

2. Introduction

2.1 Venomous snakes of Southeast Asia

2.1.1 The venom apparatus (Fig 2)

Venomous snakes of medical importance have a pair of enlarged teeth, the fangs, at the front of their upper jaw. These fangs contain a venom channel (like a hypodermic needle) or groove, along which venom can be introduced deep into the tissues of their natural prey. If a human is bitten, venom is usually injected subcutaneously or intramuscularly. Spitting cobras can squeeze the venom out of the tips of their fangs producing a fine spray directed towards the eyes of an aggressor.

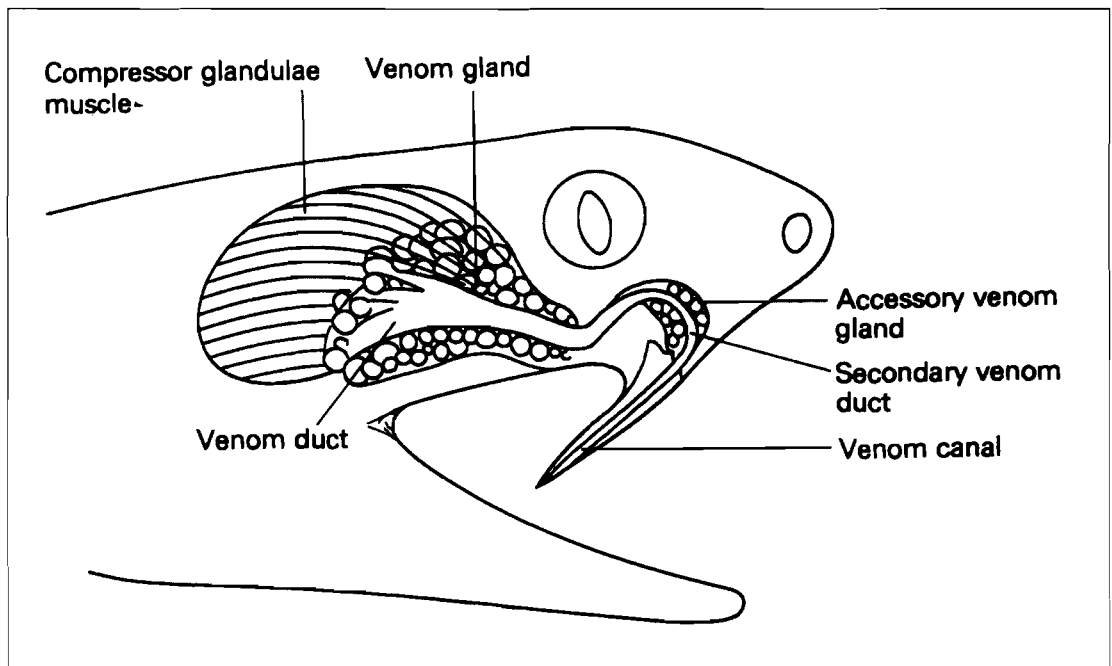


Figure 2 : Venom apparatus of a saw-scaled viper.
(copyright DA Warrell)

2.1.2 Classification

There are two important groups (families) of venomous snakes in Southeast Asia - **Elapidae** have short permanently erect fangs (Fig 3). This family includes the cobras, king cobra, kraits, coral snakes and the sea snakes. The most important species, from a medical point of view, include the following :

cobras :
 (genus *Naja*)
N naja
N oxiana
N kaouthia
N philippinensis
N atra

common spectacled Indian cobra (Fig 4)
 North Indian or Oxus cobra (Fig 5)
 monocellate cobra (Fig 6)
 Philippine cobra
 Chinese cobra (Fig 7)



(Left)
 Figure 3 : Short, permanently erect, fangs of a typical elapid (Thai monocellate cobra - *Naja kaouthia*).
 (Copyright DA Warrell)



(Right)
 Figure 4 : Common spectacled cobra (*Naja naja*); specimen from Sri Lanka. (Copyright DA Warrell)

spitting cobras :	<i>N siamensis</i> (Fig 8),	<i>N sumatrana</i> (Fig 9), <i>N sputatrix</i> etc
king cobra :	<i>Ophiophagus hannah</i> (Fig 10)	
kraits :	<i>B caeruleus</i>	common krait (Fig 11)
(genus <i>Bungarus</i>)	<i>B candidus</i>	Malayan krait (Fig 12)
	<i>B multicinctus</i>	Chinese krait (Fig 13)
	<i>B fasciatus</i>	banded krait (Fig 14)

Sea snakes (important genera include *Enhydrina*, *Lapemis* and *Hydrophis*) (Fig 15)

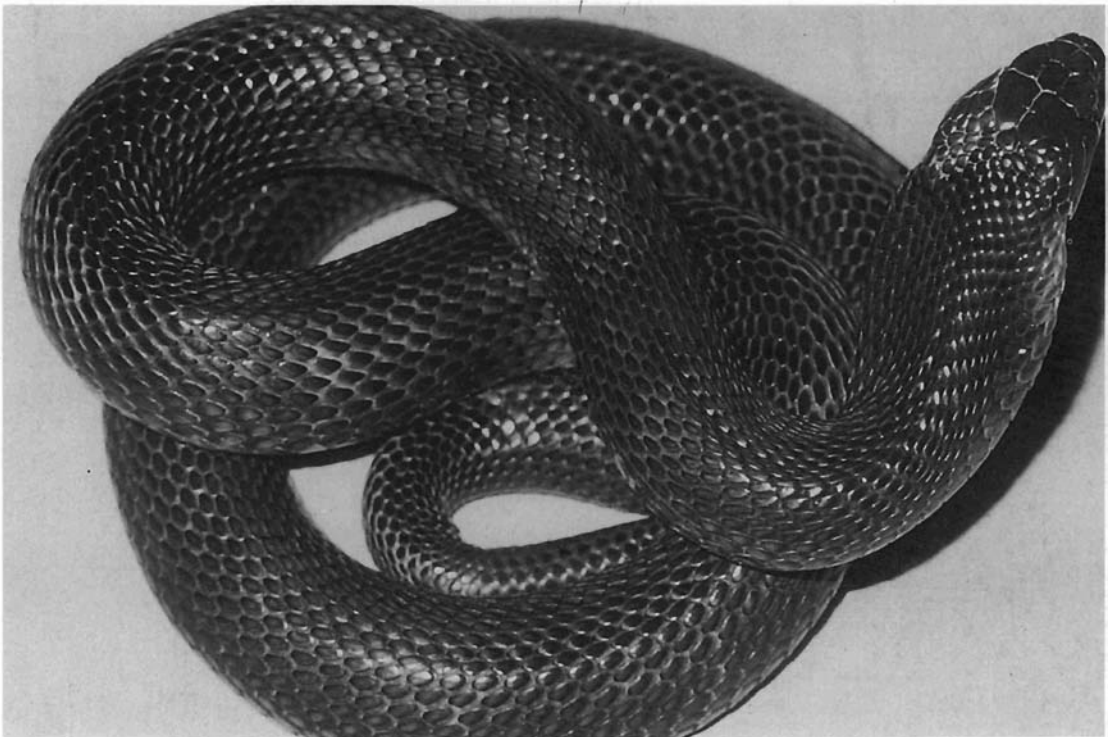


Figure 5 : North Indian or Oxus cobra (*Naja oxiana*). (Copyright DA Warrell)

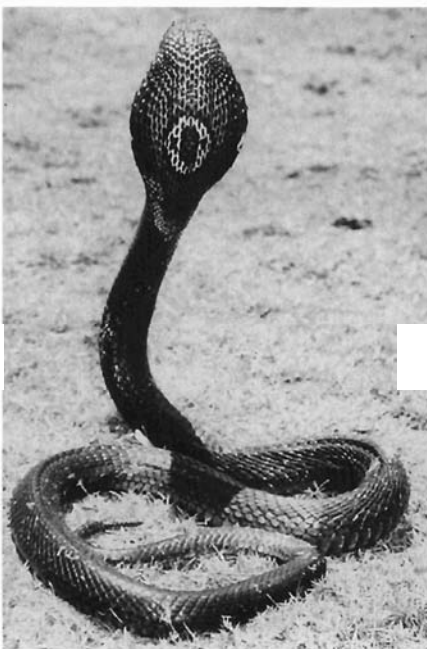


Figure 6 : (Left) Monocellate cobra (*Naja kaouthia*). (Right) Detail of hood. (Copyright DA Warrell)

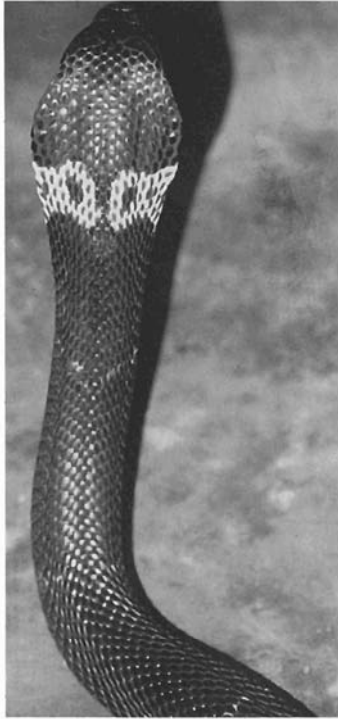


Figure 7 : (Left)
Chinese cobra
(*Naja atra*).
(Copyright DA
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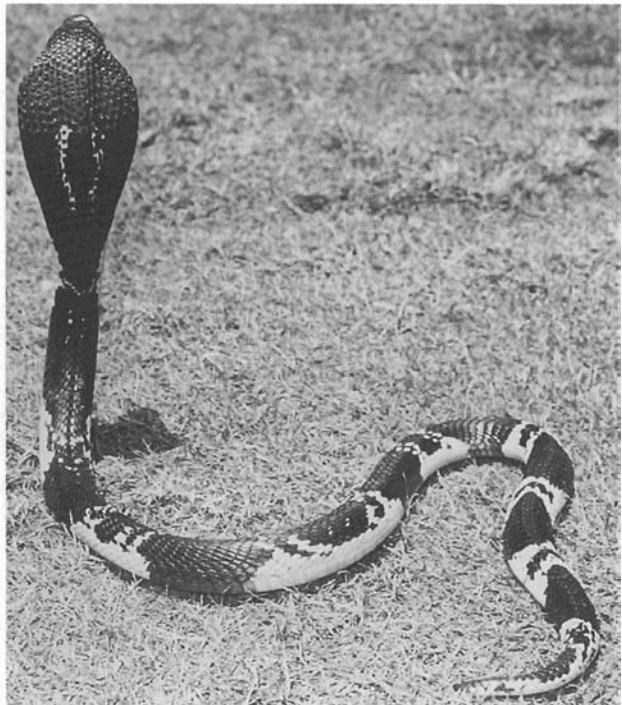
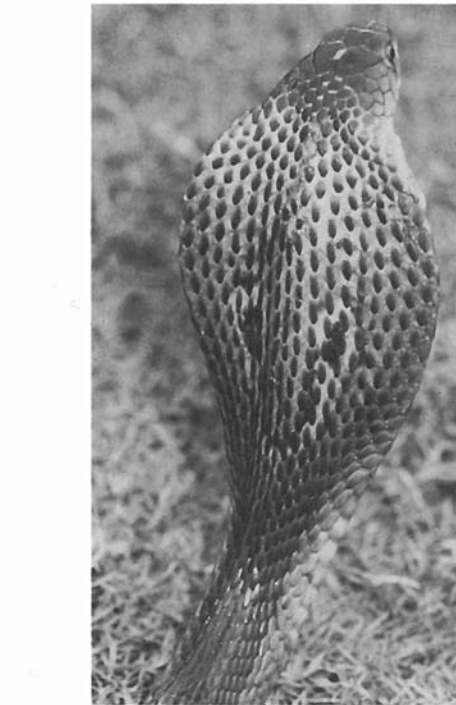
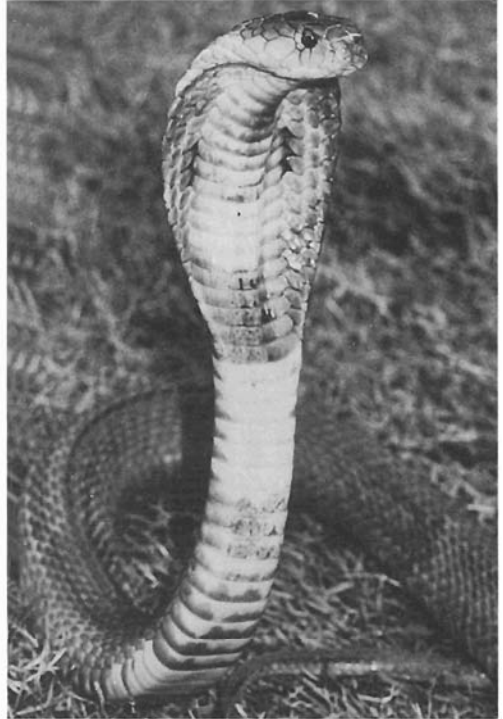


Figure 8 : (Top right) Indo-Chinese spitting cobra (*Naja siamensis*). (Left) Brown-coloured specimen with spectacle marking on hood. (Right) Black and white specimen with ill-defined spectacle marking on hood.
(Copyright DA Warrell)

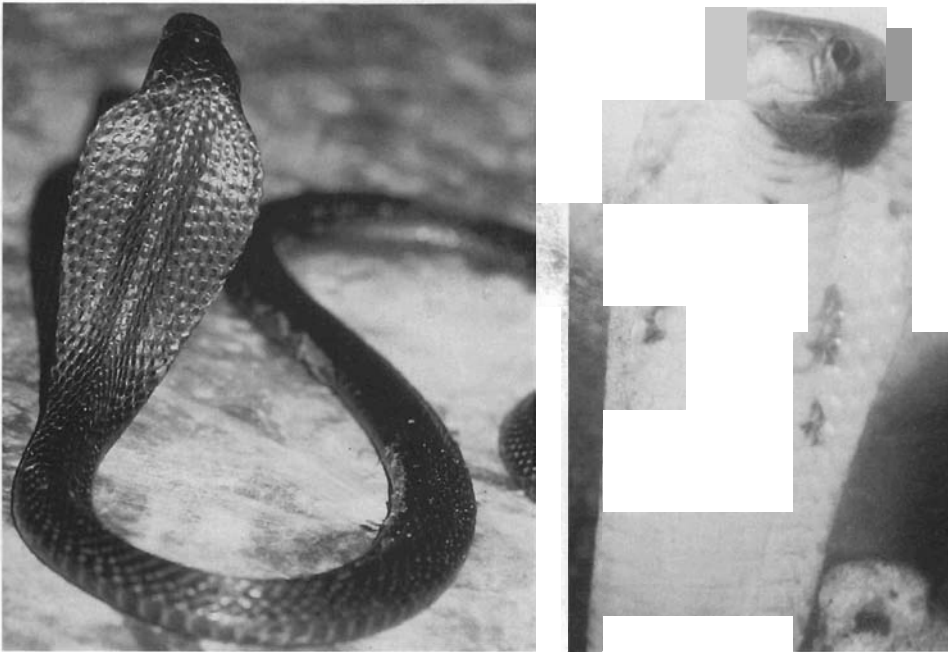


Figure 9 : Sumatran spitting cobra (*Naja sumatrana*), (Left) black phase, (Right) yellow phase.
(Copyright DA Warrell)



Figure 10 : King cobra or hamadryad (*Ophiophagus hannah*). The famous king cobra dance in Yangon, Myanmar.
(Copyright DA Warrell)

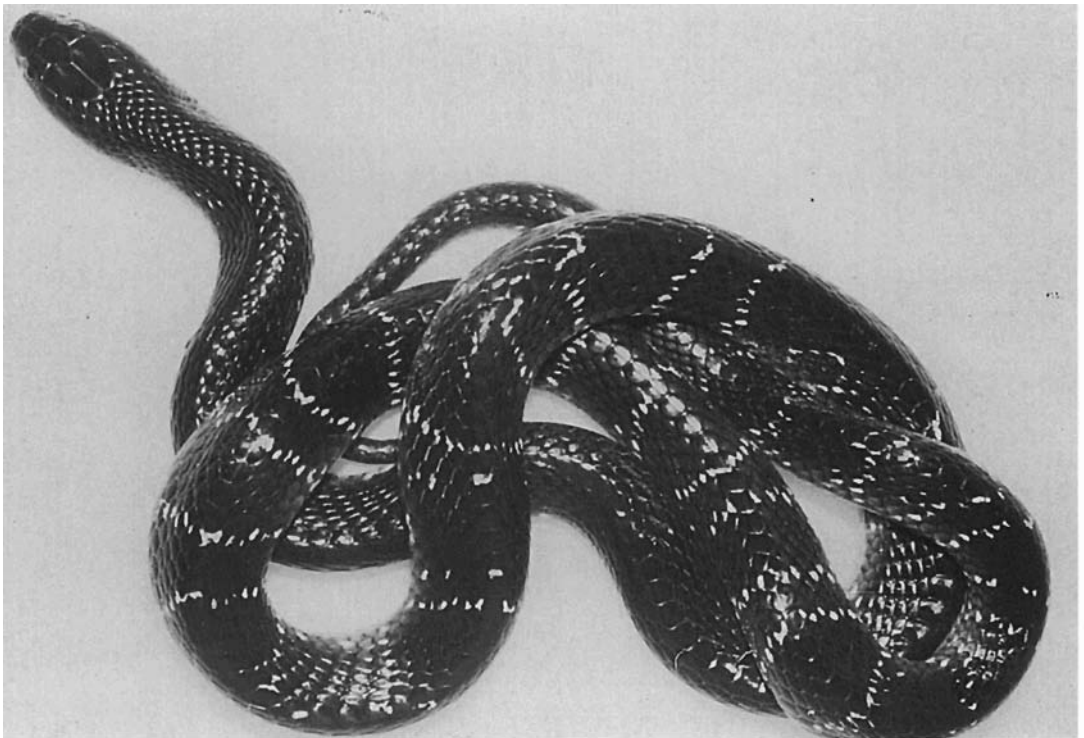


Figure 11 : Common krait (*Bungarus caeruleus*). (Copyright DA Warrell)

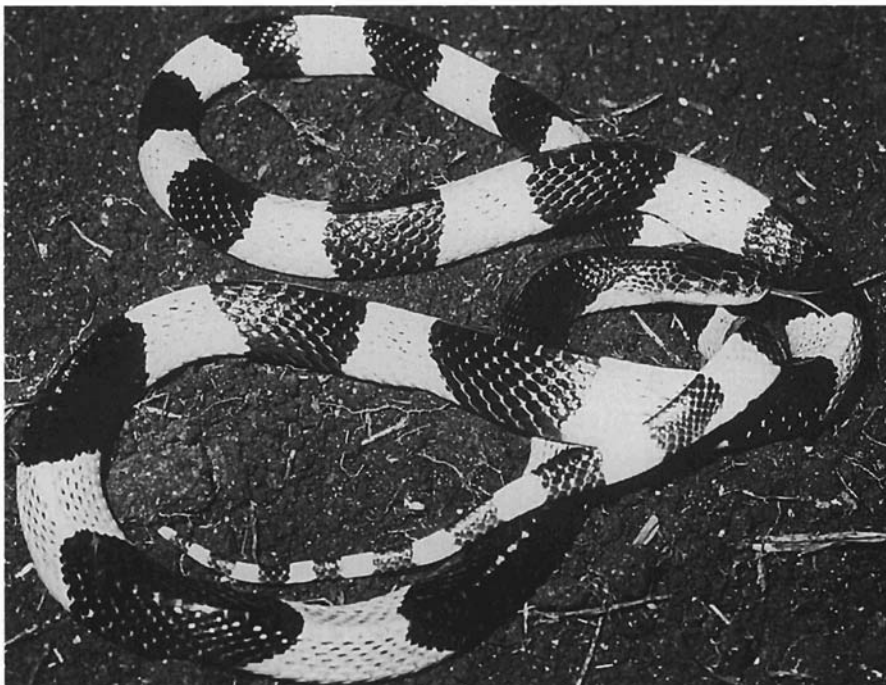


Figure 12 : Malayan krait (*Bungarus candidus*). (Copyright DA Warrell)



Figure 13 : Chinese krait (*Bungarus multicinctus*). (Copyright DA Warrell)

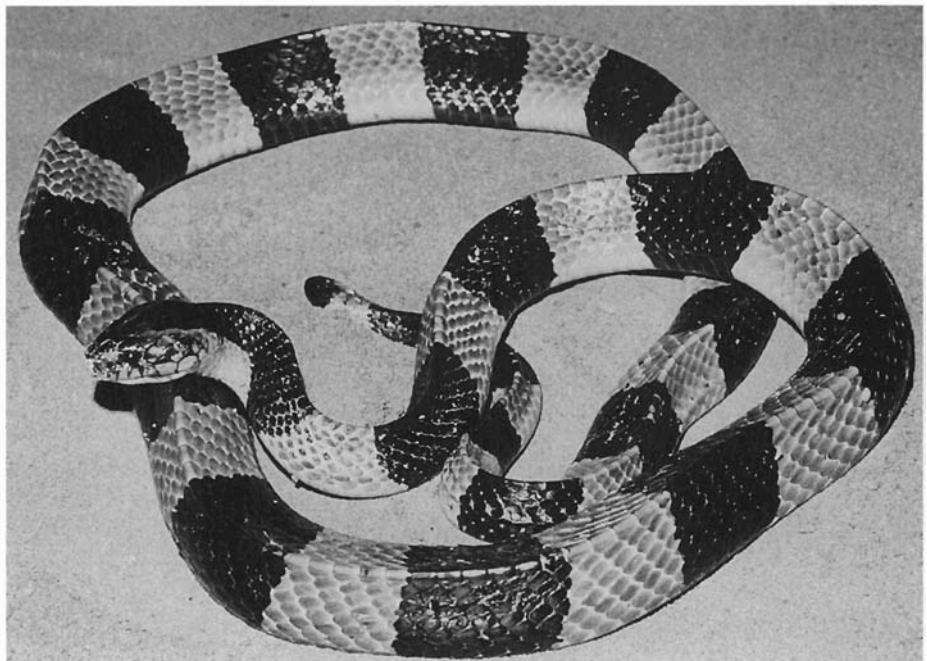


Figure 14 : Banded krait (*Bungarus fasciatus*). (Copyright DA Warrell)

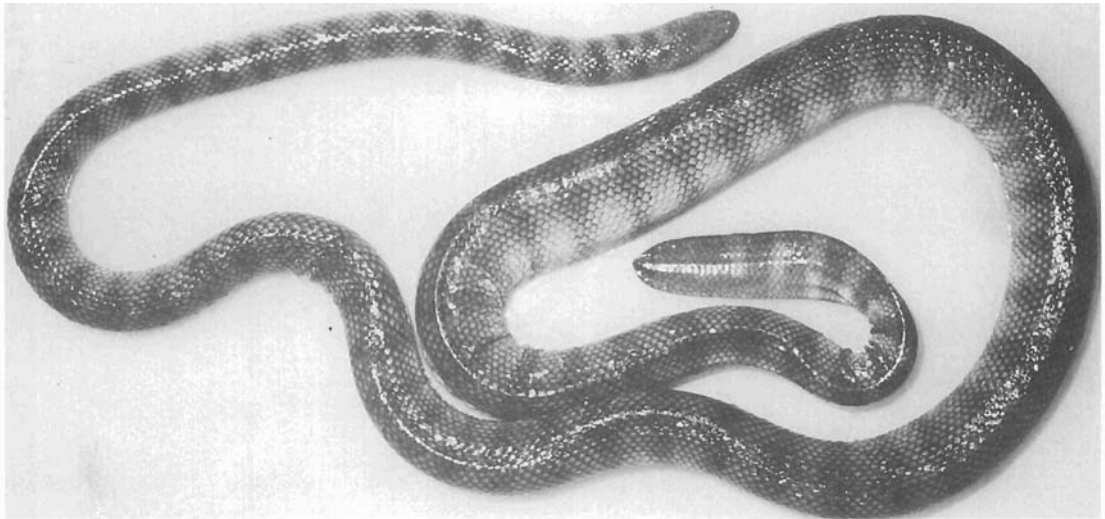


Figure 15 : Blue spotted sea snake (*Hydrophis cyanocinctus*). (Copyright DA Warrell)

Viperidae have long fangs which are normally folded up against the upper jaw but, when the snake strikes, are erected (Fig 2). There are two subgroups, the typical vipers (Viperinae) and the pit vipers (Crotalinae). The Crotalinae have a special sense organ, the pit organ, to detect their warm-blooded prey. This is situated between the nostril and the eye (Fig 16).

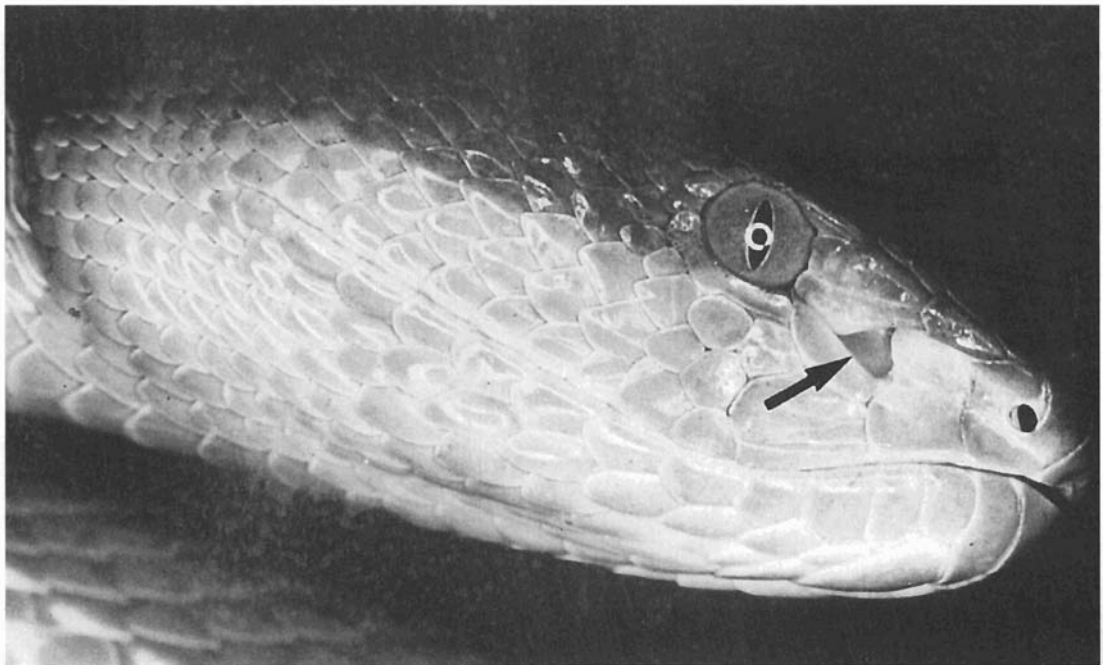


Figure 16 : Head of a typical pit viper - white-lipped green pit viper (*Trimeresurus albolabris*) showing the pit organ (arrow head) situated between the nostril and the eye. (Copyright DA Warrell)

Medically important species in Southeast Asia are:

typical vipers	<i>Daboia russelii</i> <i>Echis carinatus</i> and <i>E sochureki</i>	Russell's vipers (Fig 17) saw-scaled or carpet vipers (Figs 18, 19)
pit vipers	<i>Calloselasma rhodostoma</i> <i>Hypnale hypnale</i>	Malayan pit viper (Fig 20) hump-nosed viper (Fig 21)
green pit vipers or bamboo vipers (genus <i>Trimeresurus</i>)	<i>T albolabris</i> <i>T erythrurus</i> <i>T gramineus</i> <i>T mucrosquamatus</i> <i>T purpureomaculatus</i> <i>T stejnegeri</i>	white-lipped green pit viper (Fig 22) Myanmar green pit viper Indian bamboo viper Chinese habu (Fig 23) mangrove pit viper (Fig 24) Chinese bamboo viper

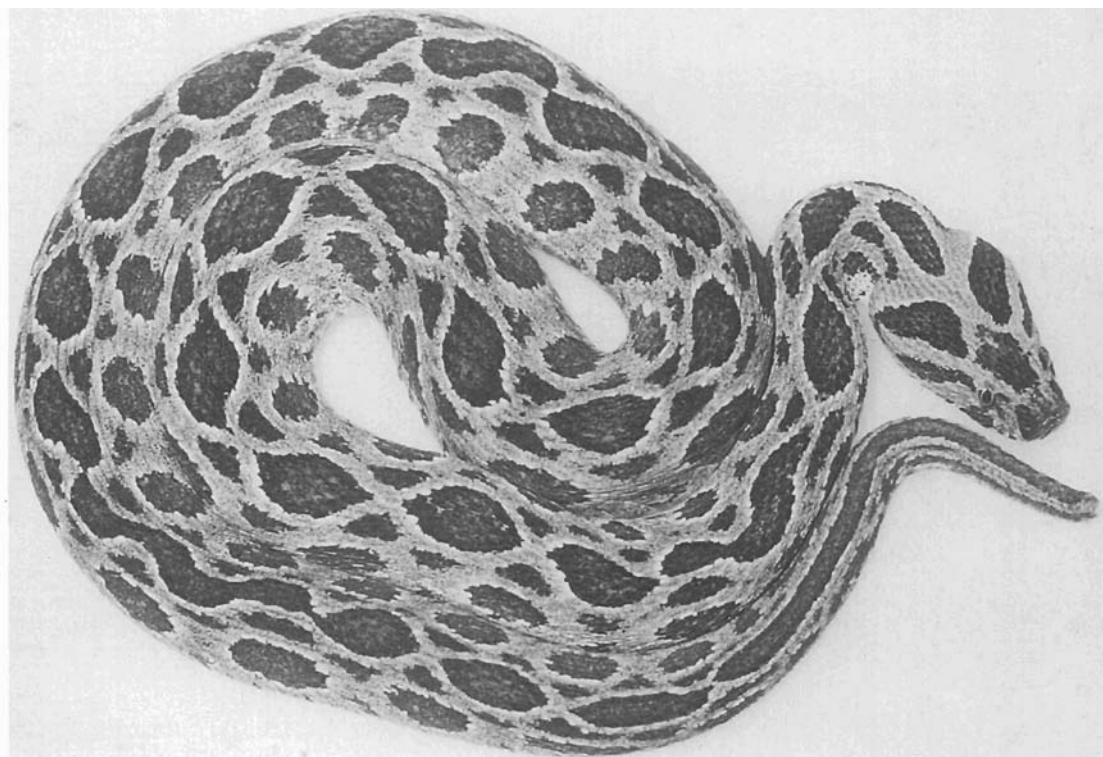


Figure 17a : Russell's vipers. (Copyright DA Warrell) Eastern subspecies (*Daboia russelii siamensis*) specimen from Myanmar.

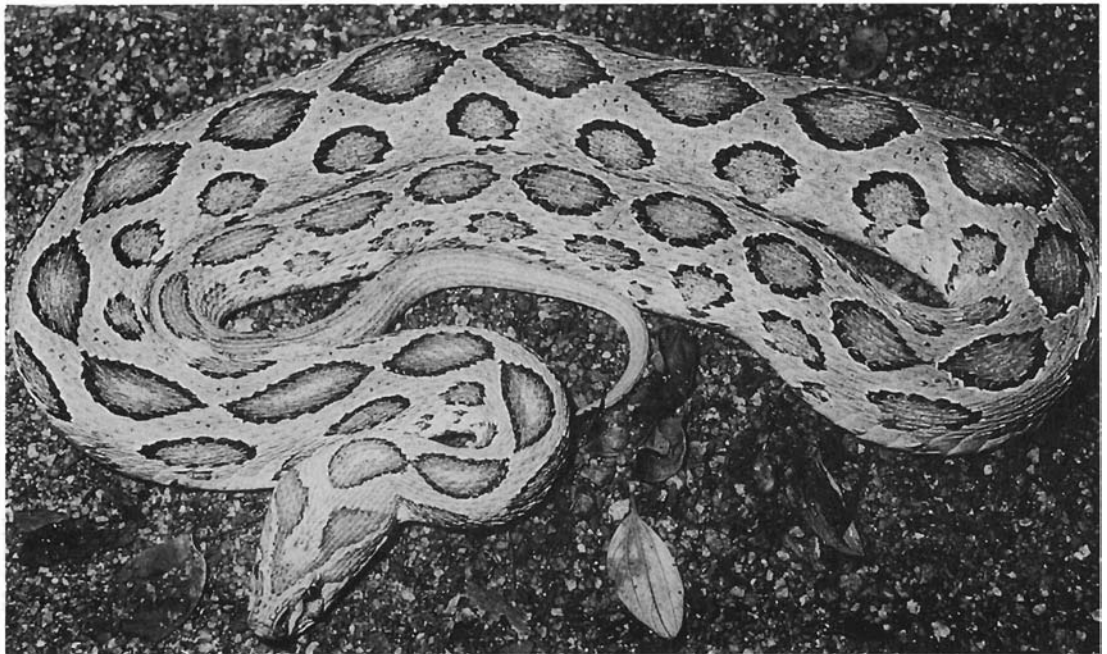


Figure 17b : Russell's vipers. (Copyright DA Warrell) Western subspecies (*Daboia russelii russelii*) specimen from India.

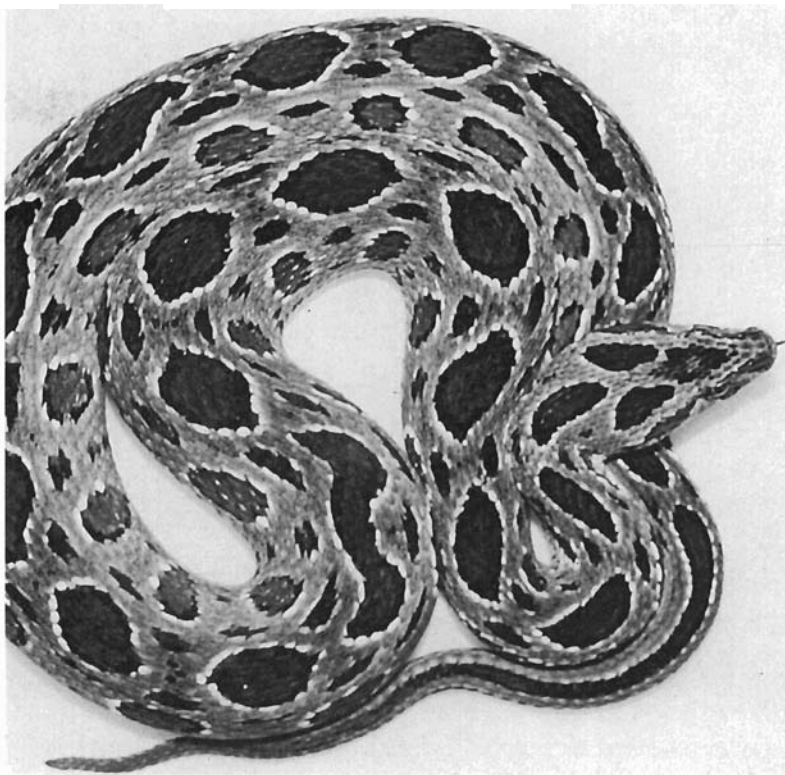


Figure 17c : Russell's vipers. (Copyright DA Warrell) Eastern subspecies (*Daboia russelii siamensis*); specimen from Thailand.

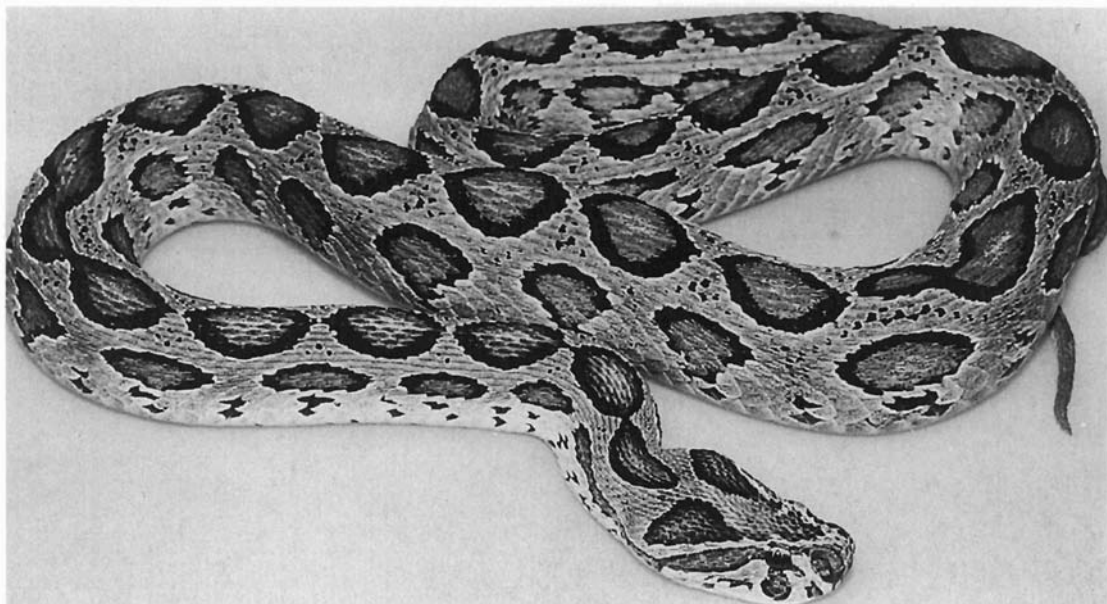


Figure 17d, e : Russell's vipers (*Copyright DA Warrell*)
 (Top-d) Western subspecies,
 (*Daboia russelii russelii*)
 specimen from Sri Lanka.
 (Bottom-e) Details of fangs.



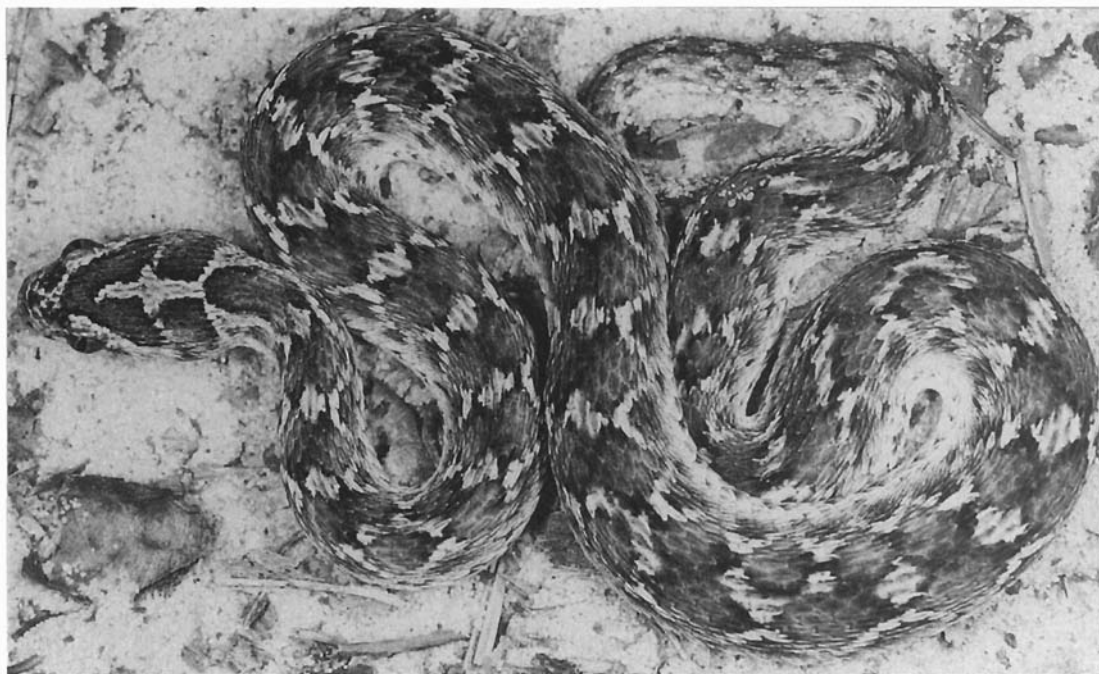


Figure 18 : Saw-scaled viper (*Echis carinatus*) specimen from Sri Lanka. (Copyright DA Warrell)

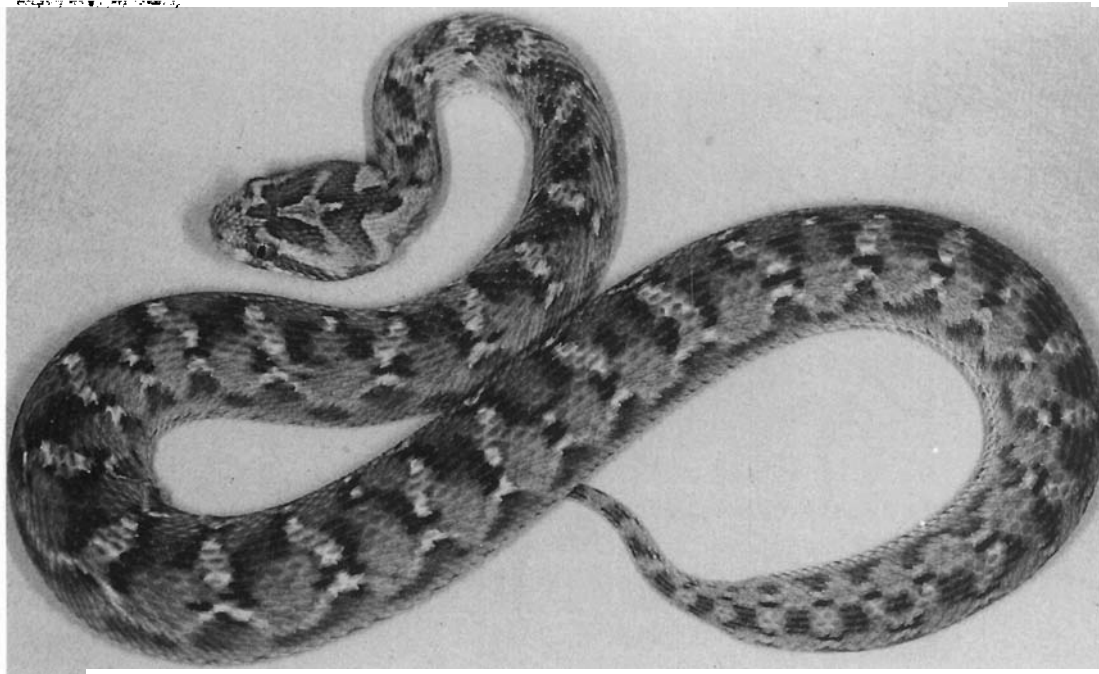


Figure 19 : Northern saw-scaled viper (*Echis sochureki*). (Copyright DA Warrell)

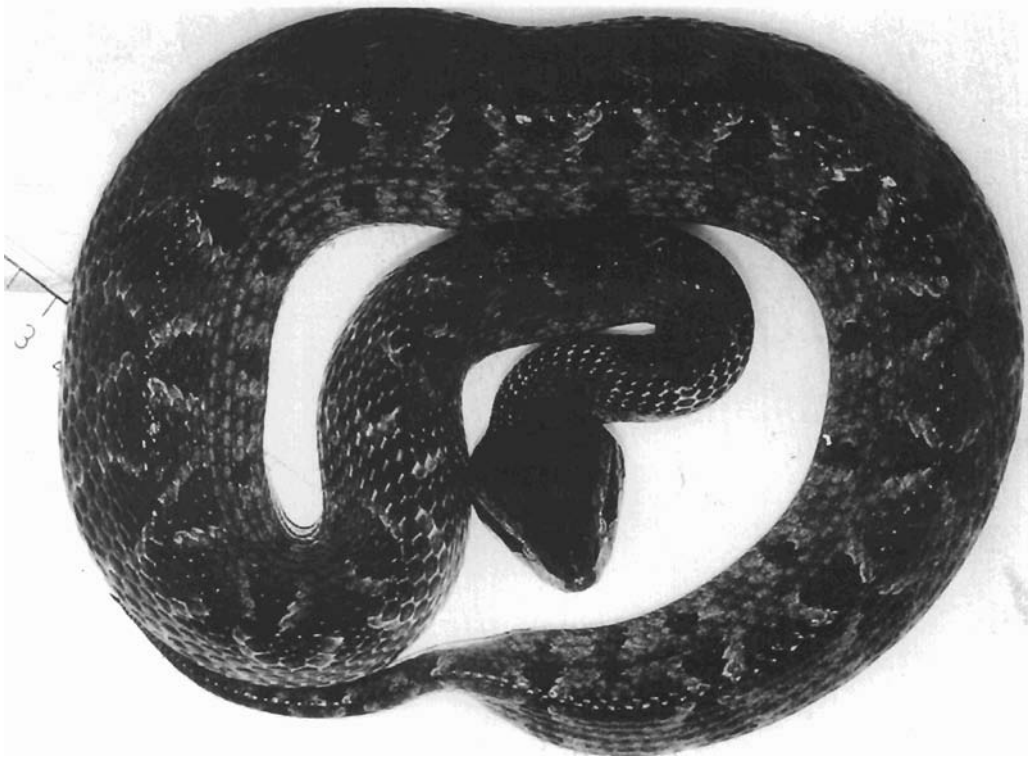


Figure 20 : Malayan pit viper (*Calloselasma rhodostoma*). (Copyright DA Warrell)

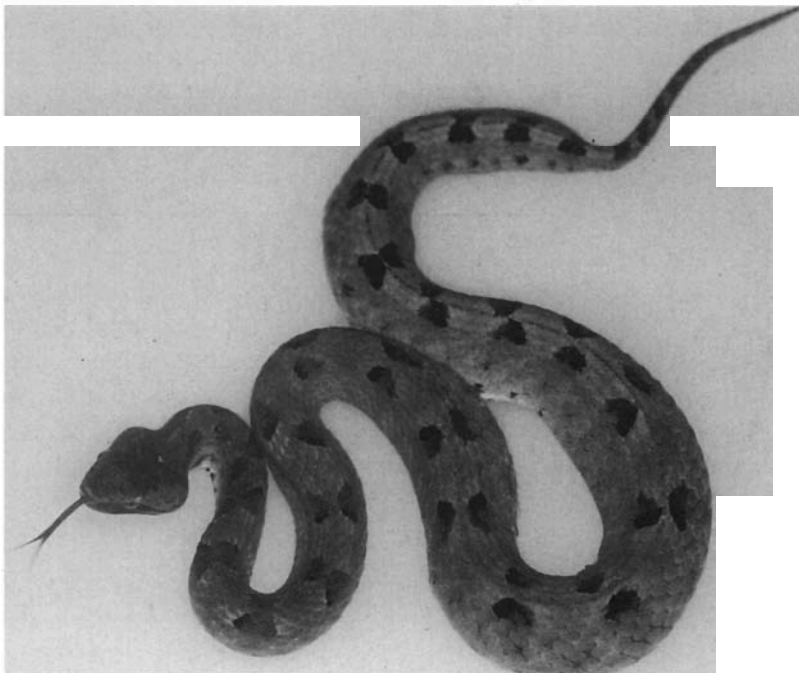


Figure 21 : Hump-nosed viper (*Hypnale hypnale*).
Specimen from Sri Lanka.
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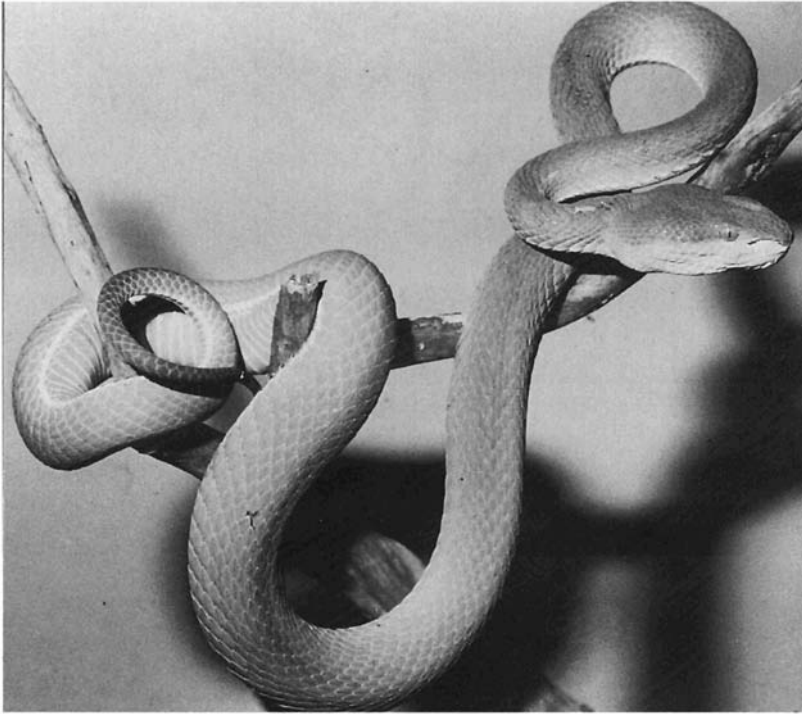


Figure 22 : White-lipped green pit viper (*Trimeresurus albolabris*). (Copyright DA Warrell)

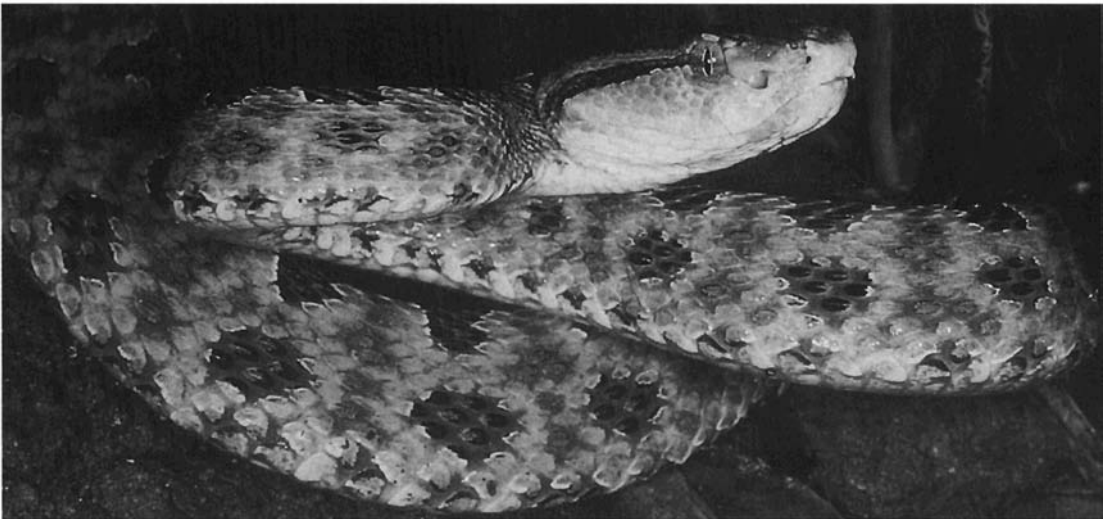


Figure 23 : Chinese habu (*Trimeresurus mucrosquamatus*). (Copyright DA Warrell)

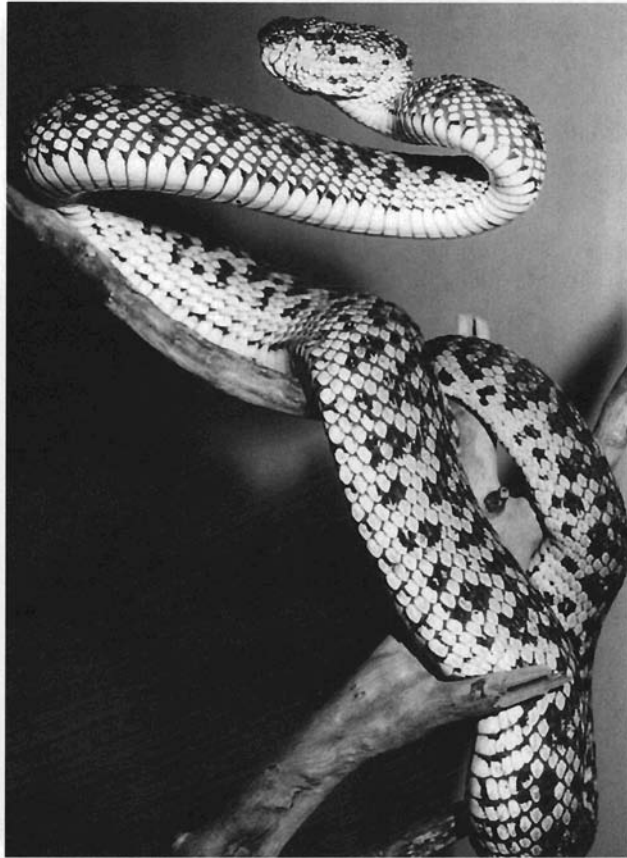


Figure 24 : Mangrove pit viper (*Trimeresurus purpureomaculatus*). (Copyright DA Warrell)

2.1.3 How to identify venomous snakes

There is no simple rule for identifying a dangerous venomous snake. Some harmless snakes have evolved to look almost identical to venomous ones. However, some of the most notorious venomous snakes can be recognised by their size, shape, colour, pattern of markings, their behaviour and the sound they make when they feel threatened. For example, the defensive behaviour of the cobras is well known (Fig 8) : they rear up, spread a hood, hiss and make repeated strikes towards the aggressor. Colouring can vary a lot. However, some patterns, like the large white, dark rimmed spots of the Russell's viper (Fig 17), or the alternating black and yellow bands of the banded krait (Fig 14), are distinctive. The blowing hiss of the Russell's viper and the grating rasp of the saw-scaled viper are warning and identifying sounds.

2.2 Snake venoms

2.2.1 Composition of venom

Snake venoms contain more than 20 different constituents, mainly proteins, including enzymes and polypeptide toxins.

The following venom constituents cause important clinical effects :

Procoagulant enzymes (Viperidae) that stimulate blood clotting but result in incoagulable blood. Venoms such as Russell's viper venom contain several different procoagulants which activate different steps of the clotting cascade. The result is formation of fibrin in the blood stream. Most of this is immediately broken down by the body's own fibrinolytic system. Eventually, and sometimes within 30 minutes of the bite, the levels of clotting factors have been so depleted ("consumption coagulopathy") that the blood will not clot.

Haemorrhagins (zinc metalloproteinases) that damage the endothelial lining of blood vessel walls causing spontaneous systemic haemorrhage.

Cytolytic or necrotic toxins - these digestive hydrolases (proteolytic enzymes and phospholipases A₁), polypeptide toxins and other factors increase permeability resulting in local swelling. They may also destroy cell membranes and tissues.

Haemolytic and myolytic phospholipases A₂ - these enzymes damage cell membranes, endothelium, skeletal muscle, nerve and red blood cells.

Pre-synaptic neurotoxins (Elapidae and some Viperidae) - these are phospholipases A₂ that damage nerve endings, initially releasing acetylcholine transmitter, then interfering with release.

Post-synaptic neurotoxins (Elapidae) - these polypeptides compete with acetylcholine for receptors in the neuromuscular junction and lead to curare-like paralysis.

2.2.2 Quantity of venom injected at a bite

This is very variable, depending on the species and size of the snake, the mechanical efficiency of the bite, whether one or two fangs penetrated the skin and whether there were repeated strikes. The snake may be able to control whether or not venom is injected. For whatever reason, a proportion of bites by venomous snakes do not result in the injection of sufficient venom to cause clinical effects. About 50% of bites by Malayan pit vipers and Russell's vipers, 30% of bites by cobras and 5-10% of bites by saw-scaled vipers do not result in any symptoms or signs of envenoming. Snakes do not exhaust their store of venom, even after several strikes, and they are no less venomous after eating their prey.

Although large snakes tend to inject more venom than smaller specimens of the same species, the venom of smaller, younger vipers may be richer in some dangerous components, such as those affecting haemostasis.

Bites by small snakes should not be ignored or dismissed. They should be taken just as seriously as bites by large snakes of the same species.

2.3 How common are snake bites?

It is difficult to answer this question because many snake bites and even deaths from snake bite are not recorded. One reason is that many snake bite victims are treated not in hospitals but by traditional healers.

To remedy the deficiency in reliable snake bite data, it is strongly recommended that snake bites should be made a specific notifiable disease in all countries in the Southeast Asian region.

Bangladesh - a survey of 10% of the country in 1988-9 revealed 764 bites with 168 deaths in one year. Cobra bites (34% of all bites) caused a case fatality of 40%. A more recent postal survey, covering a wider area, suggested an incidence of 4.3 bites per 100,000 population per year with 20% case fatality. Most people are treated by traditional healers ("ohzas").

Bhutan (no data available)

Cambodia (no data available)

India - estimates in the region of 200,000 bites and 15-20,000 snake bite deaths per year, originally made in the last century, are still quoted. No reliable national statistics are available. In 1981, a thousand deaths were reported in Maharashtra State. In the Burdwan district of West Bengal 29,489 people were bitten in one year with 1,301 deaths. It is estimated that between 35,000 and 50,000 people die of snake bite each year among India's population of 980 million.

Indonesia - no reliable data are available from this vast archipelago. Snake bites and deaths are reported from some islands, (*eg* Komodo), but fewer than 20 deaths are registered each year.

Lao DPR (no data available)

Malaysia - bites are common, especially in northwest peninsular Malaysia, but there are few deaths.

Myanmar (Burma) - snake bites and snake bite deaths have been reliably reported from colonial times. Russell's vipers are responsible for 90% of cases. In 1991, there were 14,000 bites with 1,000 deaths and in 1997, 8,000 bites with 500 deaths. Under-reporting is estimated at 12%. There are peaks of incidence in May and June in urban areas and during the rice harvest in October to December in rural areas.

Nepal - there are estimated to be at least 20,000 snake bites with about 200 deaths in hospitals each year, mainly in the Terai region. One survey suggested as many as 1,000 deaths per year. Among 16 fatalities recorded at one rural clinic during a monsoon season, 15 had died on their way to seek medical care.

Pakistan - there are an estimated 20,000 snake bite deaths each year.

Philippines - there are no reliable estimates of mortality among the many islands of the archipelago. Figures of 200-300 deaths each year have been suggested. Only cobras cause fatal envenoming, their usual victims being rice farmers.

Sri Lanka - epidemiological studies in Anuradhapura showed that only two-thirds of cases of fatal snake bite were being reported to the Government Agent Statistical Branch. However, the Registrar General received reports of more than 800 deaths from bites and stings by venomous animals and insects in the late 1970s and the true annual incidence of snake bite fatalities may exceed 1,000.

Thailand - between 1985 and 1989, the number of reported snake bite cases increased from 3,377 to 6,038 per year, reflecting increased diligence in reporting rather than a true increase in snake bites; the number of deaths ranged from 81 to 183 (average 141) per year. In 1991 there were 1,469 reported bites with five deaths, in 1992, 6,733 bites with 19 deaths and, in 1994, 8,486 bites with eight deaths. Deaths reported in hospital returns were only 11% of the number recorded by the Public Health Authorities. In a national survey of dead snakes brought to hospital by the people they had bitten, 70% of the snakes were venomous species, the most commonly brought species being Malayan pit viper (*Calloselasma rhodostoma*) 38%, white-lipped green pit viper (*Trimeresurus albolabris*) 27%, Russell's viper (*Daboia russelii siamensis*) 14%, Indo-Chinese spitting cobra (*Naja siamensis*) 10% and monocellate cobra (*N. kaouthia*) 7%. In an analysis of 46 fatal cases in which the snake had been reliably identified, Malayan kraits (*Bungarus candidus*) and Malayan pit vipers were each responsible for 13 cases, monocellate cobras for 12 and Russell's vipers for seven deaths.

Vietnam - there are an estimated 30,000 bites per year. Among 430 rubber plantation

workers bitten by Malayan pit vipers between 1993 and 1998, the case fatality was 22%, but only a minority had received antivenom treatment. Fishermen are still occasionally killed by sea snakes but rarely reach hospitals.

2.4 How do snake bites happen?

In Southeast Asia, snake bite is an occupational hazard of rice farmers; rubber, coffee and other plantation workers; fishermen and those who handle snakes.

Snake bite : an occupational disease in Southeast Asia

Farmers (rice)
Plantation workers (rubber, coffee)
Herdsman
Hunters
Snake handlers (snake charmers and in snake restaurants and traditional Chinese pharmacies)
Fishermen and fish farmers
Sea snake catchers (for sea snake skins, leather)

Most snake bites happen when the snake is trodden on, either in the dark or in undergrowth, by someone who is bare-footed or wearing only sandals. The snake may be picked up, unintentionally in a handful of foliage or intentionally by someone who is trying to show off. Some bites occur when the snake (usually a krait) comes in to the home at night in search of its prey (other snakes, lizards, frogs, mice) and someone sleeping on the floor rolls over onto the snake in their sleep. Not all snake bites happen in rural areas. For example, in some large cities, such as Jammu in India, people who sleep in small huts (jhuggies) are frequently bitten by kraits.

2.5 How can snake bites be avoided?

Snake bite is an occupational hazard that is very difficult to avoid completely. However, attention to the following recommendations might reduce the number of accidents.

- i) *Education !* Know your local snakes, know the sort of places where they like to live and hide, know at what times of year, at what times of day/night or in what kinds of weather they are most likely to be active.
- ii) Be specially vigilant about snake bites after rains, during flooding, at harvest time and at night.

- iii) Try to wear proper shoes or boots and long trousers, especially when walking in the dark or in undergrowth.
- iv) Use a light (torch, flashlight or lamp) when walking at night.
- v) Avoid snakes as far as possible, including snakes performing for snake charmers. Never handle, threaten or attack a snake and never intentionally trap or corner a snake in an enclosed space.
- vi) If at all possible, try to avoid sleeping on the ground.
- vii) Keep young children away from areas known to be snake-infested.
- viii) Avoid or take great care handling dead snakes, or snakes that appear to be dead.
- ix) Avoid having rubble, rubbish, termite mounds or domestic animals close to human dwellings, as all of these attract snakes.
- x) Frequently check houses for snakes and, if possible, avoid types of house construction that will provide snakes with hiding places (*eg* thatched roofs with open eaves, mud and straw walls with large cracks and cavities, large unsealed spaces beneath floorboards).
- xi) To prevent sea snake bites, fishermen should avoid touching sea snakes caught in nets and on lines. The head and tail are not easily distinguishable. There is a risk of bites to bathers and those washing clothes in muddy water of estuaries, river mouths and some coastlines.

3. Symptoms and signs of snake bite

3.1 When venom has *not* been injected

Some people who are bitten by snakes or suspect or imagine that they have been bitten, may develop quite striking symptoms and signs, even when no venom has been injected. This results from an understandable fear of the consequences of a real venomous bite. Anxious people may overbreathe so that they develop pins and needles of the extremities, stiffness or tetany of their hands and feet and dizziness. Others may develop vasovagal shock after the bite or suspected bite - faintness and collapse with profound slowing of the heart. Others may become highly agitated and irrational and may develop a wide range of misleading symptoms. Another source of symptoms and signs not caused by snake venom is first aid and traditional treatments. Constricting bands or tourniquets may cause pain, swelling and congestion. Ingested herbal remedies may cause vomiting. Instillation of irritant plant juices into the eyes may cause conjunctivitis. Forcible insufflation of oils into the respiratory tract