear to constitute an important problem. Mortality figures for snakebite are not available.

Trinidad and Tobago. During the quinquennium 1946-50, there were 75 deaths from attacks by venomous animals of different kinds, giving a rate of 2.49 per 100,000 population per year. The majority of these deaths are believed to have been caused by the bites of scorpions.

Although at least two species of venomous snakes, *Bothrops atrox* and *Micrurus corallinus*, have been found on the islands, cases of snakebite are said to be rare.

Uruguay. Deaths attributed to attacks by venomous animals numbered 15 during the years 1935-46. Of the venomous snakes collected during a recent survey by the Uruguay Department of Hygiene, 80% were of the genus *Bothrops*, 15% *Elaps*, and 5% *Crotalus*. The only species of *Bothrops* found in Uruguay is *B. alternata*, although during flood seasons specimens

of *B. lanceolata* and *B. neuwiedii* are sometimes carried into the country by the Paraná River. *B. alternata* is quite common in the basin of the Uruguay and Negro Rivers, in the departments of the east and south-east, and in Tacuarembó and eastern Durazno. *Crotalus terrificus* is infrequent, but specimens are found in the Departments of Lavalleja, Maldonado, Cerro-Largo, and Tacuarembó. *Micrurus frontalis*, the most abundant species among the coral snakes, is distributed throughout the country with the exception of some central departments.

Venezuela. The majority of fatal cases of poisoning by venomous animals in Venezuela are due to snakes. The following tabulation, giving figures of cases of snakebite reported under Regulations on Diseases of Compulsory Notification of 1939, and of corresponding deaths from snakebite, illustrates this :

Year	*Snakebite*		*Deaths from venomous animals*
	cases	*deaths*	
1947	271	149	162
1948	389	122	141
1949	635	148	154

The last column of this tabulation shows total deaths from attacks by venomous animals of all kinds as recorded under Items 175 ba and 194 of the International List (1938 Revision). The average annual death-rate from snakebite is 3.1 per 100,000 population.

Of the genus *Bothrops*, *B. atrox* is the most widely distributed snake in the country. Other species include *B. schlegelii*, *B. lansbergii* (semi-arid localities of the north-east), *B. medusa* (central coastal region), and possibly *B. xanthogramma*. *Crotalus durissus terrificus* and *Micrurus coral-linus* are also present.

Asia

The region extending from Pakistan to Malaya is very well provided with poisonous snakes, and these include " representatives of the Viperidae (true vipers), Crotalidae (pit vipers), Elapidae (cobras and kraits), Hydridae (sea snakes) and Colubridae (colubrine snakes) . . , comprising examples of all existing families containing dangerous poisonous snakes. The most spectacular are the cobras, although the daboia (or Russell's viper) is one of the commonest and deadliest snakes of India ".[3]

Although the number of vipers known in Asia is not large, some of the most dangerous reptiles belong to the family Viperidae. In addition, it is said that vipers are abundant in some regions of India because of the fact that they are able to produce living young, thereby escaping the rebuffs to reproduction encountered by egg-laying snakes.

Russell's viper (*Vipera russellii*), which is also known as the daboia or tic-plonga, is found in Burma, Ceylon, China (southern Yunnan), India, the Malay Peninsula, Pakistan, and Thailand. This reptile secretes its venom in large quantities, and it has been estimated that even comparatively small specimens are able to inject with a single bite approximately double the lethal dose for man.

Echis carinatus, the carpet or saw-scaled viper, is a relative of *E. coloratus*, which occurs in Arabia and Palestine. *E. carinatus* also prefers a sandy habitat, and is found in sandy areas in India, Iran, and Syria.

Some of the Asiatic members of the genus *Trimeresurus* are very similar to the palm vipers of tropical America. These arboreal reptiles are commonly known as bamboo snakes. Their venom is less toxic than that of some of the true vipers, but their bites are nevertheless not without danger to man. The bite of the habu (*Trimeresurus flavoviridis*) is extremely poisonous.

The Indian or spectacled cobra (*Naja naja*) and its very closely allied subspecies range from the eastern shores of the Caspian Sea through Asia into China and Taiwan, the Malay Archipelago, and the Philippines. Cochran has described this snake as " probably the best of any of the poisonous snakes of Asia and . . . more deadly and more feared than the others ".[3] The bite of *N. naja* has been responsible for a large number of deaths.

The largest of all the poisonous reptiles is the king cobra or hamadryad (*Naja hannah*). This snake is found in China, eastern India, the Malay Archipelago, east Pakistan, and the Philippines. However, the venom of the much smaller krait is more virulent than that of the cobra. The krait is widespread in southeastern China, India, the Malay Archipelago, and Taiwan.

The sea snakes are found from the Persian Gulf to southern Japan, among the islands of Oceania, and along the coast of tropical Australia. It has been established that one species possesses a venom that exceeds the toxicity of cobra poison, but most sea snakes are believed to have only a weak poison. Nevertheless, deaths have occasionally been reported among fishermen who have been bitten when a sea snake has been hauled in with their catch of fish.

India

In India, as in so many other countries, the registration of deaths is admittedly defective, many deaths not being recorded. This, as already stated, is believed to be particularly the case in remote rural areas and jungles where deaths from snakebite are likely to be relatively more frequent. There is also the difficulty of ascertaining the species of snakes

which are responsible for these deaths. Seldom is the culprit snake caught or killed, and even when it is killed there is hardly anybody in the area who can identify it by its scientific nomenclature. Moreover, the general indifference of the population in ascertaining the cause of death does not encourage people to send the snakes to a scientific institute for identification.

TABLE III. ANNUAL DEATHS FROM SNAKEBITE IN INDIA DURING THE PERIOD 1940-9

Province	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
Ajmer-Merwara *.	11	21	16	45	41	37	41	16	21	15
Assam	134	140	76	28	36	30	77	89 †	68 †	80 †
Bihar *	3,127	3,293	2,253	3,404	4,017	3,646	3,623	2,636	2,627	2,286
Bombay	1,004	1,011	992	996	1,061	942	705	735	798	877
Coorg *	2	7	2	4	1	2	6	1	**	**
Delhi *	9	6	21	6	7	4	14	**	10	9
Madhya Pradesh	938	1,043	799	1,164	1,100	1,095	1,075	854	996	696
Madras *	2,146	2,356	2,437	2,352	2,334	1,959	1,842	1,854	1,989	1,336
Orissa *	650	545	551	618	595	542	579	502	681	504
Uttar Pradesh . .	3,141	2,870	3,177	2,626	2,670	2,331	2,659	2,195	1,570	1,465
Bengal	3,263	3,593	3,889	3,503	3,433	3,119	1,778 †	1,768 †	1,725 †	**
Punjab	710	862	738	719	581	723	180 †	84 †	113 †	128 †
Total	*15,135*	*15,747*	*14,951*	*15,465*	*15,876*	*14,430*	*12,579* †	*10,734* †	*10,598* †	*7,396* †

* Figures include deaths due to attacks by wild beasts
** No data available
† Figures relate to the State emerging after partition

A rough idea of the magnitude of the snakebite problem in India can be obtained from the recorded statistics of annual snakebite mortality for the period 1940-9 for individual States in India. The partition of India into India and Pakistan took place in August 1947, and therefore the series of figures for the States of Assam, Bengal, and the Punjab given in table III relate partly to the undivided States and partly to the States emerging after partition.

For the purpose of inter-State comparisons, averages have therefore been calculated on the recorded figures of the quinquennium 1941-5 and are shown in table IV. The corresponding annual death-rates per 100,000 population, for the same period, are also given.

Before August 1947, snakebite was responsible for about 15,000 deaths each year, corresponding to a rate of 5.4 per 100,000 population. Numerically, the largest numbers of deaths occurred in the States of Bengal, Uttar Pradesh, Madras, Bombay, and Bihar. The highest death-rate during the period 1941-5 was recorded in Bihar (9.1 per 100,000), followed by Madhya Pradesh (7.9 per 100,000); both figures, of course, include an unknown number of deaths resulting from attacks by wild beasts.

In 1914, it was estimated that about 8% of the persons bitten by snakes (poisonous and non-poisonous) died. This figure was based on records of military and prison statistics (for the period 1896-1909) for snakebite, which showed that out of 480 persons known to have been bitten by snakes, only 38 died. Although these figures are highly approximate, they may perhaps indicate that the number of humans bitten annually by snakes (poisonous and non-poisonous) in India may be of the order of about 200,000.

Table V shows the percentage of snakebite deaths to total deaths from all causes in individual States in India during the year 1948. From the

TABLE IV. AVERAGE ANNUAL DEATHS FROM SNAKEBITE AND DEATH-RATE PER 100,000 POPULATION IN INDIVIDUAL PROVINCES OF INDIA DURING THE PRE-PARTITION PERIOD 1941-5

Province	Average annual deaths	Annual death-rate per 100,000 population
Ajmer-Merwara . . .	32*	5.5*
Assam	62	0.6
Bihar	3,323*	9.1*
Bombay	1,000	4.8
Coorg	3*	1.9*
Delhi	9*	1.0*
Madhya Pradesh . . .	1,040	7.9
Madras	2,288*	4.6*
Orissa	570*	6.5*
Uttar Pradesh	2,735	5.0
Bengal	3,507	5.8
Punjab	725	2.5

* Including deaths due to attacks by wild beasts

statistical point of view, these percentages are not strictly comparable and indicate only roughly the magnitude of the snakebite problem in individual States. These percentages may be studied in conjunction with the rates of snakebite mortality per 100,000 population given in table IV.

TABLE V. SNAKEBITE MORTALITY IN INDIVIDUAL INDIAN STATES, 1948

State	Population (in thousands)	Deaths from snakebite	Total deaths (all causes)	Percentage of snakebite deaths to total deaths
Assam	7,493	68	63,984	0.11
Bihar	37,592	2,627*	517,169	0.51
Bombay	22,540	798	494,581	0.16
Madhya Pradesh .	17,586	996	518,430	0.19
Punjab	14,435	113	205,091	0.06
Madras	52,268	1,989*	958,069	0.21
Orissa	7,641	681*	179,829	0.38
Uttar Pradesh . . .	58,658	1,570	819,266	0.19
West Bengal . .	22,334	1,768**	387,165**	0.46

* Figures include deaths due to attacks by wild beasts
** These figures are for 1947.

It would seem that, relatively speaking, snakebite mortality is a greater problem in the States of Bihar, Orissa, and West Bengal. In other States, also, it is not unlikely that certain areas exist where the incidence of snakebite is relatively more frequent. For this reason, a study of snakebite mortality figures for individual districts (average population ranging from one to three million) of each State has been made on the basis of the recent statistical data available.

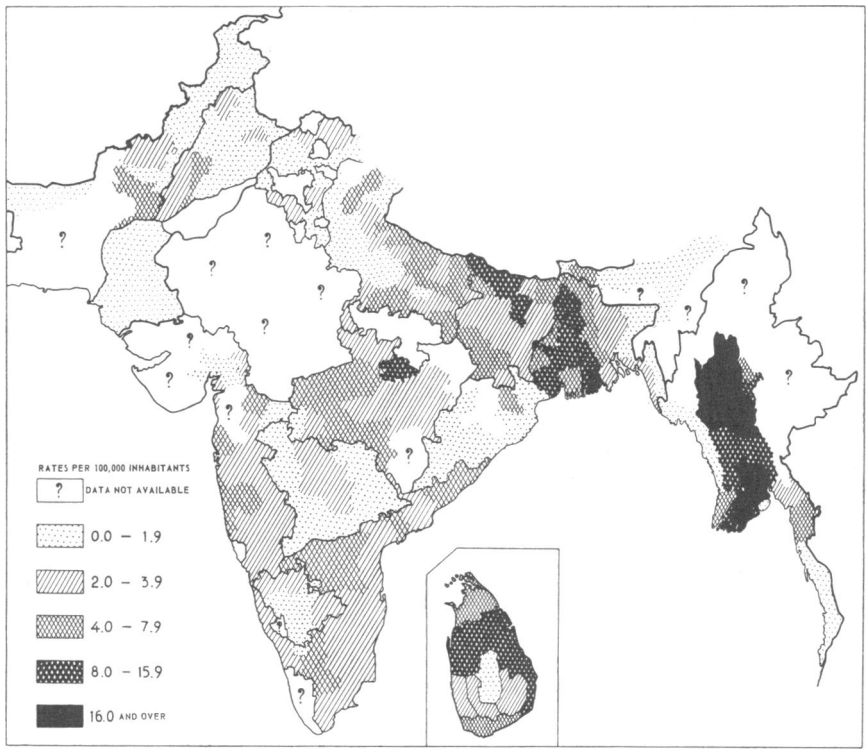
For each district of India, average annual snakebite death-rates were worked out per 100,000 population. For the majority of the States, i.e., Bihar, Hyderabad, Madhya Pradesh, Uttar Pradesh, and West Bengal, the period covered is 1947-51, while for others, i.e., Bombay, Orissa, and the Punjab, the information relates to 1948-52. In the case of the districts in Mysore State, the available information is for the period 1943-7, and for Assam, 1945-9. A comparison of rates relating to different quinquennia may not be justified, but since a preliminary analysis has shown that the level of snakebite mortality does not vary materially from year to year, these figures are used for making broad comparisons.

The geographical distribution of the average annual snakebite mortality rates for individual districts in India is presented in fig. 1 (see page 60). Similar rates calculated for individual districts of Burma and Pakistan and for provinces of Ceylon are also shown.

Fig. 1 shows some striking differences from place to place. Although districts of Burma record the highest mortality rates, considerable differences exist within India itself.

The region of highest snakebite mortality lies in West Bengal in the delta of the Ganges. The highest death-rate for snakebite recorded is

FIG. 1. DISTRIBUTION OF FIVE-YEAR AVERAGE SNAKEBITE MORTALITY RATES IN BURMA, CEYLON, INDIA, AND PAKISTAN *



* The period to which these average rates relate varies to some extent in different areas depending on the availability of the data. Thus, in the case of Ceylon, India, and Pakistan the quinquennium covered ends during the period 1949-52, while the Burma figures are for the quinquennium 1936-40. For Burma, India, and Pakistan the distribution is shown by districts, and for Ceylon by provinces.

that for Dinajpur (12.6 per 100,000), which is followed by those of Nadia (12.1), Murshidabad (10.4), and Midnapore (10.0).

It is noteworthy that the districts along the Brahmaputra River, even in its deltaic region, do not show such a high mortality rate as do the districts lying in the Ganges delta. In his report for the year 1923, the Director of Public Health, Bengal, stated :

" The worst districts for snakebite form a solid block more or less contiguous in the centre of the province, a little to the west of the middle line. Murshidabad is the worst district south of the Padma, and Rajshahi the worst district north of this river. Nadia and Jessore are the next most dangerous areas, and Dinajpur and Malda come next on the list. It would appear from this peculiar distribution of snakebite that the regional factor has a considerable influence in this connection. People in Eastern Bengal, which is generally much more densely populated and also much wetter than the area we have been discussing, are far less subject apparently to snakebite than those who live in the districts in the west of the province . . . deaths from snakebite are most frequent during the period May to October. From December to March they are at a minimum ".[2]

It is of interest to note that, in the adjoining State of Bihar, the districts with relatively high rates of snakebite mortality, namely, Muzaffarpur (10.7), Darbhanga (10.6), Champaran (9.6), Monghyr (8.4), and Saran (7.4) constitute one contiguous belt of area lying at the foot of the Himalayas north of the River Ganges. In south Bihar, the districts of Ranchi and Palamau also show relatively high mortality rates.

The hilly districts of Assam show relatively very low rates of snakebite mortality compared with the districts of Bengal, lying west, and of Burma, on the east.

In Uttar Pradesh, the districts showing relatively high mortality from snakebite are also generally those bordering on Nepal at the foot of the Himalayas. It is also noteworthy that, on the eastern side of this State, the region of relatively high snakebite mortality extends further south than in the western part of the State.

In Bombay State, districts with relatively high snakebite mortality lie on the western side, generally along the coast. Almost all the forest areas in this State are believed to be infested with snakes. These areas are mostly confined to the interior parts of the forests of Kanara division, and the Nagargali and Khanapur ranges of Belgaum division; Dangs division, parts of Vyara division, and Dharampur in Surat division; hilly tracts of Mahabaleshwar and mountainous areas of Kolaba; portions of the Tapi valley; hilly tracts in Thana districts and parts of Ratnagiri district.

In Hyderabad State, a relatively high mortality rate is found in the districts of Nander (5.2), Parbhani (2.7), Bidar (2.3), Nizamabad (2.2), and Medak (2.2), which form one continuous tract in the north of the State.

In Madhya Pradesh, the highest snakebite mortality is found in Mandla (8.2), the rates being relatively high for districts at lower altitudes.

In the Punjab, the districts lying in the southern dry sandy plains, namely, Hissar Rohtak and Karnal, show high figures.

The general belief held is that there are at present only four common poisonous snakes in India, and that the venom collected from any one of them would be antigenically the same as that collected from any other snake of the same species caught anywhere in the country. This, of course, is contrary to the strict specificity displayed by the venoms, especially those of the Viperidae so far tested. The Haffkine Institute, Bombay, prepares a polyvalent anti-snake-venom serum, but it is not known whether this is effective against all the snakebite victims in India.

The following information has been supplied by Colonel M. L. Ahuja, Director, Central Research Institute, Kasauli, India : [a]

" Cobra, krait, Russell's viper, and *Echis* are the commonest types of poisonous terrestrial snakes met with in India. They are responsible for practically all the snakebite

[a] Personal communication

deaths in this country; deaths from bites of Hydrophides are uncommon and may be ignored for all practical purposes.

Analysis of records of 376 consecutive snakebite cases received from all over India and covering a period of five years (1948-52) shows that 151 cases were bitten by poisonous and 225 by non-poisonous varieties of snakes—a ratio of 40% poisonous to 60% non-poisonous bites. [table VI]

TABLE VI. FATALITY RATE PER 100 BITES AMONG 376 CASES OF SNAKEBITE BY DIFFERENT SPECIES OF SNAKE

Snakes	Bitten persons	Deaths	Fatality rate (%)
Colubrine snakes			
Cobra	42	2	4.8
Krait	9	8	88.9
Unknown	36	10	27.8
Total . . .	*87*	*20*	*23.0*
Viperine snakes			
Russell's viper . . .	12	1	8.3
Echis	11	4	36.4
Unknown	41	2	4.9
Total . . .	*64*	*7*	*10.9*
Non-poisonous snakes .	225	—	—
Poisonous snakes . . .	151	27	17.9
All snakes .	*376*	*27*	*7.2*

The proper identification of these snakes and other incriminating varieties is based on either the examination of the snake by the medical officer treating the case, or by symptoms characteristic of cobra, krait, or viperine poisoning.

The overall mortality from snakebites in this series was 7.2%.

Mortality among 151 persons bitten by poisonous snakes was 17.9%.

These patients received antivenene treatment; the interval between the bite and commencement of antivenom serum treatment varying from 30 minutes to 48 hours. Cases in all stages of poisoning, from moribund to slight evidence of toxaemia, have been included. Antivenene used is a bivalent concentrated globulin solution potent against the venoms of cobra and Russell's viper. It does not contain protective factors against krait and *Echis* venoms."

Pakistan

The annual snakebite mortality rates for individual districts of Pakistan are shown in fig. 1 (see page 60). In west Pakistan it is worthy of note that Muzaffargarh district (lying along the Indus River) has a relatively high rate of snakebite mortality, followed by the adjoining district of Dera Ghazi Khan.

In East Bengal, snakebite mortality is relatively very high in the districts lying in the Ganges delta. For instance, the highest rate of 14.2 is recorded for Rajshahi district (bordering on the Ganges), followed by Khulna (10.0). As stated already, the districts lying in the delta of the Brahmaputra River show a relatively lower mortality rate than the southern districts of West Bengal lying in the delta of the Ganges.

Burma

During and after the second World War the registration of vital statistics in Burma was interrupted, so that complete figures of snakebite mortality for a recent period are not available.

It was some two decades ago that mortality due to snakebite became a subject of public interest, when questions were asked in the Legislative Council and articles appeared in newspapers. From 1936 onwards, therefore, arrangements were made to have the figures of snakebite mortality separately tabulated.

The geographical distribution of snakebite mortality for individual districts of Burma for the quinquennium 1936-40 is shown in fig. 1.

As compared with other countries of the world, the incidence of snakebite in Burma is very high, the average rate being 15.4 per 100,000 population, with the district of Sagaing recording as high a rate as 36.8 per 100,000. Of a total of 30 districts, 15 have snakebite death-rates as high as 15.0 per 100,000 or over. These districts are : Sagaing (36.8), Meiktila (34.0), Magwe (32.5), Thanawaddy (31.4), Shwebo (30.8), Lower Chindwin (28.5), Minbu (26.8), Insein (20.3), Pekokku (20.0), Pyapon (18.6), Pegu (18.1), Manbin (17.0), Yamethin (17.0), Hanthawaddy (15.5), and Prome (15.0).

The districts with relatively high death-rates from snakebite are those in the low-lying areas traversed by the Irrawaddy and Chindwin rivers. Two contiguous areas of relatively high incidence are : (1) the southern area of the Irrawaddy delta comprising the districts of Pegu, Thanawaddy, Insein, Manbin, and Pyapon, and the contiguous areas on the north; (2) the group of districts with a still higher death-rate in the north, comprising Sagaing, Shwebo, and Lower Chindwin (Sagaing Division), Yamethin, Myingyan, Meiktila (Mandalay Division), Pakokku, Magwe, and Minby (Magwe Division).

The highest mortality is generally recorded in December.

The annual totals of snakebite deaths in the years 1935-40 were as follows :

Year	*Number of deaths*	*Year*	*Number of deaths*
1935	2,186	1938	2,098
1936	2,244	1939	2,156
1937	2,088	1940	1,961

The poisonous snakes of Burma and their geographical distribution are described below.

Family : Elapidae

1. *Naja naja* (the common cobra). Two varieties exist :

(*a*) spectacled (Indian cobra), rare in Burma, but may be found near human habitations;

(*b*) monocellate (Burmese cobra), which lives near fields, most commonly in Lower Burma.

Both varieties are very irritable and very poisonous and can usually inject many times as much venom as is required to kill a man. Hence, they are responsible for the majority of deaths due to snakebite, especially among farmers.

2. *Naja hannah* (king cobra) inhabits deep jungles and, hence, although very poisonous, bites by this reptile are not so frequent.

3. *Bungarus* (krait). Two varieties occur :

(*a*) *Bungarus candidus* (common krait), and

(*b*) *Bungarus fasciatus* (banded krait).

Both are widely distributed in the plains, and although dangerous, are not easily irritated and have small mouths. Although more poisonous than the cobra or Russell's viper, they presumably cause negligible mortality.

4. Coral snakes. These small snakes have the identifying characteristics of a cobra. They are rarely seen and, hence, they can be ignored from the point of view of case incidence.

Family : Viperidae (true or pitless viper)

1. *Vipera russellii* (Russell's viper or daboia). This very savage and poisonous snake is responsible for a good number of deaths. It is found in the valley of the Irrawaddy river.

2. *Azemiops feae.* This is a small viper found in the hills of Upper Burma. It is probably not responsible for many deaths owing to its scarcity and habitat.

Family : Crotalidae (pit viper)

Lachesis (or *Trimeresurus*) *gramineus* (green pit-viper) is usually found on trees; it is not very poisonous, and can seldom kill an adult human being.

Family : Hydridae

Sea snakes are found in the Bay of Bengal and may come up the rivers with the flood tides. They are very poisonous, but are not known to constitute a great hazard to man.

Thus, cobras, vipers, and kraits are widely prevalent all over Burma and account for the mortality from snakebite.

Only a small number of snakebite cases are seen and treated by qualified doctors in hospitals, etc. Most of the cases are attended to by Saysayas (herb doctors), snake-charmers, and snakebite curers. Of course, as a large number of snakebites occur in the rural areas (paddy fields, etc.) distances and transport difficulties largely account for this.

Antivenenes are not produced in Burma but are imported from India.

Ceylon

The following tabulation shows annual deaths from snakebite in Ceylon from 1939 to 1949. On the average, about 300 deaths from snakebite occur each year in Ceylon, with an annual death-rate of 4.2 per 100,000 population for the whole island.

Year	*Deaths from snakebite*
1939	213
1940	202
1941	289
1942	268
1943	299
1944	321
1945	259
1946	316
1947	296
1948	307
1949	275

These figures fail to suggest any trend for an increase or decrease in mortality during the eleven-year period.

The relative distribution of snakebite mortality in individual provinces of Ceylon is shown in fig. 1. The largest death-rate is reported from the North-Central Province (13.3 per 100,000), followed by North-Western Province (10.9 per 100,000), and Eastern Province (9.9 per 100,000).

The most dangerous snakes of Ceylon are Russell's viper (*V. russellii*), the cobra (*Naja naja*), and the Indian krait (*Bungarus candidus*). Of the many species of sea snakes found in the Indian Ocean, only some are poisonous.

Thailand

Figures of snakebite mortality are not separately compiled, deaths from this cause being recorded under Item E927 of the International Classification (1948 Revision) or Category 194 of the International List (1938 Revision).

It is reported that, as far as the observations go, the deaths included in these categories were seldom caused by any venomous animals other than poisonous snakes.

The following figures give the estimated loss of life from venomous animals in Thailand for the period 1946-50 :

Year	*Number of deaths*
1946	168
1947	200
1948	263
1949	264
1950	224

The annual death-rate for the country as a whole is 1.3 per 100,000. Considerable variation is known to exist in the mortality rates for individual provinces.

The province with the highest death-rate per 100,000 is Trat (6.7), followed by Chumphon (4.5), Samut Prakan (4.4), Chantburi (3.8), Samut Sakhon (3.6), Phichit (3.2), Ayuthya (3.1), and Nakhon Pathom (3.1). For the remaining provinces the death-rate is below 3.0 per 100,000.

Among the snakes causing the largest number of deaths are the common cobra (*Naja naja*) and the king cobra (*N. hannah*). Russell's viper also occurs. The kraits (*Bungarus*) and the coral snakes (*Calliophis* and *Doliophis*) are also common. Of the genus *Trimeresurus* the common species is *T. gramineus*, the common green, or bamboo, viper.

As imported serum was not found efficacious, in 1923 a " snake park " was established where sera are prepared.

Indonesia

Registration of deaths is incomplete in Indonesia. In Jakarta city (population 2,000,000), no death from snakebite has been registered nor have any snakebite cases from the city or adjoining rural areas been admitted to the Central Hospital at Jakarta. But judging from the number of applications for antisera received by the Institut Pasteur at Bandoeng, there appears to be a significant number of snakebite cases in the country.

The common snakes of Indonesia are *Bungarus fasciatus* (banded krait), *B. candidus*, *B. flaviceps*, and *B. javanicus*. *Naja hannah*, the king cobra, also occurs, and is reported to attack at times. The highly venomous death adder (*Acanthophis antarcticus*) is present in New Guinea. Many kinds of sea snakes are known to live near the coasts, but they are rarely known to attack humans.

Singapore

Two deaths from snakebite occurred in the colony of Singapore during 1948. During the years 1949-52, no snakebite death is known to have occurred.

Federation of Malaya

Snakebite deaths recorded in Government hospitals during the years 1948, 1949, and 1950 were 6, 7, and 11, respectively.

It is believed that, apart from sea snakes, the great majority of Malayan snakes are harmless. The species of poisonous snakes include the pit viper of the genus *Trimeresurus*, the king cobra or hamadryad, coral snakes, and the Malayan krait.

Viet Nam

Cases of snakebite are relatively more frequent in the south of Viet Nam than in the central or northern parts of the country. During the period 1948-52, 124 cases of cobra-bites were treated in the Institut Pasteur, Saigon; of these two died. The Province of Cantho registered four deaths from snakebite during 1948-50.

In central Viet Nam snakes are rare and only two or three cases of snakebite were treated with no fatality.

In north Viet Nam only one death from snakebite was registered during 1948-52.

Syria

Figures of annual deaths caused by poisoning, including deaths from snakebite, are given below :

Year	*Deaths*
1950	33
1951	39
1952	42

Separate figures for snakebite deaths are not available.

Jordan

There were 84 recorded deaths from snakebite in the five-year period 1948-52 in Jordan. Their distribution by districts was as follows : Nablus (33), Northern (22), Jerusalem (18), Balqa (9), and Hebron (2).

The scientific identification of snakes in general is not possible. However, a few kinds of the viperine and the colubrine families are known to exist.

Iraq

Cases of snakebite treated in hospitals in Iraq during the period 1948-51, together with the number of deaths, are shown below :

Year	*Cases*	*Deaths*
1948	142	2
1949	182	1
1950	138	5
1951	336	4

The majority of snakebites are caused by the blunt-nosed viper (*Vipera lebetina*). The other poisonous snakes of Iraq are the horned viper (*Cerastes cornutus*) and the hoodless cobra (*Naja morgani*). The saw-scaled viper, *Echis carinatus*, is found in the Diwaniya area. The poisonous sea-snake, *E. schistosa*, occurs in the Persian Gulf, although it rarely bites man.

Europe

The only poisonous snakes found in Europe and in northern Asia are the true vipers of the genus *Vipera*. Of these, the common viper (*Vipera berus*) has an extensive range, being found from the 67th degree in Scandinavia to the Apennines, the Balkans, and the Pyrenees. It also ranges across northern Asia to the Amur River and Sakhalin Island. This snake, which is also called the northern viper or adder, is the only poisonous reptile known in the British Isles, where it occurs in England, Scotland, and Wales, but not in Ireland. Two distinct forms inhabit different parts of Yugoslavia, and a third is present in northwestern Spain and Portugal. Fatalities from its bite have been recorded, more frequently in France and Germany.

Orsini's viper (*V. ursinii*) lives in southern France, Hungary, northern Italy, and some parts of Yugoslavia. This snake resembles *V. berus* in appearance. A closely related form, except for its more pointed nose, is Renard's viper (*V. renardi*), which occurs in the Crimea and parts of eastern Russia, extending well into central Asia.

The aggressive asp viper (*V. aspis*) is found in great numbers in southern France and is responsible for many accidents, some of which subsequently prove fatal. *V. aspis* also occurs in the Apennines, the Pyrenees, and Yugoslavia, and a subspecies is present in Calabria (southern Italy) and Sicily.

The venom of Lataste's viper (*V. latasti*) is considered to be less harmful than that of *V. aspis*, since deaths resulting from its bite are most infrequent. Lataste's viper is found in stony, arid, and forested areas of Algeria, Morocco, Portugal, and Spain.

A viper that has many varieties and which is reported to have a venom that is more dangerous than most of its European relatives is *V. ammodytes*. This snake is frequently found in Austria, Bosnia, and Herzegovina, and is also known in other Balkan countries. One of its common names, i.e., long-nosed viper, is especially apt. *V. ammodytes* is also called the sand viper. In Greece and European Turkey it is replaced by a close relation, *V. ammodytes meridionalis*.

V. lebetina lebetina (the blunt-nosed viper or kufi), which has an extensive range in Africa and Asia, occurs on Melos (one of the Cyclades Islands) and on Cyprus. Among its varieties (most of which are rather ill-defined) are *mauritanica* and *deserti* from Algeria, Libya, and Morocco, and *xanthina* from Asia Minor.

Separate figures for snakebite mortality are generally not available. Table VII shows in a summary form the mortality caused by venomous animals in various countries of Europe in recent years.

TABLE VII. AVERAGE ANNUAL DEATHS FROM VENOMOUS ANIMALS IN VARIOUS EUROPEAN COUNTRIES

Country	Period	Average annual deaths *	Death-rate per 100,000 population
Denmark	1946-50	—	—
Spain	1946-8	5.3	0.02
Finland	1946-50	1.2	0.03
France	1944-7	21.5	0.05
Ireland	1943-9	—	—
Italy	1944-8	17.6	0.04
Norway	1946-50	0.4	0.01
Netherlands	1946-50	0.4	0.004
England and Wales	1945-9	8.0	0.02
Scotland	1946-50	0.2	0.004
Sweden	1946-50	0.4	0.006

* Classified under Item 194 of the International List (1938 Revision)

Death-rates per 100,000 population for this broad group which includes snakebite deaths are generally of very low order as compared with those for countries in Asia. Rates from snakebite alone would therefore be of still lower magnitude.

France and Italy show relatively high rates. Remarks on some individual countries are given in the following sections.

England and Wales

There have been seven deaths from adder-bite in England and Wales in the last 50 years. The Registrar General's Statistical Reviews of England and Wales show that, for the years 1940-8, out of a total of 95 deaths registered under Item 194 of the 1938 Revision of the International List, only two were from snakebite.

According to Barnett,[1] there are three species of snakes in England and Wales—the northern viper or adder (*Vipera berus*), the cross or ring snake (*Natrix natrix*), and the smooth snake (*Coronella austriaca*). Of these, only *V. berus* is venomous. It is believed to hibernate during the colder months.

Walker [11] states that cases of adder-bite have been reported throughout the season March to October, high summer being the season of maximum danger. Fatal cases are rare.

Denmark

According to statistics of the Danish National Health Service, the number of persons bitten by snakes during the period 1900-47 was approximately 1,200, of whom seven died. All deaths occurred among children between the ages of 1 and 12 years.

Sweden

The following tabulation is a summary of information compiled by Marquart [7] from the statistics of the Swedish Public-Health Service.

Sweden : Snakebite cases hospitalized, 1915-44

Period	*Number of cases*	*deaths*
1915–24	1,584	7
1925–34	1,754	6
1935–44	1,398	2
Total . . .	4,736	15

The figures show that about 151 persons bitten by snakes were hospitalized annually. From information given by 182 physicians, it was estimated that only one bitten person was hospitalized for 8.5 wounded persons, so that the annual number of bites by *Vipera berus* would be around 1,300 per year. The total number of deaths from 1915 to 1944 was 15. No deaths were returned from the northerly regions, almost all the deaths being registered in central and southern Sweden. Higher mortality was recorded among children.

Switzerland

Petitpierre [9] has stated that from 1881 to 1930 there were 25 deaths due to the bites of vipers in Switzerland. Most of these deaths occurred in the Tessin (south Switzerland). The number of bite cases each year is estimated by him to be between 5 and 10. All these cases are due to the bites of *Vipera aspis* and *V. berus*, which are known to be numerous in France, Germany, and Switzerland.

Oceania and the Pacific

In this region, poisonous reptiles are absent from New Zealand and the Hawaiian islands, and also from many of the sporadic islands of the South Pacific. They are, however, abundant in Australia, New Guinea, and the Solomon Islands.

The land-dwelling snakes of Australia all belong to the family Elapidae, and although a number are not dangerous to man, the larger kinds have been described as being " outstanding for their abundance, insolence, and high toxicity ".[3]

Notechis scutatus (the tiger snake) is one of the most aggressive reptiles found in Australia. It has an extremely toxic venom, and is reported to be responsible for a very high proportion of the deaths from snakebite in the country.

The brown snake (*Demansia textilis*) and the black snake (*Pseudechis porphyriacus*) are both widely distributed, although the latter is absent from northern Australia and Tasmania. The brown snake has an extremely toxic venom, but the poison of the black snake is comparatively weak. Another snake with a relatively weak venom is *Denisonia superba* (the copperhead snake), which lives in southeastern Australia and Tasmania.

The poison of the death adder (*Acanthophis antarcticus*) is especially active and dangerous. This snake occurs in most of the sandy areas of Australia, but is absent from southern Victoria.

Many sea snakes of the family Hydridae are present in the waters of the northern coasts, and among these 27 different species have been identified. This family is the only other family of poisonous snakes found in Australia besides the Elapidae already mentioned.

Several representatives of the dangerous reptiles present in Australia inhabit New Guinea. These include the death adder and relatives of the dreaded brown snake. In addition, very many sea serpents are known to occur in the coastal waters.

The death adder also occurs in the Moluccas, and several other members of the family Elapidae are present in the Solomon Islands.

Australia

Annual total deaths from snakebite during the period 1942-50 for the whole of Australia are given below :

Year	*Deaths from snakebite*	*Year*	*Deaths from snakebite*
1942	6	1947	4
1943	6	1948	7
1944	9	1949	4
1945	8	1950	7
1946	5		

The annual snakebite death-rate for Australia during the period 1945-9 was 0.07 per 100,000 population.

Out of a total of 28 deaths during the period 1945-9, 18 occurred in the Province of Queensland, 6 in New South Wales, 3 in Western Australia, and 1 in Tasmania. No deaths from snakebite were recorded from other provinces.

Tiger-snake antivenene is used in the case of bite by any Australian venomous snake, and it is believed that this antivenene is effective not only against the venom of the mainland tiger-snake, but also against those of a number of other common species of venomous snakes, against which it affords " cross-protection ".

Tidswell [10] and Ferguson [5] give the following figures indicating the fatality rate from the bites of different species of snake in Australia :

Species of snake	*Number of persons bitten*	*deaths*	*Fatality rate (%)*
Death adder	10	5	50.0
Tiger	45	18	40.0
Brown	70	6	8.6
Black	125	1	0.8

New Zealand

No deaths from snakebite are known to have occurred in New Zealand as no poisonous snakes are found.

Norfolk Island

There are no venomous reptiles in this island.

Nauru Island

There are no venomous reptiles in this territory.

Papua and New Guinea

The only figures available in respect of snakebite cases in the territories of Papua and New Guinea are those relating to cases admitted to Administration Hospitals.

In Papua during the years 1949-52 there were 118 admissions to hospitals from snakebite; of these 9 persons died. In the same period, there were 123 admissions to New Guinea hospitals but no fatality.

The most dangerous snakes in these territories are the death adder (*Acanthophis antarcticus*), the brown snake (*Demansia textilis*), and the black snake (*Pseudechis porphyriacus*).

Fiji

No case of snakebite or death from snakebite is known to have occurred in Fiji. Harmless grass snakes exist on some of the islands, and black- and white-banded sea snakes are present in the coastal waters.

Macao

No case of or death due to snakebite was reported in Macao during the five-year period 1948-52.

Colony of Hong Kong

During the twelve months from August 1951 to July 1952 20 cases of snakebite were seen at the Queen Mary Hospital (the largest Government hospital on Hong Kong Island). It is stated that many cases are treated at home with Chinese remedies, or are not treated at all. If allowance is made for cases seen in other hospitals and for cases not seen at all, it is estimated that about 100 cases of snakebite occur in the Colony each year. No death from snakebite has been recorded in the last five years. The species responsible for most of the bites is *Trimeresurus albolabris* Gray, a green pit-viper, also called " bamboo snake ". Another species presumably responsible for bites is *Hydrophis cyanocinctus* Daudin, a sea snake which bites rarely, but with fatal consequences.

Another common poisonous terrestrial snake occurring in the colony is *Naja naja.*

Japan

The figures of annual deaths for Japan given below relate, for the year 1950, to Item E927 of the International Classification (1948 Revision) and, for the years 1947-9, to Categories 194 and 175 ba of the International List (1938 Revision).

It is reported that about 90% of these deaths occurred from snakebite.

Year	*Number of deaths*
1947	90
1948	107
1949	119
1950	119

For the country as a whole the annual death-rate from snakebite is of the order of 0.13 per 100,000 population. Prefectures showing relatively high death-rates (exceeding 0.40 per 100,000) are Shimane (0.68), Nagasaki (0.55), Saga (0.53), Miyazaki (0.50), Oita (0.48), and Kagoshima (0.43).

It is noteworthy that these prefectures lie in southern Japan, the majority being in Kyushu island.

Out of a total of approximately 100 annual deaths occurring from snakebite in the whole of Japan (46 prefectures), the six prefectures mentioned above account for nearly 40% of the deaths.

The common poisonous snake in Japan is the " mamushi " adder (*Agkistrodon blomhoffii*). Poisonous sea snakes are uncommon.

Philippine Islands

Relatively few poisonous reptiles are found, and mortality from snakebite is therefore negligible. However, two coral snakes—*Doliophis bilineatus* and *D. philippinus*—are known to occur.

North Borneo, Sarawak, and Brunei

In North Borneo figures of deaths included in the category " deaths from venomous animals " are available only since 1951. During 1951 there were no deaths recorded under this heading, and during 1952 only five deaths.

In Sarawak, no death from snakebite has been recorded. Registration of deaths from remoter parts of Sarawak is far from accurate and it is believed that Sarawak has a large number of snakes.

No death from snakebite is known to have occurred in Brunei during the period 1945-52.

The cobra and the adder are the most important poisonous snakes in this region.

Eastern Samoa

There are no poisonous snakes in the territory.

Pacific Islands

The territories of the Pacific Islands, stretching from 1° N to 20° N, and from 130° E to 170° E, are composed of about 2,140 individual islands. The climate is tropical with small seasonal changes, and rainfall is heavy. In this large area of scattered islands, harmful reptiles are scarce.

No deaths from snakebite have been recorded.

Conclusions

The analysis of snakebite mortality in various parts of the world has revealed two interesting features : first, that considerable variation exists from one area to another, and secondly, that high rates are generally found

in topographically similar areas, presumably because of the preponderance of certain species of snake in that habitat.

The largest number of deaths is reported from India, but if proper allowance is made for the size of the population, it is observed that the highest snakebite mortality rate is recorded in Burma.

The total population of the countries which possess national systems for vital statistics registration and for which snakebite mortality data comparable to the population exposed to risk are available is 1,122 million. On the basis of this figure, the total number of snakebite deaths in the world (excluding China, the USSR, and central European countries) is estimated to be between 30,000 and 40,000 annually. Of this total, the highest figures are those for Asia (25,000-35,000), followed by South America (3,000-4,000). North America (including Mexico), Europe, and Oceania all record relatively low figures—300-500, 50, and 10, respectively. For Africa, however, it is difficult to make even an approximate estimate, but it is thought that the annual total of snakebite deaths is around 400-1,000.

An estimate of the total snakebite cases is even more difficult to make, but if a guess is to be ventured it may be stated that about half a million persons are bitten annually by poisonous and non-poisonous snakes.

RÉSUMÉ

Les auteurs ont passé en revue les données concernant la mortalité par morsure de serpent et l'espèce de serpent en cause, dans diverses parties du monde, afin d'évaluer l'importance de cette cause de décès.

Les statistiques dont on dispose sont incomplètes et les chiffres connus ne donnent qu'une idée approximative de la réalité.

Deux conclusions se sont imposées, à l'analyse des données : le fait qu'il existe des différences considérables d'une région à l'autre dans la mortalité par morsure de serpent; et le fait que les taux de mortalité les plus élevés s'observent généralement dans des régions ayant la même topographie, cela probablement en raison de la prépondérance des mêmes espèces de serpents dans un même habitat. La population totale des pays pour lesquels on dispose de statistiques démographiques et de chiffres de mortalité par morsure de serpent — par rapport à la population totale — représente environ 1,122 milliard. Le nombre total de décès par cette cause, dans ces pays, parmi lesquels ne figurent ni la Chine, ni l'URSS, ni les pays de l'Europe centrale, est estimé à 30.000-40.000 par an. L'Asie vient en tête avec 25.000-35.000 décès, suivie par l'Amérique du Sud (3.000-4.000); l'Amérique du Nord vient ensuite (300-500), puis l'Europe (50) et l'Océanie (10). Il est difficile d'avancer des chiffres pour l'Afrique. On peut estimer le nombre de décès dans ce continent à 400-1.000.

Les auteurs mentionnent, pour chaque région géographique importante, les espèces de serpents les plus dangereuses.

Il est plus hasardeux d'estimer le nombre de cas de morsures de serpent. On peut cependant évaluer à environ 500.000 chaque année le nombre de personnes mordues par des serpents venimeux ou non venimeux.

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