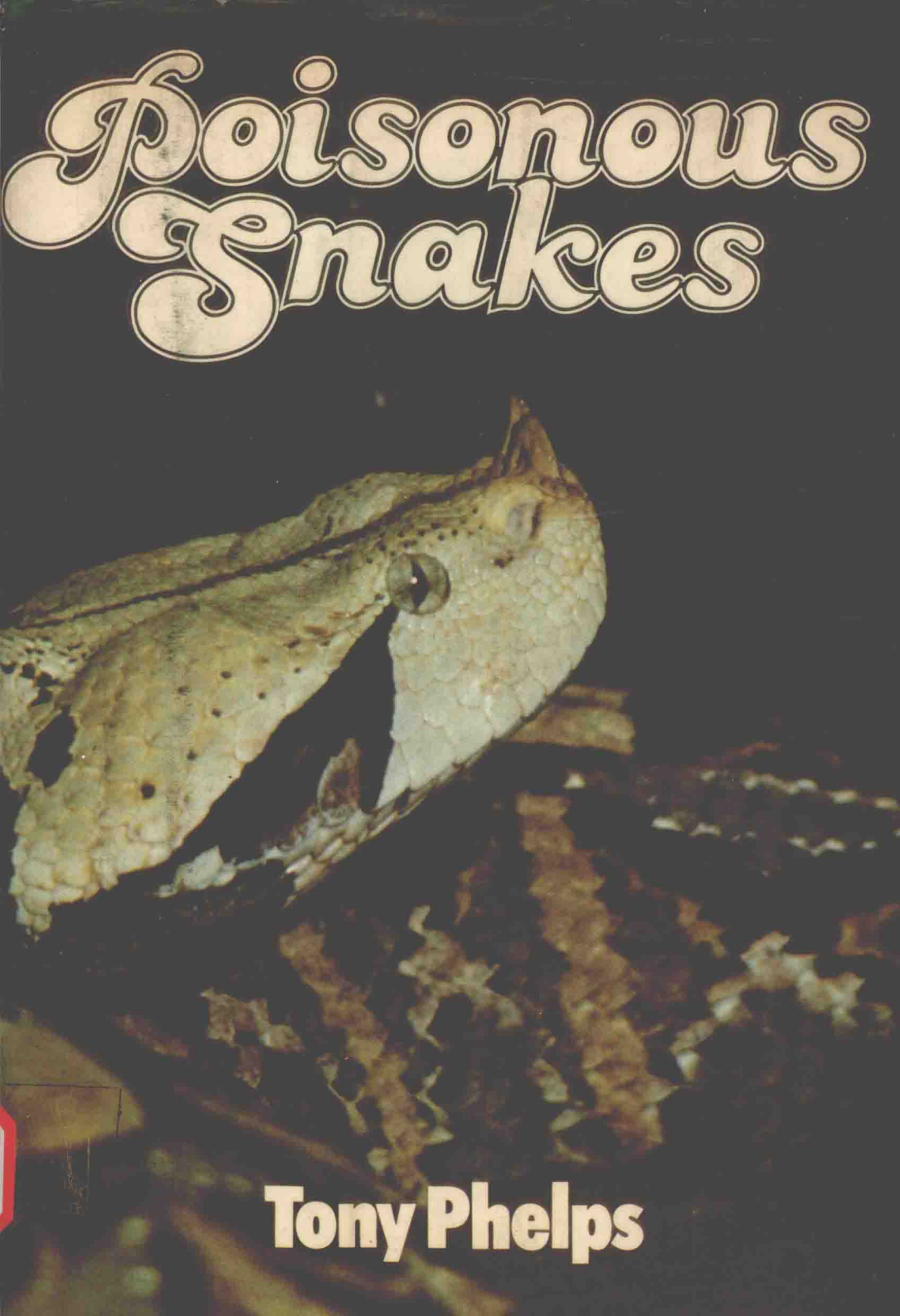
Poisonous Snakes



Tony Phelps

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Author's Preface

The subject of snakes is often an emotive one. It is a topic that at once fills many people with fear and loathing and these are feelings that are very real; a phobia that is caused by very few other animals with the possible exception of spiders. This situation is further enhanced when it is known that many of these creatures, that move so mysteriously without the aid of limbs, can also deliver a fatal bite.

Although it is a medical fact that people do have phobias about snakes, the majority of prejudice is a result of plain ignorance and misunderstanding. This book does not profess to convert such people towards a kinder outlook on snakes, but to state the facts as they really are. This is achieved by exposing some of the myths that surround these creatures. I have also tried to be realistic and point out situations where venomous snakes are a hazard to man.

The primary function of this book, and indeed most books, is for the reader to gain from the author's experience and the knowledge gathered as a result of that experience. Many of us are specialists in our own particular fields and I have been lucky enough to have been able to study snakes in both wild and captive conditions.

Past literature on the subject has mainly dealt with identification and anatomy. In other words, we may know what a certain snake looks like and how its body functions, but to a much lesser extent do we know how it lives and how it functions within the environment where it occurs. Similarly, the care and handling of venomous snakes appears to have almost been a trade secret in the past, and this is highlighted by the fact that many of the world's authorities on the subject have been almost entirely self taught with regard to the actual problem of the 'first restrain your snake' type of situation.

It can be appreciated that the many and varied types of venomous snakes require different techniques when it comes to handling. This book can therefore be regarded essentially as a practical guide to both field study, and husbandry and handling. However, such important aspects as distribution, and relationships with man, have not been ignored. Descriptions of species have been kept to a minimum and I am indebted to such specialist knowledge that I have deemed fit to lean on.

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Tony E. Phelps
Poole, 1980

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1
Introduction

Reptiles are the remnants of a bygone age and all the groups that remain today are familiar to most people. The crocodiles, turtles, lizards and snakes that inhabit the earth are just a small reminder of the great age of reptiles when *Triceratops* and *Iguanodon* roamed the humid swamps; an age that lasted 120 million years.

The lizards and snakes form the majority of contemporary reptiles, each group having about three thousand species.

The snakes represent many diverse forms and are distributed throughout the world with the exception of the polar regions. One group, the sea snakes, have successfully colonised the open sea.

Front-fanged venomous snakes constitute about 15 per cent of the total number of snake species, and only a comparatively small number of these are considered dangerous to man. Venomous snakes are further represented by the majority group of snakes, the colubrids, which contain many genera of rear-fanged snakes of which only two or three species offer any threat to man.

Before describing venomous snakes in particular it is necessary to have some understanding of what snakes are: their anatomy, bodily functions, how they feed and, quite simply, how they move.

Anatomy

Snakes evolved from lizard-like ancestors and as a result of the slow process of evolution the elongate flexible body underwent considerable

changes both externally and internally. The most obvious change is the complete lack of limbs; the boas and pythons and several other small groups, have vestigial remains of hind limbs in the form of small spurs. Internally, with the exception of those mentioned, no snakes have any traces of any skeletal features relating to limbs. All snakes have well-formed vertebrae and ribs which vary in number from species to species but usually in the region of between 140–160. Notable modification of the vertebrae can be seen in such groups as the sea snakes where the tail is laterally compressed and oar-like.

The internal organs have also become adapted to accommodate an elongate form. Most snakes possess only one lung; only some primitive species have retained both lungs. The heart is simple and consists of a left and right auricle and a single ventricle.

Most snakes feed on large prey which they swallow whole, and for this reason the gullet is capable of great distension to allow the passage of large items of food. Similarly, the long tubular stomach has the capability of accommodating large food items.

Snakes do not possess a single penis but a paired organ which is joined at the base and is called the hemipenis. This organ when not erected lies in the anterior part of the tail close to the vent. Each penis is employed quite independently of the other. The hemipenis of snakes varies, but is generally a stubby organ covered with soft spines. These spines prevent the penis from being dislodged from the female. Snakes pair for long periods and withdrawal is eventually effected by a retractor muscle. Snakes will often expose the hemipenis when handled or in pain.

Senses

Snakes have no external ear and as such cannot perceive airborne sounds. However, snakes are perceptive to ground vibrations which are picked up via the jaw and quadrate bone. Snakes are particularly perceptive to changes in the surface on which they lie, whether it be vibration or temperature change, and it is possible that some of the internal organs play a major role in detecting these changes.

Situated in the palate is the remarkable organ known as the organ of Jacobson, which is the snake's main means of perceiving smell. The constant flickering of the tongue of a snake is familiar and in fact the tongue is passing scent particles to the Jacobson's organ.

Snakes do not have eyelids and the eye is capable of only limited

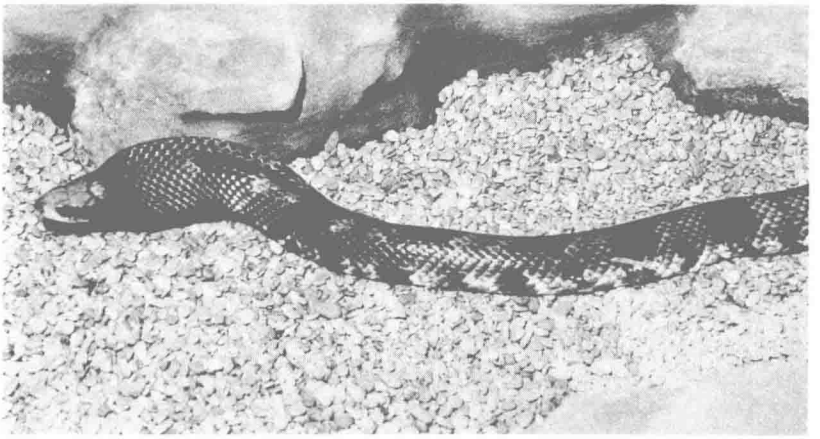

FIG. 1 The false water cobra, *Cyclagras gigas*, a colubrid snake of the New World which resembles some of the Old World elapids in appearance. Note the prominent hood.

movement. This does not involve even partially closing the eye. The covering of the eye is a watch-glass affair called the brille, which in fact is part of the skin and is shed periodically each time the snake moults. Many snakes, notably the burrowing types, are virtually blind while others have fairly good vision and can spot irregularities on the horizon for some distance. However, sight can be regarded as a secondary sense, particularly when considering the fact that during the post-moulting period the eye covering is opaque, rendering the snake blind for several days.

Other senses include a susceptibility to temperature changes which must be paramount for a creature that is dependent on the immediate surrounding temperature.

Heat detection is perfected by one group of venomous snakes known as the pit vipers. The term, pit viper, refers to an organ, the 'loreal pit', which is situated just below the eye and is used for locating warm-blooded prey.

It is true to summarise by stating that snakes are poorly equipped for perceiving distant stimuli but much better adapted for close contact conditions.

Feeding

The majority of snakes do not feed every day but usually about once each week. Snakes cannot chew or tear their food and so they are

obliged to swallow food whole. The jaws, however, are not rigidly hinged and are capable of expanding to allow prey of a larger girth than the snake to be swallowed. Swallowing is effected by literally 'walking' the jaws over the prey. This is seen to full effect with the vipers, which use the large fangs alternately to pull the food into the throat. The skin of a snake exhibits great elasticity and can accommodate seemingly impossible large prey.

Locomotion

It is at once obvious that the lack of limbs is no handicap to a snake's life style. Although the movements are extremely graceful it is this ease of motion, without the apparent aid of limbs, that repels many people.

Snakes have adopted several modes of locomotion, the most common of which is what is termed as 'lateral undulatory'. This means simply that the snake progresses with a side-to-side movement. There is no magic in the way a snake moves; a snake is supersensitive to its bodily contact with the ground and takes advantage of every irregularity on the surface. Place a snake on a polished surface, such as glass, and it is virtually helpless.

Other legless animals such as eels and some species of lizard move by actually wriggling, but the movement of a snake is a pure muscular action co-ordinated through the vertebrae as the snake progresses.

When in a restricted space, such as a burrow, snakes adopt a concertina movement. Large heavy snakes such as the large rattlesnakes and puff adders usually use this concertina movement in normal conditions, but can employ a lateral undulatory movement when in a hurry.

Desert species employ what is known as 'sidewinding', and one species, the small desert-living rattlesnake, *Crotalus cerastes*, is called the sidewinder. However, other small desert-living vipers employ this mode of locomotion in various parts of the world. This mode of locomotion is very effective over loose sand and is effected by lifting the body, leaving only two points of the body in contact with ground at either end. The snake then moves in a sideways fashion with astonishing speed and appears to move in a series of little jumps.

Skin shedding

The renewal of the outer layer of skin in vertebrates is obligatory; in man, for example, it is a continuous process which goes almost un-

noticed. Snakes shed the skin in one piece and adults may shed two or three times each year. Immature snakes, which grow rapidly, shed the skin much more often.

Several weeks prior to shedding a snake becomes dull in colour and the eyes become cloudy until just a few days before the moult, when the eyes clear and the snake resumes almost normal coloration.

The snake then rubs the jaws against a stone, branch or some other rough object, until the skin becomes loosened. When the head becomes free of the old skin the snake literally crawls slowly out of its skin, turning it inside out as we would a sock. The skin when shed is quite fragile but retains a faithful image of the pattern of its old owner.

Periods of inactivity

The term hibernation has been deliberately avoided as it is often misleading and is better applied to mammals. Snakes that occur throughout the temperate zones of the world are obliged to spend the winter months in a state of torpor. Similarly, snakes that occur in the warmer regions are inactive for varying amounts of time during periods of excessive heat. In either case a critical factor is exhibited at each end of the temperature scale. This aspect is dealt with later when considering individual species and at this point it is sufficient to state that climate is the one major influence which determines a snake's annual cycle.

These then are the basic functions which govern the lives of snakes, be they venomous or otherwise. In addition many of the diverse species have particular requirements with regard to habitat and food while others show remarkable degrees of adaptability, even to the point of sharing our houses.

2
Classification and Distribution

The first snakes probably appeared on this earth during the Cretaceous period, some seventy to eighty million years ago. Fossil records of snakes are virtually non-existent, and the main clues to their origins are to be found by the examination of the reptile forms that exist today.

Several hypotheses exist which offer differing views as to the origins of snakes. One popular theory is that the early snakes were fossorial, or burrowing forms.

Examples of burrowing snakes exist today—the blind snakes (Typhlopidae) are typical burrowers, as are the shield tails (Uropeltidae). The primitive characteristics of contemporary burrowing snakes vary in degree; for example, some groups possess important characters of skull and lung structure, and this is an indication that these groups have evolved a stage further. However, while it is true that these fossorial snakes exhibit various stages of evolution, they differ very little in their actual habits. Some may burrow deeper than others, some may almost be considered as surface dwellers. There exists also some variation in size, but the bodily form of all these species suggests a snake that is adapted to a subterranean way of life. The most obvious external characteristics found in burrowing forms are the reduced eyes and the reduction, or absence, of the ventral plates (gastroteges).

If all snakes possess a common burrowing ancestor, then it follows that many adaptations have been achieved, both in bodily form, and in the way that snakes have colonised the various habitats. This is made

apparent by the diversity of forms that exist today. The evolution of the eye is a notable example of just one of these achievements.

As the Viperinae can be regarded as a more advanced, or recent, group, the removal of the mole vipers, *Atractaspis*, a burrowing form, from this sub-family to the colubrid sub-family Aparallactinae has certainly given support to the theory of a common burrowing ancestor. It is now true to say that no exclusively burrowing form of viper exists today, though at least two genera, *Azemiops* and *Causus*, possess other primitive characteristics.

The reptiles probably started branching out into their respective diverse groups as early as the Upper Carboniferous period, that is to say, the stem reptiles were beginning to form into different lines, and it is likely that one group of stem reptiles (Captorhinomorpha) was the common ancestor to all contemporary reptiles.

The present-day order, the Squamata, embraces both the lizards and snakes. Both are closely allied to one another, possessing many similar characteristics. This appears most superficially obvious in the legless lizards such as *Anguis* and *Ophisaurus*, and other lizards where the body is elongate and the limbs degenerate, e.g. *Lerista*. However, the monitor lizards, *Varanus spp.*, and the tegus, *Tupinambis*, possess a forked tongue and not a notched tongue as is found in other lizard species. In addition, those who are familiar with these reptiles will know that they are very serpent-like in their manner.

We know that snakes evolved from lizards, and it has been mentioned that the first snakes were probably burrowing forms. Some authorities have suggested that the common ancestor of the snakes was a lizard type with a surviving form that exists as a single species which is referred to as the earless monitor, *Lanthanotus borneensis*, which occurs in Borneo. It is interesting to note that the earless monitor is a burrowing form, measuring about 360 mm. But more interesting still is the fact that this lizard utilises the head only when digging, although it has well-developed limbs. Obviously, if it is accepted that *Lanthanotus* is related, this also gives support to the theory of a common burrowing snake ancestor. However, it is still largely a matter of conjecture and mystery, especially if other aspects such as parallel evolution and adaptive radiation are considered. This is best exemplified by the knowledge that burrowing colubrids exist, which means that these snakes at some stage have reverted to a burrowing existence.

Although some explanations of snake evolution have been

mentioned, it is equally likely that the ancestral stock of snakes has no living representative.

Snakes have evolved into efficient predators that have successfully colonised the varied habitat forms found in most parts of the world with the exception of the polar regions and the depths of the seas and lakes. Poisonous snakes probably represent the more advanced forms, but it does not follow that they are the more successful or efficient of the world's snake species. The lightning strike of a rattlesnake, for example, is quite spectacular, but many non-poisonous snakes obtain their food with an equal lack of effort. This applies when it is not necessary to subdue large and active prey which otherwise may present some danger to the predator. For example, some snakes of the genus *Natrix* prey on fish, and burrowing forms such as *Typhlops* prey exclusively on invertebrates.

Snakes that constrict comparatively large and active prey are always at risk from bites, or injury, received from prey species during the early stages of constriction. To subdue prey efficiently a constricting snake must first seize the prey in the right place. Even large constrictors such as pythons are often injured because the head of the prey is left free to bite the aggressor.

The rear-fanged snakes are somewhat variable in the use of their venom, and the front-fanged snakes have an obvious advantage in that they can deliver a quick lethal bite then retreat. This also means that in many cases front-fanged snakes are able to prey on larger animals and therefore feed less often than, say, a colubrid snake of similar size.

Before listing the groups of poisonous snakes that exist today it is necessary to state that, in presenting a classification, I have not allied it to any one particular authority, but have derived a system from a 'melting pot' which represents a mixture of opinion that exists within present-day literature.

Obviously, the system of Romer, and the work of Garth Underwood and others, have played an important part in the research for this section of the book. However, it has been impossible to ignore the work of H. Cogger on Australian snakes, and for this reason the reader may be surprised to find certain genera of Australian elapids absent, and perhaps even more surprised to find new genera! Another consequence of Cogger's work is that many of the species of Papua New Guinea will now need revising, especially when considering such genera as *Demansia.*

The classification of contemporary snakes is constantly under revision, and this must be applauded as there are groups and species of snakes that are in urgent need of reassessment. Amateur herpetologists often accuse the taxonomists of being over-zealous in their efforts to juggle the world's herpetofauna. However, to be fair, much of the present-day classification of reptiles is unsatisfactory, and current taxonomic work will eventually rectify and probably simplify matters to the satisfaction of all concerned.

One group that is currently undergoing revision is the important sub-family Viperinae. Three prominent European species which belong to this sub-family—the adder, *Vipera berus*, the asp viper, *V. aspis*, and the long-nosed viper, *V. ammodytes*—have for a long while all been allocated sub-species. However, the wide variety that exists between individuals of the same species would appear to render the designation of sub-species in some instances somewhat artificial.

The concept of sub-species is essentially geographical, and when considering mainland sub-species their validity is often contradicted by the fact that sometimes large areas of overlapping range exist which may have resulted in intergrade forms, and this can cause some confusion. However, many specialists insist that intergradation is an accepted part of the concept of sub-specific rank.

Island races, and mainland sub-species that have well-defined and perhaps localised boundaries of distribution, do not suffer from the problems of intergradation. In some cases specific rank has been given to island forms; for example, the rattlesnakes, *Crotalus tortugensis* and *C. exsul*, are both island forms that have been designated specific rank, although the criteria for determining this has more to do with the divergence from their nearest mainland counterparts. In this particular instance the degree of divergence is quite small, and Klauber, in his treatise of the rattlesnakes, has stated that *C. exsul* is perhaps a borderline case and might be referred to as a sub-species of *C. ruber*. It is obvious that opinions vary regarding the designation of sub-species, and apart from the divergence from specific forms, it seems that there are differing views regarding the aspect of intergradation.

If we gloss over these arguments, and even accept the validity of possible intergradation, then obviously many current sub-specific forms must be considered as valid, although the judgement is subjective unless a breeding barrier is demonstrated.

Although I have not included sub-species in the list of species and

their distribution, many readers would expect to find reference to sub-species, and for this reason I have included reference to sub-specific forms throughout the remainder of the text. The nine sub-species of *Naja naja* are obvious examples, and these all represent regional variation throughout the range for the species. The rattlesnakes have already been mentioned, and these are prolific in sub-species.

There are also examples where genera have been removed entirely from a family. This usually occurs when snakes are thought to have been wrongly placed in the first instance, but certain aspects of their characteristics have allied them to a particular family. A recent example, which has already been mentioned, is the mole viper, *Atractaspis*, a burrowing genus, which bears little resemblance to the typical vipers, but possesses greatly enlarged folding fangs. Recent work on the cranial mechanics of this genus has revealed that the fangs, although canaliculated, have a somewhat different structure from those of the true vipers, e.g. puff adder, carpet viper, etc.

The genus *Atractaspis* is now thought to be closely allied to the Aparallactinae, all of which are colubrid burrowing forms with well-developed venom apparatus and enlarged rear fangs, and occur throughout most of Africa and just reach the Middle East.

Fea's viper, *Azemiops fea*, a somewhat rare snake from upper Burma and southern China, bears some resemblance to a colubrid snake. However, this species, the only member of the genus, is still considered to be a true viper, but is now contained in a separated sub-family, the Azemiopinae. Fea's viper and the Malayan pit viper, *Agkistrodon rhodostoma*, are the only members of the Viperidae which possess smooth scales. At least one authority has claimed that the Malayan pit viper is placed in the genus *Agkistrodon* somewhat artificially. Apart from the smooth scales, the claim was supported by evidence of significant differences in skull structure, and in fact, if this criterion is followed, then all the Old World representatives of this genus could be subject to revision.

The other group of Old World pit vipers, *Trimeresurus*, have been extended by some authorities to include in the past the New World genus, *Bothrops*. This merger represents a total of about eighty species, and many herpetologists would prefer to have the New World and Old World forms separated as before, if only just for convenience!

In fact, it must be true to say that convenience plays a large part when considering the classification of the many and varied reptile