REPTILE LIFE

Reptiles are much maligned creatures, partly perhaps because they are proverbially associated with evil and treachery, and partly because many species are dangerous to man, Snakes, for example, are regarded by many with an aversion which amounts almost to loathing, as also are crocodiles and alligators.

But besides the mighty constrictors, the deadly venomous snakes and the crocodiles, the reptiles include tortoises, turtles, lizards, and many harmless snakes.

Z. Vogel, the distinguished herpetologist, drawing on a wealth of personal experience in handling and breeding reptiles, not only corrects many common misconceptions and shows how exaggerated is the popular aversion to reptiles, but reveals the variety, fascination and unsuspected beauty of the reptile world.

He ranges over the whole field of reptiles, and describes in detail their life in their own environment and in captivity: we learn of, among others, the great pythons, the deadly rattlesnakes, the changeling chameleons, the fantastic monitors and nimble geckos.

In addition he devotes a unique chapter to his first hand experiences of the effects of snakebite, and other chapters to the origin and evolution of reptiles and to their scientific classification.

The 145 photographs, which include 5 colour plates, were taken by the author himself and are outstanding for several reasons. The photographer is, of course, an expert on his subject, and through his familiarity in handling reptiles he is able to get intimate close-ups of even dangerous specimens. By reason of his access to rare species, he is able to present many which have rarely, if ever, been photographed before.

35 s.

REPTILE LIFE

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PREFACE

In 1947, at my home in Suchdol near Prague, I founded a herpetological station. I had two reasons for doing this. In the first place it was necessary to lay the foundations of an institute for conducting intensive research into the bionomics of amphibians and reptiles, which would later extend its activities to further branches of science connected with herpetology. In the second place, I had received requests from friends and colleagues abroad for help in making exchanges of amphibians and reptiles from different parts of the world for terraria and for scientific purposes. This meant that the animals which passed through the herpetological station must be cared for and acclimatized.

I therefore got in touch with other institutes, zoological gardens, breeders and hunters abroad and was thus able to obtain a considerable number of animals, both small and large, many of which were very rare and some of which had never, or only very seldom, been previously brought to Europe alive. I began in particular to import many species of reptiles from Central Asia and the Far East. In exchange, breeders abroad send exotic specimens from their own terraria.

In 1948 I embarked on the building of a special glass reptile house for breeding purposes and for scientific research work. The temperature can be regulated quite easily, there is the maximum possible light and air, and conditions for photography are very good. It is not, of course, equipped for visits by the general public, since it is not intended to, and cannot, serve the same purpose as the reptile house in a zoological garden. In the light of experience acquired over a period of twenty years of catching and breeding reptiles, I selected wood for the entire interior equipment of the reptile house. The cages in which the reptiles are kept are also of wood, with a pane of glass in the front and a metal mesh on the top and sides. This ensures proper circulation of the air. All the cages are opened by means of the whole of the front wall. On the left are very tall, roomy cages with metal water tanks for breeding snakes of the type of the boa constrictor and for crocodilians. On the right there are two rows of cages for the other reptiles.

A great many of the live specimens were brought back by myself and I have obtained a great many more from other parts of the world. This has enabled me to make a systematic elaboration of ecological and other biological findings obtained from a large number of animals under favourable breeding conditions. I can also compare my own experiences with the communications of foreign zoologists published in journals and books and thus avoid certain errors which might cause damage difficult to remedy, in view of the rarity of many of the animals.

On the other hand, the animals often have to be sent on to their final destination only a short time after being brought to the herpetological station, with the result that there is not enough time for serious research work. This is why, in the present book, I have described only a small part of the results of the observations made in the herpetological station, since

some of the findings will need to be supplemented, or perhaps revised, when further live material of the same species again becomes available.

At this juncture it must be said that there are many serious shortcomings in the field of herpetology, as regards its bionomics and even more the ecology and it is not always altogether easy to correct old, erroneous observations which appear time and time again in different publications. The work of modern research workers clearly demonstrates that in all branches of zoology nothing is so important as direct observation of living animals. Living animals provide far more complete biological material than those preserved in alcohol.

The chapters which follow the brief general information on the life of reptiles describe some of the most interesting specimens bred in the herpetological station in the first years following its foundation. Most of the photographs were taken with an ordinary camera, some of them with the aid of reflectors or by flashlight, when not taken in natural surroundings. The photographing of snakes—especially those which can move swiftly or are easily excited —is often an extremely difficult and even dangerous proceeding, particularly if the photographs are taken at close quarters. I nevertheless succeeded in taking a number of photographs of reptiles from the remotest parts of Central Asia, which may well be the first pictures of these animals ever to have been shown.

"Reptile Life" has now been published in three languages. I hope it will make many new friends for these animals, which are only too often unfairly condemned.

A WORLD OF MYSTERIOUS CREATURES

Reptiles are among the strangest—and often the most feared—of all the animals. Their name is derived from the Latin *repere,* to crawl. In most reptiles the upper surface of the body is covered with scales or horny formations. Tortoises have strong dorsal and abdominal shells, while crocodilians are covered with strong armour-plating.

Reptiles are divided into four orders—the Tuatara *(Rhynchocephalia),* tortoises *(Testudines),* crocodilians *(Crocodylia)* and scaly reptiles *(Squamata).* The last of these comprises the following subdivisions: lizards *(Sauria)* and snakes *(Serpentes).* The first of these orders is also the most ancient and contains only one genus and species—the strange lizard known as the Sphenodon (or *Tuatara),* which closely resembles the Permian fossil reptiles and has a third, median eye on the crown of the head, with which it may possibly still be able to see. Then come the crocodilians, 21 species of which are to be found in the various tropical regions of the world, followed by tortoises, lizards and snakes, which together number some 5,800 species. In Europe the further south one moves, the greater grows the number of reptiles. They are found most profusely in tropical regions.

Reptiles have no body temperature of their own. Mammals and birds automatically develop considerable temperatures in their own bodies, i. e. they are warm-blooded, whereas reptiles, with the exception of rare and always temporary cases, are incapable of producing heat independently, i. e. they are poikilothermic animals, with a variable body temperature. This means that reptiles can develop their vital capacities to the full only under optimum conditions. The lowest limit of temperature suitable is about 15°C, the highest about 40°C. The average optimum temperature range is from 20—35°C, according to the species.

In the temperate zones, when the nights begin to grow chilly, reptiles begin to hibernate and do not emerge from their winter sleep until the spring. Even in the summer, if there is a long spell of inclement weather, reptiles may cease taking food and their activity diminishes because their circulation is slowed down. In hot regions, many reptiles become dormant during the dry season.

What do reptiles feed on and how do they take their food?

Most reptiles only catch prey which they are able to swallow at once. The size of the prey is naturally relative to the size of the reptile and to its ability to swallow a given volume. Some snakes and some lizards are capable of swallowing relatively large objects. The extent to which they can open their jaws is nevertheless limited and it is doubtful whether even the biggest python could swallow a horse, although there are records of them swallowing a 4′ 2″ leopard, a 14-year-old boy and similar sized objects. The Common Viper may attain a length of over 30 inches but has the greatest difficulty in swallowing a mammal the size of a mole or a young bird.

Water snakes feed only on fish, frogs and newts; young vipers feed on lizards and later mainly on voles. In Czechoslovakia the Smooth Snake is still to be found. This slightly resembles the viper and is equally inclined to bite, but is quite harmless. This small snake lives on lizards, slow-worms and the young of other snakes. The Aesculapian Snake is found in S. E. Czechoslovakia; this attains a length of six feet. It hunts mice and small birds and its young catch lizards.

In the terraria of zoological gardens we mostly find only exotic snakes, which require expert attention. These include the giant serpents, which sometimes grow to 20 feet and

more, and various snakes of the Colubrine and Viperine types. These snakes feed chiefly on warm-blooded vertebrates. Large specimens swallow white rats, rabbits, hens and even sheep and goats.

The lizards found in Czechoslovakia feed on insects, particularly various larvae, locusts, crickets, earwigs and spiders. Small slow-worms, which are actually lizards without legs, prefer a diet of earthworms and slugs. Many of the larger lizards occasionally eat small vertebrates and may actually turn cannibal, to the peril of their own offspring. The big lizards are confirmed beasts of prey. Some lizards, however, are omnivorous and also like vegetable food. Many tortoises are herbivorous. Some turtles are carnivorous and some of the larger species are even dangerous to man. Crocodiles prey on everything within their reach and are capable of biting off part of the body of a large animal.

I have often been asked to what size various reptiles can grow. This is not an easy question to answer as the material is very extensive.

The charming little Viviparous Lizard grows to barely six inches, including its tail, but in southern regions there are lizards only half that size. The Green Lizard can grow to over 16 inches, the S. European lizard to over three feet, the Central American lizard the Teju to four feet, the Iguana to over six feet, some species of monitors to seven to ten feet and the giant "Komodo Dragon" from the island of Komodo and the surrounding area to over ten feet.

Among the tortoises some species are quite tiny, while some of the giant tortoises or turtles may weigh several hundredweight. Apart from a few small species which reach a length of six or seven feet, the crocodiles include some species which grow to a tremendous size and weight. The Mississippi Alligator and Black Caiman grow to over 13 feet, the Nile Crocodile to 20 feet and the Estuarine Crocodile to 33 feet. A seven-foot crocodile is a big enough monster, but what about a colossus like the full-grown Estuarine Crocodile! It recalls the giant reptiles which lived on the Earth countless ages ago, whose mighty skeletons we gaze at in wonder today in the museums. The crocodiles are living relics of those bygone ages.

Among the snakes, too, there are giants and dwarfs. There are species which do not grow to even ten inches, while others grow to 30 feet and over. Considerable differences in size may be seen within a single family. For example, the Giant Anaconda grows to a length of 30 feet, with corresponding circumference and weight, whereas some sand boas of the genera Eryx and Lichanura attain barely 20 inches.

In summing up it may be said, therefore, that the largest lizards in existence are the *Varanidae,* headed by the giant Komodo Dragon, which grows to as much as ten feet and may weigh from 1½—2 cwt. The biggest member of the tortoise family is the Leathery Turtle *(Dermochelys)*, which lives in the sea and whose flat, leathery carapace measures some seven feet in diameter from the front to the rear edge. Next to this comes the Giant Tortoise from the Galapagos Islands and others. At least five species of crocodiles grow to over 16 or 17 feet, such as the Estuarine Crocodile, which used to account for the lives of many human beings. Among the snakes, the Reticulated Python attains a length of 33 feet, but seven other species also attain considerable length and weight. Even some of the venomous snakes are veritable giants. The King Cobra of S. E. Asia may grow to 16 feet, the S. American Bushmaster, or Mute Rattler, to 11 feet and the N. American Western Diamond Rattlesnake to almost ten feet.

All reptiles are of very ancient origin. They reached their heyday in the Mesozoic era, particularly in the jurassic and cretaceous periods. Many impressive groups perished at the end of the cretaceous period and made way for more adaptable animals which were better equipped for the struggle for existence on the Earth in the cainozoic period. Many reptiles of today have a salamander-like body akin to that of their ancient ancestors. In spite of the shape of their body, however, reptiles are more closely related to birds then to amphibians in their skeleton. This is only logical, since birds developed directly from reptiles. The oldest fossil-

bird, the Archaeopteryx, had a lizard's tail, even though it may have sported a pair of feathers to each vertebrata and had jaws with well-defined sharp teeth.

Reptiles live to various ages. Small lizards live five years and more, while the big reptiles, such as the giant serpents, crocodiles, monitors and tortoises, live to a comparatively much greater age. Perhaps this is due to the fact that the big reptiles are neither physically nor mentally very active. They will lie in a suitable spot for hours, or even days, sunning themselves, lurking for prey or digesting a tasty morsel. Only three factors are capable of evoking swift (sometimes lightning) movement in these creatures. These are the mating instinct, defence against an enemy and an attack on prey.

When one sees an enormous, brightly patterned snake coiled motionless round the branch of a tree in the zoological gardens, it is hard to believe that at a given moment, this same snake is capable of considerable speed and strength. It will catch a rabbit, however, and at the same time coil itself round it so rapidly that the eye can scarcely follow its movements.

A crocodilian or a lizard is equally adroit at catching its food and even a tiny lizard will hurl itself at a fly or an earwig with a violence that betrays its rapacity. Many turtles also attain considerable speed when catching fish.

Reptiles do not usually take food every day. Only the small species hunt frequently, because owing to their greater activity the food is metabolized more quickly. Somewhat larger lizards are usually fed twice a week, some only once a week. Snakes are fed still less frequently, the large species being fed only once every few weeks. All reptiles can go without food for long periods, probably the longest of all the vertebrates.

The visitors who come to our garden think that the apparent lifelessness of our reptiles is due to their being confined in too small a space. That is not, however, the case. I have often tried to keep lizards or snakes in more spacious quarters, or—in summer—in the open but in these surroundings the reptiles became completely savage and it was difficult and even dangerous to tend them. At the same time they usually lay for whole days on a favourite branch, just as in the small terrarium.

From my own experience I can confirm that the management of large, rapacious reptiles in the hot season or in a glass-house is always associated with considerable risk. Even when they are not actually poisonous their claws or teeth can cause severe, suppurating wounds which heal only with difficulty. Crocodilians and some lizards can also administer exceptionally strong, well-aimed blows with their tail and in this way, according to their size, can maim or kill a man.

The rapidity of the attack of an infuriated reptile at short range is perhaps even greater than that of the feline beasts of prey. It must also be borne in mind that the small brain of a reptile is incapable of distinguishing between its keeper and strangers, and some reptiles, in particular the big snakes, are always ready to attack at the slightest provocation. Fortunately, however, such attacks only rarely have really serious consequences.

As soon as the giant serpents reach a length of 14 feet and weigh from 40—60 lb., their viciousness and blind aggressiveness usually increase. They then not only attempt to bite a supposed enemy, but also try to coil their muscular body round him. In such an event, a smaller snake can be caught by the tail and unwound again, but a healthy 20—30-foot snake is so strong that several men are unable to restrain it.

Great care is also required in dealing with crocodilians. The mildest tempered are usually the alligators, which are also the least agile. The fiercest biters are the caimans, especially the Black Caiman and the Broad-nosed Caiman, which display this propensity while still very young. They are not so agile on dry land as in the water, but they are still quick enough to face an enemy in any position, with wide open jaws bristling with a pallisade of close-packed teeth. In the water the crocodilian is particularly dangerous because of its ability to snap at prey from the side. On the other hand, it is a known fact that crocodilians may become so tame in the course of frequent contact with their keeper to the extent that they do not bite and allow themselves to be handled. Young crocodilians, espe-

cially caimans, are captivating little creatures, apart from their inborn inclination to bite. When excited they growl or utter a coughing bark.

With few exceptions, tortoises are slow, harmless creatures, which defend themselves against an enemy passively, by withdrawing their head and limbs beneath their carapace. Children can play even with the biggest giant tortoises without the slightest danger. The larger species of turtles, however, bite and, because they have beak-like jaws as sharp as knives, they can cause serious injury. Monitors, iguanas and other lizards also have extremely strong jaws.

The most notorious reptiles are, of course, the venomous snakes. There are numerous stories about the tropics in which these most dreaded creatures in the world figure. Snakes have caused the death of countless thousands of people and a single scratch from their poison fangs is a source of terror and suffering. There are not, however, many species of truly dangerous venomous snakes and tropical and subtropical countries are not exactly overrun with them. In the course of my travels I have hunted for snakes in places where there were reported to be large numbers of them and often had great difficulty in finding any at all. In Africa, for example, there are few places where a large number of venomous snakes are to be found over a small area. Some regions of N. and S. America and Australia possibly form an exception.

The dangerous venomous snakes, of which there are only about 200 species out of a total of 2,500 species of snakes altogether, belong to the Elapine and Viperine snakes. Both these groups differ basically in the way in which their poison acts on the organism, although the ultimate result is much the same. The Elapine snakes, such as the Cobras, Kraits, Mambas or the Australian Death Adder, produce a poison in which neurotoxins predominate. These act on the peripheral and central nervous system. The Viperine snakes, which include the Rattlesnakes, produce a poison in which the chief component is usually a haemotoxin, which destroys the blood cells and thus prevents the transport of oxygen from the lungs. In some of the rattlesnakes, neurotoxin and haemotoxin act simultaneously and in equal measure.

The wound caused by the bite of an Elapine snake does not usually swell at all, whereas following the bite of a Viperine snake, considerable swelling and haematomata occur. In either case, however, the victim is very ill. The temperature of the environment and the state of health of the snake and its victim at the crucial moment are also of decisive importance, as well as the species of snake. Some people can resist the action of organic poisons better than others. A victim suffering from a disease which saps the body of its natural resistance is in particularly great danger from the bite of a venomous snake.

Some of the big venomous snakes, the cobras, are able to discharge their venom, mixed with saliva, to a distance of seven to ten feet. If the skin is whole, the venom does not usually have any effect[1]), but if it gets into the eye or even the most minute crack, it can produce all the signs of severe poisoning.

Most snakes belong to the harmless species. That does not mean to say, however, that they have no poison glands. In many of the venomous Colubrine snakes, however, the poison fangs are situated at the back of the upper jaw, so that when they bite they use only their non-canniculated front teeth, from which the venom is unable to run out. Other Colubrine snakes have small poison glands containing potent venom, but they neither have canniculated fangs nor any other way of egress for the poison into the mouth, so that they are absolutely harmless. There are few species of Colubrine snakes which have not at least some trace of poison glands.

The mechanism of snake-bite is very interesting. The least perfectly developed apparatus is found in those Colubrid snakes in which the canniculated fangs are placed at the back; in those in which the fangs are at the front the apparatus is more perfectly developed, while it is most highly perfected in the snakes of the Viper family.

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[1]) The venom of the cobra Naia nigrocollis and others sometimes produces a tremor merely on coming into contact with the skin.

How does the viper use its deadly weapon?

When a mouse is let loose in the terrarium, if the snake is hungry it will at once show an interest in the tasty morsel. The mouse remains crouched down for a while but soon begins to look cautiously about the cage. The snake raises its head and draws in its neck and the front part of its body in the form of an S, so as to allow sufficient purchase for the attack. When the mouse comes within a range of about four inches, the viper suddenly darts out its head; it rarely misses, but usually bites once more. The mouse springs away, with convulsive jerks, struggles for breath and is soon dead. Then, using its sensitive tongue, the snake feels for the head of its prey and begins to swallow it.

An attack by a viper on a mouse is amazingly swift. The whole process takes only about one-tenth of a second, rarely longer. The most interesting feature is that this single, swift action involves a whole series of independent and interdependent movements. The viper first darts out its head to the required distance, opening its mouth, then rears its poison fangs, which until that instant had been folded back, erect, drives them into its prey, at the same time injecting a little venom through the longitudinal canal in both fangs, again withdraws its fangs from the victim's body and draws back its head into the original position of attack. All this is accomplished in the fraction of a second.

Venomous Elapine snakes, when attacking, act in much the same way. Their poison fangs, however, are much shorter and are always erect even when the mouth is closed.

It would appear that snakes of one species (and sometimes of one genus) cannot harm one another. It often happens that vipers or cobras fight over their prey and that one bites the other out of spite, without any dire results. There may, of course, be serious injury from the long poison fangs. When a cobra, however, bites a viper, for example, the situation is quite different and the viper soon dies. Many species of snakes which occasionally devour other snakes have particularly potent venom which takes rapid effect on other types of reptiles.

Illustrated magazines sometimes print tragicomic photographs of two snakes, with the larger one in the process of swallowing the smaller. Such occurrences are actually not altogether rare in zoological gardens, although the pictures in the magazines are often faked. Harmless Colubrid snakes which have lived together for a long time in the same terrarium suddenly quarrel over a frog, which the one has seized by the head and the other by the back leg. A tug-of-war ensues, accompanied by frantic swallowing and whichever of the two snakes is the quicker, gets its jaws over the head of the other and swallows it together with the frog. Of course, as I already explained, there are some species of snakes which make a regular practice of preying on other snakes. This is sometimes the case, for example, with the Smooth Snake *(Coronella austriaca austriaca)*. The classic example, however, is the Black Mussurana *(Pseudoboa cloelia)*, a large Colubrid snake found in Central and S. America. Wherever it is to be found the Mussurana is known and protected, because it does not hesitate to attack and eat the dangerous pit vipers of the genus *Bothrops,* one species of which is known as the Jararaca, or Fer-de-lance. With a lightning movement it seizes the venomous snake by the head, coils itself firmly round it to its full length and at the spot where it has bitten the other, it pushes its jaw further over until it can drive its rear fangs into its prey. In a quarter of an hour the Jararaca is usually helpless and the Mussurana unreels it into its capacious stomach.

A great deal has been said about the fascination exercised by some reptiles, which are supposed to be able to hypnotize their prey and make it surrender without a struggle. This is said in particular about crocodiles and snakes.

It is true that many crocodilians and snakes seem to fix one with a somewhat glittering eye which some people find unpleasant, but the gaze of a venomous snake most decidedly does not hypnotize the object of its attack. People who are frightened of vipers run away when they see one and are certainly not frozen to the spot by its glance. In the same way, a mouse or other animal which is approached by a snake is often able to save its skin at the last moment by a quick jump. The fact that the prey does not pay sufficient attention to the snake's

approach is due to the snake's peculiar and unusual appearance, the strange rustling noise it makes as it glides along and to the fact that it is difficult to distinguish a snake from a moving branch, especially if the victim is not very sharp-sighted. Animals, such as monkeys, the big cats, and some birds which occasionally hunt snakes are well acquainted with them and either run away from them or render them harmless.

It is interesting to note that when toads are in danger they raise their bodies and puff themselves up, at the same time uttering a kind of croaking groan. This is passive defence, as these creatures are too slow to be able to attack. They puff themselves up not only when they see a snake, but also a lizard, shrew-mouse, mouse or bird and when touched. When frogs see a snake, they immediately take to their heels, just as they do in the face of any other danger. Because their sight is poor, however, they can only distinguish a snake when it is quite near and then it is often too late.

Crocodiles are carnivorous and their diet consists of fish, birds and mammals. They usually snap at water birds from deep water and at mammals when they come to drink. Any animal which sees, hears or smells a crocodile immediately makes off and does not dream of letting itself be held by any "fascinating" gaze. How pleasant life would be for snakes and crocodilians if they were able to catch their prey just by looking at it! In actual fact they often have to go short of food for many weeks at a time and are able to fast for long periods.

The idea of hypnotism may have arisen from the observation of large snakes in zoos or menageries, when rabbits or guinea-pigs are thrown to them. These animals, which have lived in captivity for hundreds of generations, are far less aware of imminent danger than their wild kin. They therefore often approach the big snake almost without fear and are immediately caught.

In other words, tales of the potency of a snake's gaze are nonsense.

Another piece of nonsense is the belief that reptiles can be hypnotized. This belief is so widespread that it is met with everywhere where dangerous reptiles are hunted, bred and exhibited. Fascinated Europeans have often watched snake-charmers in Africa or India, who for a little baksheesh carry cobras around with them and show them, as they indignantly rear their heads and spread their hoods, making a truly frightening picture. In actual fact, the snake's fangs have either been drawn or the fakir is extremely careful to see that nothing happens to himself.

Tales of hypnotized snakes and crocodilians, which were afterwards supposed to be unable to harm their "charmer", used to be spread by the owners of travelling circuses in order to rouse the awe of the spectators for the big snakes and also for those who handled them, since it is common knowledge that people enjoy a sensation of fear and are willing to pay to see "hypnotized" snakes helpless in the hands of their master, as he picks them up and pats them on the back. Of course, only alligators and the Indian Rock Python can usually be reckoned among the benevolent reptiles, with daily training. Any bold visitor could do the same with them as the charmer, without making any special effort of the will.

Here it would be useful to mention a few facts about the way reptiles see, hear and feel.

Let us begin with sight, since this is the most important of the senses in almost all reptiles, with the exception of strange, subterranean forms *(Typhlopidae, Leptotyphlopidae)*. Sight permits the reptile to observe its prey and to find a suitable hiding-place. Reptiles do not, however, see so well as human beings. Not even the most perfectly developed eye of some of the larger lizards is capable of much accomodation and cannot see movements further than a few score feet away. Tortoises and snakes in particular have even worse sight. Snakes cannot see even the most enticing prey in their immediate vicinity unless it moves, or if the snake does not touch it with its sensitive tongue. It may justifiably be assumed that crocodilians have the best sight, since their eye is the most perfectly formed. Immediately after them come the monitors. Small lizards of the family of the *Lacertidae,* which include most of those found in Czechoslovakia, also see very well, but only at close range. The geckos and many of the agamids have outstandingly good sight. Nevertheless, it is doubtful whether reptiles can dis-

tinguish all the colours and it would appear that the majority of species have very limited colour sense.

It is probable that not all the members of the order are endowed with hearing. A whole group of snakes and turtles probably does not hear at all. Snakes have a very primitive auditory apparatus, with no tympanic membrane or internal orifices. They do, however, notice loud noises or blows which cause vibrations in the ground.

Lizards and crocodilians are very responsive to a suspicious noise. Tortoises have a less marked reaction.

Opinion is divided as to the sense of smell in reptiles. As far as I can judge from my own experience, which has been gained not only from the observation of reptiles in terraria, but also in natural surroundings, reptiles do not detect odours by means of their nose. It is understood that the special sensory cells above the palate of many reptiles, known as *Jacobson's organ,* are able to detect odours via the tongue, as assumed by many authors, but it would appear that this organ is related to taste rather than to smell. A mouse which has been bitten by a snake springs away and sometimes dies at quite a distance from the spot where it was attacked. After waiting for a moment, the snake begins to look for its prey in approximately the direction in which it jumped. In this it is sometimes helped by the mouse's dying convulsions. As it searches, the snake continuously feels its way with its tongue and it actually looks as though it is trying to find its victim by smell. In actual fact, however, it does not find its prey until it touches it with its tongue and otherwise misses it even when only an inch or two away.

From this it may be seen that the snake's tongue is primarily an organ of touch and secondarily an auxiliary organ of taste, which transmits sensations of taste to the cells in the palate.

The reptiles include many weird species, conspicuous for their bizarre forms or bright colours. Among the crocodilians there are the G h a r i a l s, whose jaws form a long, thin beak, closely packed with teeth. Some of the carnivorous turtles have a soft, leathery carapace and an elongated nose shaped like a tube. Many of the lizards, such as the S. American *iguanas,* have a crest of tough spines on their head and back and various other fear-inspiring protuberances. Some of the a g a m i d s which inhabit the hot regions of Africa, Asia and Australia, are also equipped in a similar way. Other lizards, such as the Anguids, are without limbs, or have vestigial legs, and many are able to puff themselves up or to flatten themselves out. Some species of snakes are brilliantly coloured. Others are five feet long and only as thick as an ordinary pencil.

It is not surprising, therefore, that the keeping of reptiles in terraria has become so popular and in no way lags behind aquarium keeping. Eeven as early as in the second half of the last century, reptile keeping had spread not only throughout Europe but also to other parts of the world. Reptiles are handsome creatures, interesting to keep and many species will live for years in captivity, given the proper care. A number of interesting books have been written on the subject of keeping terraria.

Terrarium keeping differs from aquarium keeping on two main points. In the first place, reptiles cannot be bred and reproduce in the same way as fish and secondly, there is a difference between the reptiles which private enthusiasts can keep on their own premises and those which can be kept in zoological gardens and special institutes.

Reptiles not infrequently mate in captivity but in the case of those which lay eggs—and these are the majority—it is only very rarely that the young hatch out. The necessary microclimate and other conditions are usually lacking. Nevertheless, some species of reptiles reproduce well even in captivity, chiefly lizards and snakes. Pythons coil round their eggs and "sit" them out, but it is rare for more than half of the young ones to hatch out.

With the viviparous reptiles the situation is better. With proper care and food it is fairly easy to rear the young.

Large or dangerously venomous snakes, with the exception of vipers, are decidedly un-

suitable for small private terraria and it is also a pity to keep the more difficult species to rear, if the proper care is not available. They can only be given this in scientific institutes and zoological gardens with modern equipment. The best reptiles for keeping at home are various small lizards, small snakes and decorative tortoises. If sufficient care is taken, some smaller species of vipers can also be kept in a private terrarium, but the danger of their bite and the possibility of escape should always be borne in mind.

Some breeders have also reared young crocodilians or pythons and these interesting reptiles have given them much pleasure. With the proper care, however, these young reptiles grow to such proportions within only a few years that there is no alternative but to give them to the zoo, where they will have enough space and not cause any unpleasantness by their great strength.

Reptiles are not easily injured but they succumb easily if attacked by disease. Many reptiles suffer from various diseases which are not always easy to diagnose in time, since reptiles do not possess sufficient mimic ability to express their sufferings. Snakes are the most subject to infection. Their most dreaded disease is mouth rot, which is cured more easily in large snakes than in small ones. This malignant disease has destroyed many of the most valuable snakes in terraria. It is caused chiefly by *Pasteurella haemolytica.*

Reptiles are also good hosts for internal and external parasites, which sometimes make their life a misery. Their chief pests are small and large ticks and parasitic worms. For this reason there is often a great deal of trouble with reptiles in zoos.

People usually distrust reptiles, perhaps because it is not always easy to tell the difference between a harmless and a venomous snake and also no doubt because there are many strong and even big and dangerous animals among the reptiles. It is highly probable that if a lion or tiger were to escape from its cage, the onlookers would not be half so terrified as if a large python or rattlesnake escaped. Such an event is fortunately quite improbable, as every care is taken to prevent the reptiles from taking French leave from the terrarium.

It is an interesting thought that even the most dangerous of these animals is often separated from the visitors only by a thin sheet of glass and that everyone can inspect it in complete detail. There is no need to fear that an infuriated reptile might dash its head or tail against the glass and break it. After a few half-hearted attempts even the most obstinate cobra will stop its pointless attack on the cold, hard glass and the crocodilians and monitors also soon grow accustomed to the transparent, impassable barrier as soon as they realise that they cannot get at the onlookers through the glass—and *vice versa.*

It is therefore all the more surprising that the reptiles, which are in no way disturbed by the moving, gesticulating public, immediately show signs of excitement if the keeper or a scientific worker looks at them from the inner enclosure. After a certain time, the reptiles evidently recognise the way in.

One of the most important conditions for successful reptile breeding is a varied diet. We have found that it is better to feed captive reptiles on wild animals than on domestic animals, which are usually too fat. This further involves the continuous breeding of various small rodents, lizards and sparrows. Most snakes prefer live prey; many tortoises and crocodilians prefer dead prey or even pieces of meat. However, although they are predominantly carnivorous, aquatic turtles also relish eel grass and water plants, and tortoises are often vegetable eaters. Most lizards prefer living food and many will accept dead food also. Some reptiles are fond of birds' eggs. All this has to be constantly borne in mind, particularly where there is a large number of reptiles.

Anyone who has seen the terraria built in exhibitions and glasshouses in the past will no doubt be surprised on first entering the herpetological station, although it is the first indication of what the future large vivarium will look like. The animals' quarters look quite different from those used formerly, which were got up to "resemble natural conditions" and were transformed into a dense jungle which tickled the imagination of the public but did not suit the animals. In such damp, unventilated quarters the poor captive was doomed do death in ad-

vance. Today we try to keep every animal alive as long as possible and therefore provide it with comfortable, warm and well ventilated quarters with a regular supply of fresh water and with conditions which make inspection and handling easy. Gone are the unhygienic glass tanks, which were actually nothing more than aquaria without the water, with all their deficiencies, to be replaced by special cages built according to the latest experience.

Man's present-day outlook on nature, which is more sincere and free from old prejudices, can be seen in the better care taken of captive animals. Reptiles used to be imported almost entirely for exhibition purposes, to die after a short time. Today every effort is made to secure their longevity, since their lives are of interest not only to the general public, but also for the scientific knowledge which can be gained from them.

YOUNG CAIMANS

We often import and breed young crocodilians, especially caimans. These are S. American crocodilians, with a relatively short snout, with the exception of the Spectacle Caiman, which has a longer snout, pointed in the form of a wedge, inconspicuous colouring and large, prominent eyes. Young caimans are the most active and most fascinating members of the entire order, but they can only rarely be picked up by the bare hand, as they are incorrigible biters right from birth.

We have so far bred two species in particular: the Broad-nosed caiman *(Caiman latirostris)* and the Black Caiman *(Melanosuchus niger)*. Both species attain a considerable size in their natural environment. They inhabit the tropical regions of S. America, where large numbers of them are still to be found in some places, without constituting a particular danger.

They are nevertheless the most vicious crocodilians imaginable. Their short jaws contain smaller teeth than those of other members of this order, but they are remarkable for their belligerence and rapacity. As far as I can judge from observations made in captivity, I should say that the main food of caimans under natural conditions is not fish, as it is with the other crocodilians, but small mammals and birds. Our young caimans always prefer live mice, for which they crawl out of the water, and which they catch with a snap of their jaws and carry them back into the water, where they drown and devour them.

When swallowing their prey, all crocodiles stretch their neck above the water. After a few attempts, they finally manoeuvre their prey into the right position, with the head foremost and with rapid, jerky movements they convey it into their stomach. Sometimes they adroitly use their hind legs to help them, sometimes their fore legs. They also use their hind legs for scratching themselves and for cleaning their eyes and nasal orifices.

In addition to mice, both old and young caimans eat pieces of meat, fish, frogs, lizards and snakes, large insects (especially grasshoppers) and crabs. The food must be frequently varied. For newborn caimans, which are about eight inches long, weevil grubs, crickets and pieces of veal are sufficient; later, small fish and young mice must be added. When the caiman is about 16 inches long, it can swallow an adult white mouse, which satisfies its hunger for 2—4 days.

The main prerequisite condition for the successful breeding of these handsome reptiles is warmth. If they have not enough warmth they do not take food, remain without moving and finally sicken and die. As soon as the temperature falls below 25° C, therefore, we irradiate them with powerful electric lamps suspended 8—16 inches above the surface of the water. At night the temperature can fall to 15°C. It is important to note that in captivity young crocodilians do not like deep water and prefer water so shallow that they are unable to swim in it. For a single caiman measuring 8—20 inches, a tank measuring 40×16×16 inches is quite

sufficient, with two-thirds of the space taken up by water and the remaining third by "dry land". The best material for this is wood, which should be firmly fixed so as not to float and made to slope gently down into the water. Rough bark or rungs should be attached to this so that the animal can climb out.

After a short time algae begin to proliferate in the water and, influenced by the light, particularly the electric lamps, soon give the entire water a greenish colour. These algae are well-known to aquarium keepers, who from time to time have to clean the front wall of the tank to prevent it from becoming opaque. The algae also settle on the crocodilians' scales, and it was once the practice to change the water frequently and take all kinds of precautions for ridding the animals of them. It was soon seen, however, that the crocodiles in "neglected" tanks were much more lively and grew better than those in clean, model terraria.

One of our young caimans happened to die of sunstroke when it managed to escape from the terrarium into the glasshouse, and in its stomach, in addition to a freshly swallowed mouse, we also found a quantity of green algae which it had swallowed together with its prey about an hour previously. Algae contain vitamins and that is probably why the crocodilians in the "contaminated" water did better than the others. In their natural environment, crocodilians almost always live in water containing a large quantity of microflora, which are conveyed into the alimentary tract together with their food.

Young caimans grow comparatively quickly. A three-month-old animal measures 11—12 inches and with good care and suitable thermal conditions will grow 14 inches in one year and increase its weight eight times. As it grows older, the rate of growth slows down, but during the first five years it can grow to over five feet.

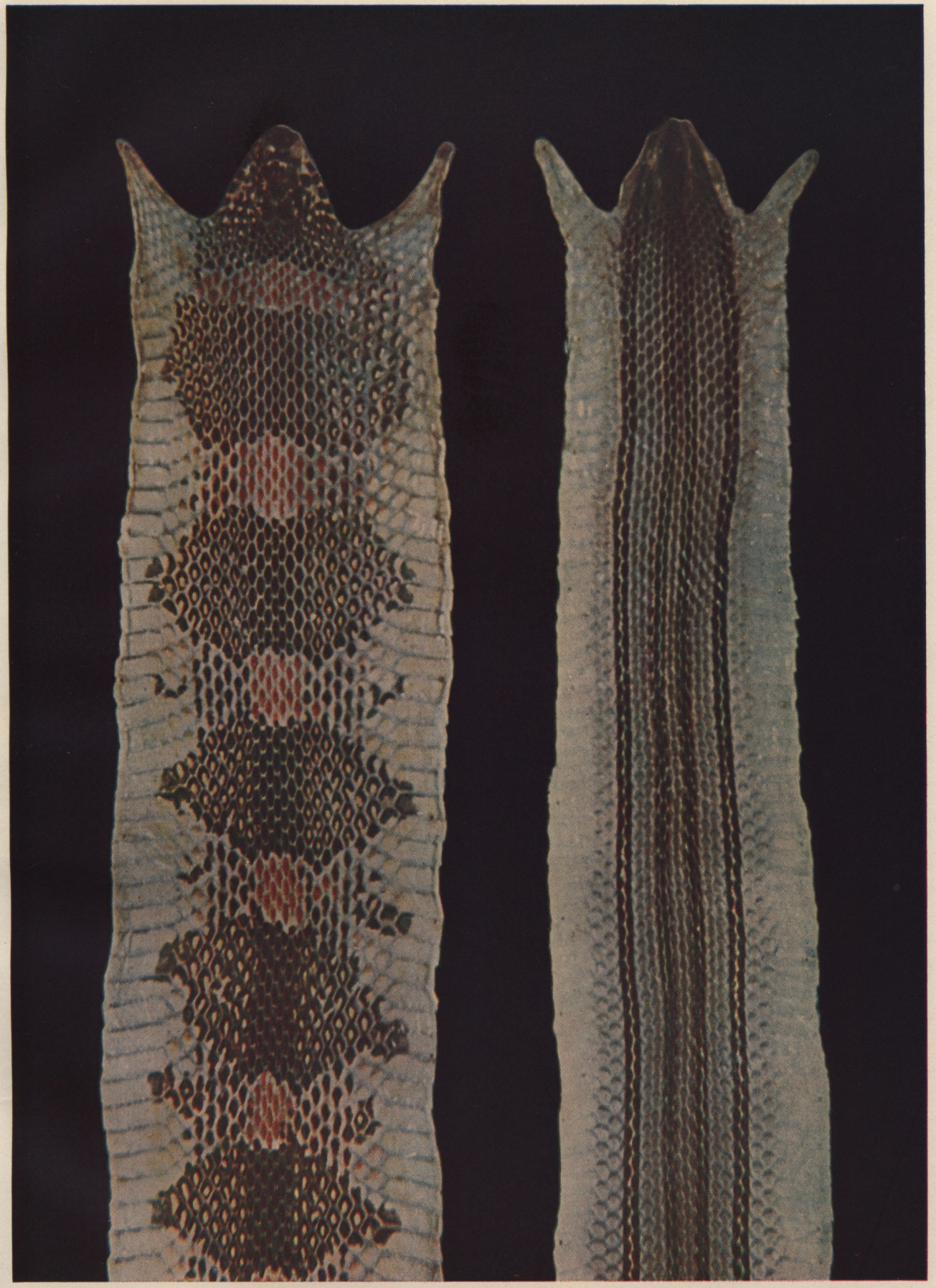
Adult Black Caimans caught in their natural environment may measure over 13 feet and the Broad-nosed Caiman over 12 feet. It should not be impossible for them to attain this length even in captivity, as they definitely do not need much exercise. We know that alligators *(Alligator mississippiensis)* in travelling menageries grow to over eight feet and may weigh three hundredweight. When one has a large, modern terrarium, one is able to keep several dozen large crocodilians and observe their further growth. In the meantime, apart from alligators, one has to be content with observing their young.

Adult Broad-nosed caimans have the same colouring as the young ones. Their abdomen is dull white, their sides light brown and their backs dark or olive brown. Along their sides and the side of the snout are round brown patches, which are continued on the tail. Adult Black Caimans are glossy black with a whitish or rich yellow abdomen. The young of this species have yellow cross-stripes on their back and tail. Otherwise, in form they do not differ greatly from the Broad-nosed Caiman.

It is more or less common knowledge that if a crocodilian remains for several days without water, the upper surface of the tongue and the pharynx become parched, so that however much it may want to, it is unable to swallow even the smallest morsel of food and is unable to convey food to the stomach again until it has had a thorough wetting. This interesting phenomenon is easy to explain. Crocodiles do not secrete saliva in the buccal cavity. This therefore makes it all the more remarkable that they can be transported for considerable distances without water. A fellow-countryman who had been to Paraguay once brought me a cigar-box in which two young caimans were cooped up. They had been packed into this box immediately after hatching and survived the two weeks' journey without any ill effects.

There is nothing more comical than when an infuriated young caiman begins to croak. Its croaking is not from fear, but from fury. It puffs itself up and jumps about and is always ready to turn its vocal menaces into actual bites. All the same, a croaking caiman is a very funny sight.

At other times, caimans—including older animals—will utter loud growls. This may either be due to annoyance or come at the moment when they succeed in catching a particularly juicy morsel, i. e. when they are content. Caimans make themselves heard more often and more loudly than any of the crocodilians. They react to every stimulus by growling,



I. From left: Anterior part of skin of Colubrid snakes *Rhinocheilus lecontei tessellatus and Conophis lineatus.* Enlarged by about 1/4.

croaking, snorting or snuffling, according to the type of stimulus. At mating time, or if they are injured, they roar like thunder. In view of their vocal equipment they announce their presence in no uncertain manner. Crocodilians undoubtedly belong to the few reptiles with a true laryngeal voice.

Caimans are the most agile of all the crocodilians. Their young especially are sufficiently nimble to make successful attempts to escape from a terrarium with insufficiently high walls or where there is tough plant growth up which the active little reptile can climb. On dry land also, caimans move easily and fairly rapidly, even though they are not so agile as lizards. They can also jump, and when alarmed, they dive into the water head first. If a young caiman is caught by the tail, it can twist and turn so adroitly that it is sometimes able to bite the hand which holds it. When seized by the head, however, the caiman is completely helpless, like all the other crocodilians. It scratches desperately with its hind legs, but the claws are too blunt and too weak to harm anyone.

As to the senses of armour-plated reptiles, I think it is important to reduce to their proper proportions unfounded reports on the behaviour of crocodilians which purport to be based on the acuteness of their senses, particularly the sense of smell.

I have often had the opportunity of observing crocodiles. Their abilities are very similar to those of caimans and alligators, since all the crocodilians form a characteristic and closely related group, although it contains types which differ in the form of the jaw and hence to some extent in their mode of life. It is often stated that crocodiles smell out their prey and that a piece of meat or a living animal will attract a crocodile by its odour. I tested this assertion by throwing a little dried blood into a tank in which crocodiles were swimming *(Crocodylus cataphractus)*, but none of them paid any attention to it. A large piece of washed meat, tied on a string and let down into the water, also went unnoticed for a long time, until it was found by chance the following day by a small crocodile. I also bound the eyes of young crocodiles and very carefully, so as to prevent any vibration, I placed pieces of washed meat on a stone so that they partially lay in the water, but the animals showed not the slightest interest, although they were hungry and when a piece was placed in their open jaws they swallowed it immediately. When the crocodiles were on the "shore", I poured a little paraffin into the water, but the animals went into the water as usual and did not show any signs of uneasiness until the paraffin began to burn their tongues. Unwashed meat, which tinged the water red, was immediately hunted out as soon as the water admixed with blood touched their tongues.

In view of this and many other experiences. it can hardly be claimed that crocodilians are guided by their sense of smell, quite apart from the fact that when under water, their nostrils are tightly closed. As far as their hearing is concerned, it would appear that crocodilians can hear only above the water. Immediately behind their eyes they have slit-like auditory orifices, which slant backwards and which they can close with a movable flap before submerging. The internal structure of the crocodilian ear does not differ substantially from that of a lizard or of a bird. The fact that crocodilians show a marked reaction to loud sounds (when not below the surface of the water) does not signify that they hear better than lizards but that, as the most intelligent of the reptiles, they pay greater attention to sounds.

The crocodilian has taste buds on its tongue and is possibly able to differentiate the taste of different kinds of meat, but most experiments in this direction fail because of the crocodilian's natural voracity. Even our own young caimans and alligators often blindly swallow an inedible substance, which afterwards causes them discomfort and which they may have to regurgitate, with great difficulty. It may therefore be assumed that the sense of taste plays only a small part in the selection of food.

The bright eye of the crocodilian, which sometimes seems to gaze glassily into space for long periods together, is actually taking a lively interest in all that is going on around it. In the daytime the pupil contracts to a narrow horizontal line, while at night-time it is dilated in the form of a circle, so that the whole eye is dark. The contractility of the pupil is evidence that the crocodilian is a beast of the night and, indeed, crocodilians are at their most active

when dusk falls. It would be an error, however, to think that these reptiles see badly by day. As the result of experiments which I conducted with caimans, I formed the conviction that they can distinguish several colours, that they can see large outlines quite sharply at 17—33 feet and that they can distinguish a marked movement at at least 100 feet. A crocodilian can also distinguish between objects which are not moving, so that its attention is not dependent only on a prey or enemy moving. We cannot therefore deceive a crocodilian simply by remaining still for a time; as soon as it has seen us clearly, it will never mistake us for a tree or some other innocent object.

All crocodilians commit their experiences to memory. They also use ruses to catch their prey and the fact that these ruses often require considerable patience and a certain self-control demonstrates that the crocodilian is able to link up some conceptions into a coherent sequence. How would it otherwise be possible for the crocodilian, on suddenly sighting water birds or drinking mammals, to turn, as it often does, its back on its prey, swim a little distance away, submerge and return, unobserved, underwater to the unwitting victims and then fall on them? I doubt whether a dog or feline beast of prey would turn its back on its prey for a single instant, even if it wanted to circle it. This is one of the many proofs that animal psychology cannot always be judged by the systematic classification used in natural science or according to the relative size of the animal's brain.

Caimans are comparatively easy to rear. They do not do well, however, unless they have sufficient peace and quiet. They dislike frequent disturbances, especially being caught and carried about. It is necessary, of course, to catch and wash the animals once a week, since their scales get covered with various deposits and with algae. The best thing for washing young caimans is an ordinary toothbrush. Big crocodilians can be scrubbed with a big scrubbing brush attached to a stick or with a rough broom, since to handle them at closer quarters might bring trouble.

If anyone wants to keep a young crocodilian at home I would recommend an alligator, as these are more hardy than caimans and do well at a temperature of 26—28° C. The care of caimans makes greater demands, including the type of food required. It can be said, however, that next to alligators, caimans are the most worthwhile and the most hardy of all the crocodilians for keeping in terraria.

LIFE ON WALL AND CEILING

When I used to set off for Africa, my friends often saw me off with the words: "... and don't forget to send us some geckos!" I wanted to do my best to satisfy them and so, immediately on arrival after my last journey to Tunis, I began a search for spots where I might find these charming little reptiles in large numbers.

The Moorish Gecko *(Tarentola mauritanica)* is a lizard, but its body is not covered with coherent rows of scales, as is usual in other lizards, and its sparse scales form irregular groups of granuliform formations. The whole impression is one of a skinned lizard with a frog's head. Its wide mouth is deeply indented, its short legs are equipped with strong toes and suction pads, by means of which the gecko can run across any smooth surface, such as the window or the ceiling, with incredible confidence. Its most handsome feature, however, are its cunning yellow eyes, with their contractile vertical pupils. There are many species of Geckos in warm regions, especially the tropics. They form a special family in the sub-order of the *Lacertilia,* but I am of the opinion that they would be better classified as an independent sub-division in the group of scaly reptiles.

I generally came upon the haunts of these charming little reptiles quite by chance. In Morocco they are mostly found near crowded human settlements and are unusually plentiful

in Casablanca, but elsewhere, where the country is ecologically not so favourable, they are seen only rarely. In the town of Tunis and the surrounding country they are also rare and I therefore thought that it would be a waste of effort to direct my search for them there. One day I went out with a young Arab to inspect the historic ruins of Carthage and to my joy I saw a whole host of handsome skinks of the species *Chalcides ocellatus* which, on being disturbed, disappeared like lightning in the Punic and Roman ruins. It is impossible to lure a skink out of its hiding place once it has run away and so I had no alternative but to wait until one came out again. Suddenly my attention was drawn to a rapid movement on the wall—and lo and behold! there was a gecko running away! As I went closer, to the alarm of my young Arab, the whole cracked surface of the walls and stones came to life as if by magic. Wherever I looked, the head of a lively little reptile was looking out and where the head could not be seen, the excited twitch of a tail betrayed its owner's presence.

Do not imagine that catching geckos is an easy matter. Just as you are about to catch one it disappears with breath-taking rapidity into a safe refuge or some inaccessible cellar. I gazed sadly after the geckos, which at the last moment ran spiral-wise up the old stone columns whenever I put out my hand to seize them and remained there, head downward. It looked as if they were enjoying a joke at my expense.

Finally, however, we got the better of the nimble little beasts. We realised that a slow approach was needed. I lent Yussuf my handkerchief and myself took a linen bag and in this way we approached an intended victim. Slowly, gradually, whichever of us was in the most convenient position would raise the hand that was holding the handkerchief or the bag, while the other would try to draw attention to himself. At last, with the hand only two inches above the gecko—a sharp movement and the surprised victim, hampered by the soft material, would find itself dropped, unharmed, into a bag. In this way I managed to catch three dozen geckos in a few days, but few of them longer than 4—5 inches. In the inaccessible cellars and crannies of the ruined buildings, however, sat geckos of almost twice that length, catching spiders and big flies and quarrelling, undisturbed, over these juicy morsels, safe from any intrusion.

Later I caught many geckos without any trouble in the beautiful Belvedere Gardens in Tunis, where I found them under the peeling bark of the cork oaks *(Quercus suber)*. In May I observed gatherings of geckos in the oases of Central and S. Tunisia, when they would run about the walls and ceilings even after the lamps were lighted. Occasionally one of them would fall with an audible bump on to the table or somebody's head, where it would continue to eat the moth it had caught, quite unruffled.

As far as I can judge, geckos mostly go to sleep after midnight and sleep until the rays of the sun have sufficiently warmed the air. They then come out and sun themselves, not omitting to catch every fly which comes within their range. When the sun reaches its zenith, they hide in shady cracks. In the afternoon, however, they again come out and sit on the walls, catching insects and teasing one another. Only when the sun sets do they really come to life, however, running about and investigating every nook and cranny. The gecko approaches its prey in a leisurely manner, on its hind legs, and only the twitch of its tail betrays its excitement. Finally the gecko seizes its victim, crushes it in its strong jaws and swallows it. When it has finished it licks its lips with its tongue, which much resembles that of a mammal; it also uses the tongue to clean out its eyes.

Some of the geckos which I caught on my last expedition I kept for myself and on my return I gave them the run of the glasshouse. Although that was several years ago, they are still there and doing well, since there are some of quite respectable size among them, and others, quite tiny, which first saw the light of day behind the snakes' quarters. It is an amusing sight when I first switch on the light in the reptile house in the evening and a number of geckos hastily vanish into their hiding-places. We have even seen one of these little creatures sitting on a big python, which took not the slightest notice of this intimacy.

Anyone wanting to take up reptile keeping ought to start with geckos, particularly with the species described above. The Moorish Gecko is a relatively hardy reptile, for which normal

room temperature is sufficient in captivity. At first, of course, it does not display any special activity during the day; on the contrary, it lies low in the darkest corner. Later, however, as it becomes accustomed to its new surroundings, it comes out and runs about early in the afternoon. It must, however, be fed only during the day, otherwise it will remain wild. Its favourite food is spiders, grasshoppers and large flies, but it also catches small beetles, butterflies and woodlice. It is also very fond of weevil grubs and crickets. Only very rarely does it eat a bee or a wasp, and ants it completely ignores. It does not take dead insects or pieces of meat.

I have already indicated that geckos are not very peaceable creatures, but that they often quarrel. This is usually over an insect which some member of the clan has succeeded in catching. The quarrel is not dangerous, but it may involve the loss of a tail. Jealous geckos are fond of biting their companions in this fragile appendage, which easily breaks off and is swallowed with the same relish as any other dainty morsel. Old male geckos especially have this propensity and very often there is no alternative but to separate them from the others to prevent them biting off the tails of all the other geckos. The tails quickly grow again but differ from the original tails by being thicker and bare, or covered only with plain scales.

The Moorish Gecko is very adroit at climbing on walls, ceilings, rocks and tree-trunks, but is very bad at crawling on twigs. We tested its skill on thread and string and found that this mode of movement is not at all suited to it. It moves best on broad surfaces, even and uneven.

The toes of many species of geckos, which are specially equipped for climbing quite smooth surfaces, are very interesting. Under every toe there is grooved, fringed skin and this can be tightened and contracted as required, and there are also lamellae covered with hair-like structures. The gecko can easily hold on to a smooth surface without any effort on its part. It is somewhat analogous to the bird's foot, the normal position of which is clenched, thus enabling it to sit for hours on a narrow perch without discomfort. The principle of the system by which the gecko grips a smooth surface is in some ways the same as with the rubber disc which is hollow beneath and adheres to glass.

In the terrarium the geckos must have enough room for playing about, a dry atmosphere and climbing facilities. The ideal thing is to cover the internal back and side walls with cork or pieces of bark. A bowl of water in one corner is essential, but geckos also like to be sprayed with water and lick up the drops. Geckos shed their skin frequently. The shed skin is whitish and very fine. It comes away in large pieces, sometimes all at once, and occasionally the geckos eat it, although this is unusual in reptiles.

Geckos rarely mate in small terraria, but they do well in roomy quarters and call and chase each other until finally white eggs are laid, from which the young hatch out after 90—120 days. These have the same habits as adults, which, however, often prey on them, as is no doubt the case in our own station, where the number of geckos does not seem to increase.

STRANGE LIZARDS OF THE DESERT

They are indeed strange lizards. They have small, bright eyes, broad noses and often queer spiny protuberances on their head and body. They are the same colour as the desert sand, sometimes a little darker, sometimes a little lighter, but they can also change colour, and the most interesting thing about them is that they catch their prey with their tongue, like frogs.

I should like to mention four members of this characteristic family, which is distributed throughout the tropical and subtropical regions of Africa, Asia and Australia. It is undoubtedly a very ancient family, as may be seen not only from its general appearance, but also from the trace of a third eye on the crown of the head in some of its members. Two of the lizards which I shall describe live in N. Africa, a third also inhabits the Near East and the

fourth the hot parts of Australia. I brought back many specimens of the first two kinds from my Tunis expedition in 1948 and will therefore begin with them.

When passing through the desert between Gafsa and the salty, sandy marshes of Shot el Dzherid with Arab guides, looking for various small animals, my attention was caught by a movement on a pile of stones such as are scattered about in this area in innumerable quantities. Sitting on a white pebble was a little grey-brown creature with a long tail, regarding me with a solemn look and at the same time beating time, as it were, with its head. A little further away sat another, and then another—and all of them were watching me and nodding their heads at me in unison. They had no thought of running away.

These were members of the family of the *Agamidae* and of the species of the same name (*Agama mutabilis*), which is very widespread in Africa. True believers look askance when they see this small lizard, which bows till one would think it must be breathless, since they think that the agamas, which they call *bukashesh,* imitate the Mohammedan way of calling on Allah with evil intent. Of course, agamas bow and behave in this conspicuous manner only to frighten away a supposed enemy. On closer inspection it is seen that the bowing basically consists in straightening and flexing the fore part of the body. It is an unusually original, but probably not very effective, method of passive defence.

When the rays of the mid-day sun become unbearably hot, the agamas rest under clumps of bush-like sage. The best time for catching them is in the early morning, when they are only just beginning to get warm and come creeping out on to the piles of stones.

I got my greatest pleasure from the agamas, however, at home in the terrarium. They soon grew accustomed to their new surroundings and behaved in an entirely natural manner, proceeding with their bowing exercises for their own amusement. Furthermore, like almost all desert reptiles, they are not fussy about their food and can be fed on weevil grubs and crickets. They are also fond of small hard beetles, which they chase with great agility, and they also catch flies by jumping after them. They are likewise fond of catching wasps and bees, and the larger species even dare to tackle hornets.

The small, somewhat slanting eyes of the agamas, which somewhat resemble those of the chameleon, see well, but can take in only a small section of the horizon. That is why agamas usually look at objects from the side, as many birds do, but they see, of course, only for short distances. On the whole they pay no attention to sounds and are probably guided entirely by sight.

The agamas shed their skin several times a year. The old, membrane-like skin turns grey and the animals shed it piece by piece, almost without its being noticeable. The shedding process causes the agamas no discomfort and they take food normally. Half-way through the summer the females lay from five to ten eggs, according to the age (or size) of the female. Under natural conditions they bury the eggs in the sand, under the stones, but in the terrarium they usually lay them somewhere in a corner, where the eggs dry up or go bad. It is very interesting to note that smaller varieties of this genus are not usually content to lay just one batch, but lay for a second time a few weeks later.

In a terrarium provided with patches of fine, loose sand, the agamas can bury themselves in a short time, using sharp, jerky movements.

All the species of this family, including the one mentioned below, do not run on all fours when they want to move quickly, but on their hind legs. It is strange to see a lizard running for a short distance in a straight line, without the characteristic undulation to which one is accustomed in these animals. Normally, the agamas crawl on all fours.

The agamas are quiet and somewhat timid in habit, but when danger threatens they can not only run away quickly, but also bite. They have remarkable teeth; in many species, on either side of the upper and lower jaw, one stronger and longer tooth protrudes from among the row of small teeth, in the manner of the canine teeth in beasts of prey. This characteristic is also present in members of the genus *Phrynocephalus* and others, whereas the genera which include the larger species have no such long teeth. Another interesting

feature of the tiny agamas is that when they are excited, they twirl the end of their tail into all kinds of shapes, usually into the form of a question mark.

In the neighbourhood of Gafsa, especially in the Mulares oasis, I caught a different species of agama from those described above, considerably larger and also with different habits. These were the well-known Spiny-tailed Lizards *(Uromastyx acanthinurus)*. They are characterized chiefly by their short, thick tail. This is covered with circular, transverse rows of hard, short spikes, which are actually modified scales. Spiny-tailed Lizards are grey-black or black-brown on top, while the young are a light slate-grey.

Do not imagine that it is easy to catch this apparently timid animal, which is about 16 inches long. It prefers to come out of hiding in the morning, when the thermometer already shows over 40° C in the shade and every step costs the hunter a pint of perspiration. The endless expanse of sand shines like burnished gold in the rays of the sun and every pebble glitters like molten silver, almost blinding one. The Spiny-tailed Lizards live in deep holes, which they burrow out themselves under piles of stones and only rarely move away from their hiding-place to any distance. When the lizard thinks that danger is at hand, it raises its head and chest and stares before it without moving, so that it can hardly be distinguished from the stone. It allows the enemy to approach to within about 15 feet and then darts into its hole.

Unearthing the Spiny-tailed Lizard is very hard work in the heat of the African sun, but there is hardly any other way to catch these animals intact. Only very rarely does one succeed in catching one of these nimble reptiles before it pops into its hiding-place.

When, after several days, I had caught ten of these lizards, I sent them to Prague in a date-box. Like all other reptiles, even the big, black Spiny-tail Lizards stood up well to the journey. In the terrarium they soon picked up under the warming rays of the strong lamps and began to take food.

These strange lizards are described in the literature as herbivorous and satisfied with vegetables and fruit, and only a few more recent communications (since 1900) state that they also take animal food. I convinced myself that all the varieties of Spiny-tailed Lizards prefer grasshoppers and crickets to vegetable food and that they suffer from protein deficiency if fed only on a vegetarian diet. I have not yet had the opportunity of observing the habits of the Spiny-tailed Lizards in their natural environment, because too much precious time would have been needed, but I am of the opinion that in their own country these lizards feed largely on big locusts, which because of their clumsiness are an easy prey for the Spiny-tailed Lizards, young monitors and small birds of prey.

Like *Agama mutabilis* and most of the other members of this family, the Spiny-tailed Lizard catches its food with its tongue. The tongue is not forked, but plain, fleshy and oval in form and resembles the tongues of mammals. The lizard uses its sticky tongue to convey a stalk or leaf into its mouth, to collect pieces of apple or to hunt for large, straight-winged insects. The Spiny-tailed Lizard has peculiar teeth. They are broad and spatular, so that the lizard can use them like a sharp knife for biting off as much food as it wants at one time. Sometimes, however, it swallows long pieces of peel or whole grasshoppers at once.

The Spiny-tailed Lizard was not observed to drink, except perhaps to lick up the drops which fall on its head from the watering-can. In captivity it sometimes has difficulty in shedding its skin, and the old skin, which should be shed piece by piece, dries on to the new skin. This is due to the considerable heat which is required by the lizard for its normal activity, but which in turn has an adverse effect on the shedding of the skin. I speculated for a long time on how to help these animals, which dislike being sprayed. Finally I remembered that on digging them out of their holes in the desert, damp sand could be felt about one and a half feet down, increasing the deeper one went. Thus, for the whole night and part of the day the Spiny-tailed Lizards were in a damp environment, which was a considerable help when they were shedding their skin. I therefore arranged sleeping quarters for them in a piece of rotting tree trunk, which held the moisture sufficiently well, and this simple expedient was

a great help in the problem of skin-shedding, which is perhaps of greater importance to reptiles than moulting in animals or birds.

One of the most charming characteristics of the Spiny-tailed Lizards is the ease with which they become accustomed to conditions in captivity and learn to eat out of one's hand. Within a short time they lose their timidity and boldly take food from a human hand, which many reptiles never really learn to trust, and do not object to being inspected or handled.

A newly caught Spiny-tailed Lizard, of course, puts up a fight. It rarely tries to use its powerful teeth, but always lashes out with its short, club-shaped tail, which is strewn with whorls of spikes. It is a comparatively harmless weapon, however, as the spikes are not sharp enough to do any damage, and ultimately the lizard closes its eyes in surrender and resigns itself to its fate.

In captivity, the Spiny-tailed Lizard feeds on small slices of apple or pieces of peel, small pieces of the white of a hard-boiled egg, lettuce, dandelions, clover, lucerne and young nettles. Occasionally it is advisable to give a little hay and pieces of roll soaked in milk. In the summer, this vegetarian diet should be supplemented, as already mentioned above, by crickets and grasshoppers. Pieces of raw veal can also be mixed in the vegetable food.

A plain-coloured but very agile agama is the Hardun *(Agama stellio)*, which lives in Egypt, Turkey, Palestine and Syria. It is a handsome, black-grey to light-grey lizard, which grows to a length of 12 inches. Fully grown males have a bluish coloured throat. They have long, powerful hind legs which enable them to take long leaps. When frightened, the Hardun runs so quickly that it is utterly impossible to catch it by hand. It is also an excellent climber. In the terrarium it is a pleasant inmate, it is hardy and shows no reluctance to take food, but it is a veritable Jack-in-the-box. When its quarters are being cleaned or it has to be handled for some purpose or other, it is easily frightened and afterwards leaps about the cage so wildly that it causes confusion among the other lizards.

It eats almost all the larger insects, including wasps and bumble-bees, and likes to crunch hard beetles, so much so that it would appear that in its own country it is the main enemy of the hard-working scarab beetles, which obstinately roll together — and steal from one another — little balls of cow-dung. On opening a consignment of reptiles from Syria in 1950, one Hardun escaped in the garden and hid itself so well that we were obliged to leave it at liberty. About a month later it was sighted on a rock where rock plants were growing, and this it frequented until October. It was finally found in a laundry, in which it eventually spent the winter, without any ill effects.

The last of the four species of agamids which I should like to describe is without a doubt the most remarkable of all. It is found in Australia, the country of so many strange creatures and living relics of bygone ages that the bizarre form of this lizard ought not to surprise us. And yet we have to marvel at the plainly coloured reptile, with strange spines and an expansible ruff, known as the Bearded Lizard *(Amphibolorus barbatus)*. It grows to a length of two feet, half of which is accounted for by the tail. It catches its insect prey with its somewhat shortish tongue, although it has a fearsomely gaping mouth with which it could probably catch its food more surely.

Newly arrived Bearded Lizards, when alarmed, inflate a large, hollow flap of skin which otherwise lies flat against the neck, open their mouth, which is furnished with strong, regular teeth, and follow every movement of the supposed enemy. The bristling beard, filled with air, spreads from ear to ear. Its function, of course, is simply to inspire fear. This lizard will also bite an incautious finger, but it soon becomes tame to the extent that it ceases to bristle and eventually allows itself to be picked up.

Many members of the group of extinct giant lizards which inhabited the Earth in the jurassic and cretaceous periods ran only on their hind legs. This form of movement is of undoubted advantage in providing a better view of the surroundings and also makes fewer demands on muscular energy than running on all fours. Few people are aware, however, that some of the lizards in existence today, while nothing like the giant lizards in size and strength,

use only their hind legs to run short distances. This also applies to members of the genus *Amphibolorus,* which suddenly, quite unexpectedly, rear themselves on their hind legs and run a few steps, lashing out from side to side with their tail.

The reason why reptiles do this today is not the same as in the case of the giant lizards. The Bearded Lizard leans slightly forward as it runs; it is evident that it is soon fatigued by movement on its hind legs and it does not appear to use an upright position so as to get a better view. The lizards of the genera *Chlamydosaurus, Tupinambis* and others, which are also able to run on their hind legs, likewise use this mode of movement only on rare occasions and only when in danger. We may therefore justifiably assume that some present-day lizards run upright only in order to inspire fear in their enemy by this unusual, unexpected form of movement.

In spite of its size, the Bearded Lizard is exclusively insectivorous and can be kept together with various small species of lizards and also with the two species previously described, without the slightest danger. In addition to large, straight-winged insects, they also catch butterflies, may-bugs, beetles, weevil grubs and wasps. They dislike earthworms and slugs but are very fond of spiders. When it is very hot, these lizards like to be sprayed with water. They do not usually drink, but when drops of water run down their snouts they begin to lick them up with relish.

Among the interesting characteristics of these animals we should not forget their exceptional gift for flattening themselves out. The Bearded Lizard has oblique folds of loose skin along its sides, which stretch out horizontally when the ribs spread out, with the result that the abdomen is flattened in an astonishing manner. When sunning itself, the Bearded Lizard looks like a grey-brown dart-board with head and tail appended.

On sighting its prey, this lizard lowers its head, since it has to focus with one eye. It then approaches cautiously and finally leaps to seize the insect. If it is not immediately successful it runs after the insect and repeats the attempt several times until it ultimately, perhaps, succeeds. When given weevil grubs, it may happen that one of the larvae burrows into the sand, but to no avail. The lizard sees the slight movement, leaps forward and digs out the grub with rapid movements of its forelegs.

It is a pity that this interesting lizard is afflicted with roundworms, which cause apathy, loss of strength and finally the death of the poor animal. The worms first live in the intestine, where they proliferate to such an extent that the lizard commences the reptile's usual reaction to various forms of discomfort, i. e. a hunger cure, thus restricting the supply of food to the worms, which then bore through the wall of the bowel and penetrate into the lungs and liver. At least two Bearded Lizards out of ten suffer from these parasites. By removing every piece of faeces and subjecting these from time to time to microscopical examination (the excretions of affected animals contain the eggs of the worms) and by isolating thin and apathetic animals, I have almost done away with the risk of infection.

Bearded Lizards are quite hardy, amusing animals, which bring something of the exotic atmosphere of the Australian wilderness into the terrarium. The most interesting thing, however, is to watch a duel between these animals. Two fully grown males will inflate their beards, face each other with open jaws, lash out with their tails and nod their heads with jerky movements. Sometimes they bite one another, but never do any serious harm. In the evening, when it grows dark, the two rivals will climb up together on to a single branch and go to sleep, to continue the duel next day.

All agamids, even those species which appear to be clumsy, have very acute senses, although not so sharp as the lizards of the genus *Lacerta.* They have one peculiar defect, however, which in man we should call day-dreaming. Sometimes the agamid is lively and takes in all that is going on around it, while at other times it sleeps with its eyes open and does not even notice the insects which are thrown to it, although it may be hungry. If we touch it or, if need be, tap it on the head, the agama wakes up and seizes its prey. Almost all species of the family suffer from this failing in captivity, with the exception of the most active species,

such as the *Agama agama* and others. It appears to be an adverse, degenerate trait and it would be interesting if this finding could be supplemented by observations made in the creature's natural environment.

The agamids differ from many lizards by not having the property of autotomy (spontaneous breaking) of the tail, which is regenerated. It can therefore safely be lifted by the tail, which is not the case, for example, with many European lizards.

Almost all agamids can change their colour, according to mood, temperature and environment. When excited, agamids sometimes develop a positive riot of colour, at other times they turn grey and their markings are barely distinguishable. The four species reared in our reptile house are not conspicuous for their fine colouring, but the illustrations show that they are nevertheless quite presentable.

FROM THE SANDY PLAINS OF CENTRAL ASIA

Thanks to the kind co-operation of the "Zoocentr" in Moscow, we have been receiving, since 1948, interesting and rare reptiles from the steppes and semi-deserts of Central Asia. Since these are mostly small lizards, which do not endure long journeys so well as snakes, special care is paid to their transport. Most consignments arrive in good condition and their contents give me the keen pleasure felt only by a zoologist who has obtained material which has not been available for many years.

I have selected just a few striking examples from the wealth of species which inhabit the broad, inhospitable plains of Kazakhstan, Astrakhan, Uzbekistan, Kirgizia and Turkmenia, where dunes of fine, yellowish red sand stretch away into the distance, dotted with islands of dry shrubs and clumps of yellow grass. After a cold night, the sun blazes down on to the dunes from a cloudless sky and occasionally there is a fierce, hot wind which raises vast clouds of sand, levelling the old dunes and forming new ones; but when the storm settles, numerous desert insects, scorpions and arachnoid "solpugy" again creep out of the sea of sand and tiny lizards appear, as if by magic, hunting these insects.

In the preceding chapter I mentioned the species *Agama mutabilis* from N. Africa. The Central Asian counterpart of this lizard is *Agama sanguinolenta*. It is a very active little creature, with its eyes always half-closed. In the morning and evening it is grey or brownish grey, but in a warm environment it is decorated with chocolate brown spots. When this agama is in a good mood, the dark spots on its back change to a bright vermilion. The males have a blue throat and when excited—which is no rare occurrence with these excitable creatures—it dilates into a sharp-edged keel, with the point towards the ground.

The way in which these agamas avoid capture is unusual. They lie on the sand like a long-shaped stone and allow one's hand almost to touch their back. Then they leap away with a long jump and run madly for a few score feet, to disappear suddenly or to lie down again. They rarely burrow in the sand, but often sit in groups on stones. A group of agamas sitting face to face, with their heads and chests raised and beating time with their rounded heads, is such a comical sight that it is impossible not to laugh at it. They are harmless, lively little animals, which may at first bite one's finger, but soon adapt themselves and come running along when the door of their terrarium is opened in the hope of getting something good to eat.

These agamas lay their eggs between April and July, usually 8—10 at a time, sometimes more, and bury them in shallow pits in the sand. I mentioned the number of eggs laid at one sitting so that the reader would not imagine that they are satisfied with one batch a year, like most other reptiles. These agamas lay three batches of eggs, one in April, the second at the end

of May and the third in July. Hatching is a long process, however, usually taking two months. When hatched, the young measure 1½ inches, including the tail, but grow fairly quickly. At first they eat small flies and beetles in the terrarium, later they become passionately fond of young weevil grubs and the larvae of meal moths. Fully grown animals also take pieces of fruit and lettuce and it would appear that an occasional spell of vegetarian diet is necessary to them.

Some reptiles inspire fear when seen for the first time, since they can make themselves so ugly that they look like the dragons in the fairy-tales. This form of passive defence sometimes takes effect on beasts of prey, which are alarmed at the sudden change in the form and appearance of the lizard, which only an instant before had looked so harmless. This feature is especially marked in the agamids. I have already described the Bearded Lizard of Australia, which can expand a collar of spikes round its mouth. A still greater expert in the art of scarification is the species *Phrynocephalus mystaceus* from Central Asia. This is a small agamid, which seldom grows to over eight inches, but which has a broad, sturdy body. It is brownish grey to pinkish brown in colour. The head is conspicuous for its powerful protruding lower jaw, with orange-coloured nostrils and spiny sacs on either side, which lie beside the corners of the mouth when at rest. In the male the sacs are always larger.

Phrynocephalus has hardly sighted something suspicious when a drastic change takes place in it. Instead of an inconspicuous little lizard there appears, as if by the waving of a wand, a positive devil. The strange creature stands with its head reared high, its gaping, violet-red mouth armed with a miniature set of teeth like a dog's and on either side of its mouth pink protuberances stand out like enormous ears. Its thin tail, the last third of which is jet black, twirls in spirals, its black eyes glitter—and the little dragon jumps towards its enemy, not hesitating to use its sharp teeth. Once it has got a firm hold on something, it shuts its eyes and remains hanging there. This is no doubt an unpleasant experience for small enemies of the aggressive agamid and they therefore avoid such a fury. I have also seen a small Sand Boa halt in front of an infuriated Phrynocephalus and take to flight.

These lizards have elongated toes, with spiny protuberances along the sides, rather like a saw. This facilitates movement on the fine sand, into which the reptile's feet would otherwise sink. Phrynocephalus is also very good at burrowing. It uses the same method as the Viperine snake of N. Africa, *Aspis cerastes.* It lies down in a suitable spot, its back vibrates with feverish rapidity and in a few seconds it completely disappears. It does this particularly in the late afternoon, when it digs itself in to sleep.

The favourite food of Phrynocephalus consists of locusts, grasshoppers and crickets, but it also likes weevil grubs. There must never be even a small water container in the terrarium where these agamids are kept, as it sometimes happens that one of them climbs into the unwonted bath, stays there overnight, catches cold and dies. It is therefore sufficient to spray the terrarium occasionally.

In our experience, Phrynocephalus is one of the most difficult reptiles to rear.

Many animal lovers will have already kept small, brightly coloured lizards from S. Europe, such as the different varieties of the Wall Lizard *(Lacerta muralis)* and know how quickly these animals can run. They simply dart out of sight. I should like to introduce you to one of their closest relatives, which is even smaller and slimmer, but can run so swiftly that it flashes away to a distance of several yards like a streak of lightning. This is the *Lacerta parva,* which is an unobtrusive brown colour with a trace of green in it and dark stripes and spots.

This lizard is found rather on mountain sides and in stony steppe country than in deserts. In captivity it is very active, running over stones and branches and leaping into the air. It does well in the company of slower agamids and other, larger lizards, because it can steal all the tastiest morsels right from under the noses of its less agile kin. Anyone who has had the opportunity of observing these lizards in our reptile house cannot tear himself away from the sight of their antics.

Catching them is a more difficult matter. Their brittle tail easily breaks off and it is

virtually impossible to catch this little creature in one's hand. I therefore used to have to search for them very early in the morning, as they lay curled up asleep beneath pieces of bark and were still stiff with the cold.

The African and Pyrenean genus *Acanthodactylus* has its counterpart in Central Asia in the genus *Eremias,* some branches of which also extend into Africa. These are small but sturdy lizards, with plain but pleasant colouring. The young of some species have dark, longitudinal stripes, while most of the fully grown animals have spots. The largest spots, which ornament its sides, have a blue, brown or white centre. The head is smaller than in our lizards. The small eyes are placed somewhat high up and are half closed; this is no doubt a protection against the blinding sun.

Like the agamids, lizards of the genus *Eremias* are typical inhabitants of sand dunes covered with sparse vegetation. Every one of them digs its own hole at the root of some shrub, in which it can take refuge when in danger. How quickly they can run I know from my own experience with the N. African species *Eremias guttulata,* which closely resembles the Central Asian species and has the same habits. It is almost impossible for a single person to catch this lizard in the open. The most annoying thing is that the lizard is well aware of its own agility and does not attempt to go into hiding for a long time. Instead, it runs from one clump of grass to another and back again, playing at hide-and-seek round the stunted shrubs and runs over broad stretches of sand so nimbly that it is sheer martyrdom to chase it in the heat of the morning. Two people, however, can catch it quite easily. They approach slowly, one from the right, the other from the left, until they compel it to dive into its hole. It is then sufficient to prise it out carefully with a knife and the astonished lizard is caught.

Of the many species we have received recently, I should like to mention two from Central Asia: *Eremias velox* and *Eremias grammica.* The first of these is not conspicuously coloured, but the adults have beautiful blue eye-spots on their sides, with a black border. The other species is densely speckled in bronze and black.

These are active, clever and inquisitive little lizards, which require a fairly high temperature, but are not fussy about the arrangement of the terrarium. They have different habits, however, from our own lizards. They do not adapt themselves so easily to the changed conditions and do not usually mix with the other inhabitants of the terrarium. They are dangerous to young lizards, which they prefer to all other food. They are terrified of snakes. Whereas our own lizards (the Common and the Green Lizard) allow a snake to approach quite close and are only alarmed when the snake touches them with its tongue, lizards of the genus *Eremias* run to safety in good time and for a long while distrustfully inspect all the places they frequent. The cause of their inborn fear of snakes is without a doubt the S a n d B o a *(Eryx),* which suddenly rises up out of the sand where it has been hiding, to attack and suffocate the lizard. Many species of snakes of the genus *Coluber* and the venomous *Malpolon monspessulanus* like to hunt these lizards.

In their own country, lizards fall into a lethargic winter sleep lasting from three to four months. In captivity they suffer from no ill effects when they remain active the whole winter. During that period, like most other reptiles, they need the additional heat of powerful lamps as well as normal heating.

Some species of the genus *Eremias* burrow in the sand and spend the night there. They never sleep on branches or stones as do many other lizards, such as the Bearded Lizard. Their favourite food consists of small beetles, spiders, crickets and locusts.

SLOW-WORMS AND THE GIANT GLASS SNAKE

Slow-worms, or blind-worms, which belong to the family *Anguidae* are small, helpless creatures, which live on soft larvae, earthworms and slugs. Everything about them is a trifle topsy-turvy. They look rather like snakes, but cannot move so quickly. They have brittle tails which, when snapped off, do not grow again so perfectly as in true lizards and they have small, bright eyes, but are known as blind-worms. In most of Europe there is only one species, *Anguis fragilis fragilis,* which is viviparous.

S. E. Europe and W. and Central Asia are inhabited by an Anguid so large that anyone coming upon it unawares would be alarmed. It has a large, powerful head, a peculiar grooved fold along its side and a thick, long tail, which narrows towards the point. This giant of the slow-worm family, which measures up to four feet, has some characteristics in common with our own slow-worm, but is a positive robber for its size.

It is known as the European Glass-snake *(Ophisaurus apodus)* and lives on all the small creatures which its none too considerable speed permits it to catch. In spite of its shape, the Glass Snake does not possess the swiftness of the snake, let alone its elegance. In captivity, however, it is one of the gentlest and sturdiest reptiles to keep.

It would not be true to say that the Glass Snake was a rare inmate of terraria. In its own habitat it is fairly common and is therefore often caught for sending to terraria. The young are lighter coloured than the adults, but the Glass Snake is always only one colour—a light, greyish yellow, light brown or a coppery shade. It sometimes has small, irregular brick-coloured blotches along its sides. Its favourite food consists of large caterpillars, grasshoppers, mice and small lizards, but it does not reject a piece of meat or fish and is not fussy about its food. Like all other reptiles, it naturally needs water for drinking and for bathing in on hot days.

When at rest, the Glass Snake lies half curled up behind a stone or a tree-stump, where it dozes with closed eyes. When something rustles, it cocks a wide-awake, bright eye and ascertains the cause of the disturbance. If it thinks that the approaching object spells danger, it presses the point of its nose a little closer to the ground, closes its eyes and pretends to be asleep. It probably imagines that if it does not see the enemy, the enemy will not see it. This is a grotesque illustration not only of the psychology of the Glass Snake, but of many other reptiles.

When alarmed, the Glass Snake hisses, but without much effect.

If this strange reptile is picked up, it begins to turn rapidly on its own axis, so that it easily slips free. This movement, which is typical of the slow-worms, is seen most markedly in the swallowing of a large piece of food. A Glass Snake which has caught live prey closes its eyes and begins to twirl rapidly, like a spindle, rendering the mouse or lizard unconscious. When two Glass Snakes get hold of a single prey, from either end, there is a tremendous whirling and twirling. As a rule, both antagonists twist in opposite directions, so that they soon succeed in twisting the mouse and tearing it in two. They do not mind that sand and grit may be sticking to the pieces, but swallow the lot with gusto.

It is hardly possible for a Glass Snake to catch adult mice under natural conditions, as it is too clumsy and noisy. Even a white mouse often gives it a lot of trouble. It is more likely that it crawls into the burrows of voles and eats their young. In captivity it sometimes makes do with snails and large slugs, but I have not seen it eat them with any great relish. It crushes the snail's shell with its jaws and swallows it together with the body of the unfortunate mollusc. Only the young of the Glass Snake eat larvae; the adults are more rapacious.

The Glass Snake catches its food in the following manner (including pieces of meat and live prey): it approaches to within an inch or two, raises its head and suddenly, without feeling with its tongue, it snaps up the morsel from above. At the same time it opens its mouth wide and it sometimes happens that it takes in some other object, such as a piece of wood, etc.

Slowly, with an effort, it shifts the food into a convenient position and then swallows it. It should be emphasized that it definitely recognizes a piece of meat or other motionless food at a distance of about eight inches. This demonstrates its good sight. Its sense of hearing, however, cannot be compared with that of other lizards. It sometimes seems as though the Glass Snake does not hear at all; the same applies to our own slow-worm.

In contrast to its smaller relative, the tail of the Glass Snake does not snap off. It can be picked up without the fear of this important member remaining in one's hand. If a piece of the tail is lost through injury, the wound heals but regeneration does not occur.

The Glass Snakes in our terrarium mated about the end of April and at the beginning of June the female laid from 6—8 eggs, averaging 1.7 inches in length, in moist sand covered with moss. The young hatched out after six weeks. At first, these measured only about five inches, but grew rapidly. They fed on earthworms, slugs and various larvae, but soon began to attack small, spotted newts *(Triturus vulgaris)*, which were kept together with them, until they were completely exterminated. These large slow-worms, therefore, are rapacious right from birth, when given the opportunity. They probably do not devour one another, not even the adults—at any rate, not in captivity. It is not altogether out of the question, however, that fully grown Glass Snakes sometimes attack their own young, as is frequently the case with lizards. At all events, the Glass Snake devours its smaller relations, *Anguis fragilis,* with great relish.

It takes some time for the Glass Snake to lose its natural timidity, but it then eats out of one's hand, either on the table or on the floor. It bites hard into the morsel and fights for it with its keeper just as it would with another Glass Snake, twirling on its own vertical axis until it tears a piece off. It can be lifted into the air with a piece of meat and shaken, but does not let go of the food. The Glass Snake does not attack its prey blindly, however. Although it is very fond of white mice, it stops short of white rats, as it is perfectly able to estimate size. Large lizards and snakes are also safe from the Glass Snake.

The surface of the Glass Snake's body is smooth (only the tail is somewhat rougher) and its scales are very tough, with a glassy appearance. It cannot therefore coil itself as easily and gracefully as a snake, but its plating nevertheless has a certain advantage—it protects the Glass Snake from the bites of the venomous snakes and scorpions it is so fond of itself.

I carried out a number of experiments, all of which convinced me that the Glass Snake is very dangerous for small snakes, regardless of whether they are venomous or not. I first presented my own specimens with a dead viper, which they immediately devoured with gusto. Then, to make sure, I separated one of them from the others and let free with it a half-grown, live viper. The snake coiled itself into a spiral, while the Glass Snake approached with raised head. The viper struck at the lizard several times like lightning, but the latter dodged and then suddenly went over to the attack, seizing the snake by the middle of its body. The viper immediately bit its attacker, which only, however, began to worry it on the ground and to move its jaws towards the head, without paying any attention to the bites. The Glass Snake finally succeeded in gripping the viper by the head and in half an hour had swallowed it, in spite of its resistance and contortions. When it had finished swallowing its prey, I made a detailed examination of the Glass Snake and found that the viper's poison fangs had not at any point penetrated the scales. On holding a torch close to the lizard, a few drops of viper venom could be seen shining on the back and sides of the Glass Snake.

I later introduced a handsome, 26-inch Nose-horned Viper *(Vipera ammodytes ammodytes)* to the Glass Snakes. Although they at first fought shy of the snapping snake, two suddenly attacked it almost simultaneously by the head and tail, immediately began to swallow it and finally to twist the unattractive dish, but without success, so that I was obliged to cut it in two, right in front of their jaws, to the great satisfaction of both.

Various further experiments showed that the Glass Snake attacks all smaller reptiles, not excepting snakes. It captivity it pays no attention to large ones.

Not even the scorpion's sting penetrates the skin of large Grass Snakes. When scorpions

of the species *Buthus australis* were thrown to them, they showed no great interest, but neither did they show any fear of the scorpion's elongated stern, the sting of which attempted in vain to pierce their smooth, glassy armour.

Nevertheless, the Glass Snake is probably not immune to the scorpion's venom, as a dose of 4 mg. injected subcutaneously into the tail sufficed to cause death within 42 hours from paralysis of the central nervous system. It is almost certain, therefore, that the Glass Snake is not immune to snake venom, the action of which is far more powerful, and that only its strong body covering protects it from the bite of small venomous snakes.

The Glass Snakes are not particular about the temperature of the terrarium. They do well at a temperature of 25—30° C. They need a shady spot, however, where they can take refuge when the sun's rays are too hot. I have so far found only one disease among them and that developed without a doubt from very unfavourable conditions in captivity. Before the herpetological station and the new, temporary terrarium were built, a consignment of six Glass Snakes arrived at the Zoological Gardens in Prague from Bulgaria, and for lack of space were kept in a small glass tank. On returning from a long journey I found them in bad condition, with septic sores all over their bodies. They received every care, but ultimately died. Otherwise, however, these reptiles are very hardy in captivity. Even the ordinary little slow-worm may live for over 20 years in a terrarium and a Glass Snake even longer.

The members of the *Anguidae* either have vestigial legs or their legs are in a stage of development indicating progressive atrophy. It is a most interesting phenomenon and one which is found repeatedly in amphibians and reptiles. A careful study of reduction of the limbs in some reptiles will undoubtedly contribute many new findings on this peculiar feature, which is no doubt of ecological origin and is due to certain changes in the environment of the reptile. The Glass Snake has only vestigial hind legs, although its ancestors had proper limbs. The miocene Glass Snake, *Propseudopus,* had only slightly larger vestiges of the hind legs and it is evident that atrophy of the limbs of the Glass Snake commenced much further back.

If we observe Glass Snakes and other species of Anguids in captivity, we gain the impression that the absence of their legs is a drawback to them. The reverse, however, is the case. Slow-worms live on stony slopes, always near their hiding-place, and before an enemy can reach them, they disappear. The brittle Glass Snake is also found most frequently beneath stones, where it is well protected, at least from animal enemies, since apart from the bear and the wild boar, no carnivorous animal will overturn a stone. This makes it all the more difficult to catch the Glass Snake, which is quicker than its small cousin and inhabits inaccessible places. For this very reason it is fairly abundant and is not threatened with extermination, although often caught for terraria.

THE MOST RAPACIOUS LIZARDS

Among the lizards found in tropical and subtropical regions, the monitors occupy a special place. It may be said that together with the iguanas, the agamas, the sphenodon, the crocodiles and the boas, they are the true representatives of prehistoric eras on our Earth.

The very appearance of the monitors would justify every observer in regarding these lizards, most of which are very big, as the prototype of all the dragons in the fairy tales. Some monitors, especially those which inhabit the swampy jungles of the tropical belts, are strongly reminiscent of the carnivorous giant lizards of the mesozoic period. If they were able to run only on their hind legs the resemblance would be complete. Some of the more primitive monitors still have the trace of a third eye on the crown of their head and attain considerable volume and size, sometimes measuring over 10 feet. All these monitors have a primary, oar-shaped tail and lead an amphibious life. Some smaller species, on the other hand, especially

those which inhabit open plains and steppes, are more streamlined, less clumsy and more adaptable. In these species the tail is usually entirely or partially oval.

In addition to over 200 other reptiles, I brought back from Tunis nine Desert Monitors *(Varanus griseus)*, which were very difficult to catch. The most easy to obtain were a few which I dug out of the lairs of desert rats. In the neighbourhood of a wadi (a watercourse filled with water only in the rainy season), several underground nests of these rodents are usually to be found at no great distance, opening up on to the ground by means of two or three holes. If the tracks of a monitor lead to one of these holes and are not seen to emerge elsewhere on the surface, then the monitor is sure to be found inside.

The digging takes quite a long time. The sand tends to collapse at first and so, after digging with the spade or hoe, the hand must be used to find the direction of the passage. About two feet down, however, the sand becomes damp and more compact and the passage can be traced more easily. The monitor is usually lying in a blind alley, but digs down deeper when it feels danger approaching. This makes it helpless, however, as it cannot turn to face the enemy. As soon as the end of its lashing tail has been seized, it is sufficient to scrape away the sand, at the same time moving one's hand along to its head, and the furious monitor can be pulled out and put into a bag.

The biggest Desert Monitor I have caught myself measured a little over a yard and weighed just over four pounds. This lizard provided me with a little adventure. I caught sight of it just before mid-day, as we sat down to lunch about 40 yards away. It was standing on the edge of the steep sides of a wadi, with upraised head, and was staring at us intently. I immediately got up to drive it into the bed of the wadi, which contained fine, loose sand, in which it would not be able to run very well. The monitor, however, did not want to go into the wadi and ran out into the desert. It was wonderful to see the big, yellow lizard racing along on its hind legs, with its abdomen not touching the ground, at a remarkable speed. Fortunately, it turned out that I was a better long-distance runner than it was, although I could feel the perspiration pouring off me as I ran. By our combined efforts we finally succeeded in chasing the monitor into the nearest wadi. When it realized that there was no escape, it turned on its pursuers like lightning, leaped up at my waist and fastened its teeth in my shirt. This, of course, only hastened its journey into captivity.

At first I kept the monitors I caught in a large cage in the garden of the Mulares oasis, where I had my headquarters, so that they could enjoy the sun, but they began to bellow so furiously that I was obliged to put them in two big sacks. In the cool dark their fighting spirit deserted them and there was no need to fear that they would kill one another.

It is difficult to imagine the power which even a small monitor has in its jaws. This strength soon becomes apparent in the terrarium, when the monitors begin taking food. A monitor measuring only 22 inches, complete with tail, would hurl itself on a half-grown white mouse, catch it by the neck and shake it so violently that the poor creature would at once lose consciousness. With an adroit movement of the jaws, the monitor would then seize the mouse by the head and crush its skull with one crunch. It would then, with difficulty, swallow it.

All monitors attack their prey in this way. If the animal is too large, the monitor holds it in its mouth and tears the body with alternate movements of its front legs, so that it is sometimes in shreds. The monitor's oesophagus is dilatable, as in snakes. The manner in which the swallowed food is conveyed into the stomach is also similar—during the process the monitor writhes like a snake. The first part of the swallowing process, however, does not resemble that of a snake or lizard. The monitor raises its head and throws the food into its oesophagus with jerky movements, using neither the jaws nor the tongue. There, the food falls by its own weight. Only then does the writhing begin. When swallowing particularly large prey, the monitor takes short rests and pants with a groaning noise, so as to assemble its forces for the next effort. And it really can achieve a great deal. A monitor weighing less than two pounds swallowed a white mouse weighing nine ounces and a week later a second, weighing

over 11 ounces. Another monitor, weighing just over three pounds, swallowed a pigeon, complete with feathers and wings.

The Desert Monitor devours almost everything which is given to it, with the exception of vegetable food, which it refuses. It cannot be said that it is over-particular, but it is none the less better to feed these lizards according to their own individual taste. Some like to catch snakes and slow-worms, others only eat them as a last resort. Not all monitors eat fish and very few will look twice at a frog. All, however, are passionately fond of white mice and their young also catch white mice and others, and lizards and young birds. In nature study books we read that they also feed on bird's eggs, but not one of the monitors in my possession ever attempted to eat a bird's egg, even when warmed. They enjoyed turtle's eggs, however, swallowing them whole.

A duel between a monitor and a big snake is a very dramatic sight. The monitor often first administers a few sharp blows to the snake's head with its tail, so as to break its spine or at least to stun it. It then seizes the snake by the head or by some other part of its body and crushes it in its terrible grip, moving its jaws up towards the snake's head. At the same time, the cracking of the snake's spine can be heard. The snake defends itself frantically, coiling itself convulsively round the lizard's neck and mouth and thus preventing it from breathing and swallowing. In that case the monitor shakes itself violently a few times, till the sand and gravel fly, and shakes the snake off. The fight sometimes lasts half an hour, but the monitor always emerges the victor; it then rapidly unreels the snake's body into its capacious intestine.

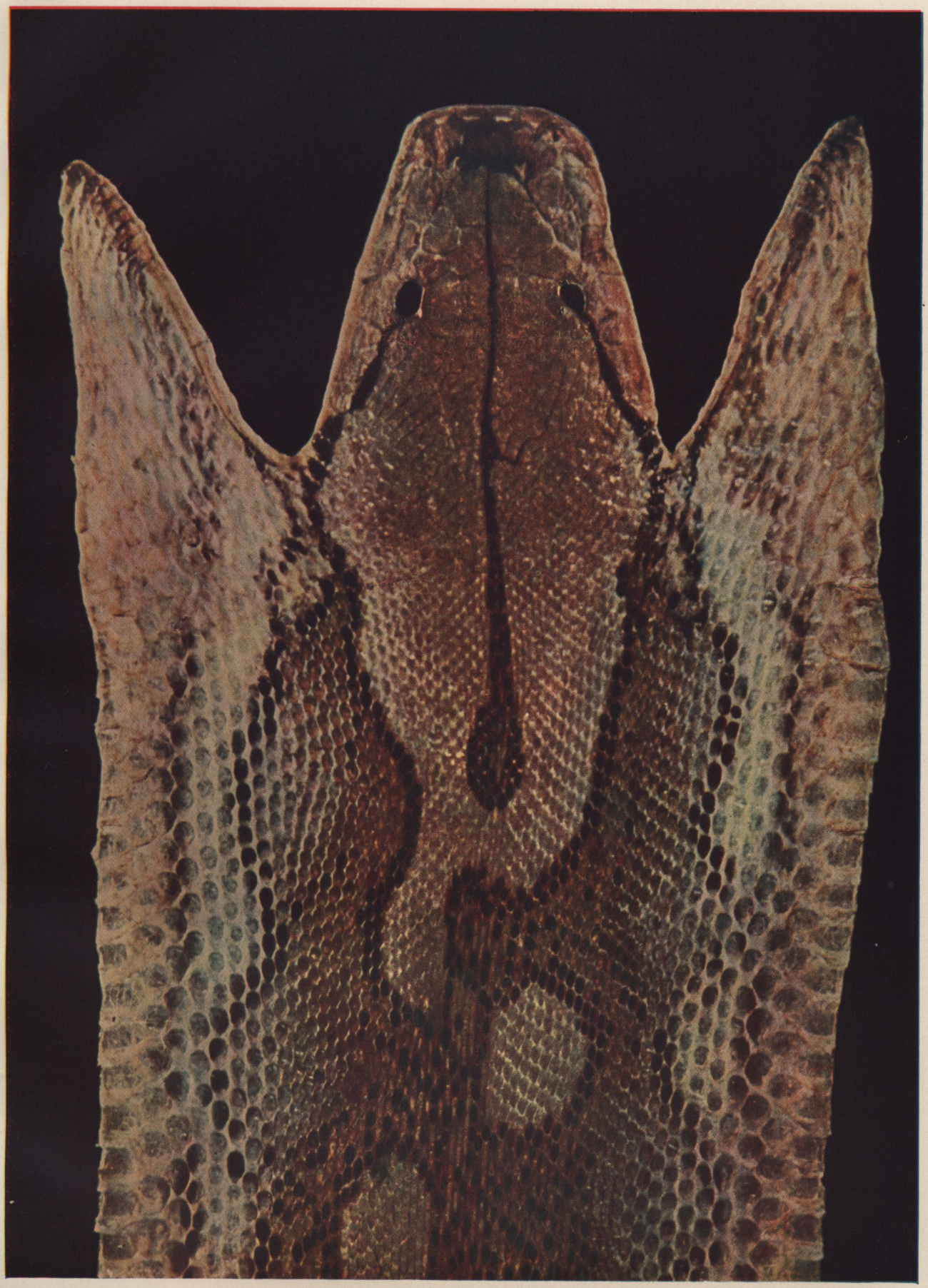
Like all the other monitors, the Desert Monitor is covered with a very strong, rough skin, which the fangs of the smaller venomous snakes cannot penetrate. Perhaps this is the only reason why a hungry monitor attacks these dangerous reptiles, since it is not immune to their poison (a bite from *Vipera lebetina* will kill it in a quarter of an hour, as I have seen with my own eyes). This snake, however, is a denizen of the mountains and under natural conditions the monitor probably never meets it.

In the terrarium the Desert Monitor requires coarse sand mixed with pebbles and a shelter for the night. It is a typical diurnal animal and as soon as it feels the chill of the evening it retires to its shelter for the night. When asleep it lies close to the ground, with its head tucked in to its side. It sleeps till the morning air is warm, since it requires a temperature of at least 25° C for normal activity. It then runs round the terrarium, climbs clumsily up the meshing and looks round with its restless yellow eyes with their black pupils for prey. It soon learns to take fresh, raw meat from a pair of tongs, but very few allow themselves to be touched with impunity. When annoyed, this excitable animal puffs itself up, hisses loudly, aims powerful and accurate blows with its tail and does not hesitate to bite. The monitor's bite is very painful and bleeds copiously, as its teeth, although sparse, are sharp and strong. To pick up a monitor, one must hold it with one hand by its long neck and the other hand must press both hind legs to its tail, to prevent it lashing out with its tail and scratching with its extremely sharp claws. It does not defend itself with its forelegs.

When the weather turns rainy and cold, the monitors need a strong lamp, hung low over their terrarium. We use 200 watt bulbs. If the weather is too hot, we spray the monitors with water, as they are very fond of a gentle shower. They drink only rarely, lapping up the water with their tongues. When they are very thirsty they also dip the front of their snouts into the water when drinking.

In captivity, monitors of approximately the same size get on quite well together, as long as food is not involved. They often fight over prey, however, displaying great strength. In my opinion, mammal beasts of prey of the same weight are relatively much less strong than rapacious reptiles. Not even the big nomad dogs, which have no hesitation in attacking a strange human being, would dare to approach too closely to a monitor, for whose tail and teeth they no doubt have a healthy respect.

The Desert Monitor sheds its skin frequently, in patches, but the process does not affect its appetite. The shed skin of the monitor is much thicker than that of other reptiles.



II. Anterior part of skin of Reticulated Python *(Python reticulatus)*, from specimen measuring 10 feet. Actual size.

The monitor's faeces usually contain waste substances such as the fur or feathers of its victims. Fur is found in separate bunches and when these dry they can be picked up. They look almost like the pellets ejected by owls, although in the latter case they are ejected from the beak. Sometimes thick bones or even whole jaws, if particularly massive, are found in the faeces of the monitor; these are usually found after large lizards have been eaten.

These strange reptiles undoubtedly live to a considerable age. This can be deduced from their slow rate of growth. In three years the Desert Monitors grew on an average by seven inches, the young ones somewhat more rapidly, the older ones more slowly. Even if they grow more quickly under natural conditions, the difference cannot be very marked. The monitors showed a disproportionate gain in weight, however, as they have little opportunity for exercise in captivity and are very well fed. Surplus fat is stored in the root of the tail. When the monitor is thin, the skin on its sides is wrinkled and the root of the tail is narrow; when it is in good condition, the body is oval and almost pot-bellied and the root of the tail is thick.

We also receive Desert Monitors from the Soviet Union, but these differ considerably from the typical African forms. Apart from the different markings and shape of the body, the tail in adult animals is flattened laterally, from about the first sixth to the last third, while the end is again rounded; in the African and Arabian forms, the tail is rounded from the root right to the tip. This striking feature was already observed by some earlier authors, but for lack of suitable material they were unable to determine for certain whether or not this was an independent subspecies[2]). In our abundant material, the difference in the Transcaspian monitors is clearly evident.

It is only natural that even the Desert Monitor, which is very fond of warmth, should not be able to stand too much of the sun's rays, particularly in the terrarium. At temperatures of over 40° C, it half opens its mouth and often goes into the water tank. How is this behaviour to be explained when it is known that in N. Africa the monitor is active even in the noonday heat? The explanation is quite simple. Even though the wind is warm or even hot, the continuous current of air over vast areas ensures a sufficient supply of oxygen. In the terrarium, which is in an enclosed room, there are no air currents and when the temperature is very high, the oxygen rises to the top of the cage or escapes via the meshing. This explains why a somewhat lower temperature than under natural conditions is sufficient for optimum conditions in the terrarium.

Another species kept by us is the Water Monitor *(Varanus salvator salvator)*. This is one of the biggest, as it grows to as much as ten feet, three-fifths of which, of course, are accounted for by the tail. Animals for trading purposes are usually up to six feet long, rarely more. Five-foot Water Monitors are handsome, powerful lizards, with much stouter bodies than the more lightly built Desert Monitors. The thin animals which arrive in crates from abroad usually weigh from 20—30 lb., but rapidly put on weight and may attain over 45 lb.

One of our Water Monitors, which died in 1949 from a malignant tumour, was found at a postmortem examination in the National Museum to have quite a few pounds of subcutaneous and abdominal fat.

The Water Monitor is more brightly marked when young. Later, the transverse rows of yellow spots on the back almost disappear and the lizard is pitch black. It has a long neck, a small, narrow head and a long snout with unusually strong jaws and bright black eyes. Its senses are quite as acute as those of the Desert Monitor and it is just as rapacious, but it is not able to swallow—relatively speaking—such large morsels as its smaller cousin. In captivity it requires correspondingly larger quarters, a water tank and a tree trunk for climbing. It takes food without any trouble, although at first it waits for the keeper to go away. Later it feeds out of his hand and follows him about, trying to snatch the food from him. It will take half-pound

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[2]) In his excellent book *Die Familie der Warane* (part III, p. 345), Prof. R. Mertens states that there are probably two subspecies: *Varanus griseus arabicus* and *Varanus griseus caspius*. On the basis of measurements and comparative studies carried out by myself I am of the opinion that this differentiation is correct.

pieces of veal (several of which it will swallow at a time), guinea-pigs, white rats, pigeons, raw eggs (which it crushes and, with raised head, allows the contents to run down into the oesophagus), fish and frogs, and is also very fond of large lizards and colubrid snakes.

The Water Monitor has different habits from the Desert Monitor. Its mode of life is determined by the swampy jungle environment in which it lives. The Water Monitor lies in wait on rotting tree trunks and thick branches, crawls through muddy pools, and when in danger jumps into the deep water, where it can remain for a long time. Although it has no webbing between its toes it is a good swimmer, using its long, powerful tail, which is flattened at the sides.

A remarkable feature demonstrating the ancient origin of this monitor is the trace of the remains of a third eye, which in some individual animals is particularly evident. The "eye" is tough and white and incapable of vision; it looks like a small, inconspicuous white spot.

The Water Monitor is found between Ceylon and the Philippines, including the East Indies. Being scattered over so wide an area, it is not surprising to find several subspecies, which differ both in colouring and also morphologically. It is also found on the islands of Flores and Komodo and on others, which are at the same time the home of its rare and more powerful cousin the Komodo Dragon *(Varanus komodoensis)*. On dry land the Water Monitor moves well but not very rapidly; its powerful claws are useful for digging and when in danger it defends itself by lashing out with its muscular tail and by biting and scratching.

I have felt the strength of a monitor's tail more than once. Big monitors, when newly caught, lash out with their tail at every opportunity and a powerful blow will fell a man to the ground. One of the monitors, measuring just over six feet, knocked a rung out of a chair, while another almost broke a table. The tail suffers damage, however, from sharp blows against hard objects; the thin tip may be injured and become inflamed and a small amputation often has to be carried out. This is why firms abroad often deliver monitors with tails from four to twelve inches too short.

I have also had occasion to feel the strength of the jaws of these big lizards. Their wide apart, but very sharp, teeth are in themselves a wicked weapon, but in combination with the remarkable strength of the jaw they are as dangerous as the jaws of the crocodile. The Komodo Dragon can crush a goose's head with one movement of its jaws; when it bites a stick it leaves behind deep indentations and often bites splinters out of it. It is not afraid of man and soon behaves as if it had quite forgotten that it had been living not so long before in the freedom of natural surroundings. It lets itself be stroked, but care should always be taken to guard one's hand from its jaws. It is not easy to catch this big lizard and pick it up. It must be taken by both hands under the forelegs from behind and lifted up, taking care not to let the hind legs get caught in one's clothes, which they would otherwise tear.

These directions for seizing a monitor appear simple, but the actual process is usually dramatic. The animal puffs itself up, twists and turns, hisses, flails about with its tail and tries to bite.. One man alone is not able to hold a big monitor and needs an assistant to hold it by the tail.

The following example will demonstrate what a Water Monitor can do. A monitor measuring six feet (body 2 ft. 8 in.) was harnessed after a hard struggle to a little cart in which rode a child weighing 36 lb., and pulled it without any effort. I then got in myself, with my nine-and-a-half stone and the monitor—this time with an evident effort—pulled this tremendously increased load as well.

The faeces of the Water Monitor are soft and fluid and the Monitor excretes them with a loud splash. This makes its quarters dirty, in contrast to the Desert Monitor, which produces mounds of firm faeces which can easily be collected with a shovel. The water in the large tank requires changing every week, as the Water Monitor excretes its faeces most frequently in the water.

The amphibious mode of life of the Water Monitor results in this lizard being less susceptible to changes in temperature than its smaller cousin, in spite of the fact that it lives in

tropical regions, and it even takes food at a temperature of 24—26° C. It is, of course, more active at higher temperatures. Its favourite occupation is to lie in warm water, completely submerged, and it will remain like this for hours without stirring. Towards evening it becomes more lively, puts out its long, forked, bluish-violet tongue, comes out of the water and looks around the cage. At this time of the day it is also somewhat nervous. After 10 o'clock in the evening it returns to the water and sleeps till the early morning.

When annoyed, the Water Monitor expands its throat, hisses like a goose, but is never the first to attack and defends itself only when in a tight corner. It is not vicious, therefore, like the Desert Monitor, which is, of course, much more agile.

One of the handsomest, and also biggest, of the Monitors is the Australian Monitor *(Varanus varius)*. It may grow to over seven feet, but in contrast to the Water Monitor, retains its bright colouring throughout its life. It is brown-black with bright yellow cross-stripes, its abdomen is whitish or yellowish white with black stripes or blotches. This monitor has particularly long, strong claws.

So far I have had occasion to keep only one of these monitors (about three feet long), for eight months. At first it was very distrustful and whenever anyone approached the cage it showed signs of great perturbation, but it soon grew accustomed and calmed down. Although it would eat out of one's hand, it would never voluntarily allow itself to be touched and always characteristically drew in its whip-like tail, ready to strike. When picked up, it retaliated chiefly by biting and scratching. It could climb quite well, but preferred to remain on the ground. It liked being sprayed with warm water, which it required several times a day, but it rarely climbed into the water tank.

Like the Water Monitor, *Varanus varius* cannot swallow such relatively large prey as the Desert Monitor, which is probably the best swallower of all these lizards. The Water Monitor, for example, was unable to swallow a medium-sized guinea-pig, which had to be cut up into several pieces before it could be eaten. It was fond of mice, white rats, fish and pieces of meat. Its optimum temperature was about 30° C.

After four months in the herpetological station, the Water Monitor reacted, when I or someone else approached, by running to the front wall of the terrarium and pressing against the place where the cage opened, so that it frequently could not be opened at all, for fear of the lizard falling out. This did not happen, of course, out of any pleasure at the prospect of human company, but because the animal hoped for something to eat. When its hunger was appeased it crawled into the farthest corner and lay down to digest and to sleep. It required feeding at least twice a week. The average amount of meat or mouse, fish or other food sufficient for this monitor was about seven ounces for 2—3 days.

This monitor was at its most active in the evening, if it was sufficiently warm beforehand. When it was completely dark, it would curl up and go to sleep. Its faeces were almost as soft as those of the Water Monitor. After eight months with us, it was measured again—a very difficult task, because of the furious fight it put up. It had increased over one inch in length and over a pound and a half in weight and now it weighed 8¾ lb., as compared with the 7 lb. 3 oz. it weighed at first.

All varieties of monitors shed their skin very frequently. Amphibious species shed it almost continuously. One part of the body may already be clear of the old skin, while another part is still in process of shedding and when the pieces of membrane-like skin have been shed, another part of the body begins to peel. It is not known why monitors shed their skin so often, as they grow very slowly. In these lizards, as with the big snakes, the period of quickest growth appears to be up to two or three years, after which growth considerably slows down. Although some authors state that monitors grow fairly quickly until they are full grown, this does not tally with our own observations, made over a period of years on captive monitors, nor with experience of these animals in their natural environment, as far as this could be obtained in the animal's own country[3]).

[3]) V. Choumovits (Mulares—Tunisia) and others.

It still remains to describe reproduction in these strange lizards. The Desert Monitor buries its eggs in the sandy banks of dried-up water courses and often in the holes of desert rodents. The eggs have a rather tough, leathery covering and the period of incubation appears to be very long. We have tried by various methods to keep the eggs laid by the females imported from Central Asia until they hatched, but so far without success. The Water Monitor also buries its eggs, probably on the banks of rivers and swamps.

THE JAKRUARU AND THE SKINKS

South America is inhabited not only by big, herbivorous feeding lizards, like the Iguana, but also by the big carnivorous feeding lizards of the family of the *Teidae*. We often keep in particular the species *Tupinambis nigropunctatus,* which comes from Brazil and is conspicuous not only for its colouring, but also for its rapacity. It requires a small pool for bathing, shade, and a somewhat larger terrarium. It also requires a higher temperature, much the same as that needed by the monitors.

The Jakruaru, as it is called by the South American Indians, is at first very wild and distrustful. When first released from the crate in which it arrives by air, it is most belligerent. It stands on the tips of the short toes of its forelegs, putting out its long, pink, forked tongue, hisses and attempts to bite with its strong, sharp teeth. It also lashes out with its long tail, but since the structure of the caudal vertebrae is not very strong, the tail may snap off. It may then take more than a year for the tail to grow again partially.

This interesting lizard, which is yellowish-brown in colour, with black markings, has one feature in common with some big agamas—it can stand upright and run on its hind legs. It did not use this form of locomotion in the terrarium, but tried it when given a trial run in the garden. The Jakruaru felt the breath of freedom, looked round with its big, bright, black eyes at its captors and crawled for a while in the grass. When I made a movement, the lizard reared itself on its hind legs and ran with surprising swiftness straight for the wall. A stopwatch showed that it ran over 24 yards in about four seconds (although the timing may not have been absolutely accurate).

Later experiments, however, showed that some of the animals of this species can run only on all fours. This applies in particular to Jakruarus which have been kept for a long time in captivity. New arrivals almost always run in an upright position, to escape capture, when let free in an open space. The sight of the big reptile moving like the extinct Iguanodons is unforgettable.

If given sufficient warmth, the Jakruaru is very active. It runs about the terrarium, scales the meshing and also attempts to climb along sloping branches, but without much success, as it is a typical terrestrial animal. It is very fond of a warm bath. It usually spends the whole night in the water, with only its nostrils above the surface; in the daytime it also likes to retire to its bath when it has had enough of sun-bathing.

The Jakruaru is a very rapacious lizard, but it is not dangerous to other large reptiles, as it is unable to swallow even such large morsels of food as the monitors do and its jaws are less strong. Its weak forelegs are also unable to tear up its prey. When young, therefore, it catches mice, crickets, locusts, may-bugs, lizards and small snakes, while the adult animals also catch rats and birds and even steal eggs and do not despise fruit. They swallow their food in the same way as our own lizards, helping it down with their tongue and undulating movements of the throat. On sighting approaching prey, the Jakruaru usually remains stock still, with upraised head; when the unwitting victim is within an inch or two of the lizard, the latter seizes it with the rapidity of lightning. The Jakruaru first crushes the head of large animals; crickets are easily caught and thrown into the oesophagus with a rapid movement.

It first feels round an egg with its tongue, slowly picks it up, raises its head and crushes the shell with its teeth, letting the contents run down into its throat. It does not eat the shell.

This species is much more belligerent than its relation, *Tupinambis teguixin,* which in time permits itself to be picked up. The Jakruaru will learn to eat out of one's hand, but never allows itself to be handled. In such an event it takes up a bellicose attitude and retreats and its appearance leaves no doubts as to its intentions. When in a tight corner it offers resistance, snapping at the object of annoyance, and if it succeeds in getting its teeth into something, it tries by lashing about to cause its assumed enemy as much pain as possible.

It cannot be said, therefore, that the Jakruaru is exactly an affectionate pet.

I soon found that these lizards digest their food very quickly, even when unable to run about a great deal. A Jakruaru measuring 24 inches, including the tail, requires a mouse, a large lizard or a piece of meat every other day. If it measures over three feet, the amount is trebled. Even when shedding its skin (which it does by pieces, several times a year), it takes its food as usual. At first it catches its food shortly before sunset; later it does so entirely in the daytime, retiring to its shelter, or into the water, to sleep in the late afternoon.

The Skinks are smaller, but equally interesting terrarium inmates. This name does not mean much to the uninitiated, as only one slender species is found in Czechoslovakia — the Snake-eyed Skink *(Ablepharus pannonicus)* — and even this is restricted to S. Slovakia. The skinks are found chiefly in tropical and subtropical regions. For the most part they have relatively short legs and some species have partially or completely stunted limbs. Those which live in the desert move over the sand with the greatest ease in a serpentine fashion.

From Tunis I brought back many skinks of the species *Chalcides ocellatus* and *Eumeces schneideri,* which have proved to be unassuming and hardy inhabitants of the glass-house. It will no doubt interest the reader to learn how these small but charming reptiles were caught.

The skinks of the species *Chalcides ocellatus* are found more along the coast of the Mediterranean. A great many are to be found in Carthage, for example. I first saw them in a long, high wall surrounding a large monastery. The brown head of a skink, with its metallic sheen, could be seen poking out of almost every chink. At any suspicious movement the heads would vanish, to reappear a few minutes later. When I stood quite still, the skinks, with their long, cylindrical bodies, would emerge completely, take a careful look round and begin to run with jerky movements, with the whole abdominal surface touching the ground. Every instant a skink would snap at a beetle or some other insect and it frequently occurred that two or three would quarrel over their prey. They do not even despise the harder beetles and crunched their wing-sheaths with audible enjoyment.

When I moved, the skinks looked at me with their bright black beady eyes, waited a moment and then, when nothing further happened, resumed their activities. It was very difficult — virtually impossible — however, to catch a skink, even when it was very close. It would run a short distance with surprising rapidity, zig-zagging as it went, and usually reached its shelter before it could be caught. The young Arabs who watched my efforts with undisguised interest and amusement, offered (after I had tried in vain for about two hours) to bring me a skink for five francs. I promised readily enough and lo and behold! in a very short time they brought me four handsome live specimens all at once. We finally arranged that I should give them 100 francs in return for the secret of how to catch the *zerzumi,* as they called them.

It was quite simple. We went to the nearby main road, which was intersected by various side tracks. In the ditch below every crossroads there was a pile of rubble. This rubble was full of holes and from almost every hole a skink was peering out invitingly. It was enough to take a small hoe and in two hours I had a crateful of skinks to send home.

This small reptile, which may measure as much as ten inches, but is usually smaller, has a small, pointed, somewhat wedge-shaped head, short, weak legs and a short tail. Its body is covered with hard smooth scales, which make it very difficult to hold a skink in one's hand.

The body is oval-shaped in section. In the terrarium it requires warmth, but it is one of the best reptiles to keep. It eats almost all types of insects, including hard beetles, and is quite content with a piece of raw meat or a boiled egg and likes an occasional piece of sweet fruit.

It approaches its prey very cautiously and when near, suddenly strikes, usually without missing. Its movements are sure only on the ground. In the terrarium it can climb up the meshing or rough branches, but occasionally it falls down; this does not prevent it from trying again, however. It soon learns to eat out of one's hand and becomes quite tame and very trusting. *Chalcides ocellatus* is sociable; the males sometimes fight, but never seriously hurt each other.

The most satisfying feature about these lizards is that they often mate and reproduce in captivity. The female will unexpectedly produce several young ones, which are independent from the very first and, apart from their size, are identical in appearance with the adults. The feeding of the young ones does not cause any special difficulty and they adroitly catch small insects and their larvae.

Like many other lizards, these skinks can be kept in sand, partly coarse and partly fine, with small and large pebbles scattered here and there and a water tank sunk into the ground. At night, or when it is too hot, the skinks burrow in the sand; otherwise they are outside all the time. Young ones, however, hide in the sand more frequently.

One of the most handsome and largest of the skinks is *Eumeces schneideri*. I also hunted these lizards on my Tunis expedition and brought back several dozen of them. This skink looks much more like a lizard than *Chalcides*, not only in form, but also in posture. It attains a length of ten inches, two-fifths to one-half of which are accounted for by the tail. Its back is brick-red or vermilion, with small, deep yellow spots, its sides are yellow and its underside is pure white.

These reptiles are particularly hard to catch, because they are rarely found anywhere except in the clumps of thorny bushes which grow in small islands in the desert. Here they dig burrows not far below the surface, with several openings, and they often inhabit such an island of shrubs together with the desert rat *(Gerbillus hirtipes)*, a small yellow rodent.

In order to obtain a large number of *Eumeces*, there was no alternative but to cut down the whole of one of these islands of shrubs with sharp knives, clear away the branches and dig carefully down into the shallow burrows so as to avoid the sand collapsing inwards. We rarely succeeded in digging out more than two or three skinks at once, however, and these did not submit without a struggle, but bit unwary fingers viciously. It was no easy matter to cut down the shrubs and catch the skinks at a minimum temperature of 40° C in the shade, but the lizards were sufficient reward for our trouble.

These skinks are not so hardy or so sturdy as *Chalcides ocellatus*, but with good care they will also do well. The males, which have a larger head, often engage in violent duels, causing each other serious injury with their powerful teeth. Large males should therefore be kept separate. They are fond of weevil grubs, but also like large beetles, crushing their hard wing-sheaths with ease. They frequently shed their old top skin; a few days prior to this they almost lose their colouring and often refuse food.

Skinks of the species *Eumeces algeriensis* soon grow so tame that they can be picked up without attempting to run away and eat out of one's hand without any reluctance. They are fond of cherries, pieces of apple and other fruit and also eat pieces of tomato. They have carnivorous tendencies, however, and cannot be kept together with small lizards, as they are very clever at catching these, crushing their heads and greedily swallowing them (usually biting off the tail). They even eat small Colubrid snakes which have just hatched out, and it is not unlikely that they also attack the young of venomous snakes. I have often found remains of large scorpions in the faeces of freshly caught skinks.

The terrarium of these skinks must be arranged in the same way as that of *Chalcides ocellatus*, but it is better to sprinkle the ground only with coarse, washed sand, as fine sand often gets into their nostrils and is difficult to get rid of (by sneezing). It cannot enter the

ears, as these can be closed by comb-like flaps. *Eumeces algeriensis* also likes to burrow itself in for the night, but not very deep; it remains only just below the surface of the sand. It requires greater heat than *Chalcides* and if the temperature comes down to below 25° C will refuse food. The smaller form, *Eumeces schneideri,* several specimens of which I brought back from Syria, also behaves in the same way.

The skinks have a brittle tail, but not so fragile as that of lizards of the genus *Lacerta* or of the slow-worms. It also takes longer to grow again and is usually irregular or otherwise disfigured. In skinks with a longer tail, such as those of the genus *Eumeces,* the tail is more brittle, whereas in those with a shorter tail, such as *Chalcides ocellatus,* the tail is not so easily lost.

One of the most lively skinks is *Mabuya aurata affinis* from Nakhichevan in Azerbaijan. It is light bronze-gold in colour, with distinct black markings. It is a slender lizard, attaining a length of seven inches, and inhabits low-lying areas and hills in steppe country, where it runs about in the long grass. It catches small insects and their larvae, spiders and centipedes. It is a nimble, active little creature, but cannot be kept together with other small skinks, as it would steal most of the food before the others even got a look in.

In their own small terrarium, which is part sand and part grass, these skinks have a somewhat different mode of life from other members of the family. They are fond of the water when it is hot and avoid the direct rays of the sun.

THE WORLD OF THE CHAMELEON

It is interesting to note how some quite innocent animal may become proverbial without the majority of people who use the proverb knowing what the original really looks like. One example of this is the Chameleon *(Chamaeleo chamaeleon),* which is found almost everywhere round the Mediterranean. It is a comparatively small reptile with flattened sides, strangely constructed eyes and prehensile feet and tail. Its usual colour is light green, but when excited it can change its colour to dark-green, yellowish brown, brownish grey or grey-blue. Sometimes large spots or blotches may appear, only to disappear again suddenly. People long ago noticed these changes in colour and thus the comparison grew up between a person who easily changes his mind and the chameleon.

This strange and remarkable creature is specifically adapted to life in trees, in which it is hidden by its gift of colour adaptation. It has long, thin legs and the toes, which are divided into two complementary groups and are partially fused, enable the chameleon to grip even the slenderest of stems. At the same time it does not take a single step without mooring itself by its thin but muscular tail, by means of which it maintains so strong a hold that it can hang by it like a monkey.

The eyes appear very small, as only the dark, glittering pupil is visible. The rest is hidden behind a large, circular, rough skin covering, which is nothing more nor less than a special eyelid. The chameleon can move either eye independently of the other and can thus see two different fields of vision at once. For example, it can observe a fly with one eye, while the other watches a person's every movement. The tongue is also an original feature. Relatively speaking it is the longest in all the vertebrates and shoots out to catch various insects with amazing accuracy. It is thin and cylindrical in shape, the end being wider and provided with a sticky suction disc.

So much for a brief introduction to the chameleon, which is an example of the highest possible specialization among the reptiles. How does it live in the glasshouse? We have kept chameleons from N. Africa and Palestine; although belonging to the same species, the latter are larger. The African variety came from Tunis, where I caught them in the Gafsa area, on

shrubs and olive trees. It might seem to be unusually difficult to catch sight of this quick-change artist, but it is not so in actual fact. It is true that the chameleon cannot usually be seen immediately among the dense shrubs, but it is sufficient to poke them carefully with a stick and the chameleon betrays its presence by moving to a safer place or by taking up a threatening stance. When doing this, it flattens itself even more than usual, so that it is possible to count its ribs, performs strange contortions, expands its neck to twice the normal volume and opens its mouth wide. All that then remains to be done is to pick up the chameleon carefully, together with the twig to which it is convulsively clinging, and put it into the bag.

Of the many species of the family of the *Chamaeleontidae* which, with the exception of the species described above, inhabit only Africa and Madagascar, the Common Chameleon, which also inhabits India and Ceylon, is probably the most difficult to keep, although it is not the smallest, as there are chameleons which measure little more than two inches, tail included. It does best in conditions of relative freedom, but will also live long in a small terrarium, with enough warmth and dryness. It needs some climbing facilities and a suitable shelter, in this case preferably a small evergreen shrub. Since the Common Chameleon drinks only rarely and is satisfied with drops of water hanging from the leaves, a water container is superfluous and even dangerous. Water is sprayed every few days, taking care not to touch the body of the animal, as every drop which falls directly on to the chameleon causes it discomfort.

The chameleon, which has a pointed, bony "helmet" on the nape of its neck, sits on a small branch in the middle of the shrub; very occasionally it slightly shifts its position, but otherwise remains motionless. Suddenly it will catch sight of a large fly, which has settled on a leaf some eight inches away and has begun to clean its large, complex eyes with its legs. The chameleon slowly turns its head. One eye is focussed forwards and warily observes the fly, the other jerks backwards, upwards and downwards, looking out for danger. The fly sits motionless. The chameleon is hampered by a twig which it must circumnavigate in order to reach its prey. It does not matter that the fly does not move, the chameleon's sight is as sharp as the well focussed lens of a camera. It carefully places one foot in front of the other, loosens and re-coils its tail and thus makes its way round the obstacle. It then opens its mouth, there is a flick and a click, and in a few bites the fly disappears into the chameleon's stomach.

The way in which the chameleon can use its tongue at a range further than the length of its own body is quite as remarkable as the speed with which it seizes its prey. Sometimes it shoots out its tough tongue more slowly, but only for shorter distances. It appears to reach longer distances only when it flicks the tongue out sharply. It is also interesting to note that it can catch quite large insects, such as grasshoppers, with its tongue. Everything which is conveyed to its mouth is crushed by its strong teeth and only then eaten. The chameleon digests its food quite quickly and since it most frequently catches small insects, it is always on the look-out. Its favourite food consists of grasshoppers, cockroaches and locusts. It also eats weevil grubs.

Chameleons like peace and solitude and dislike excitement. They should always be kept separately from other reptiles, therefore, and because there is not always enough room, owing to the constant coming and going of reptiles, I solved the problem by letting the chameleons loose in the glasshouse, where they settled on suitable plants and on the cages. There they had flies and spiders in abundance and we also kept them supplied with crickets.

Some people may think that a chameleon's life is dull. They forget, however, that the imagination and desires of chameleons, lizards and crocodiles cannot be judged by human standards. Man has developed so far that he is hardly capable of comprehending the simple mental life of animals, even in part. Actually their life is not so monotonous. They are able to accumulate experience and also, if need be, to apply it, in their somewhat rigid manner. They always have to be on their guard against attacks by an enemy and have to be able to defend themselves, either actively or passively, according to the weapons with which nature has provided them. Many beasts of prey, which live on other animals, have adventures every day (and sometimes several times a day), of the type which man goes out to seek with rifle

or fishing-rod in hand, as a pleasant or dramatic pastime. It would be wrong, therefore, to assume that an animal is bored, when it must be on the alert all its life and make constant use of all its inherited and acquired skill in finding food and the other necessities of life.

As with all the other vertebrates, the mating period is a particularly bright spot in the life of the chameleon. In August or September, the invisible action of hormones turns the attention of the males from more mundane matters to the females. It may even occur that in their quest after the females, the males may settle old accounts of jealousy, and the sight is indeed a comical one. The rivals sit swaying, face to face, on a thin twig, holding on firmly by their tails, and with their forelegs drawn up to their chests like kangaroos. The skirmish, which sometimes lasts for quite a long time, usually ends without scratches or scars. About two months after the mating period (about the middle of October), I found one of the females burrowing a hole in a flower-pot at mid-day and laying eggs in it. Another female also laid eggs in another large flower-pot. No young ones hatched out, however, and all the eggs went bad, possibly because the soil in the flower-pots was too damp from frequent watering.

The commonest cause of death among chameleons in terraria is chill. The animal shows signs of disquiet, moving about from one place to another, refuses food, loses the ability to change colour and more and more remains lying on the ground. It finally takes on a greyish or yellowish hue and dies. Chameleons also die very easily from injuries.

Among the chameleons we find not only tiny dwarfs, but also veritable giants. The Madagascar Chameleon *(Chamaeleon oustaleti)* may measure over three feet, whereas the Common Chameleon attains barely twelve inches. Of the African species I have often brought back and kept the species *Ch. basiliscus,* which is found from Egypt southwards and in West Equatorial Africa, and *Ch. dilepis* from East Africa. Both are similar in size to the Common Chameleon, but they are permanently green or grey and are not so difficult to rear. These two species, which are found in Africa in abundance, are the species most commonly sold in pet shops.

STRANGE BLIND SNAKES

Artists in the Middle Ages painted snakes—mostly the well-known "sea-monsters"—as some kind of monstrous worm. Today it makes us smile to see pictures of these grotesque conceptions, which have nothing in common with reality. Science has done away with all these fantasies and replaced them by real creatures, the complexity of whose body structure and habits far exceeds that of the strange creatures of imagination of those ancient mariners.

There still exist today, however, families of snakes which bear a striking resemblance to earthworms or threadworms. These are the snakes of the group of the *Opoterodonta,* which are divided into two families—the *Typhlopidae* and the *Leptotyphlopidae.* They have in common a vestigial pelvis, very small eyes, like dark pin-points, an almost indistinguishable mouth and a singular similarity between the fore part of the body and the hind part, which is formed by a short, blunt tail. Even an experienced zoologist must look closely before he can distinguish one end from the other.

We have so far kept only one species in our terrarium. This is the species *Typhlops vermicularis,* which is found in the south of the Balkan Peninsula, N. Egypt and W. and Central Asia. Some natural historians have given it the name of "blind snake", with reference to its most important characteristic. This species has relatives in all parts of the world, particularly in tropical countries. All these snakes have inconspicuous colouring, mostly light brown, brownish pink or yellowish. *Typhlops vermicularis* is a somewhat pinkish brown colour, with a lighter abdomen and small, very smooth scales and an unusually tough skin, which even a sharp needle has difficulty in piercing. The eyes shine through the skin like small, black

points and the snake can distinguish only light and dark. Occasionally the *Typhlops* protrudes its small, pink, forked tongue, but not nearly so often or so far as other snakes.

From among the large number of these snakes which I had at my disposal at the time I selected a few females which were about to lay their eggs, but in spite of the fact that they were kept separate and in a good environment, they all laid their eggs on the surface of the sand or beneath a piece of bark, where the embryo dried up. Under natural conditions they doubtless lay their eggs deep in the narrow passages of their own burrows, where there is sufficient moisture. The eggs, which were laid in May, were unequal in size and very elongated. Their average length was from 3/8 to just over 1/2 inch.

Typhlops have a strange form of locomotion. Their tough but pliable body undulates very little, but tends to move forwards rather in a straight line. Only the head moves from side to side. The movements of this snake, which measures about 14 inches at most and is 1/8 to 1/4 of an inch thick, differ completely from those of other snakes.

In the areas which it inhabits it may be found in dry places, chiefly under stones, where there is usually a whole cluster of them together. In the terrarium they require the same conditions, but with more moisture than in their natural environment. It is not quite clear why this is so, but I assume that it has something to do with the special climatic conditions in the terrarium, which differ from natural conditions chiefly because of the reduction in the amount of oxygen in the air even with only a small increase in temperature.

The optimum temperature, at which *Typhlops* are the most active, is 22—24° C. If the temperature is higher or lower, they crawl into the soil. When twilight comes they crawl about the terrarium, looking for food. Incidentally, their food is unusual, like themselves — they live on ants' eggs (pupae).

The frontal, rostral part of the head is very sensitive and is also used by the *Typhlops* for burrowing, which it does with great dexterity and strength. When the snake touches an ant's "egg" with its mouth, it stops, feels it with its tongue and seizes it in its mouth by slightly raising its head and opening its small, almost straight mouth as widely as possible. It adjusts the pupa somewhat clumsily, so that one end points inwards, and then promptly swallows it. *Typhlops* prefer the pupae of smaller species of ants, e. g. *Tetramorium caespitum,* no doubt because of their size and the greater ease with which they can be swallowed.

As far as I was able to observe, I have seen a *Typhlops* swallow from 6—12 ants' eggs in quick succession. This was apparently sufficient to appease its hunger, as it paid no further attention to the pupae. These minute snakes digest their food fairly quickly, however, since they fed again two or three days later.

I have conducted many experiments to ascertain whether *Typhlops* will take any other food than ants' eggs. I left them without food for a number of days and then presented them with fly larvae and pupae, small earthworms and young weevil grubs. The experiment was successful only in the case of small pupae and even these had to be quite fresh and soft. The snakes sometimes investigated older and harder pupae, but did not eat them. They paid no attention to fully developed ants, whether alive or dead, although many of these were swarming over their bodies. It is interesting to note that newly born ants often made furious attempts to bite the *Typhlops,* but their sharp jaws slipped on the smooth scales. This enables these snakes to enter the inmost passages of an ant-heap for pupae (and possibly larvae) with complete impunity.

When caught, *Typhlops* never bite. They could not actually bite, as their mouths are so small, but they sometimes coil themselves round one's finger with a strength surprising in so small a creature. Not even this, however, is sufficient defence against an enemy and it is therefore surprising that these snakes are still so plentiful in certain parts. I myself have received proof in a freshly-killed specimen, that the shrew-mouse *(Sorex araneus)* does not hesitate to eat *Typhlops.*

At first sight it would appear impossible that *Typhlops* are closer to the Boas in the reptilian order than to other snakes, but such is the case, although it is only a matter of some

ancient features which bring these groups close together. If we assume that snakes developed from lizard ancestors via a temporary subterranean mode of life and then returned to a terrestrial form of life, we may see in the family of the *Typhlopidae* and *Leptotyphlopidae* an example of this metamorphosis, preserved right down to the present day.

It is indeed a strange, restricted world, difficult for man to comprehend, in which these small blind, or almost blind, snakes live in eternal darkness, like many types of insects and their larvae and also some crustaceans and worms. However, there are also blind fish, amphibians which live in eternal darkness and also examples among the mammals, in the orders of insectivorous animals and rodents, many of which are almost or completely blind (e. g. various species of rodents of the family of the *Spalacidae)*. All these animals live mainly by their sense of touch and many by their sense of smell and hearing, and they do not seem to be at a disadvantage in the struggle for existence, as compared with those which can see.

It is only logical that if the *Typhlops* adapted itself to life in small passages beneath the ground and under stones by degeneration of sight, as a superfluous sense, the rest of the body must also have been affected. Strong facial and rostral scales cover the front of the head to form a firm plate, enabling the snake to burrow with ease in the soil and sand. The upper jaw, in which there are only a few, strikingly strong teeth, placed obliquely on either side, protrudes markedly beyond the lower jaw. This formation can also be seen in the Sand Boas, in the Colubrid snakes of the genus *Lytorhynchus,* in the lizardlike skins and in some other reptiles which burrow in the sand. The nostrils are very small and can be closed against the penetration of small particles of soil. The most remarkable feature is the skull, which is massive and is adapted for burrowing quite as strikingly as that of the mole, although it is much more primitive in form.

Many subtropical and tropical species of the family of the *Typhlopidae* live on termites, and actually inhabit their imposing structures or live in the immediate vicinity.

PYTHONS AND BOAS IN THE TERRARIUM

There are some snakes which measure less than eight inches, but there are giant snakes which attain well over 30 feet and a corresponding weight. The reader has no doubt seen smaller specimens of these big snakes in a circus menagerie or zoological gardens. Few have had the privilege of meeting a boa or a python in its natural tropical surroundings, and I doubt whether many people would keep these reptiles in a terrarium, to enjoy the beauty of their colouring and movements and to observe their tremendous strength when they coil themselves round their prey in a deadly embrace.

I have kept about 100 big snakes and know them well from all aspects. Sometimes, however, I cannot judge beforehand the disposition of individual snakes, which can only be estimated after at least three months. Some species are regarded as particularly docile, such as the Indian Rock Python, which is a favourite of travelling menageries and is used in various kinds of snake dances, but I have found that even among these pythons there are some irritable ones, which tend to bite. After a certain time, when the snakes have been placed in suitable quarters and have recovered from the effects of their journey, it is possible to ascertain which of them are suitable for "closer contact" with man. For this purpose we do not recommend snakes longer than about 14 feet, which by then may already weigh over 70 lb.

In the literature and from natives we hear tales of gigantic snakes which inhabited Africa, S. E. Asia and S. America before the lord of creation came along. History contains reports of snakes measuring 50 feet and more, which were said to be able to swallow a horse. In the light of present knowledge these reports must be regarded as exaggerated, since there is no evidence of any snake of that size having existed within the era of history, even if some such

big species might have been exterminated in ancient times by man. The biggest snakes now extant, as already stated, may attain as much as 30—35 feet, but their average length is 14—20 feet.

When estimating the length of a big snake, there is always a tendency to exaggerate; this is a natural trait of human psychology. If this is true today, it applies even more to times when every generation regarded it as its moral duty to add something from its own imagination and to add a yard or two to every snake.

Of the giant serpents inhabiting the tropics of the Old and the New World, the longest are the Reticulated Python *(Python reticulatus)*, from Indochina and Malaya, the dark Indian Rock Python *(Python molurus bivittatus)*, also from Indochina and Malaya, and the Giant Anaconda *(Eunectes murinus)* from S. America. These snakes are also the heaviest, the heaviest of all being the Anaconda. Occasionally the African Rock Python *(Python sebae)* attains a length of 25 feet. The well-known Indian Rock Python *(Python molurus molurus)* and the Boa Constrictor rarely attain more than 16 feet. The other species are smaller.

In travelling menageries, snakes rarely survive for longer than 5—20 years, as they do not receive the proper attention. In large zoological gardens, where they have comparative peace and quiet and a regular check is kept on their health, they often live much longer. The giant serpents probably developed in the Cretaceous period of the Mesozoic era, as the remains of some species found by palaeontologists in tertiary strata already closely resemble present-day forms. Some scientists are of the opinion that both the giant serpents and other snakes developed from lizard ancestors by a subterranean mode of life, followed by a return to life on the Earth's surface but current theories suggest that they developed from aquatic, terrestrial or burrowing ancestors. There are still some groups of snakes which live below ground and have become adapted to this way of life by complete loss of vision and other characteristics. The boas developed earlier, from aberrations of more ancient ancestors than the Colubrid and Viperine snakes. This is borne out by the vestiges of hind limbs in the boas, seen as a small toe with a tough claw on either side of the cloaca. The skeleton also shows the vestiges of a pelvis, formed by rudiments of the sacral bones and others.

The following snakes are kept frequently, or even constantly, in the herpetological station: the Indian Rock Python, the dark Indian Rock Python, the African Rock Python, the Reticulated Python and the Short Python *(Python curtus)*, the Boa Constrictor and *Constrictor constrictor imperator*, the Argentinian *Boa occidentalis* and the Yellow Anaconda *(Eunectes notaeus)*. The Short Python and the Yellow Anaconda are among the rarest of all the snakes. Of the smaller species we also keep the Green Tree Boa *(Corallus caninus)*.

Visitors approach the cages of the big snakes in zoological gardens with a certain awe, but this is possibly precisely the reason why the terrarium has so many visitors. Big snakes are not actually unsightly; on the contrary, they are beautifully coloured and their markings are as handsome as those of an oriental carpet. The patches and stripes on their bodies do not produce so striking an effect in their natural environment as they do in captivity. In their natural environment the brighter colouring is interrupted by darker patches in such a way that the snakes can scarcely be distinguished from their surroundings. This enables them to catch their prey, which imagines the snake to be the root of a tree or some other harmless object, as long as it does not move.

The life of these big snakes is interesting. No doubt many readers have already read something about them, but little that is pleasant or true. Writers still have a habit of brightening dubious tales of adventure with big snakes, which come to a tragic end from blows or bullets after previously trying—with the best intentions—to strangle or swallow somebody. The boot is usually on the other foot, as ninety-nine times out of a hundred it is the man who attacks the snake, either for no particular reason or for the sake of its skin. Cases of men being attacked or swallowed by snakes in their natural environment are very rare indeed. They are,

III. From left: Anterior part of skin of young Yellow Anaconda *(Eunectes notaeus)*, Green Tree Boa *(Corallus caninus)* and Desert Sand Boa *(Eryx miliaris)*. Actual size.

however, great enemies of various rodents, wild pigs and birds. In many places they are welcome to the natives as they exterminate rodent pests, especially rats. Sometimes they regard them as holy, as in some parts of Africa and Asia. On the whole it may be said that the natives are not greatly afraid of the big snakes. It is not, of course, either pleasant or safe to be in the vicinity of a 20-foot snake, and this also applies to zoological gardens, where the snakes are easily roused, because in time they lose their fear of man. That is also the reason why the worst accidents with snakes occur in circuses and zoos.

The Indian Rock Python inhabits India and Ceylon and other neighbouring parts of Asia. Specimens sent to Europe measure from 10—14 feet; longer ones are very rare. This is a handsome snake, with large, grey-brown to pinky brown patches on a yellow-brown background. The eyes are small, with somewhat poor vision. The snake sees best at dusk, as it has a contractile pupil like all the other big snakes, but it does not appear to be able to distinguish the outline of different objects very clearly. For this reason the big snakes are unable to recognise their keeper, as is sometimes erroneously thought to be the case. They see only a large, indistinct, living mass, to which they more or less become accustomed. Even their prey is recognised only from a short distance, often only at 12—20 inches. These snakes are stout and indolent and are very fond of a tepid bath. Their favourite food comprises white rats, rabbits, pigeons and hens, but because they also require wild animals in captivity, the bodies of which probably contain more growth-promoting and other important substances than the bodies of domestic animals, which are sometimes unpleasantly fat, their diet is supplemented as often as possible by wild rabbits, hamsters and ground squirrels.

It is widely supposed that snakes digest their food very slowly and that they can fast for a long period. This opinion is quite wrong. Snakes digest their food comparatively rapidly, as their gastric juices are unusually strong, but once the food is absorbed, it circulates very slowly in the blood stream, fat is partially deposited in the form of small scales and is dissolved with difficulty, and evaporation and other forms of water excretion are negligible. A big snake, if not too thin at the outset, can fast, therefore, for more than a year. They must be an object of envy to the miserly, who could calculate how much they would save if they could do the same, forgetting that they are not physiologically equipped for hunger strikes.

The darker variety of the Indian Rock Python has olive brown markings on a lighter background. Its general colouring is simple, but attractive and in actual fact it is more beautiful than the Indian Rock Python proper, but appears darker. It inhabits Burma, Siam, Indochina and the East Indies. It grows to a length of 30—33 feet. It is the biggest of the three subspecies of the Indian Rock Python. It has the same habits, but big specimens can be very vicious. It is imported much less frequently than the true Indian Rock Python.

Another very attractively but plainly marked snake is the African Rock Python. This is very similar to the Indian Rock Python, but is slenderer and more active. Its back is light grey or grey-brown with dark markings, which in some extreme forms merge into reticulated shapes somewhat resembling the ancient Egyptian hieroglyphics.

This handsome snake is found throughout Equatorial Africa and in most parts of S. Africa, with the exception of those parts in which it has been exterminated by Europeans. In some parts it is held by the natives in great reverence. For example, there are the snake temples of Dahomey where, in the small town of Wida, there is actually a large reserve for these snakes, where they are tended by priests and priestesses. The snakes are not shut up in the "temple"; on the contrary, they are allowed out, not so much for reasons of health as to let them catch their food themselves. This leads to trouble with the owners of poultry, dogs and goats, who stand in awe of the pythons but do not appreciate the loss of an animal which the python may have stolen and devoured in the night. The longest python in this snake temple while I was there measured about 14 feet. The priests picked up two small specimens, which were unusually placid, but the rest of the "deities" were unfriendly and inclined to bite. It is interesting that the snakes always return to the temple (or so it is said), even though they may spend several days or weeks away.

The African Rock Python is brought to Europe fairly frequently, but not so often as the Indian Rock Python. It is quite placid on the whole, as big snakes go, and could be used for snake dances if it were not too active and too restless. In its natural environment it hunts for food when dusk falls, but in captivity soon becomes accustomed to hunting by day. Its habits are the same as those of other pythons. Some of these snakes are fond of taking a bath, others rarely enter the water. Some prefer catching mammals, others birds.

The Reticulated Python has the reputation of being the longest of the snakes of today, as it grows relatively quickly and 20—25-foot specimens are no rarity. It is slenderer than the other pythons and its markings are quite different; it has four pits in the upper labial plates and its large mobile eyes, tinged with brick-red are particularly striking. It has the best sight of all the pythons. It inhabits the same regions as the darker variety of the Indian Rock Python, but is also found further north, as far as S. China and the Philippines. This python is more adaptable than others and also inhabits busy harbours and the vicinity of large towns. During the daytime it requires no more than a shelter beneath some wood or in a shed and in the evening it goes off in search of food.

This enormous, but slender, snake has particularly beautiful markings. Black, criss-cross markings on a brown-grey, light grey or reddish grey background are interwoven with sulphur yellow or orange and a snake which has just shed its skin has a deceptive blue-green opalescent sheen. At the same time, the Reticulated Python undergoes striking colour changes. At lower temperatures its colours are darker and often quite inconspicuous; at higher temperatures they are so bright that no one would think it was the same snake.

The Reticulated Python is definitely not a placid snake. It is wild and inclined to bite and I do not recollect ever having seen it used for any specific purpose. In 1951 we received six newly caught Reticulated Pythons from Singapore, the shortest of which was almost 12 feet long and the others from 16 to 23 feet. The longest one was a female with dark markings, while the others were all beautifully coloured. When taking them out of the crates, I always quickly seized the snake by the neck, just behind the head, my assistants then seized other parts of the body and in this way we examined the snake and carried it to its new quarters. Some of them submitted without a struggle, but others resisted so fiercely that it took the combined efforts of five or six people to restrain them. The biggest python was at first quiet and allowed itself to be taken to the cage comparatively easily. As for understandable reasons the head is always the last to be released, I was the last to remain within reach of the python, after my assistant had all come out, and the snake struck at me like lightning. To get at me it had to cross the water tank and this cooled its ardour; this was the only thing which prevented a dramatic struggle—which would, of course, not have been either my first or my last.

One of the biggest pythons was placed in the herpetological station. At first it always struck at me with unusual violence, with wide open jaws, but later became so accustomed that the cage could be swept out; no one, however, could handle this snake. When we sent it abroad some nine months later, it had become so docile that I was able to catch it myself and with the assistance of Inspector Crhák, who came to take it to the station, I placed it in a comfortable crate. Another equally big snake, measuring about 20 feet, which we were sending from the zoological gardens to another destination, put up such a fierce fight and was so strong that it took almost an hour and all our strength to get it into the crate. It finally lifted up the lid of the crate, together with the man who was sitting on it, and almost managed to escape.

The Short Python attains about only five feet, but its physical and mental capacities are quite equal to those of its bigger cousins. It is a particularly beautiful snake, coloured pale pink, crimson, grey, yellow and black. The body is stout and heavy and the neck short and thin. It therefore should not be picked up by the neck, as the cervical vertebrae are damaged by the weight of the heavy, writhing body.

This snake inhabits jungle clearings near swamps and river pools. It feeds mainly on rodents. When in danger it attacks its enemy so savagely that it almost leaps in the air. This,

of course, is only a means of inspiring terror, and together with the striking coloration may well make a successful combination. This snake was sent to us from Malaya and I was able to make a detailed study of its habits. During the daytime it lies motionless in the water tank, with only the tip of its nose above the water. At night it glides about the terrarium. It will also catch a white rat in the daytime and strangle it with such force that it is immediately suffocated. Our pythons did not eat pigeons or other birds, although they sometimes killed them. They are indolent, but irritable and very strong for their size. They require more warmth than many other big snakes.

Another big snake, as well known as the Indian Rock Python, is the Boa Constrictor. It would actually be more correct to say that their names are well known, but not so much the snakes themselves. Visitors to zoological gardens usually think that all the big snakes are either Indian Rock Pythons or Boa Constrictors, because they do not know any other species.

The boas differ from the pythons in that unlike them they have no supraorbital bone, but they also have a somewhat different appearance. Whereas the head of a python is more or less flattened like a duck's beak, the head of a boa is high and square at the side rather like a dog's head. A section through the body of a python forms a semicircle or ellipse, with the abdomen as the base, while a section through the body of a boa gives an up-ended oblong with rounded corners. Pythons lay eggs, round which they coil themselves and wait for two months until the young hatch out; during this time there is a slight increase in their body temperature, which at other times is practically the same as that of the surrounding air. Boas are ovoviviparous and the whole of ovular development takes place in the mother's body.

Otherwise, pythons and boas have the same habits and the same propensity for biting. The bite of a big snake bleeds copiously and heals with difficulty. Particularly deep wounds are made by the beautifully coloured Green Tree Boa, which has relatively the most powerful teeth. In dealing with these snakes, therefore, one must always be careful, particularly if one has to handle them frequently.

The Boa Constrictor is usually a pale tan, light grey or pink, with large, dark blotches with lighter markings. The tail is brick-red, blood-red or crimson, with black and white markings. Some old females from the jungle are less strikingly marked and the young ones are not so brightly marked as half-grown examples. The Boa Constrictor inhabits tropical S. America.

The Central American species is reddish brown and differs from the S. American species in that it is not so brightly coloured and also has a large quantity of oval blotches on its back. It is also stronger and more vicious.

The black or brown-black Argentinian Boa was formerly only seldom exported. It has small, not clearly distinguishable silver or yellowish markings. It has a shorter, higher head than those mentioned above. It inhabits N. W. Argentina, Uruguay and Paraguay.

The Central and S. American boas which I have kept up to now did not exceed 14 feet in length. These snakes are usually exported when they measure from five to eight feet. As far as I know, unless given the greatest care and attention, they rarely survive long in captivity. They require very clean conditions and a constant supply of fresh water, and occasionally need the direct rays of the sun. They are also liable to the dreaded mouth rot disease, which responds to treatment only in the early stages. Only few snakes are able to rid themselves of this malignant disease, by dipping their mouths in clean water as often as possible and washing away the pus.

Another class of constrictors are the Anacondas. In its own country, which is the same as that of the Argentinian Boa, the Yellow Anaconda attains about 17 feet, substantially less than its enormous cousin, the Giant Anaconda. It is an unusually strong snake, with lead-coloured eyes and plain but striking colouring. The basic shade is pale yellow or orange and the back is marked with a row of rich red, irregular transverse blotches. On the head there are regular black markings. The head is short, especially in fully grown specimens, and the neck is very thick.

An adult anaconda, which was sent to us from Buenos Aires, gave birth to 23 young ones just before leaving. These were sent to us immediately by air by the zoological gardens and arrived before their mother. The young ones showed an inclination to bite right from the outset and after a short rest they began to eat white mice with a hearty appetite. At first one mouse per week per snake was enough. After two months they each ate two mice or one sparrow a week. When first measured, the young anacondas were from 18—20 inches long; two months later they measured 22—28 inches and at one year they were 44—52 inches. Early on one of them fell a victim to the cannibalism of a companion, which attacked it while catching a mouse and ate it after a struggle lasting three hours. Next day, however, this outsize meal produced such flatulence that the fratricide was obliged to regurgitate it.

In water, anacondas move best of all the big snakes; water is their native element. Some authors declare that these snakes eat fish, but none of our anacondas, either old or young, ever ate fish or amphibians. Their favourite food is mammals and birds and, occasionally, other reptiles. Young anacondas, at any rate, are fond of lizards. During the daytime they lie coiled up on branches or in the water. Before dusk they become more lively and glide about the cage. They are relatively hardy and eat well, but require high temperatures.

The Green Tree Boas are very colourfully marked reptiles. They have a bright, pea-green back marked with white cross-stripes. The abdomen is yellow. These snakes inhabit the edges of equatorial forests in S. America, living in dense undergrowth, where their green coloration makes them quite undistinguishable. All day they doze, coiled spiral-wise round a branch or the stem of a Monstera tree and creep about in the evening. Their flattened body is so specifically adapted for climbing that they have to spend almost all their life on bushes and trees because they are so clumsy on the ground. They are good swimmers, however, and this is no doubt vitally important to them, as during the rainy season these areas are flooded extensively. The Green Tree Boa catches birds up to the size of a pigeon. In order to prevent its prey, with its dense, slippery plumage, from escaping, it has a truly terrible set of teeth; the front fangs of a Green Tree Boa with a skull about 2 inches long, measure over 0.4 inches!

The Green Tree Boa is one of the most difficult snakes to rear and it rarely lives long in captivity. The difficulty lies in the fact that it requires absolute quiet and roomy quarters, partly shaded, with a suitable amount of the proper vegetation. It needs a tropical terrarium, but at the same time cannot stand a hothouse atmosphere. In zoological practice it is included among the animals requiring individual attention.

I have already mentioned several times that the big snakes have a propensity for biting. Some, however, only snap in warning or do not strike far enough to reach the intruder. Another time they will open their jaws as wide as they can and push the object of annoyance away. They do this most frequently when they are satiated or are not hungry for some other reason (e. g. before shedding their skin). In this way they push away a rat or a rabbit which runs in front of their nose. If a snake really wants to bite, it contracts the facial muscles, moves its jaws as if swallowing, with the tip of its tongue protruding through a depression at the point of the lower jaw and hisses often and viciously. Sometimes the tip of the tail twitches, a sign of excitement which the experienced keeper does not miss. The Green Tree Boa forms an exception, as it usually only moves its eyes, slightly relaxes it neck and suddenly strikes with such suddenness that it sometimes succeeds in administering two or three bites before the hand which is attacked can be withdrawn.

If I give a fair amount of attention to a young snake— as long as it is not a particularly irritable specimen—I can soon handle it, carry it and play with it like an ordinary household pet. Daily contact is an essential condition, however. This method is of undoubted importance for studying snakes at close quarters, but can hardly be used by someone with insufficient time, as one cannot do any other kind of work with a snake writhing on one's lap. Otherwise, however, the snake soon becomes wild again.

It is a great pity that big snakes rarely mate in captivity. For observing the development of the young ones we are dependent on the chance occurrence of an imported female giving

birth to young ones or laying eggs. The number of eggs and young depends on the size of the female. Older females produce more young ones. These shed their skin almost as soon as they are born and immediately afterwards begin taking food. It is interesting to note that of all the eggs that are laid, some never hatch out and of the young boas which are born without shells, only about half are viable.

THE SAND BOAS

When one speaks of "boas", everyone imagines enormous, strong and dangerous reptiles inhabiting tropical forests and jungles. This group, however, includes quite small snakes, which do not grow to be any larger than our own vipers and—with two exceptions—do not inhabit the tropics, but live in subtropical steppes and deserts extending into the temperate zones. These are the Sand Boas. They have one property in common—an ability to burrow. Some species adroitly burrow into loose sand, where they can be seen immediately below the surface in the form of a moving vein. In order not to throw off the sand while doing this, a shallow concavity is formed the length of their back. Other species live in holes.

Of the genus *Eryx,* which comprises nine species, the Spotted Sand Boa *(Eryx jaculus)* inhabits S. E. Europe and Turkey; this is often found in the terraria of zoological gardens and private owners. It is a small, pretty snake, with a very small head; the dividing line between head and neck is not clearly marked. The eyes are small and the pupil can contract to a line. The basic colour is greyish yellow and the densely distributed spots on the back and sides are brown or grey-brown.

We have most frequently received Spotted Sand Boas from Bulgaria[4]), where they inhabit stony and sandy steppe country. We arranged the terrarium in much the same way as the ground in its natural surroundings. For this, a tub of sand and a few stones were sufficient, with one or two fleshy-leaved flowers in pots to brighten it up. When placed in the terrarium, the snakes immediately burrowed into the sand and after a little while the front of the head could be seen protruding as far as the eyes. In a few days they began to take food—white mice and voles. I wished to try them with live reptiles and offered them a few small skinks and lizards, but the sand boas began to catch these only when they had been without mice for a long period.

These snakes catch and constrict their prey in the same way as other boas, except that they usually strike at the mouse from the sand. Occasionally they attack their prey outside, from stones or even from a branch, on to which they sometimes climb. They immediately coil the front part of their body, or even their whole body, round the mouse, and if the latter is big and strong, they roll round the terrarium like a whirlwind until the mouse has been overcome. Their strangest feature is their ability to swallow relatively large objects, and anyone seeing them do so for the first time is indeed surprised. It is not so strange as it seems, however, as the small mouth can stretch to an extremely wide compass and a 16-inch sand boa will swallow a mouse in a very short time. We once had the rare opportunity of assessing the strength of a sand boa by matching it with another snake. Someone brought a fine Smooth Snake *(Coronella austriaca austriaca),* about 26 inches long. For lack of space it was put in with the sand boas. Soon afterwards a large common lizard was thrown to it and this the smooth snake attacked and constricted. As it began to swallow its prey, however, one of the sand boas, about 24 inches in length, sidled up and although it was not really keen on lizards, it bit this one in the leg in an access of jealousy and coiled itself round the lizard and the smooth snake, which had meantime swallowed the head of its prey.

The embrace of the sand boa was so unpleasant that the smooth snake loosed its hold

4) *Eryx jaculus turcicus.*

of the lizard's head and furiously bit the sand boa in the body. The sand boa, however, did not relax its grip but, on the contrary, tightened its coils still further. The smooth snake could not free itself and was pressed tightly against the lizard. After half an hour it suddenly began to open its mouth and gasp for air. At this point I interrupted the duel and separated the contestants. It is not certain that the sand boa would not have suffocated the smooth snake. This is a demonstration of the exceptional strength of these small boas, which is all the more remarkable as their body is soft and pliant to the touch.

The Spotted Sand Boa can grow to about 32 inches, but is usually smaller. The young ones which were born in September 1950 to one of our females measured about five inches. Five died by the end of December, the rest measured from 6—7 inches. In March the following year they were already 8—9 inches long and by October they measured 10—11 inches. At first they lived only on small lizards and then on young white mice.

These snakes require relatively more warmth than their bigger cousins. On cold days they require irradiating, otherwise they refuse their food and easily catch cold. They drink water only on rare occasions, usually before shedding their skin. In their own country they hibernate, but in captivity this is not necessary.

Although the Sand Boas have very long, strong teeth, they use them only occasionally for defensive purposes. When in danger they usually coil themselves into a ball, lash about and hiss, but do not actually bite. It may occur, however, that an especially large specimen will snap at one's hand. The Sand Boa defends itself from beasts and birds of prey and from monitors by coiling itself round their legs or neck. I once observed a duel between a 26-inch sand boa and a monitor of the same size. After only ten minutes the monitor overcame the snake by constant violent shaking and crushed its head. It then swallowed the sand boa with gusto.

We have several times received two other species of Sand Boa from the Soviet Union. One of these is the Desert Sand Boa *(Eryx miliaris)*, which is somewhat smaller and weaker than the Spotted Sand Boa and has less distinctive markings. Its main colour is grey-brown, with tan spots; the males are lighter. This Sand Boa is found only in the Central Asian part of the Soviet Union.

The Eastern Sand Boa *(Eryx tataricus tataricus)*, which comes from Uzbekistan and Tadzhikistan, measures over three feet. It has a strong body and the back is whitish grey or whitish yellow, with grey or grey-blue blotches. The Desert Sand Boa lives almost exclusively in sandy places, while the Eastern Sand Boa inhabits woods and steppes. The Eastern Sand Boa does not burrow so much in the sand, as its habits are more like those of the big boas, and it lives in the burrows of voles. In the evening it comes out to look for prey, which consists of young birds and ground squirrels. In the terrarium it likes strong branches for climbing, but also sometimes burrows in the sand. When it is very hot, it climbs into the water tank, where it may remain for several hours.

Sand Boas get on very well with one another. They pay no attention to their young and only the throwing of food into the terrarium disturbs the harmony which usually prevails there. Two or even three snakes will then engage in a desperate tug-of-war for one mouse, while the rest have already eaten their fill. Many of them eat several mice one after the other and two or three days later bring them up again, because their stomach cannot stand the strain. We therefore had to give every mouse separately to every Sand Boa in turn, with a pair of tongs, taking care that those which had not yet fed or had already swallowed their prey should not come within dangerous range. Otherwise there would have been no means of keeping a check on when and how much every individual boa had eaten.

From all that has been said above, it is evident that the habits of Sand Boas differ considerably from those of the majority of the members of this family. Other forms of small, boa-like snakes have developed, also inhabiting sandy areas and steppe country, such as the N. American genera *Charina* and *Lichanura* and the African *Calabaria;* these do not resemble the genus *Eryx,* however, either systematically or developmentally.

The contractile pupil of the Sand Boas indicates that these creatures come to life after dark. In the evening these miniature boas come out from the sand and other places of shelter, glide about the cage, inspect every corner of the terrarium and show quite unexpected activity. It is odd to hear in the dark their strange rustling, which is never absent and is audible now here, now there. They begin to creep about towards eight o'clock and keep this up until ten o'clock or one o'clock, according to the temperature. During this time they do not, however, display any great interest in catching prey, as might be expected. On the contrary, their activity seems to be feverish, aimless and pointless. I have occasionally observed, however, that not only Sand Boas have this habit (in their natural environment also), but that it is a characteristic of the Viperine snakes, chiefly those of the genera *Vipera, Aspis* and *Echis.*

The Sand Boas have yet another interesting characteristic. This is the attraction which strong light has for them, even cold light, such as that of a pocket lamp. One only needs to switch on the light in the evening and in a little while all the boas come out, crawling round within the circle of light and trying to climb up on to the bulb itself, i. e. they develop active phototaxis. This peculiar characteristic is also shared by other snakes, particularly Viperine snakes, whereas as far as I know none of the other boas possesses it.

Of the three species of Sand Boa which I have so far had the opportunity of keeping, the hardiest, and for our purposes the most satisfactory, has proved to be the Desert Sand Boa, although it is relatively the slimmest. Next comes the Spotted Sand Boa and lastly the Eastern Sand Boa, which does not easily become adapted to the different conditions of life in captivity.

INTERESTING COLUBRID SNAKES

Nature's creative activity throughout the ages has been vast and manifold. Many different conditions of life are continuously arising, and to these plants and animals are continuously adapting themselves, more or less successfully, in the struggle for existence and so as to bequeath to their offspring a better, more highly perfected body, together with the possibility of developing old and newly acquired characteristics still further. This results in a vast variety of forms, so well adapted that they fascinate us constantly. Both utility and beauty are present in this variety. A small part of this beauty can be seen in our terraria where, in separate quarters, covered in by metal meshing and glass, many reptiles lie, glide or run about, some of them with strange forms and wonderful colours, which in the animal's natural environment have their own significance and purpose. I should like to describe some of these below.

The Colubrid snakes found in Europe are handsome enough (the Common Grass Snake and the Tessellated Snake), but they cannot compare with their tropical or even subtropical cousins. The same applies to the Smooth Snake, which is very plainly coloured, although it is closely related to others which are in no way inferior to the notorious venomous Coral Snakes *(Micrurus)* in brilliance of colouring. Of the snakes found in Europe, only the Aesculapian Snake *(Elaphe longissima),* although it can boast of only one colour, is so attractive to the eye and moves so elegantly that it is as popular as other members of the same genus from other countries.

We often receive samples of two fine species of the genus *Elaphe* from the Moscow Zoological Gardens. The first of these is the handsome *Elaphe quatuorlineata sauromates,* which grows only to about five feet, but has a stout body. Its abdomen is pale yellow to sulphur yellow and the back and sides are mainly yellow or orange with dark, often black, blotches and lines. Some specimens are very dark, others are more brightly coloured, according to the degree to which the basic colour predominates. This snake is found in Bulgaria, Rumania, Turkey and N. Iran and is also widespread in Moldavia, the Ukraine, the Crimea and the Caucasus.

It ought to be ideally popular with all terrarium enthusiasts, as it is not only decorative, but is also easy to rear. Some specimens tend to bite, but their bite is not dangerous, even though it may be unpleasant. It catches mice and sparrows and larger ones attack and swallow white rats, which are a favourite titbit of all the larger snakes. It coils itself round its prey and suffocates it in the manner of the boas. If the prey is large, it coils its whole body round it, if small, it uses only one or two coils. When catching mice, it carefully inspects the whole cage, creeping under bark and moss and looking everywhere for more.

To satisfy its hunger, a four-foot snake requires 6—8 mice. It also eats birds' eggs, but only up to the size of pigeon's eggs. It inspects hens' eggs with its tongue, but does not try to pick them up. It swallows an egg with care, until it is from four to six inches inside the oesophagus and then crushes the shell by lateral pressure and swallows it together with the contents. Adult snakes catch lizards only under exceptional circumstances, while the young snakes live entirely on them until they measure about 16 inches, when they change over to mice and voles.

In the Ukraine and the Caucasus this snake inhabits stony steppe country and woods; it is very fond of climbing and often remains for days at a time in the branches of trees. In captivity it also requires a branch, on which it will spend the greater part of the day. Towards evening it is more lively, while during the day it usually sleeps. It drinks frequently, but rarely goes into the water of its own accord.

In August I often had the opportunity of observing how these snakes lay their eggs. The female crept restlessly about the sand and from time to time, with an evident effort, expelled a yellowish white, elongated egg. When, after some hours, she had finished laying, she coiled herself round the eggs, forming them into a rounded heap, and remained there for several days. It is likely that in natural surroundings she remains with the eggs until they hatch out, like many other members of this genus. The protective coils of the female no doubt ensure the necessary microclimate, since if she leaves the eggs they soon dry up or go bad. One batch of eggs contained 8—12 eggs.

Elaphe dione, quantities of which we have received several times from the Ukraine, is a smaller and correspondingly slender snake, with simpler, but equally handsome colouring. The main colour of the back is light grey-brown or reddish brown, with longitudinal rows of small dark spots, which sometimes form almost unbroken stripes. The markings of the head are interesting and somewhat resemble those of the well-known S. European Leopard Snake *(Elaphe situla)*. This snake attains a length of about three feet and inhabits both mountainous and flat ground. Commencing in the Ukraine it is found throughout Central Asia to the south of the Far East and China.

This beautifully marked snake remains mostly on the ground. When shedding its skin it likes to lie in the water, otherwise it enters the water tank only when the sun's rays are too hot. It catches mice and large specimens also catch small birds. We have often observed the passion with which snakes of the species *Elaphe dione* hunt. Whenever I placed a white mouse near a cluster of sleeping snakes, a violent chase immediately ensued, which ended in one of the snakes catching the mouse and coiling itself round it like lightning. The others would then glide up to the successful hunter, feel for the prey with their tongues and if one of them found a part of the mouse's body not properly covered by the coils, it would immediately seize hold of it and an endless tug-of-war and wrestling match would then ensue. It was almost always necessary to intervene and to unravel the writhing snakes. This was naturally no easy matter, as it is difficult to recognise heads and tails in such an interwoven, knotty mass. Among these snakes, some individual specimens became accustomed to eating pieces of fresh meat.

These snakes generally have a placid disposition. They only rarely defend themselves by biting and soon become used to frequent handling and various experiments for testing their physical and mental capacities.

It is interesting that these trusting and somewhat limited snakes (as regards movement) should be found over so wide an area, where they have many natural enemies, which do not, however, seem to do them any great harm. These snakes have developed only one real weapon

of defence, which they use only passively. When in danger they lash about with their tail, stirring up sand and stones and making a faint rattling sound. In this they resemble the Siberian Halys, which is one of the Pit Vipers and makes the same type of sound, only somewhat louder. Perhaps it succeeds in this way in frightening away at least some of its enemies.

Another group of decorative snakes which are commonly kept in our terrarium are the Racers *(Coluber)*. These are very slender, quick and nimble snakes with large eyes and good vision and a sloping nose. Some species move amazingly quickly and can catch a fleeing mouse or lizard even on slightly undulating ground or on loose sand. In spite of their agility and speed, however, their movements are not so graceful as those of the snakes of the genus *Elaphe,* but are rather stiff, like the undulations of flexible wire. Their body is also stiff to the touch. They remain mostly on the ground, on walls and on rocks, and a few species also climb trees. In captivity they like to climb, even those species which normally remain on the ground. All the Racers are very nervous and inclined to bite and some species actually attack those who disturb their peace and bite them furiously, but this is only a gesture to drive the enemy away, since not even big specimens can cause any graver damage than a few punctures in the skin with their minute teeth.

We very frequently receive Caspian Whip Snakes *(Coluber jugularis caspius)*, which are generally sent from Bulgaria and the Soviet Union. These specimens usually range from 3—6 1/2 feet, but this species can attain still greater size. It is the longest European snake, though not the largest, as it is always slimmer in proportion than the equally long Aesculapian Snake. This handsome Racer has a strikingly small head. Its colouring is light brown to nut brown, often with an olive shade in it. The abdomen is a yellowish white. Some individuals may, however, be quite black.

The Caspian Whip Snake is a comparatively quiet, indolent snake for this genus, but if it imagines itself to be in danger, it rears the fore part of its body and strikes at the enemy with such force that it appears to leap. In its own country it also frequently alarms horses or donkeys, which rear and throw their riders. In our terrarium, this snake lies coiled up in the sun, as it loves warmth. At night it sleeps. When it catches sight of prey, which it can distinguish at about two feet, it slowly uncoils itself and then makes a sudden attack. If it does not succeed in catching its prey at once, it pursues it and sometimes catches it just as it tries to jump to safety. It often does not coil itself round smaller prey (mice, lizards), but shifts it rapidly in its mouth until it comes to the head and then quickly swallows it. It sometimes kills mice by holding their heads firmly in its jaws until they suffocate. It wraps two or three coils of its body round large prey (white rats), but rarely as completely as the other snakes described previously. It rather attempts to press its victims against some hard object.

The situation is quite different, however, if the Caspian Whip Snake catches another snake. Intraspecific cannibalism does not appear to come normally into consideration among the Racers, as small and large ones live together in harmony (except at feeding time), but they are very dangerous to other species of snakes. They also distinguish "tasty" and "less tasty" snakes. They reject the Common Grass Snake and Tessellated Snake almost without exception, whereas they eat Smooth Snakes without the slightest reluctance. In their natural environment they doubtless catch their prey immediately on sighting it, whereas in the terrarium, where a number of them are kept together, they only detect the presence of another species of snake by touching it with their sensitive tongue.

As soon as the Racer recognises that the other snake is not a fellow Racer but potential prey, it stops, redoubles its attentions, feels the snake's body with its tongue and sets out after it, trying to catch up with the head, which it seizes suddenly and unexpectedly, like lightning. Sometimes, however, it seizes the snake by the middle of the body. It then encircles the body of its victim with numerous coils, to its full length, squeezing it convulsively, with the result that sooner or later it is suffocated. It swallows a snake or a lizard in the same way as the Smooth Snake, with short, jerky movements of the jaw from one side to the other, biting hard

all the time so as to prevent any possibility of the prey extricating itself. It should also be mentioned that some specimens prefer mice, while others prefer reptiles.

Two slender and simply, but attractively, coloured racers come from Central Asia. These are *Coluber karelini* and *Coluber rhodorhachis*[5]). The first of these is found more in sandy steppe country, while the second is found quite high up in the mountains, but in general their habits are the same. They catch small lizards. Fully grown specimens, which measure as much as three feet and over, sometimes catch mice. From among our own lizards, both these species of racer were fond of young Green Lizards.

Both these species are slate grey, light grey or light brown-grey, interspersed with bands of black the whole length of the back. The abdomen is creamy white and glossy.

We were not able, unfortunately, to observe these attractive snakes for very long, but we can say that they are very difficult to rear and are fond of warmth. They usually only pretend to bite; the snake strikes at its enemy, but immediately turns aside and quickly slips away to safety. It tolerates smaller snakes and attempts to frighten large lizards by darting out its head and hissing.

Another handsome snake is the Algerian Racer *(Coluber algirus)*, the habitat of which is in N. Africa. It is somewhat more powerfully built than other species of the same size and genus and is pale yellowish grey or yellowish brown, with black cross-stripes. I brought back some of these snakes from Tunis, where I caught them near Gafsa, on mounds of stones and on hillsides. Like most African snakes, these Algerian Racers are very lively and have hearty appetites. They catch mice and lizards and are also very fond of sparrows. They grow to a length of about three feet.

My attention was drawn to their presence near Gafsa quite by chance. One of the local Arabs who accompanied me climbed up a steep hillside to look for the place where a small skunk *(Poecilctis libyca)* had hidden a short time before. He slipped, and his foot dislodged a flat stone beneath which two striped snakes were reposing. The frightened Arab gave a terrified scream, which brought me to the spot in time to catch both snakes. I was then naturaly more observant and was soon able to add a further trophy to my first two.

Algerian Racers are worthwhile snakes to keep in a terrarium, as they soon became reconciled to the absence of the blazing African sun and were quite satisfied with normal room temperature. They were very lively and soon allowed themselves to be picked up. I once threw a small brown frog to the snakes, together with some white mice. While pursuing the white mice, the biggest snake seized the frog and began quickly to swallow it. When the frog had half disappeared, the snake suddenly stopped and brought the slippery prey up again. Perhaps it was only then that it realized its mistake. For a long time afterwards it wiped its nose on a stone in evident disgust. From the human point of view, of course, this may seem a strange fastidiousness, as frogs, mice and lizards are all equally unpleasant to us ....

One of the racers, the Diadem Snake *(Spalerosophis schirazianus)*, has very unusual colouring. Its back is yellowish brown, tinged with pink, while its abdomen is silvery white. Along the back are rows of diamond-shaped cross-stripes and blotches, which are not very easily distinguishable. On the forehead there is a shining, pale brownish-pink band between the eyes, which gives the snake its name.

The Diadem Snake is a pretty, quiet snake, which does not like unnecessary movement and therefore remains for many hours half coiled up in various sheltered places. It is most lively in the early morning and evening, when it catches lizards and mice. It is a good climber and although its natural environment is in stony steppes, in the terrarium it is fond of climbing to the highest branch. It grows to a length of six feet.

In June 1951, one of the Diadem Snakes escaped while being moved in the garden and after a vain search was written off as a loss. Half-way through October of the same year it was found in a building site about half a mile away, quietly warming itself in the last rays of the

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[5]) We have kept both forms, which are found in Turkmenia and Tadzhikistan: *Coluber rhodorhachis rhodorhachis* and *Coluber rhodorhachis ladacensis*. The former has a narrow brick-coloured stripe the length of its back.

sun. When caught it did not bite or make any serious attempt to escape. It was in good condition. It had no doubt been living on green lizards, which are very plentiful in the Prague Zoological Gardens.

Another handsome snake, somewhat more powerful than the Caspian Whip Snake, is *Ptyas mucosus* (the Indian Rat Snake). It is light brown, dark brown or black, with a beautiful bluish sheen. It inhabits Western and Central Asia and spreads south-east as far as Malaya, S. China and Formosa. It grows to almost 14 feet and is the biggest non-venomous Colubrid snake in the world. The specimens which we have received so far, and which came from the Soviet Union and Palestine, did not, however, exceed seven feet. At this size they are already capable of reproduction.

Ptyas mucosus is on the whole a quiet, sluggish snake, which on hot days often goes into the water to cool down. It lives in the most widely differing biotopes, in steppe country, rocks, forests and oases, as long as it has easy access to water. This is evidence of its considerable adaptability. It is fond of catching toads, several of which it will eat at once. It also eats mice and rats. It attempts to strangle its prey, but often with scant success, as few of these snakes are able to coil themselves properly round the animals they have caught. They therefore usually try to suffocate their prey merely by the pressure of their powerful jaws, or else swallow it alive. Our snakes would not take any other food than that mentioned above. They examined fish and sparrows, but did not eat them. If they ate green frogs, they always brought them up again, either undigested or partly digested.

If it can be said that the Racers resemble the venomous snakes of the family of the *Elapidae,* because of their tendency to bite, this is even more true of the genus *Ptyas,* the members of which rear the first third of their body when excited, spreading their necks in the form of a hood and striking in an arc, like the cobra. The only difference is that the spreading of the neck is not due to lateral stretching of the ribs, but to ventral extension of the muscles by means of inspired air. Among the non-venomous Colubrid snakes, the Central and S. American Spotted Rat Snake *(Spilotes pullatus)* is best able to dilate its throat when provoked; this is also perhaps the most beautifully marked of all the Colubrid snakes.

BEAUTIFUL, BUT VENOMOUS, COLUBRID SNAKES

Many people do not trust snakes because they are not able to distinguish venomous from non-venomous ones. The same applies to animals: if a chimpanzee, baboon or long-tailed monkey is shown a harmless Colubrid snake it is just as terrified as if presented with a viper.

Indeed, it is sometimes very difficult to distinguish a poisonous snake from a harmless snake at first glance, especially if it is one of the vast group of Colubrid snakes, which include our own Common Grass Snake and Tessellated Snake, as well as the dangerous Cobra and Mamba. When a cobra is gliding along the ground it looks quite harmless; only when it suddenly rears and spreads its hood does it reveal its true character.

It would be a mistake, however, to imagine that our own harmless Smooth Snake is as harmless inside as it appears to be from the exterior. Its bite is actually harmless, as the venom has no way of egress into the oral cavity and the fangs are neither hollow nor grooved. Postmortem examination, however, reveals a small poison gland on either side of the upper jaw, containing sufficient venom to kill a small warm-blooded mammal.

Most of the Colubrid snakes, therefore, tend to be venomous; only in a few genera is the poison gland completely absent. This development progresses by the poison gland increasing in size and becoming linked up with a tooth in the upper jaw; this begins to acquire a groove along its surface, the depth of which, with few exceptions, is in direct proportion to the

effectiveness of the venom. Finally, the fang is completely or almost completely perforated by a small canal, through which the venom is injected into the bite wound. The most highly perfected apparatus is found in the Viperine snakes, whose fangs are very long and movable. Even the most venomous of the Colubrid snakes have only non-movable teeth with a more or less imperfectly closed canal, with the result that the venom partly runs out into the mouth, sometimes when the snake is merely excited. That is why some cobras are able to spit their venom, mixed with saliva, as the reader no doubt already knows.

A kind of transitional group between harmless Colubrid snakes and cobras is formed by Colubrid snakes which are able to discharge venom from their poison glands, but in which the poison fangs are not at the front, but at the back, so that a bite from these snakes is not dangerous, as they are usually able to bite only with their front teeth. They are obliged to suffocate their prey in their coils, or at least grip it firmly in their jaws like the non-venomous Colubrid snakes, shifting their jaws along its body until they are able to insert their rear fangs, which soon kill or paralyse the victim. Bigger species, which are able to open their mouths very wide when biting and can use their rear fangs without having to shift their jaws afterwards, have many times caused the death of human beings.

Colubrid snakes used to be divided into three groups—snakes with solid teeth *(Aglyphae)*, snakes with grooved fangs *(Opistoglyphae)* and snakes with fangs with a central canal *(Proteroglyphae)*. This classification should be modified, as it is not exact and does not cover transitional forms.

The members of the genus *Psammophis* resemble the swift, agile Racers. These snakes inhabit deserts and dry steppe country. They have large eyes which sometimes have a gold lustre, and while their colouring is usually inconspicuous, they are sometimes ornamented with dark bands which run the length of their body. They are fairly abundant in N. and S. Africa and even extend into India. The largest number of species is found in S. Africa. I am best acquainted with the species *Psammophis schokari*, which is very common on the borders of the deserts of N. Africa and Arabia and is either light grey or grey-brown in colour, or may have chocolate brown stripes the length of its body. The head is steep above the eyes, sloping down from this point to the mouth.

This snake, which measures about three feet, is very difficult indeed to catch. I have caught many of them, but every time it gave me a great deal of trouble. These snakes may be seen in the morning or afternoon on flat, stony ground, crawling about slowly with upraised head and occasionally stopping and taking a sharp look round. As soon as they catch sight of a lizard, they are after it like a shot, ignoring the fact that the lizard has also caught sight of the snake and is trying to escape by rapidly running away, zig-zagging as it goes. *Psammophis* usually catches its prey within a few yards, seizes it in its mouth by any part of the body and coils itself round it a few times. In a little while one can observe the snake alternately raising and pushing forward its upper jaw, until it succeeds in driving in its poison fangs, which are placed far back, beyond the eyes. It them remains motionless for a few minutes, while the movements of the lizard grow weaker and weaker until they finally stop altogether. The venom evidently acts rapidly.

When pursued, *Psammophis* makes off so swiftly that it is difficult to believe that a limbless creature can attain such speed, often on a relatively smooth or loose surface. For the first dozen yards it can outdistance a sprinting man, but its velocity then decreases and if there is no shelter in the immediate vicinity, it can be caught.

I have never heard of the bite of *Psammophis* harming man, although its venom is quite effective. It is not, however, an aggressive snake and only the largest ones defend themselves by biting and when doing so, they open their mouths so little that it is unlikely that their poison fangs would make contact. That is why nothing usually happens to unwanted mice which annoy the snake so long by their running about that it snaps at the ringleaders.

In captivity this snake requires plenty of sun or irradiation, a stony, sandy floor and quiet, as it is easily frightened and is easily injured if it suddenly takes to headlong flight.

It is one of the most difficult reptiles to keep and often dies unexpectedly from a burst gall bladder. Its most suitable food is the Common Lizard and the young of the Green Lizard. Some of these snakes which I sent from Tunis survived for three years in our terrarium.

Another genus very similar to *Psammophis* is *Taphrometopon,* which inhabits Central Asia. From the Soviet Union we receive the specimen *Taphrometopon lineolatum,* which is one of the prettiest of the small snakes. Its head does not slope so much as that of *Psammophis.* Some specimens have light longitudinal stripes with a metallic lustre.

This slender, decorative snake is not too difficult to rear. It is content with a simple terrarium and soon snaps at small lizards, which are killed relatively quickly by its potent venom. It is not so strikingly agile, however, as the species described above.

The reader has no doubt read in travel stories about India of the unusually thin green tree snake sold by the native boys in harbour towns to tourists. These snakes are so gentle and bizarre that even tourists who have no great liking for snakes buy them, for the same reason that they buy monkeys or baby crocodiles—and afterwards do not know what to do with them. They are unaware that the Indian Whip Snake *(Ahaetulla mycterizans),* as it is called, has poison ducts leading off into elongated, grooved fangs, with which it kills the lizards it catches, It does not normally bite, however, and when it does there are no unpleasant consequences, as it does not open its mouth wide enough to use its poison fangs.

This snake has a number of other striking features, apart from its unusual slenderness. Its head is very elongated and the rostral part terminates in a small, soft snout, the purpose of which is not known. The eyes have a black, contractile pupil, which is horizontal and not vertical as in most other snakes. When the snake is excited, the pupils dilate and contract, the snake rears its head and shakes and turns it from side to side, without moving its neck, which is no thicker than a goose-quill. The snake finally lowers its head at right angles to the plane of the neck and looks an intruder directly in the face and not from the side, as most other reptiles and birds do.

The tough body of the Indian Whip Snake resembles a steel spring, especially when the snake is excited or attacks its prey. When at rest, at least half of its body hangs down from the dense foliage and is indistinguishable from its surroundings. When alarmed, the snake raises the pendant part of its body without any apparent effort, hooks itself to some small branch by its head and silently vanishes, reappearing a little later somewhere else, with the fore part of its body hanging in the air, ready to pounce on a lizard or a small bird. In spite of its slenderness, the Indian Whip Snake is rapacious and eats two lizards a week. Anyone who has not had the opportunity of observing it would scarcely credit that a three-foot snake could swallow a full-grown Common Lizard without effort. It does not coil itself round its prey, but grips it firmly in its jaws, gradually injecting the venom into it. In about ten minutes the lizard is paralysed or dead and the snake proceeds to eat it, still with half its body hanging in the air.

The Indian Whip Snake protrudes its whitish tongue with its yellowish tip differently from the other snakes already described. It protrudes it as far as possible, keeping the forked end closed, and holds it motionless in this position for several seconds, so that it appears like smoke from a cigar; it then opens the fork and the tongue flickers normally.

In spite of its sensitive, contractile pupil, the Indian Whip Snake is not a denizen of the night, but hunts only during the day. Some of those kept by us drank water only from the leaves and licked the drops which clung to the stems; others drank directly from the water container. This perhaps depends on the locality from which they originally come. It is surprising that this tropical snake does not like too much heat and is content with a temperature of 20—25° C. The terrarium must, however, contain dense evergreen growth or bushes. The best plants are lemons or oranges. In such surroundings the snake is almost invisible to the unpractised eye. Its colour adaptability is heightened by the fact that it is lustreless—a feature in which it differs from the majority of snakes. It grows to about five feet in length.

Another handsome and beautifully coloured snake is the Mangrove Snake *(Boiga*

dendrophila) from Malaya. As indicated by its scientific name, this glossy black snake, which is decorated with cross-bands of fiery yellow, inhabits the tops of jungle trees, from which it climbs down in the evening into the undergrowth, where it is found in the early morning. It attains a length of about seven feet. It is flattened laterally and is therefore clumsy on the ground. In the terrarium it remains for days on a convenient branch, forming an unusually decorative picture. It hunts other snakes and probably also large lizards and birds.

Its poison is very potent, as a sparrow, for example, is killed in two minutes. This snake is altogether very inclined to bite and it is not improbable, in view of its size, that its venom could also take effect on man. At all events, a number of more or less substantiated cases are on record, in which painful swellings and other signs of poisoning appeared following a bite from the *ularburong.*

The Mangrove Snake emits a peculiar, faint but unpleasant odour, similar to that emitted by some earthworms.

In enumerating the beautiful, but poisonous, Colubrid snakes, mention must also be made of the notorious snake of equatorial and S. Africa, known by the Boers as the Boomslang *(Dispholidus typus).* It is found in several types of colouring, the commonest being pea-green or brownish green, although I have also seen completely black specimens and others with green scales bordered in black. It is flattened laterally for coiling itself round the trees and bushes in which it lives and like the *ularburong* it is rather clumsy on the ground. It has a very sloping forehead, but in contrast to *Psammophis,* its forehead is arched. It has large scales and large, bright eyes.

The Boomslang is one of the Colubrid snakes with grooved rear fangs which are known to have caused poisoning and death in man on many occasions. As far as I can judge from my own experience, this handsome snake does not appear to be very aggressive. The two small bites which I received from it (not while hunting it, but, as usual, at home in the terrarium) had no untoward consequences. It probably cannot be trusted, however, as it sometimes opens its jaws very wide when attacking, showing that it intends to bite with its poison fangs. A white rat bitten several times in succession by an infuriated Boomslang dies in six minutes in violent convulsions.

The main food of the Boomslang probably consists of chameleons; at least, these were the food most frequently vomited by captured snakes. I have caught a Boomslang, however, in the act of devouring young birds. In our terrarium we have fed these snakes successfully on lizards and small snakes. They bite mice and hold them in their jaws until they are dead, but rarely eat them. They require a fairly high temperature and fairly moist air, like all tree reptiles except the Indian Whip Snake.

When excited, the Boomslang rears its head, moves its jaw muscles and expands its neck ventrally; at the same time it tries to retreat into the dense foliage. In the terrarium it is one of the most decorative snakes, but not one of the most hardy. It attains a length of about five feet. In its natural environment it lives chiefly in acacias.

DEADLY VENOMOUS SNAKES

In the previous chapter it was stated that the most highly developed venom apparatus was to be found in the Viperine snakes. The poison fangs of these snakes, which are situated at the front, are perfect hypodermic needles, which receive the liquid venom from the poison gland at their root, either by mechanical pressure or at the snake's will, and inject it via a longitudinal canal through the centre of the fang into the wound produced by the bite. The fangs are thin, but strong and resilient and can be folded back to the upper maxillary to which the fangs are attached. The venom, with few exceptions, is very potent.

It is all the more interesting that the venomous Elapine snakes, whose poison is even more deadly than that of the Viperine snakes, should also have hollow front fangs, but less perfect and either quite fixed or only slightly movable and comparatively short. I regard this as evidence that in bygone geological periods, potent venom developed earlier than a perfect biting apparatus and that, with the exception of the present-day Viperine snakes and the most advanced of the Colubrid snakes, many groups ceased developing in this respect.

As an example of an extremely venomous snake with little developed venom fangs, I should like to cite the brightly patterned "Pama", or Banded Krait *(Bungarus fasciatus)*. This snake is about five feet long, very slender and with a sharply crested back, so that it always looks thin. It is a pale, glossy yellow with broad black cross-bands which often have a blue lustre. This handsome snake is found in comparative abundance in India, Indo-china and the East Indies and is greatly feared, as its venom is quite as deadly as that of the cobra. Fortunately, it is said to be timid and its poison fangs are so short that they do not usually penetrate clothing.

In this extremely venomous snake, which we have already kept several times, there is not only a disproportion between the quality of the venom and the length and development of the poison fangs, but the snake's diet is also somewhat unusual: its favourite food consists of other snakes (this characteristic has already been met with in some of the other snakes described earlier on). It also catches lizards, which from our point of view are certainly not so tough or indigestible as snakes.

The venom of the Krait not only paralyses harmless Colubrid snakes, but also Viperine snakes. The Common Viper, for example, is overcome in a few minutes. The bite of a viper, on the other hand, does not affect the Krait. It therefore sometimes seizes a venomous snake by the middle of the body, regardless of its biting and writhing and holds it until its convulsions stop. Only then does it begin to look for the head and swallow its repulsive dinner. The favourite dish of our Kraits was the Smooth Snake *(Coronella austriaca austriaca)*, even though these slender, but strong snakes defended themselves by coiling themselves round their enemy and almost suffocating it. Sooner or later, however, the venom began to take effect and the victim's struggles grew weaker and weaker until they finally ceased.

In order to test the disposition of the Krait, which, as already mentioned, has been described as not very aggressive, I teased it with a wooden stick, and true enough, the snake tried to creep into a dark corner. When I continued to poke it with the stick, however, it struck out several times with a sharp hissing sound at the intruder, from a distance of about eight inches. A few small drops of venom and one large drop remained on the stick. Another time I kept pushing it with my hand, which was protected by a leather glove; I also found drops of venom on the fingers of the glove after the snake had attacked it. The Krait does not, therefore, seem to me to have a very peaceable disposition, although it does not seek an opportunity for biting, like some of its more notorious kin.

From long experience I am convinced that considerable caution is required to pick up a venomous Colubrid snake by the tail and lift it, as one can do comparatively safely with a large Viperine snake. Colubrid snakes are usually much more supple and can jerk their head round to one's hand. This also applies to the Krait, if it is not completely exhausted or about to die. Once, when picking up this snake, holding the tail in my right hand and keeping the neck down with my left, by means of a piece of wood, the Krait unexpectedly swung side ways and upwards and scratched my left thumb with its fang. I need hardly say that the consequences were anything but pleasant. When handling dangerous small snakes, therefore, it is wiser to use light, strong sticks with a long, curved wire on the end, on which the snake can be carried in comfort.

The most popular of all the Colubrid snakes are the cobras, which were formerly thought to have caused the largest number of deaths from snake-bite in the tropics of the Old World. On the basis of the data, however, zoologists came to the conclusion that the largest number of such accidents were due to some Viperine snakes, such as the Tic Polonga or Russell

Viper *(Vipera russellii)* and the Carpet Viper *(Echis carinata)*. When excited, the cobra rears the first third of its body, extending the cervical ribs to form the typical hood, by which the snake usually draws attention to itself in time.

In the southern part of Central Asia and in Iran and Afghanistan, the cobra *Naja naja oxiana* is fairly common. This is a near cousin of the well-known Indian Cobra, popularly known as the Spectacled Cobra, because of the markings on the hood, which take the form of an inverted pair of spectacles and are especially conspicuous when the hood is spread. The Central Asian cobra does not, however, possess these markings, although it is in no way inferior to the Indian species as far as size is concerned. Both attain a length of about seven feet.

Anyone observing a cobra for the first time as it glides quietly along or rests, coiled up, is usually disappointed. In its normal state, the cobra is just as inconspicuous as any plain snake. At the slightest provocation, however, it rears the fore part of its body, spreads its hood and presents an apparition which is terrible indeed, not only to man, but also to many animals.

Some species of cobra have a circular pattern on their hoods, others have broad cross-stripes. The chief home of these snakes is Africa, where the largest number of species are found. Only two species, with many varieties, inhabit Asia, but these are fairly abundant. All cobras are nervous, irritable creatures, which do not attack man or their enemies of their own accord, but when in danger do not hesitate to bite, usually quite high up, according to the height to which they can rear their heads. The cobra's bite is very dangerous, even though its poison fangs are short, as it injects a large amount of venom into the wound. The composition of the cobra's venom is similar to that of the krait and paralyses the nervous system.

Many species of cobra attempt to frighten an enemy away (whether real or imaginary) by "spitting" venom. This property is possessed mainly by the species found in tropical Africa, but we have verified that on occasion Asian cobras can also spit venom, although not so well. When excited, they move the muscles of the upper jaw *(musculus temporalis anterior, medius* and *posterior)* with masticatory movements, thus applying pressure to the poison gland, from which drops of venom run down through the canals in the fangs into the oral cavity. Here a quantity of saliva is secreted; this becomes mixed with the venom and the snake ejects the fluid through a space at the point of the lower jaw through which it normally protrudes its tongue when the jaws are closed. When discharging venom, the cobra's head is always reared and its head more or less darts out.

The glass wall of the terrarium is soon splashed with whitish yellow venom, which dries and crystallizes in fine flakes. These can be scraped off and used for experiments not requiring fresh venom. The Central Asian Cobra does not eject its venom in a concentrated jet, but sprays it out, as may be seen with suitable lighting.

All tales about the miraculous powers of movement of "attacking" cobras and other extremely venomous Colubrid snakes are pure invention. Even if an attacked snake lashes about and strikes out for quite a long way in all directions, always turning to face the enemy, it is not particularly difficult to catch or kill it. It is only important that the eyes or any open wound should be protected from the venom. We have dealt with cobras in the herpetological station without any untoward incident, even when they had to be moved or packed for sending away.

Cobras chiefly catch toads, mice, young birds, lizards and other snakes. It is stated in the literature that they also eat small birds' eggs and even fish, but my experiments in this direction bore negative results.

From the psychological point of view it is interesting that the cobra feels capable of defending itself only when it rears up. It can also bite when in a normal position on the ground, but if unable to rear its head it always tries to escape. I verified this by means of a simple experiment: a cobra was allowed to crawl under a specially prepared sheet of glass fixed in a horizontal position 5 cm. above the ground, and was then irritated by sharp movement. Several times the snake tried to rear its head and spread its hood, but each time it collided with the glass. It then tried to escape as quickly as possible, with no regard for its dignity and

IV. From left: Anterior part of skin of young Western Diamond Rattlesnake *(Crotalus atrox)*, Radde Viper *(Vipera raddei)* and Carpet Viper *(Echis carinata)*. Actual size.

without any further attempts to defend itself. As soon as it was free of the glass, however, its behaviour underwent a change and it again reared itself in the normal position of defence.

One of the best Viperine snakes to keep is the Nose-horned Viper *(Vipera ammodytes)*. This used to be known as the Sand Viper, but the other name is more appropriate as this snake inhabits stony hillsides and not sandy places. This, of course, does not alter the fact that in terraria it is kept in sand. This also applies in the case of other reptiles, whose environment in captivity has to be simplified so as to facilitate the observation and handling of these animals.

The Nose-horned Viper is like the Common Viper in having a black zig-zag line along the back but differs from it in having a smaller number of plates on its head, by its somewhat stouter body, by the vertical horn on its snout, covered with scales, and by its more indolent disposition. The males are usually light grey in colour, with a black zig-zag line along their backs, while the females are dark grey, brownish grey, brownish yellow or reddish in colour, with a zig-zag stripe of a darker shade of the same colour. Very occasionally completely black specimens are caught. The difference between the sexes is not, however, so clearly marked in the colouring as in the case of the Common Viper; sometimes, e. g. before shedding the skin, it is difficult to distinguish the sex, as at this period males which have not yet shed their skin may be darker than females which have just shed theirs.

Although the Nose-horned Viper is, on the whole, a good-tempered snake, which lies for hours coiled up somewhere in a corner or on a suitable stone, it is one of the truly dangerous reptiles, not only because its venom takes effect very quickly, but also because it is easily annoyed and bites like lightning and without hesitation, although only at short range. It is found in N. Italy, S. Austria, Switzerland, Hungary, the Balkans, and spreads into Syria and Transcaucasia. It forms island-like colonies, which only rarely spread out over a large area. This snake has been found two or three times in Czechoslovakia (in Slovakia), but it cannot be said to be a native of that country.

The horn, which is situated above the nostrils, is a very conspicuous feature and gives the snake an exotic appearance, but nothing is known of its purpose, as in the case of similar growths in vipers of the genera *Cerastes, Bitis* and others. It has no particular internal features, such as special innervation, etc.

In spite of its propensity for biting, the Nose-horned Viper is a popular snake in terraria, as it is not only pleasant to the eye, but its requirements are few and it is unusually hardy. It needs chiefly warmth, fresh air and a little water. Our native Common Viper often refuses food for a long time and is at first very finicky; it also dislikes the company of other vipers, which crawl over and continually disturb one another. The Nose-horned Viper, on the contrary, enjoys the company of other snakes of its own kind, as they rarely move about more than is necessary and a whole cluster can be kept together. They are not fussy over their food —on the contrary, they are usually gluttonous and trouble with them arises only over food. It always ends in an amicable way, however, after all the mice have been eaten.

In the Nose-horned Viper it is easy to verify that snake venom does not act on others of the same species, except in artificially concentrated doses. It often happens that two vipers approach the same mouse or sparrow and attack almost in the same instant, in which case one may bite the other with full force, quite by accident. Another time a viper will attack a more fortunate rival which has snatched a dead mouse from it and spitefully bite the other one. Although the poison fangs sometimes enter the other snake's body or head quite deeply, and venom is doubtless injected, the bitten snake suffers no ill consequences.

Nose-horned Vipers soon learn to take freshly killed mice or lizards, or even pieces of meat which they take from a pair of tongs. They do not touch frogs or newts. They sometimes chase them in the terrarium, but as soon as they come up close to them and recognize their mistake, they take no further notice of the amphibians. It may happen, of course, that they bite an animal which they have no intention of eating, especially if it so big that they regard it as an enemy.

These snakes can grow to about three feet, but attain this length only rarely. It is certain, however, that they are the largest and most dangerous of the European vipers[6]) and many people have died from its bite, especially in the Balkans. It is interesting to note that the males are larger than the females.

Nose-horned Vipers usually eat small rodents, such as voles and mice. A two-foot specimen will eat two or even three mice at once and then coil itself in a loose spiral and digest its food for several days. It consumes on an average two mice weekly. Large vipers can also swallow a ground squirrel or a rat. The young, which hatch out fully developed, without any residue of the allantochorionic membrane, measure from 5 1/2 to 6 1/2 inches[7]); they feed almost entirely on young lizards. Some, however, also swallow newborn mice. Young Nose-horned Vipers are very irritable and show a propensity for biting right from birth. If touched, they immediately coil themselves into a spiral and strike at the object of annoyance. Their colouring is almost the same as that of fully grown vipers, only perhaps a little more variegated.

The young vipers, 6—14 of which are born at once, grow fairly rapidly; in three to four years they measure nearly two feet and are capable of reproduction. From then onwards, growth is more gradual. From the moment of hatching, the young ones are just as venomous as the adults, the only difference being that their poison fangs are still very short and that there is correspondingly less venom. The bite of even young Nose-horned Vipers, however, can have serious effects.

Nose-horned Vipers are sent to us most frequently from Bulgaria, especially the subspecies *Vipera ammodytes montandoni.* The typical form, *Vipera ammodytes ammodytes,* occurs more to the north and north-west. The difference lies chiefly in its more robust head and in the brick-red colouring of the under side of the end of its tail, which in the subspecies *montandoni* is yellowish green.

One of the largest vipers, apart from the Tic Polonga *(Vipera russellii),* which is the largest of the whole genus, is the Levantine Viper *(Vipera lebetina),* which is found in N. Africa, except Egypt, on the island of Melos and several other E. Mediterranean islands, in Turkey, Syria, Palestine, Arabia, Iran and Iraq, the Caucasus and part of Central Asia, Afghanistan and India. It has a number of subspecies, which vary considerably in their colouring. We have been receiving these vipers, which grow to over five feet, from the countries of Central Asia. This is the type known as *Vipera lebetina obtusa.* We have also received a few specimens from Syria.

If the Viperine snakes were to judged by aesthetic standards, the Levantine Viper would be a sure loser. Its colouring is inconspicuous, being slate-grey or greyish brown, marked with rust colour or bluish cross-bands. The eyes are dark and small. Only young specimens from Central Asia and N. India have more striking markings on the head and back. This snake has a surly expression and an unfriendly disposition, although it is easy to keep in a terrarium because it has a good appetite and has no special requirements.

The Levantine Viper is not very long and its poison fangs are not very large, but it is nevertheless a very dangerous snake. In N. Africa the French call it *la vipère minute* and although we must sometimes object to this expression because it is also used for harmless reptiles, in the case of the Levantine Viper it is quite applicable. A child bitten by this snake dies within half an hour if not treated with the specific antivenin. The Arabs call this snake the *tagerzha,* the Russians call it the *gyurza.*

This large snake, which weighs up to over six pounds, takes food in captivity within a few days, chiefly white rats and sparrows. At first it hunts only by night, as it is shy of the light. During the day it usually lies coiled up in a corner or on a branch; when there are several in the terrarium they lie coiled up in a cluster. In the evening they begin to glide about and look for food. Their relative indolence and the small degree of danger from them during the

[6]) Without counting the Levantine Viper *(Vipera lebetina),* which is found in Europe in only a few places.
[7]) Some authors say over eight inches, but I have never seen any as long.

day is probably related to their nocturnal habits. After some time in captivity they become acclimatized to the extent that they begin to hunt and move about during the day, and will even mate in front of an observer.

The male Levantine Viper grows to a larger size than the female, which rarely reaches more than three feet. The males are also much more bellicose.

The Levantine Viper strikes at its prey at short range like lightning. A rat it will bite and then let go, while it holds a mouse or sparrow in its jaws until it is dead. The rat dies as quickly as if bitten by a rattlesnake, i. e. in 15—30 seconds. This snake is very greedy and consumes a relatively large amount of food. The young, which are born in August and September, are usually fully developed (the Central Asian vipers of this genus lay eggs). They catch lizards.

As animals which move about during the cool night-time and spend the day in various sheltered hiding-places, the Levantine Vipers do not require much warmth. The optimum temperature for them is from 25—28° C. They like to go into the water and take frequent drinks. In their own country they chiefly inhabit mountainous areas, where they are found up to a height of 5,000 feet above sea level. In the terrarium there must therefore be a pile of large stones, artificial or real, over which they can climb. Because these vipers have a supple tail by which they can cling, they are also good at climbing among branches.

Another snake, similar to the Levantine Viper, is the *Vipera xanthina,* which differs from the former by its somewhat smaller size and its markings. It has a zig-zag band the length of its back, composed of diamond-shaped or rounded, dark brown blotches edged with black and on its head there is a dark, wedge-shaped blotch with the apex pointing forwards. The markings on the head and neck are much more vivid than on the back. The young ones are more brightly marked than the fully grown snakes.

This snake is found is coastal areas of the Near East; its habits are the same as those of the Levantine Viper. A few specimens which we received from Palestine at first distinguished themselves by their strong inclination to bite. Later, however, they grew accustomed and behaved in the same way as their bigger cousins, with which they were housed together.

A strikingly powerful and somewhat clumsy snake is the Puff Adder *(Bitis arietans),* which is found in Africa. It grows to over five feet and is distinctly stout and would have no attraction at all were it not for two characteristics which make it a welcome guest in terraria—these are its vivid black and yellow colouring with the unusual arrow-like markings on the back, and its easiness to satisfy as regards food.

The Puff Adder is actually one of the least difficult snakes to please and needs no coaxing to make it eat. Its chief food consists of rodents, but it also catches small steppe birds. Although it does not care for unnecessary movement and will often remain for several days in the same place, it can catch its prey at close range like lightning. It usually bites and then grips the animal in its jaws until it dies; because of the potency of its venom, this never takes long. This snake also has very long, strong poison fangs, which penetrate deep when it bites. This accelerates the action of the venom.

When the Puff Adder is annoyed, it puffs itself up (as its name denotes) and hisses loudly, keeping its head close to the ground. Sometimes it strikes with closed jaws, without biting. It is not so lazy about biting, however, as its bigger cousin, the Gaboon Viper *(Bitis gabonica),* which natives carry home by its tail. The Puff Adder is regarded as quite dangerous and a specific serum against its bite is produced in some institutes in N. and S. Africa.

In the terrarium this large viper likes a dry environment and medium temperature. As many as twenty can be kept in a single smallish terrarium without trouble, as they rarely move about the cage.

One of the most venomous, but beautifully marked vipers is the Carpet Viper *(Echis carinata),* which is altogether an unusual snake. We receive quite a number of these from Central Asia. The chief features of interest are the eyes, which are placed very close to the

nostrils, and the fact that they move over the sand, on the surface of which they live, in a mobile double spiral and not in an undulating line like most other snakes. This peculiar form of movement enables them to move over loose sand with considerable confidence and has the advantage that the snake is always coiled and ready to bite.

The colouring of this snake is rusty brown to black-brown, with light, pearly, wavy lines and blotches. On the head there is a dull white or yellowish mark in the form of a cross. The eyes are pale yellow, with a black, contractile pupil. The abdomen is pearly white. The Carpet Viper extends over a wide area. It inhabits the sandy areas of N. Africa, Somaliland and Nigeria, W. and N. Asia and India, and is greatly feared everywhere, as in spite of its small size, which is the same as that of our own viper, it has very long poison fangs and potent venom. It is also very nimble and quick to bite.

When in danger, the Carpet Viper coils its body into two narrow loops, which it rubs so hard against each other that the keel-shaped lateral scales make a loud rustling sound. The nearer the enemy comes, the louder grows the rustling and the snake's head darts forward with great speed and violence, sometimes for the whole length of its body, so that it appears to leap.

The young are born in August. In our terraria, however, we have had no opportunity of observing them, as the fertilized females all aborted premature or almost premature eggs.

The full-grown Carpet Viper catches small rodents. Although it has a relatively thin, long neck, it can convey quite bulky prey into its stomach, e. g. the jerboa. In the herpetological station and in the terrarium of the zoological gardens it is fed on white mice. A bitten mouse dies in a few instants. This snake, which has exceptionally good sight, probably sees the dead mouse before touching it with its tongue, as it usually has no difficulty in finding it. It catches lizards only when hungry and sometimes regurgitates them. It is often stated in the literature that it eats large insects and scorpions, but I have difficulty in crediting this, as I was never able to persuade a single one out of several hundred to take anything but mice and lizards.

Among the most highly developed snakes are the family of the Pit Vipers *(Crotalidae)*. They are slender, but handsome snakes, some small, some large, with an unusually well developed and potent poison apparatus. They can be divided roughly into two large groups which are differentiated by the presence or the absence of the rattle.

The rattle is a special arrangement by which the snake draws attention to its presence with the aim of frightening the enemy away. The principle is something the same as in the cobras and other snakes which rear their heads and spread their necks either laterally or ventrally to frighten away an attacker. The rattle is formed of horn; it is attached to a large scale, somewhat constricted in the middle, on the end of the tail, on which it remains behind when the skin is shed, in the form of a slightly flattened ring. When a further ring is formed, after the snake has shed its skin a few times, it remains in front of the first one, which is pushed in a caudal direction, and catches in a groove round the edge of the first one. The whole formation is, to a certain extent, movable. The process continues until a multipartite rattle is formed, which the snake uses to produce the rattling sound by violent shaking. Zoologists used to think that a new part of the rattle grew every time the snake shed its skin, but observations made in captivity have shown that this is not the case.

The age of a rattlesnake cannot therefore be determined from the size of the rattle, especially as it is easily broken off and is slow in growing again, probably by three rings a year at the most. A good-sized rattlesnake may therefore have only a small rattle, and *vice versa*.

The Pit Vipers differ from all other snakes by one unmistakable feature—by the deep pit on either side of the upper jaw, below the nostrils. Recent experiments indicate that this pit acts primarily as a sense organ for temperature discrimination: the Pit Viper is able detect the presence of warm-blooded prey and bite it effectively.

In describing the Pit Vipers which are, or have been at the herpetological station, I should like to begin with one of the prettiest and most "charming". I have put this last word in inverted commas as it is not used in the sense in which it is applied to puppies or kittens, but refers only to a snake separated from the observer by meshing or glass. The snake in question

is the Siberian Halys *(Ancistrodon halys)*, which is about the same size as the Common Viper, but is much more attractive in appearance. Its back is light grey or brownish grey, with dark cross-stripes. Its eyes are greyish yellow.

The Siberian Halys has a beautifully formed head, slightly elongated, raised, and obtusely pointed at the front. Its neck, like that of all the Pit Vipers, is slenderer and more graceful than that of the Common Viper. It remains mainly on the ground and is satisfied with coarse sand and stones, a little water and warmth. It eats mice and young birds at intervals of a few days and its whole behaviour is quite natural, like that of the Nose-horned Viper. It avoids the direct rays of the sun, however, as it cannot stand high temperatures. Great care is needed in handling this snake as it always defends itself by biting and its bite is to be feared. It has not so great a range of attack, however, and in time becomes accustomed to such an extent that its cage can be cleaned and various adjustments made in the immediate vicinity of the sleeping Halys without its making any attempt to bite.

A mouse bitten by the Halys jumps in the air, squeals and often falls dead the next instant. Only when the snake has used its fangs a short time before and the supply of venom has not yet been sufficiently renewed, does the mouse take longer to die. The position of the mouse is characteristic; it lies with its back legs extended, as they remained in the convulsion. The Halys is very rapacious and fights often develop in the terrarium over prey. It gets on well with other venomous snakes only as long as food is not involved. Otherwise there is great danger that the snakes may do away with one another by means of their deadly fangs. During a tug-of-war over a dead mouse, one of our Halyses once bit a Carpet Viper, which in the excitement paid it back in coin. The Halys devoured the mouse, but the same evening regurgitated it and died by the morning. The viper likewise died, within 42 hours.

A terrarium containing several Siberian Halyses is a beautiful sight and one which makes many people want to begin keeping venomous snakes. Many of them do not understand why venomous snakes are often easier to keep than harmless Colubrid snakes. This is often actually the case, but here more than anywhere the saying applies that "you can't be too careful". Anyone who keeps these snakes should never grow more accustomed to them than they are to him. Showing off and "snake charming" are completely out of place in the keeping of venomous snakes. I have found the bitter truth of this myself and have witnessed many other dangerous accidents due to lack of caution in dealing with venomous snakes, which always happened when least expected. Any "private confidences" with cobras, rattlesnakes and other dangerous reptiles are to be discouraged, as they may one day lead to the cemetery...

The Siberian Halys *(Ancistrodon halys caraganus)*, several of which were sent to us from Central Asia, proved to be not only a hardy snake, but also reproduced in captivity. One of two females produced seven young ones, about seven inches long, which were catching small lizards within a week. Later, however, the young ones died because of an inadequate supply of lizards. Even artificial feeding was of no avail and failed to save the young snakes.

Although the *shchitomordnik,* as it is known beyond the Volga, has no rattle, when excited it shakes the last inch or so of its tail against the sand or a stone, with a faint but audible whirring sound. Another species, but much bigger, which inhabits S. America, does the same when excited, vibrating its tail on the surface of the water with a peculiar gurgling sound. This is the Water Moccasin, or Cotton-mouthed Snake *(Ancistrodon piscivorus)*.

The Water Moccasin is much more powerful than the Siberian Halys. It attains a length of up to five feet and when fully grown has more striking colouring on the abdomen than on the back. The young ones, however, are very vividly marked, as they are ornamented with broad, dark-brown cross-bands and blotches, which later lose much of their distinctness.

This snake takes food well in captivity and is hardy, but it is unusually irritable and an almost chronic biter. Because it darts out quite a long way when biting, care must be taken

when dealing with it. In its natural environment it inhabits extensive swamps and big rivers and in these areas is perhaps the most feared of all the snakes, as many people have died from its bite.

In spite of its robust form, the Water Moccasin is very clever at catching fish and frogs, which constitute its main diet. It also attacks small birds. In the terrarium it soon learns to take pieces of raw meat and dead fish, even sea fish. It does not get on well with other species of snakes and often takes the first opportunity of biting them. Although its poison fangs are not especially long, its venom also kills animals with changing blood temperature (i. e. large fish) very quickly. It does not usually catch fish in the same way as Colubrid snakes do, i. e. by swimming, but waits on the bank until a suitable fish comes within range and then strikes. It grips the fish very tightly, in spite of all its struggles, as it has powerful jaws, and at the same time drives its poison fangs into its prey. In half a minute, or only slightly more, the fish stops struggling and goes limp and the snake swallows it; sometimes it first lets the fish fall and then picks it up again by a more convenient part. It bites mice but does not hold them in its jaws while waiting for them to die.

The young of these snakes are born fully developed, with the same habits as fully grown snakes. Although the moccasins kept by us never had young, in 1951 we received young ones which had just hatched out and I was therefore able to study their further development and growth; this is rapid indeed, perhaps because the snakes eat often and much. Morphologically the Water Moccasins belong to the most ancient of the Pit Vipers.

We once made an exchange with the Brazilian serological institute Butantan and obtained a large quantity of Pit Vipers, including the notorious Jararaca *(Bothrops jararaca)*. These are slender and fragile-looking and fairly highly specialized. Such specialized forms are always difficult to keep in a terrarium. The Jararaca is so widespread in S. America that it is one of the most abundant snakes in the world. It feeds mainly on rodents and young birds. Its bite kills white rats in 45—160 seconds.

This snake has interesting colouring. The most conspicuous markings are on the middle of the body, while on the front and the tail they tend to fade away. The poison fangs are enormous in relation to the size of the snake. A snake with a skull measuring just over 1 1/2 inches from the intermaxilla to the most caudal point of the lower jaw has fangs measuring almost 4/5 of an inch (measured over the curve). They are almost twice as long as the poison fangs of an old Sand Viper, whose fangs measure less than 2/5 of an inch and more than three times as long as the fangs of the large Common Viper. It is understandable that the Jararaca and all the other snakes of the genus *Bothrops* are a constant source of fear for those who work (mostly barefooted) on the plantations. I cannot say, from my own experience, that this snake is particularly aggressive, but life in captivity and the hardships through which it has to go before being despatched may have an effect on its natural disposition.

The most highly developed of the Pit Vipers are the rattlesnakes, with the famous rattle. Only one species of these inhabits S. America; all the other species are found in Central and N. America. These are strong, heavy snakes, which appear slim because of their long, thin neck. Their markings are clearest and most resplendent just after they have shed their skins, but later take on a greyish tinge.

Among the rattlesnakes, as among the vipers, there are pygmies and giants. The small rattlesnakes of the genus *Sistrurus,* which have a miniature and almost inaudible rattle, barely attain the size of our viper, whereas the Western Diamond Rattlesnake *(Crotalus atrox atrox)*, which we manage to keep with success, may grow to seven feet and weigh about 35 lb. It is one of the big venomous snakes and because its poison glands secrete an unusually large amount of potent venom, which can be injected by its long, strong poison fangs deep into the muscles, it is also deadly.

The young ones soon become accustomed to a smaller space and to the new ecological conditions in the terrarium; they are not, on the whole, very demanding as regards temperature and take their food with a good appetite. At first they are easily alarmed and use their rattles

on every conceivable occasion, but later they gradually forget this means of inspiring terror and come of their own accord to fetch a mouse the keeper holds in a pair of tongs.

Their rattle can be heard to a distance of 30—45 feet. When danger approaches, the vibrations of the tail increase until the rattle looks only like a misty shadow. If the assumed danger recedes, the rattling dies down; it finally gives a few more rattles, like a machine running down, and is then silent. If the snake has not yet grown used to captivity, it rattles even when taking food, if the observer makes a movement. When several of these snakes all rattle together at the same time, it makes a fearful concert, pleasant to the ears of reptile lovers, but fear-inspiring to the majority of people and animals.

The Western Diamond Rattlesnake is greyish brown or olive grey. In some snakes, the diamond-shaped markings on its back glitter like a string of real diamonds when the snake has just shed its skin. The short tail is lighter in colour than the rest of the body, with broad black rings. This is no doubt also of help in frightening enemies away, as when at rest the snake always has its tail coiled up beneath it and displays its striking markings only when excited, at the same time rattling and taking up a defensive attitude.

As far as biting is concerned, the Western Diamond Rattlesnake cannot compete with the moccasins and many other Viperine snakes. Readers will no doubt be disappointed at this, as many of them have certainly read in novels and other books of the terrible danger which rattlers constitute for travellers and cowboys and imagine them to be the very incorporation of evil. I can assure you that Pit Vipers which have no rattle are probably more dangerous; few people notice them in time and suddenly find themselves in close proximity, whereas true rattlers always sound their rattles so loudly that attention is drawn to them in time. It is, of course, possible that the rattle may be missing as the result of some accident, or that both man and snake catch sight of one another when it is too late. Nevertheless, the Western Diamond Rattlesnake cannot be regarded as being so eager to bite as the Water Moccasin.

These snakes chiefly eat small rodents and, when they are young, lizards. They are also very fond of young birds. They bite mice and rats and then wait for them to die and sometimes begin to eat them while they are still twitching. They hold birds firmly in their jaws until they die; they evidently have an inkling that a bitten bird might still be able to fly some distance away, as its body (lungs, hollow bones, etc.) contain more utilizable oxygen than the bodies of mammals, so that paralysis takes longer to set in. A three-foot rattlesnake can swallow a large white rat or a pigeon, while a six-foot specimen will eat a hen or a small rabbit. One of our own snakes was so self-possessed that it even performed in front of a film camera and swallowed its prey with tremendous gusto in the glare of the reflectors.

The movements of the Western Diamond Rattlesnake are very graceful and rapid. Even where it cannot get a hold on uneven surfaces it will glide in a straight line, swiftly and without effort. The Brazilian Rattlesnake *(Crotalus terrificus terrificus)* is slower. Its movements are not nearly so elegant. It is yellowish, reddish or olive brown and has diamond-shaped markings with yellow dots.

This rattlesnake, which grows to about five feet, has a comparatively small, narrow rattle, which produces only a very faint, whispering sound and it is very easy not to hear this sound, announcing the presence of the Cascavela. For this reason there are many cases of snake-bite by this snake in S. America and its venom is regarded as the most potent of all the S. American snakes.

We received several of these rattlesnakes from Sao Paulo, along with others. During the day they lay coiled in a cluster under the lamp and in the evening they glided about the cage. They climbed up on to strong branches which had been fixed in the cage, but while climbing they often fell, showing that they definitely do not belong to the tree-climbing snakes. After midnight they stopped moving about, coiled themselves up and slept. Their favourite food consisted of sparrows, which they were unable, however, to catch alive. They soon found freshly killed sparrows, though, located the head and immediately swallowed them. One of the females was with young, but died before it could give birth to the young ones, of which

there were eight, all of them fairly well developed. The cause of death in this snake (and in some of the others) was that before sending them, the conscientious employees of the serological institute had extracted the venom and in so doing had held the snakes carelessly and damaged their cervical certebrae. This has always been a sore point with zoological gardens, which often receive rare reptiles from tropical countries in a deplorable condition, as the natives do not understand that anyone could wish to treat a snake kindly; to them it is an enemy, or at best an unpleasant member of the local fauna.

THE ACTION OF SNAKE VENOM

The preceding chapters describe the keeping of venomous snakes which, in our herpetological station, receive every care and attention, as they are not only interesting creatures, but often also rare ones. In these chapters I have drawn attention to the danger to which everyone who has to deal with venomous snakes at close quarters is exposed. Even the person who looks after the terrarium, who only occasionally comes into direct contact with dangerous reptiles, has to be very careful when cleaning out a cage in which mere vipers are housed, in case some snake unexpectedly bites him out of annoyance. The danger is still greater for the scientific worker, who does not work only with dead specimens in alcohol, as people often erroneously imagine, but works chiefly with living material. The observation of a change of poison fangs, the study of external and internal parasites and various diseases and the classification of venomous snakes all entail holding the snake in one's hand and spell considerable risk, particularly as the snake must not be held too firmly for fear of harming it.

The situation in tropical serological institutes is quite different, since there the supply of these reptiles is almost inexhaustible and the death of one or other of the snakes is of no consequence. There they can be picked up in tongs and similar contrivances in which the snake's violent contortions damage the spine; the poison is also removed so roughly that the snake is often severely injured. I should like in this connection to quote the excellent book by R. Kraus and F. Werner: *Giftschlangen und die Serumbehandlung der Schlangenbisse,* in which the authors describe the catching and rearing of venomous snakes for serological purposes. They write: "A snake which has once been held tightly by the thumb and index finger is almost without exception doomed to death."

I think that this makes it sufficiently clear why the snakes in our station have to be handled with double care—care in the interests of those who are dealing with them and care in the interests of the snakes themselves.

The bite of the Common Viper, the only venomous snake inhabiting Great Britain, can be very unpleasant, but is only rarely fatal, whereas the bite of exotic venomous snakes is much more dangerous and without the administration of the appropriate serum almost always has a fatal outcome. I am often asked which is the most venomous snake in the world. This question arises out of people's love of the romantic. People love sensation in superlatives —the biggest animal, the most rapacious animal, the smallest animal, the most dangerous animal, etc., etc. The answering of this question gives the hearer a slight shudder down the spine and he is satisfied. It is difficult, however, to say which snake is actually the most venomous.

The potency of the venom of truly dangerous snakes is approximately the same and the bite of a cobra, a rattlesnake, a tropical viper or a coral snake all have an equally rapid and terrible result, even though the accompanying signs are different. The condition of the snake and of the victim at the given moment also influences the outcome. A bite does not always produce the same effect. The snake may be suffering from some disease which prevents the passage of the venom through the fangs, or it may have just shed its old fangs and the venom

does not penetrate the wound. Further factors are the depth of the wound and the amount of venom injected and also the properties of the actual venom, as these are not constant. Finally there is the part played by fear, which helps to magnify the symptoms of the victim.

The chemical composition of snake venom has not yet been investigated as thoroughly as one might wish and all its components are not yet known. The proteins predominate and the venom also contains water, particles of saliva and pepsin and other substances. Snake venom contains the following chief components, in differing proportion: haemotoxin (haemolysin), which destroys the red blood cells, leucolysin, which breaks down the white blood cells, neurotoxin, which paralyses the nervous system, cytotoxin, which destroys tissues, haemorrhagin, which destroys the blood vessels and mucous membranes and coagulin, which precipitates blood following agglutination. Some of these components take effect only on becoming mixed with the blood serum; the haemolysin, for example, becomes toxic only on coming into contact with lecithin, which is contained in the blood serum and together with which it forms a new, highly toxic substance, toxolecithid, which breaks down the blood cells.

The toxolecithid frees the haemoglobin (the respiratory pigment) from the red blood cells, which are rapidly destroyed. Aggregates of agglutinated and destroyed blood cells then block the capillaries.

Viper venom can be divided into approximately three main groups of components: echidnotoxin, echidnase and echidnovaccine. These components can be destroyed by heating at 75—80° C for 15 minutes.

The general action of snake venom differs from that of plant poisons, such as the alkaloids, by its more complex but swifter course, which is heightened by the fact that the venom is injected directly into the blood stream, whereas the vegetable poisons usually enter the organism by way of the alimentary tract. The poisons secreted by some other vertebrates, such as a few species of fish, the lizard known as the Gila Monster *(Heloderma)*, and the males of the oviparous Duck-billed Platypus (in a spine on the hind foot), in many respects resemble snake venom.

A few data are given below to demonstrate what minute doses are required to produce a lethal effect. First of all the average amount of venom in both poison (parotid) glands in some snakes is given, together with the weight of the venom after drying (in mg.):

Species of snake:	Liquid venom in mg.:	Dry venom in mg.:
Common Viper *(Vipera berus berus)*	30	10
Indian Cobra *(Naja naja)*	115	33
Western Diamond Rattlesnake *(Crotalus atrox)*	1050	300 and over

The amount of venom depends, of course, on the size of the snake. Only occasionally is this rule not valid, in individual species with exceptionally large poison glands. In some, like the cobra, there is a considerable admixture of saliva, so that the amount of actual venom is comparatively small. Fatal doses of the venom of the Viperine snake *Echis carinata*, dissolved in water and injected subcutaneously, are approximately as follows: for rats, 0.75 mg; for pigeons, 4 mg; for cats, 8 mg; for frogs, 9 mg. Calculating live weight in kilograms, 1 g. of cobra venom (according to Calmette) will kill dogs weighing 1,250 kg., rabbits weighing 2,000 kg., guinea-pigs weighing 2,500 kg., rats weighing 1,430 kg., mice weighing 8,333 kg., horses weighing 20,000 kg., or human beings weighing 10,000 kg. The difference in weight between guinea-pigs, for example, and horses or human beings is also deceptive: 2,500 kg. represents at least 7,500 guinea-pigs, whereas 20,000 kg. represents only 40—50 horses and 10,000 kg. 165 human beings each weighing 60 kg.

The terrible effect of snake venom can also be observed with our own Common Viper.

It requires only 0.005 g. of this venom to kill 15—20 guinea-pigs. Cobra venom, which is almost the same as that of the Banded Krait *(Bungarus fasciatus)*, already described in the chapter on deadly venomous snakes, has such a fulminating effect that 0.0005 mg. will kill a guinea-pig in three hours. R. Kraus goes so far as to state that if cobra venom is dissolved in the proportion of 1 : 15,000 in an aquarium containing tadpoles measuring 0.6—0.7 inches, they die within a few minutes.

According to Rogers, the venom of the venomous sea snakes kills fish very rapidly; the venom of the snake *Hydrophis* is up to fifty times as toxic as that of the cobra.

I myself have more than once had occasion to feel the effect of snake venom on the human organism and can do no more than confirm the view of all others who have made acquaintance with the poison fangs of a venomous snake, that snake-bite almost always leads to considerable suffering. After a bite, or after a dose of antitoxin, there is a short period of immunity, lasting only for a few weeks. Both the poison and the serum are primarily protein in composition and are sooner or later absorbed by the organism, in as far as the latter completely recovers from the original effect of the venom. I should like to describe below a few of my own experiences of snake-bite, which occurred between 1948 and 1950.

1. THE BITE OF THE NOSE-HORNED VIPER

One morning at eight o'clock, while making my round of inspection, I was bitten in the index finger of the left hand, just above the nail, by a large Nose-horned Viper. I expressed a little blood from the wound and because it was not painful I continued with my work. About half an hour later I felt the finger becoming stiff. Ten minutes later the finger began visibly to swell; in a further ten minutes the swelling had spread to the back and the palm of the hand. All the other fingers also became swollen, with the exception of the thumb. For the time being there was no pain. About one hour after having been bitten, the swelling spread above the wrist and I could move my fingers only with difficulty. Gradually, however, an acute gnawing pain made its appearance in the area of the stomach.

Since the pain was unbearable and I did not have the necessary serum to hand, I went to a hospital for treatment, accompanied by my wife. Before we got there, however, the pains in the stomach (which were evidently of nervous origin) increased to such an extent that I was unable to breathe deeply. A cold perspiration broke out on my temples. There were no other symptoms; the hand was not painful, but continued to swell. Two hours after being bitten I entered the consulting room.

The doctor who was summoned used a normal ampule of serum for the bite of European vipers, part of which he injected into the finger at the site of the bite and the remainder into the elbow. I was then given an injection of tetanus antitoxin and the minute wound on the finger was carefully cauterized. In the meantime I vomited several times, but retained complete consciousness and my pulse was normal. In a little over half an hour I was able to leave for home, calling in on the way at the offices of a journal which was under my management. The pains in the stomach disappeared completely, but were succeeded by attacks of weakness and trembling, which were no doubt due to the serum.

After resting for two days I completely recovered, although my stomach occasionally refused to do its duty for several days more. It is interesting to note that the typical haematomata produced by the haemolytic action of the poison did not appear until the second day.

2. THE BITE OF THE SIBERIAN HALYS

This occurred while cleaning out the terrarium, when I failed to observe one of the snakes, which was hidden under a piece of bark. The snake struck from the side, biting me in the little finger of the right hand, with only one fang.

I immediately incised the wound with a razor blade, allowing a little blood to run out

and then bound up the wrist very tightly. In seven minutes the finger began to swell and a gnawing pain was present. In a further ten minutes the pain changed to a prickling sensation. In order to be able to observe the further course of the poisoning undisturbed, I sat down in my study with my watch in my hand and read.

The swelling spread slowly, but the area surrounding the wound began to turn blue. The pulse was not rapid and I could read without trouble and take an interest in what I was reading. This continued for over an hour. The swelling above the wrist then stopped, but the blue mark surrounding the wound spread. I felt thirsty, but to my dismay I found that I was unable to call out. I again measured my pulse and again found it to be within the limits of the normal. During the next half hour I almost completely lost the power of speech and could only talk to my wife in a whisper. The finger was no longer painful, and completely lost all feeling. I became increasingly sleepy and only with difficulty overcame a strong desire to lie down. I drank about half a pint of strong black coffee.

About two and a half hours after being bitten, my speech returned, but my pulse dropped to fifty strokes a minute. The feeling of sleepiness turned to one of weakness and my legs refused to function. The swelling showed no further spread, however, and the haematoma also stopped spreading. I therefore informed my doctor that in spite of his insistence that I should go to hospital, I would stay at home.

Half an hour later, the weakness had almost disappeared and my pulse had risen to 80. The back and palm of the right hand were considerably swollen but were not painful. This persisted for the remainder of the day. I spent a quiet night on the whole; in the morning the swelling was already much less and by the evening it was completely gone. The haematoma on the finger took several days to disappear and the site of the bite was slightly painful for several weeks afterwards.

3. THE BITE OF THE BANDED KRAIT

(BUNGARUS FASCIATUS)

I have already described in a previous chapter how I came to be bitten by this snake, in the ball of the thumb of the right hand near the nail. I immediately incised the wound and allowed it to bleed a little, after which I bound the hand and went to notify my local doctor so that, if need be, he could inform the hospital. Two hours elapsed before I felt the first signs, the onset of which was sudden. Everything suddenly went dark around me and I lost my balance and fell. I immediately got up and sat down on the couch, where shortly after I again fainted, for a moment. I believe that this happened two more times.

I was very pale and giddy. Then I felt sick and vomited several times, after which I drank a large amount of black coffee and a small glass of rum. Three hours after being bitten, my condition was as follows: weakness, occasional vertigo, accelerated pulse. The wound on the thumb was slightly painful and a trifle swollen.

The crisis came in another half an hour. I was conscious of a feeling of anxiety, my pulse became still more rapid, I felt as if icy water was splashing in my stomach and my temperature suddenly rose to 39.6° C (103.3° F). I was fully conscious, however, and understood everything my wife said to me. I rejected a dose of viper antitoxin, which would probably have been of no assistance in any case, as the venom of the krait differs basically from that of the viper as regards its composition. I found that I was confusing the names of objects in my speech.

During the next hour my condition began to improve. The feeling of anxiety disappeared, my temperature fell almost to normal, but my hands and legs began to tremble and this persisted throughout the afternoon and during the night, when it was also joined by headache. The minute wound on the thumb turned orange, but on being painted with potassium permanganate this coloration disappeared. During the night I only managed to get snatches of sleep, but as I had no further symptoms apart from the headache I took two pyramidon tablets

and in this way obtained relief. I stayed in bed the next day, but was able to read and to do a little work. Towards evening the feeling of anxiety returned, but only for a short time. I slept for most of the night and in a few days I had recovered completely.

In describing my experiences of snake bite I should like to remind readers that I am fairly resistant to animal toxins. This means that for the majority of people these bites would have ended disastrously without the appropriate serum, even if part of the venom had been removed by allowing the blood to run out or by sucking the blood from the wound. The bite of some snakes may result in permanent blindness, deafness or paralysis, if the antitoxic serum is not used in time. I once saw an Arab boy who had been bitten almost a month previously by an Egyptian Cobra *(Naja haje);* the wound had been cauterized and native treatment administered, but both his legs were paralysed and he remained hypersensitive to touch. If he had been given serum, he would almost certainly have made a complete recovery.

Venomous snakes occasionally bite one another. Members of the same species usually do not do each other any harm and even members of the same genus often display mutual immunity. For example, Common Vipers, Nose-horned Vipers and Asp Vipers can be left together in the knowledge that they cannot harm one another by their venom. Different types of snakes, such as vipers and Common Grass Snakes, Tessellated Snakes or Smooth Snakes can also sometimes be left together. The bite of the viper does not harm these Colubrid snakes in any way. The Common Grass Snake can stand an injection of 5 mg. of pure viper venom, an amount which the viper itself never injects on biting.

When snakes whose bite is fatal to each other attack one another, the situation is worse. For example, when I was carrying a suitcase in which I had placed both Nose-horned Vipers and Carpet Vipers together, one of the Carpet Vipers bit a Nose-horned Viper; at first the latter displayed no signs of poisoning, but about an hour later it began to writhe convulsively and died. On another occasion I witnessed how the beautiful, but deadly, Australian Elapid snake *Pseudechis porphyriacus,* while chasing a mouse, attacked its fellow, the harmless Colubrid snake *Elaphe dione,* which had meanwhile caught the mouse and coiled itself round it. *Pseudechis* spitefully bit its more successful rival in the middle of the body, remained awhile in this position and then retired to a corner of the cage. The snake which had been bitten showed no signs of distress, but soon swallowed the mouse. The time was then 11 a. m. At 2 p. m. the snake regurgitated the mouse and at 4 p. m. became completely stiff. I thought it was dead and placed it in a small box, preparatory to preserving it in alcohol. In the morning, however, it again showed signs of life and towards evening had recovered to such an extent that I again placed it in the terrarium. On the night of the fourth day, however, it finally died. The treacherous venom had unexpectedly done its work.

As *Pseudechis* often eats other snakes, it is obvious that its venom takes effect on them. Its action must usually be more rapid, however, than in the case I have just described, in which the snake had just bitten two white mice and had thus exhausted a large part of its supply of venom. There still remains the question of whether these snakes swallow their victims dead, or whether they swallow them paralysed, but still alive. I have several times observed similar incidents and every time I had the impression that the victim was in a state of deep unconsciousness but was not dead. (Air remained in the lungs, etc.) Of course, this makes no difference to the final outcome—the snake is swallowed and digested in any case.

Many Colubrid snakes which occasionally or regularly feed on other snakes are immune to the bite of vipers or rattlesnakes. I have already stated that our own Colubrid snake, although it catches only fish and amphibians, is substantially immune to viper venom. The Caspian Whip Snake, as I have myself observed, can stand repeated bites from the Nose-horned Viper, which actually puncture the skin. The big snake *Ptyas mucosus* is immune to viper poison, but succumbed to the bite of the Black-necked Cobra *(Naja nigricollis)* in 50 minutes. The S. American Mussurana is immune to the bite of pit vipers. There are many more such examples and almost all of them demonstrate that the action of the neurotoxins of the venomous Colubrid snakes on reptiles or any poikilothermic animals is stronger than that of

the haemolytic poison of the Viperine snakes. Both types of venom have a lethal effect on warm-blooded vertebrates in about the same length of time and in the same strength.

The minute dose of venom which enters the victim of snake bite, is also of importance after its death. It helps with the digestion of the victim, especially where the biter is a viper or a rattlesnake, whose venom rapidly lyses the tissues of the bitten animal. This shortens the time of digestion to about half the normal time. Venomous snakes show no reluctance, of course, to devouring freshly killed prey which they have not bitten themselves. On examining the faeces of snakes which had swallowed bitten mice and normally killed mice, I found that digestion had been satisfactory in both cases, the only difference being that the time required was not the same. I therefore assume that it is not biologically essential for venomous snakes to eat only bitten prey, but it is important that they should be able to empty their poison glands occasionally by biting. A viper which has no opportunity of using its venom apparatus in captivity soon dies.

Venomous snakes probably developed from non-venomous snakes in the period of the older tertiary rocks. A number of fossils have been found in more recent tertiary strata, all of which show a highly developed venom apparatus, which must have originated at an earlier period. For example, there is the Indian miocene cobra *Naja sauvagesi* and the Öningen miocene viper, *Vipera kargii.* In the Colorado miocene period there lived a genus of pit vipers, *Neurodromicus,* from which the present genus *Crotalus* probably developed.

THE ORIGIN OF REPTILES AND THEIR IMPORTANCE

In the preceding chapters I have described some of the interesting reptiles kept in the herpetological station. Many of them remained only a few weeks or months and continued their journey in strong wooden boxes to zoological gardens and scientific institutes in various countries, some of them across the sea. Some of the reptiles have remained as a permanent reminder of their distant homes—the deserts of Central Asia or North Africa, the tropical forests and impassable jungles.

Even more than mammals or birds, reptiles remind one of bygone ages, when nature's appearance was very different from what it is today. Although reptiles are classified among the higher vertebrates, the form of many of them is so reminiscent of life on the Earth hundreds of millions of years ago that they may justifiably be regarded as living relics of those times, which have undergone little change in the course of their development.

Reptiles did not develop suddenly, but gradually, according to changes which took place in the environment of the original forms. The animals which today are grouped together under the term "reptiles", first appeared at the end of the Palaeozoic period and the beginning of the Mesozoic era (in the Permian and Trias periods).

Before these times, strange fish *(Crossopterygii)* lived in Devonian and Carboniferous waters. Like the mud fish which are still extant *(Dipnoi),* they probably had a bladder by means of which they could take in oxygen from the air at times when the swamps or lakes in which they lived temporarily dried up. It was from these fish, in the late Devonian and Carboniferous periods, that the forerunners of the amphibians developed, and in the late Permian and Trias periods the more advanced forms of these in turn developed into the precursors of the reptiles and mammals. Some forms of reptile precursors then gave rise to reptiles.

Reptiles can be classified as extant and fossile (extinct). The fossile reptiles include, for example, reptiles from the group of the *Dinosauria* (giant lizards), which lived in the Jurassic and Cretaceous periods. They died out without leaving a trace, without any descendants or

closely related forms. Other reptiles which developed and also died out in the Mesozoic era were the strange flying reptiles of the genera *Pterodactylus, Rhamphorhynchus* and others; none of the present-day reptiles resembles them. Of the present-day reptiles, there are only a few of which it can be said that we know who were their close or distant kin in the bygone geological periods of our planet.

One group of reptiles to which this unquestionably applies are the crocodilians. Their ancestors haunted shallow sea-water in the Jurassic era, but only those which moved to a fresh-water environment have survived down to the present day. The members of the extinct family of the *Teleosauridae* in the Mesozoic era are especially well known.

Remains of the oldest known true lizard of the genus *Euposaurus* have also been found in upper Jurassic strata.

The strange lizard known as the Tuatara *(Sphenodon punctatus)* is the most ancient reptile still extant. It has lived in New Zealand in unchanged form since the Triassic period. When young, it has the most developed parietal eye of all existing reptiles.

The oldest known ancestors of the monitors date from the period of the lower Cretaceous rocks. They are mainly the *Mosasaurids*. A certain relationship to the ancestors of the monitor-like reptiles is to be seen in the extinct Cretaceous groups of the *Aigilosaurids* and *Dolichosaurids*. The oldest types of true monitors or lizards closely resembling them are not to be found until the Eocene era. These are the genera *Paleosaniwa, Parasaniwa* and *Saniwa*. In the Eocene and Oligocene eras there also lived the genus *Paleovaranus cayluxi,* which shows a relationship to the *Plecosaurii*. In the period of the lower pliocene strata, *Varanus marathonensis* appeared; this resembled the present-day Desert Monitor and other genera of true monitors.

The giant serpents also developed in the Cretaceous era. It is possible that monitors and snakes developed from the ancient, eel-like lizards of the group of the *Platynota*. In view of the fact that snakes do not possess eyelids and the organization of their eyes is quite different from that of the lizards, there are serious grounds for believing that the ancestors of present-day snakes lived for a long time underground, thus checking the development of the eyes, and that they then returned to live on the surface of the Earth.

True boas, or very similar types were already in existence at the beginning of the Cainozoic period. From the Eocene period there are the genera *Paleryx, Palaeopython, Gigantophis, Boavus, Madtsoia, Protagras, Lestophis* and *Lithophis*. These were joined in the Oligocene period by *Scytalophis, Calamagras* and *Ogmophis* and in the Miocene period by *Scaptophis, Bothrophis, Heteropython* and others. In the Pliocene period there appeared the genus *Python*.

Of the Colubrid snakes mention should be made of the Miocene *Elaphe steinheimiensis,* which is almost identical with present-day members of the same genus.

Palaeontologists regard tortoises as a particularly ancient group of reptiles. Their development can be observed right back as far as the Permian period. During this period transitional forms of reptile precursors developed, such as *Eunotosaurus africanus,* which undoubtedly led to the tortoises. In the Triassic period we see the strange tortoise *Triassochelys dux* and in the Jurassic period the sea turtle *Thalassemys marina*. In the Cretaceous period there were already many true tortoises in existence.

In many reptiles an interesting phenomenon may be observed. Either they have no legs at all, or they display a tendency to dispense with their legs, which become increasingly stunted. From our point of view it is inconceivable that hands or feet should be an encumbrance and that we could move about and obtain our food better without them. In some lizards, however, this is very clearly visible, while the snakes dispensed with their limbs long ago. Many skinks, the lizards of the family of the *Teidae* and the slow-worms either have no legs at all and have only small bones on the skeleton to show where they once were, or they have such weak, short legs that they can scarcely use them. Among the snakes, boas still have vestiges of hind legs in the form of claws, seen chiefly in the males. In reptiles, a lack of limbs does not

seem to mean a lessening of their fitness for survival, but on the contrary, it is seen to be ecologically an advantage.

The fact that reptiles represent an extensive class of animals which have preserved their ancient body structure even while adapting themselves morphologically to changing conditions in their environment, also determines the position of these animals in nature. As compared with mammals and birds, reptiles are at a disadvantage because of the lability of their body temperature, which is dependent on the temperature of the environment. Only on rare occasions do a few reptiles produce their own heat, such as pythons when hatching out their eggs[8]). Climatic conditions are therefore an important factor for reptiles and of necessity limit their spread into colder regions.

The reptiles found furthest north are the Viviparous Lizard and the Common Viper. Both of these are found as far north as 67—70 degrees of latitude, but the price they have to pay is a heavy one, as their winter sleep lasts for eight and sometimes even nine months. Northern vipers must feed themselves up in the short space of three or four months, so as to be able to meet their long winter sleep again. As they are unable to mate immediately on coming out of hibernation, and do so only after several weeks have elapsed, so that the young ones would normally be born at the end of the season and thus be doomed to death, the females usually retain them in their own bodies until the following year. This is a very interesting example of adaptation to hard climatic conditions.

The further south one moves, the more species of reptiles one meets with. The majority are to be found in tropical and subtropical regions; further north their number rapidly decreases. The unsuitable climatic conditions are not the only obstacle, but in colder zones there is also a lack of the proper prey, so that larger species would not be able to maintain themselves since they are not so adept at finding food as mammals and birds.

Many reptiles do not only suit their colouring to their environment, but also change colour mechanically according to their mood or according to a change in the colour of their background or immediate surroundings. Tortoises, crocodiles, large lizards and snakes either do not change their colour at all, or it is decided by three factors: dryness, warmth and age. Many of the smaller lizards, however, are endowed with a surprising ability to change colour, as already noted in some of those which we have kept in the terrarium. Among these, the chameleon is almost legendary, but a large number of other types of reptile are also able to change their colour.

Immediately below the upper layer of the reptile's skin there is a quantity of pigment, which gives the scales their different colouring and sometimes also a metallic lustre, which is only seen, of course, in certain lights. The pigment cells are called chromatophores. The most widely distributed chromatophores in the skin of reptiles are melanophores; these contain black pigment (melanin), which takes up more heat from the sun's rays than any other of the animal pigments. The general or local coloration of the reptile's body changes by contraction or dilatation of the chromatophores.

Some reptiles have a very ancient feature on their heads, i. e. the parietal eye. This is a relic from the days of the Carboniferous and Permian reptile precursors, which, as has already been mentioned, were the forerunners of all the present dry land vertebrates (including whales and sirenia).

The parietal eye is most highly developed in the Sphenodon, in which it probably still partly functions. In the other reptiles still retaining some primitive characteristics, the socket *(foramen parietale)* is still preserved in the skull, but is often a mere vestige, especially in more advanced forms. This can be observed by studying the skulls of monitors, in which the vestige of the third eye can be seen quite clearly in the more primitive types (even on the skin of the head), while in the more advanced steppe and desert species it is barely distinguishable even on the skull. The parietal eye is formed from an extension of the middle brain. It was no doubt

[8]) Ditmars is of the opinion that the increase in temperature can be attributed to mechanical external influences and not to a physiological process.

a necessary feature in amphibian and reptile precursors, which were not very agile and could be attacked in the water by stronger and more rapacious members of their own genus or by rapacious primitive fish, but in view of the higher degree of perfection reached by present-day reptiles and the greater swiftness of their enemies, the eye has lost its purpose and is disappearing like all other organs which are no longer essential.

At one time, during the Jurassic and Cretaceous periods, the Earth was ruled by reptiles. That is why we call the Mesozoic age the Age of the Reptiles. As the giant lizards died out, together with many other groups of reptiles, the class became impoverished and its importance as a factor in nature rapidly diminished. Instead of mighty, gigantic forms, the majority of forms were now small to minute and only a few groups remained, the members of which can be regarded—according to more sober present-day standards—as really big.

Nevertheless, reptiles have their place in nature and can also be of use to man to a certain degree. These are mainly the larger reptiles, which, by virtue of their dietary régime, belong to the permanent exterminators of rodents or other animals which do harm in the fields of the native population. Even our own Common Viper is useful to the farmer and forester, as when fully grown it feeds almost entirely on voles. Water snakes mostly catch frogs and thus help to keep their numbers down. Other snakes eat other reptiles. If we analyse the diet of snakes, we find that the majority of the members of this sub-order catch rodent pests.

There are also small snakes which live on insects and their larvae.

Lizards eat chiefly insects and spiders, while large lizards are often rapacious and, like snakes, feed mainly on rodents and other vertebrates. Crocodiles catch fish, amphibians and anything else which comes their way; the same applies to the carnivorous turtles, whereas tortoises protect plants by eating grubs and molluscs. The importance of these reptiles in nature is negligible, except where their rapacity is directly harmful to man.

With the exception of the Common Viper, the reptiles found in Great Britain are harmless. They are neither harmful nor useful. As I have already stressed, the viper is useful, but its bite, of course, can be dangerous. The same can be said of all reptiles all over the world. If the venomous or particularly strong classes were not dangerous to human life, it would be possible to protect them, as many of them are as decorative as brightly coloured birds or butterflies. Deadly venomous snakes cannot, of course, be protected, but something ought to be done about the big snakes, the monitors, the iguanas, the crocodiles and other large reptiles, which are caught in large numbers for selling and for their skins and are in danger of dying out. It would be a sorry mistake if birds, rare mammals, economically important fish and rare beetles were to be protected and the reptiles were to be forgotten, which today are persecuted everywhere, especially in the tropics, even though many of them are harmless or even rare creatures.

The prevalent attitude to reptiles among the uninformed is well illustrated by the behaviour of some authorities, who often made a fuss about granting the necessary permit for the despatch of various small mammals which I caught on my travels, whereas they immediately gave me a permit for pythons, monitors and crocodiles, with the remark that they were glad to be rid of the pests. And yet these animals constituted valuable living material, which not only delighted zoologists, but also gave a great deal of pleasure and increased the general knowledge of visitors to the zoological gardens.

The big reptiles are, in actual fact, decreasing in number, mainly thanks to man. It would be very sad if we could see the large reptiles only in glass cases in the museums. It is high time, therefore, to introduce protection at least for those species which are not venomous and which have been rapidly decreasing in numbers during the past few decades.

SCIENTIFIC CLASSIFICATION

Animals and plants are classified in systematic groups, according to their relationship, which is determined by their common features. These are essential in making a scientific evaluation. Natural historians have therefore also divided reptiles into systematic units.

The lowest of these units is the species (or subspecies). Then comes the genus, containing species characterized by the closest relationship. Genera are again grouped in families, according to common characteristics, and these again in orders, which are further grouped in classes and the classes in phyla. Every unit, whether high or low, can be divided into corresponding sub-groups.

The reptiles form a special class of the phylum of the vertebrates. As the reader already knows, they are divided into four orders. The present book deals only with the last two of these orders, in which the order of the crocodiles is subdivided into two families, with a small number of genera and species, whereas the order of the scaly reptiles is subdivided into three sub-orders, with many families and an abundance of genera and species.

Many species of reptiles can be subdivided into subspecies, morphs and aberrations. The subspecies is a permanently deviating form of a particular species. Species form zoogeographic subspecies, characterized by differences due to environment, region and climate. The subspecies transmits its characteristic deviation to its offspring, and in time it is regularly reproduced, so that a new, independent species is formed. The second two forms are either not hereditary or only mildly hereditary and are not of importance for classification.

If we wish to give an animal its scientific name, we must first use the generic name. For example, if we wish to call the Indian Rock Python by its correct name (i. e. the typical species with light eye-spots on its lateral blotches): the generic name is *Python;* to this we add the name of the species, *molurus.* In natural history books we read that this species actually includes two pythons, which differ permanently by their markings, coloration, size and the places they frequent. The first of these is *Python molurus molurus,* the second, *Python molurus bivittatus.* We determine that we are concerned with the first form and find that the normal, double term *Python molurus* is only an approximation. In scientific terminology, therefore, the treble nomenclature must be used, with the last adjective denoting the subspecies. In cases where no subspecies are known, the double name is sufficient.

Reptiles have many common characteristics which justify their being classified in a single class. Some groups in this class, from the order of the Squamata (particularly from the sub-order of the Sauria) which are classified as families, ought probably to form higher groups, as while they often resemble one another externally, they are markedly different developmentally[9]). A certain, and even marked, resemblance grew up among some members of different groups because of their convergent mode of life, as, for example, with the monitors, the rapacious lizards of the Old World, and the teju or jakruaru of South America, which resembles them very closely.

On the other hand, a certain similarity can develop even with a different mode of life, if the manner of adaptation to the external environment is similar. A good example of this is seen in the slow-worms. In the course of time the slow-worms have dispensed with their legs in the same way as the snakes, because they are better off without them in the environment in which they live, but they have nevertheless remained true lizards, with all the essential characteristics.

Another interesting phenomenon is the similarity between some groups of reptiles inhabiting separate continents, which developed through their manner of adaptation in characteristic environments, such as steppe country, deserts and tropical forests. For example, the African, Asian and Australian family of the *Agamidae* have their counterpart in South

[9]) On studying the interrelationship of the individual reptilian orders, it is seen that they ought actually to be graded as a sub-class.

America in the *Iguanidae,* the many genera of which (especially the smaller size genera) correspond to the agamas both as regards the shape of their body and their mode of life. In this we see how in places where a particular family is absent, it can be completely replaced by another family.

Some groups of reptiles, on the other hand, are distributed in widely separated places. In the family of the skinks, for example, members of the genus *Eumeces* are to be found in N. Africa, Asia and America; the same applies to genera of the Colubrid snakes (*Natrix, Coluber, Elaphe,* etc.). Other groups have a very narrowly circumscribed biotope and are found only in a single, somewhat restricted area of a particular continent. These are usually the last survivors of species which were once widely distributed.

The period of great development of the reptiles is past. Although a few species are evidently still in process of development, this developmental activity is only very slight as compared with the Mesozoic period, when the land and sea were inhabited by a vast number of all kinds of reptiles, while others clove the air like enormous bats. Already at the commencement of the Cainozoic period the reptiles began to give way before the mammals, which because they were far more adaptable, with more highly developed senses and mental abilities and were also warm-blooded, took over the leading position on the Earth. Later, the mammals were joined in increasing numbers by the birds. The articulate animals also developed tremendously. Meantime very many orders and species of reptiles died out and it can now be definitely said that the class of the reptiles as a whole is a small survival from the wealth of species which once existed in bygone ages.

The scope of the present book does not permit a discussion on problems of ecology. Nor is it the task of popular scientific works to deal with specialized scientific problems. For that reason I have given only a few essential explanations to supplement this account of the life of the reptiles kept in the herpetological station.

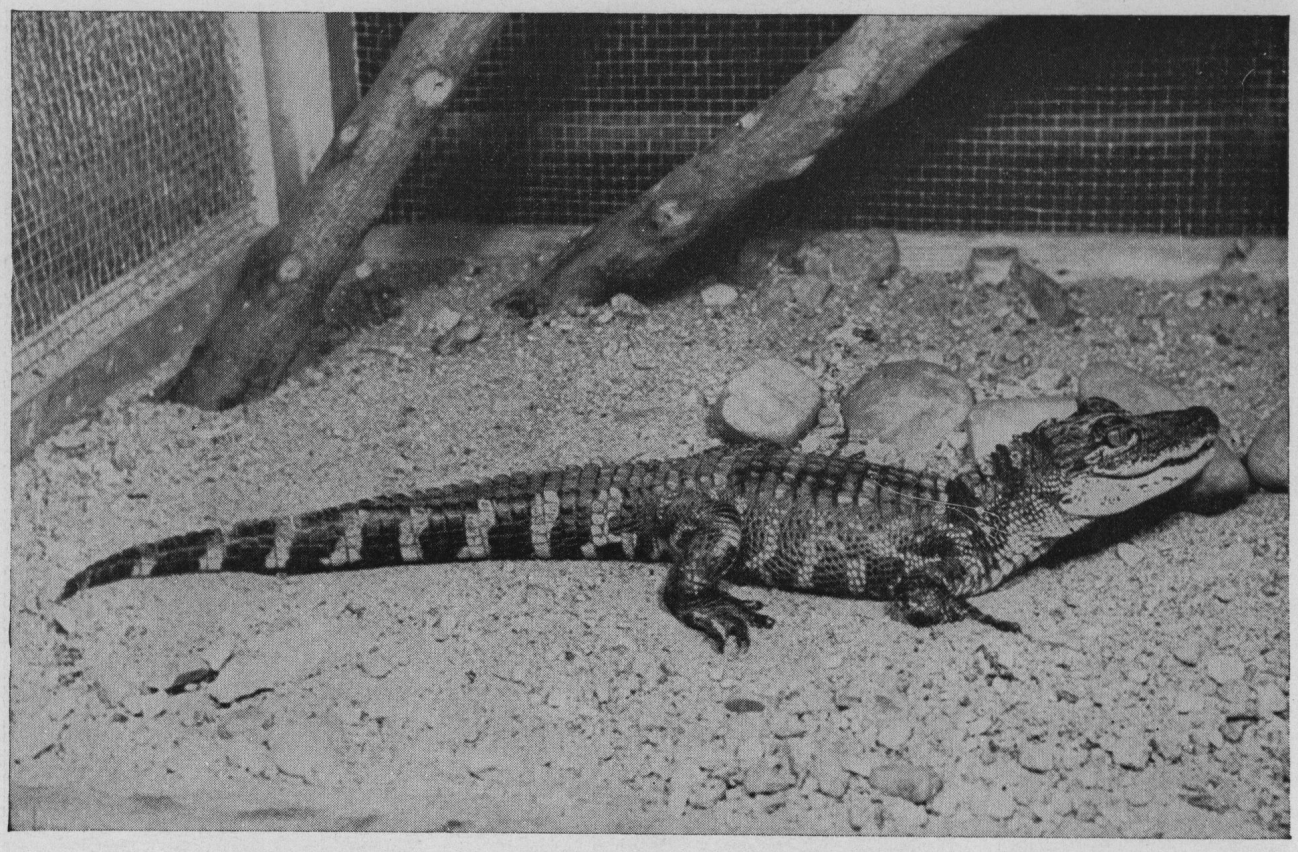
SPECIES OF REPTILES DESCRIBED IN THE BOOK

Agama mutabilis	"Bukashesh"	Tunis
— sanguinolenta	"Stepnaya agama"	Tunis, USSR (Central Asia)
— stellio	"Hardun"	Syria
Alligator mississipiensis	Mississippi alligator	N. America
Amphibolorus barbatus	Bearded Lizard	Australia
Ancistrodon halys caraganus	Siberian Halys	USSR (Kazakhstan)
— piscivorus	Water Moccasin	N. America
Bitis arietans	Puff Adder	Subtropical N. and S. Africa
Corallus caninus	Green Tree Boa	Brazil
Boiga dendrophila	Mangrove Snake	Malaya
Bothrops jararaca	Jararaca	Brazil
Bungarus fasciatus	Banded Krait	India
Caiman latirostris	Broad-nosed Caiman	Argentine, Paraguay
Melanosuchus niger	Black Caiman	Brazil
Coluber algirus	Algerian Racer	Tunis
— jugularis caspius	Caspian Whip Snake	Bulgaria
— karelini		USSR—Uzbekistan
— rhodorhachis		USSR—Turkmenistan
Spalerosophis schiraziana	Diadem Snake	USSR—Central Asia
Constrictor Constrictor	Boa Constrictor	Brazil
— — imperator	Emperor Boa Constr.	Mexico
— — occidentalis	Argentinian Boa	Argentine, Paraguay
Crotalus atrox atrox	Western Diamond Rattlesnake	N. America
— terrificus terrificus	Brazilian Rattlesnake	Brazil
Dispholidus typus	Boomslang	Port. Angola
Ahaetulla mycterizans	Long-nosed Tree Snake	India
Echis carinata	Carpet Viper	USSR—Turkmenistan
Elaphe dione		USSR—Ukraine
— quatuorlineata sauromates		USSR—Ukraine
Eremias grammica		USSR—Central Asia
— guttulata		N. Africa
— velox		USSR—Central Asia
Eryx jaculus turcicus	Spotted Sand Boa	Bulgaria
— miliaris	Desert Sand Boa	USSR—Kazakhstan
— tataricus	Eastern Sand Boa	USSR—Kazakhstan
Eumeces schneideri	"Buryun"	Tunis
Eunectes notaeus	Yellow Anaconda	Argentine
Chalcides ocellatus		Tunis
Chamaeleo chamaeleon	Common Chameleon	Tunis, Palestine
Lacerta parva		USSR—Nakhichevan, Azerbaijan
Mabuya aurata affinis	"Zolotistaya mabuya"	USSR—Nakhichevan, Azerbaijan
Naja naja oxiana	Cobra	USSR—Central Asia
Ophisaurus apodus	European Glass Snake	Bulgaria, USSR

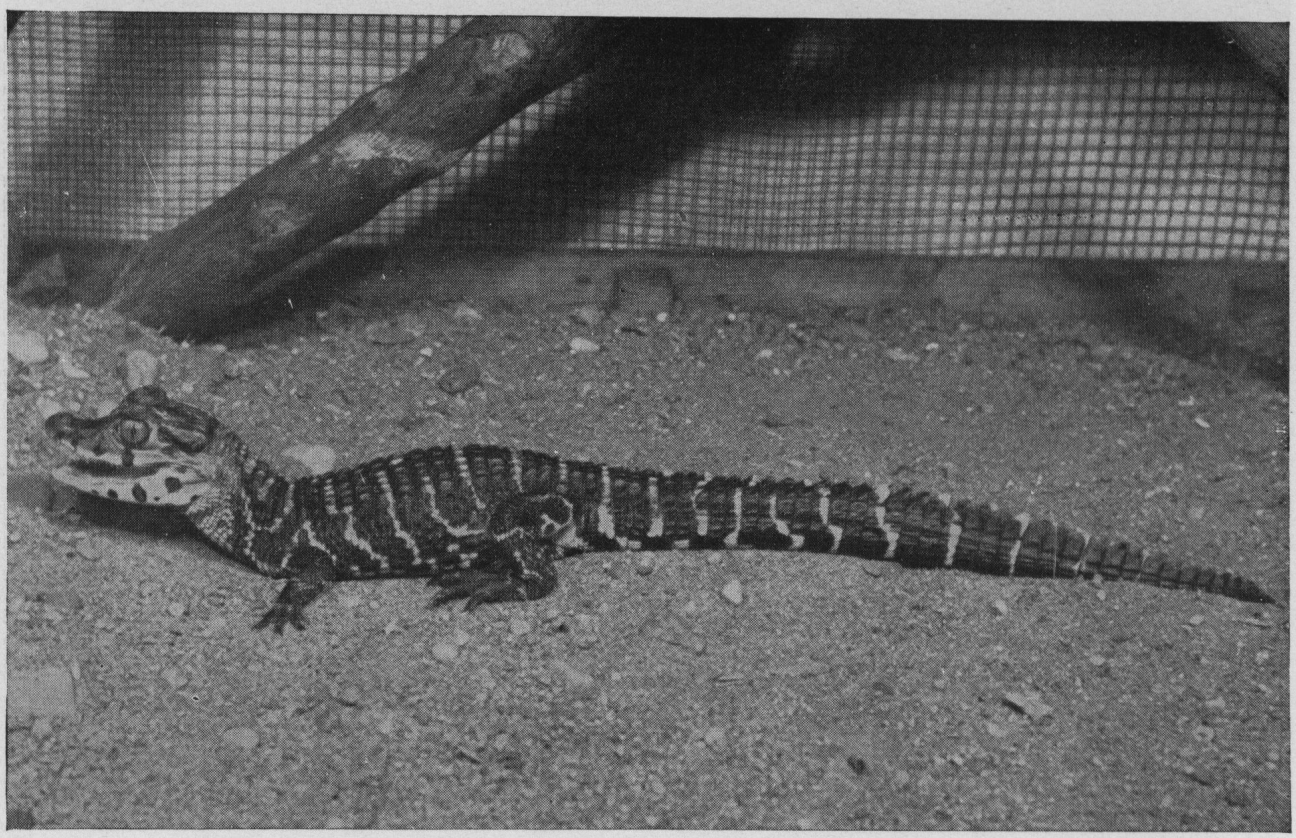
Phrynocephalus mystaceus gallii	"Ushastaya kruglogolovka"	USSR—Kazakhstan
Psammophis schokari		Syria
Pseudechis porphyriacus	Australian Black Snake	Australia
Pseudoboa cloelia	Mussurana	Central and S. America
Ptyas mucosus	Indian Rat Snake	USSR—Turkmenistan, Palestine
Python curtus	Short Python	Malaya
— molurus bivittatus	Dark Indian Rock Python	Indochina
— molurus molurus	Indian Rock Python	India
— reticulatus	Reticulated Python	Java, Malaya
— sebae	African Rock Python	S. Africa
Taphrometopon lineolatum		USSR—Uzbekistan
Tarentola mauritanica	Moorish Gecko	Tunis
Tupinambis nigropunctatus	Jakruaru	Brazil
Typhlops vermicularis		USSR—Central Asia
Uromastyx acanthinurus	Spine-tailed Lizard	Tunis
Varanus griseus	Desert Monitor	USSR—Central Asia
— salvator salvator	Water Monitor	Malaya
— varius	Australian Monitor	Australia
Vipera ammodytes ammodytes	Nose-horned Viper	Bulgaria
— — montandoni		Bulgaria
— lebetina obtusa	Levantine Viper	USSR—Transcaucasia
— palestinae		Palestine, Syria

PLATES

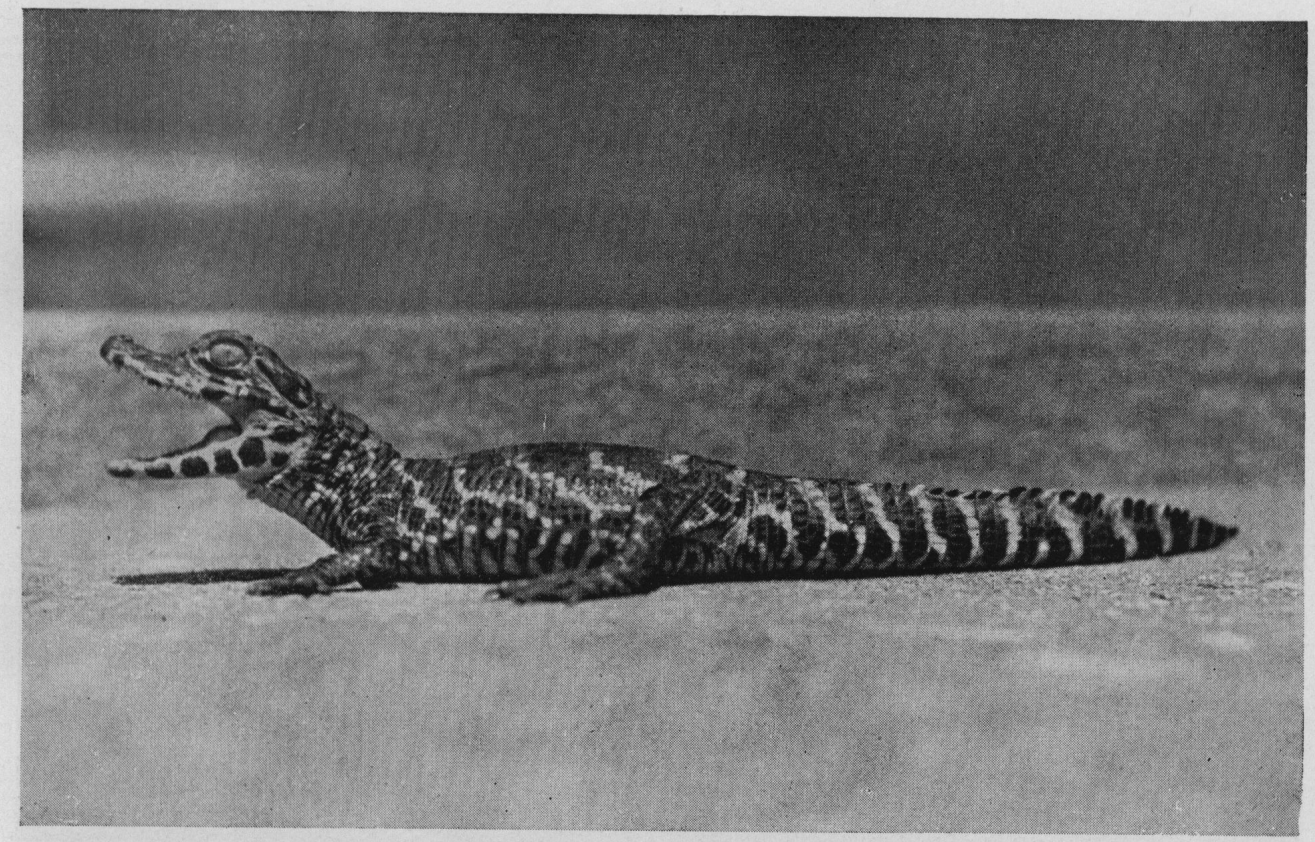
1. The author with an Argentinian Boa.



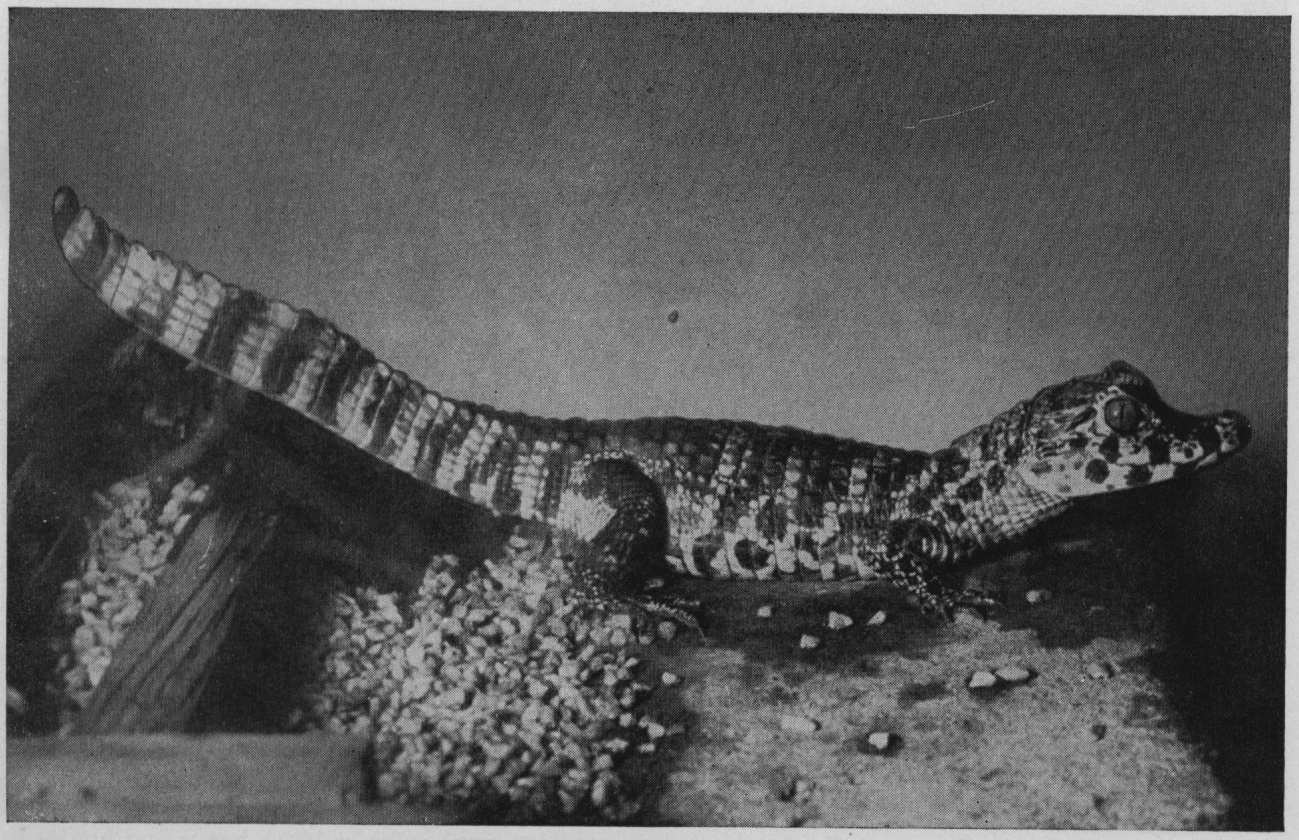
2. Mississippi Alligator *(Alligator mississippiensis)*. This alligator inhabits the south east of N. America and may reach a length of 14 feet, although today even 10-foot specimens are rare. It does best in captivity of all the crocodiles. The photograph shows a young one, aged three years and measuring 32 inches.



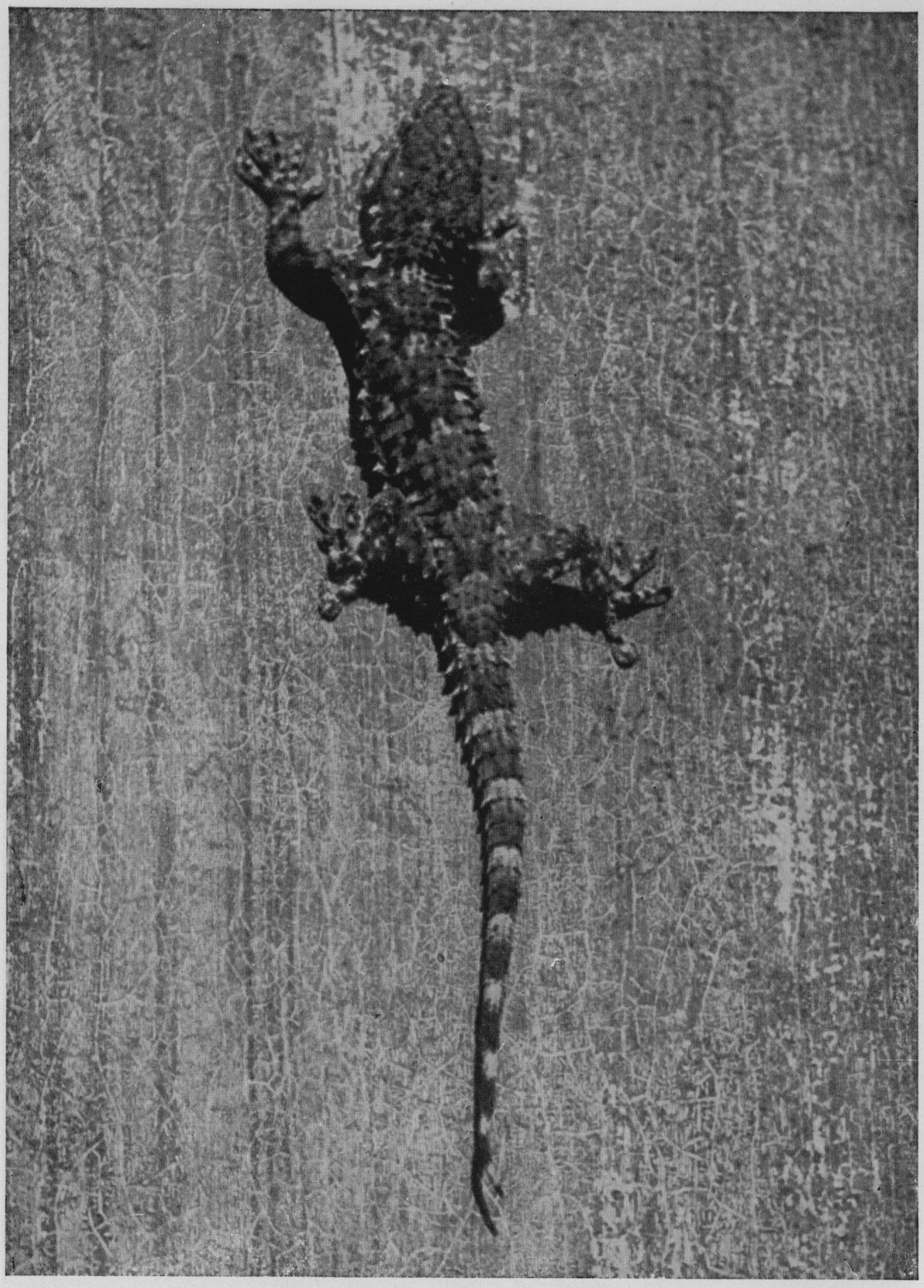
3. Black Caiman *(Melanosuchus niger)*. This is the biggest of the caimans of S. America and attains the same length as the alligator, but is slenderer and more active. Fully grown specimens lose their yellow markings and are entirely black, with a yellow or whitish yellow abdomen.



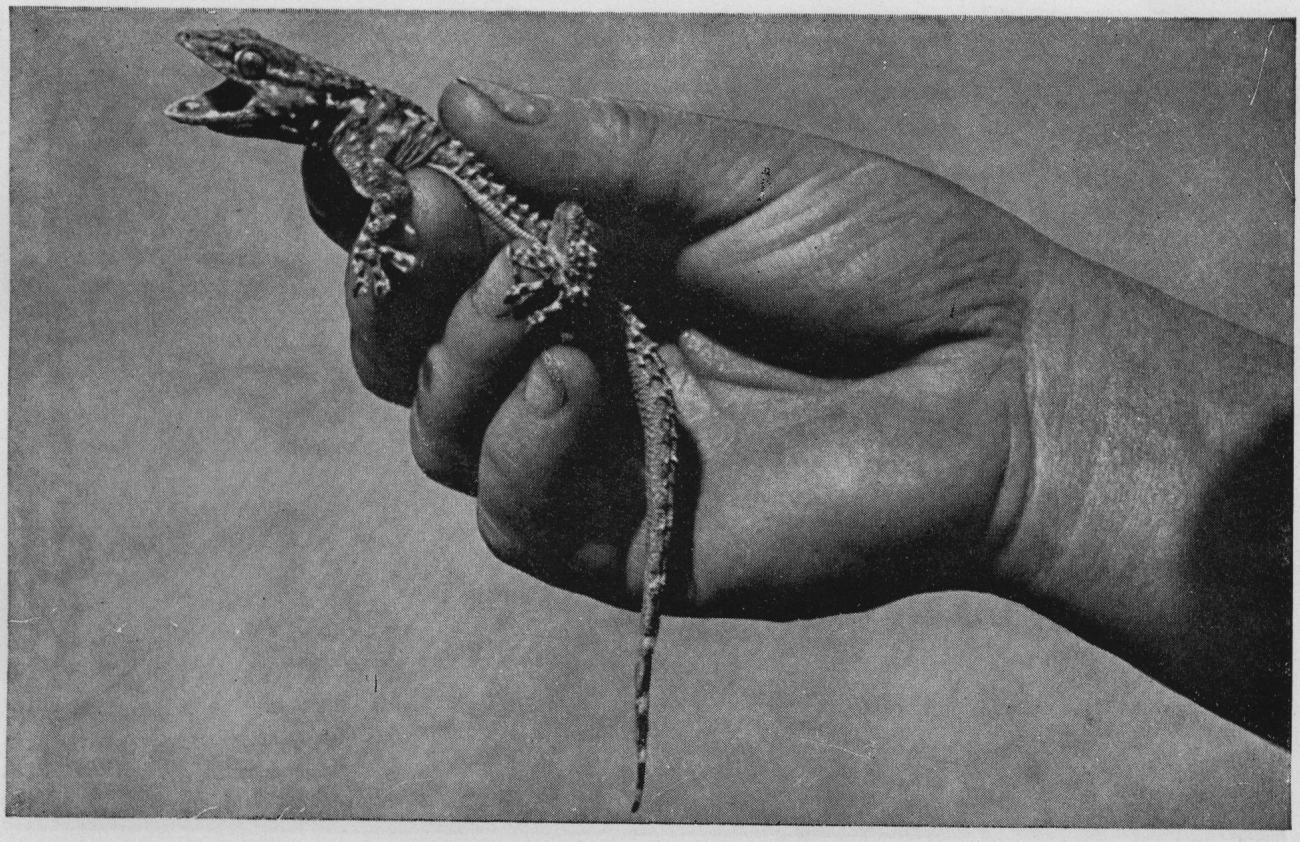
4. Broad-nosed Caiman *(Caiman latirostris)*. This caiman inhabits the southern half of S. America. It is yellow brown or olive brown, with darker blotches. The photograph shows a young one, aged two years and measuring 20 inches, from the west of the Argentine.



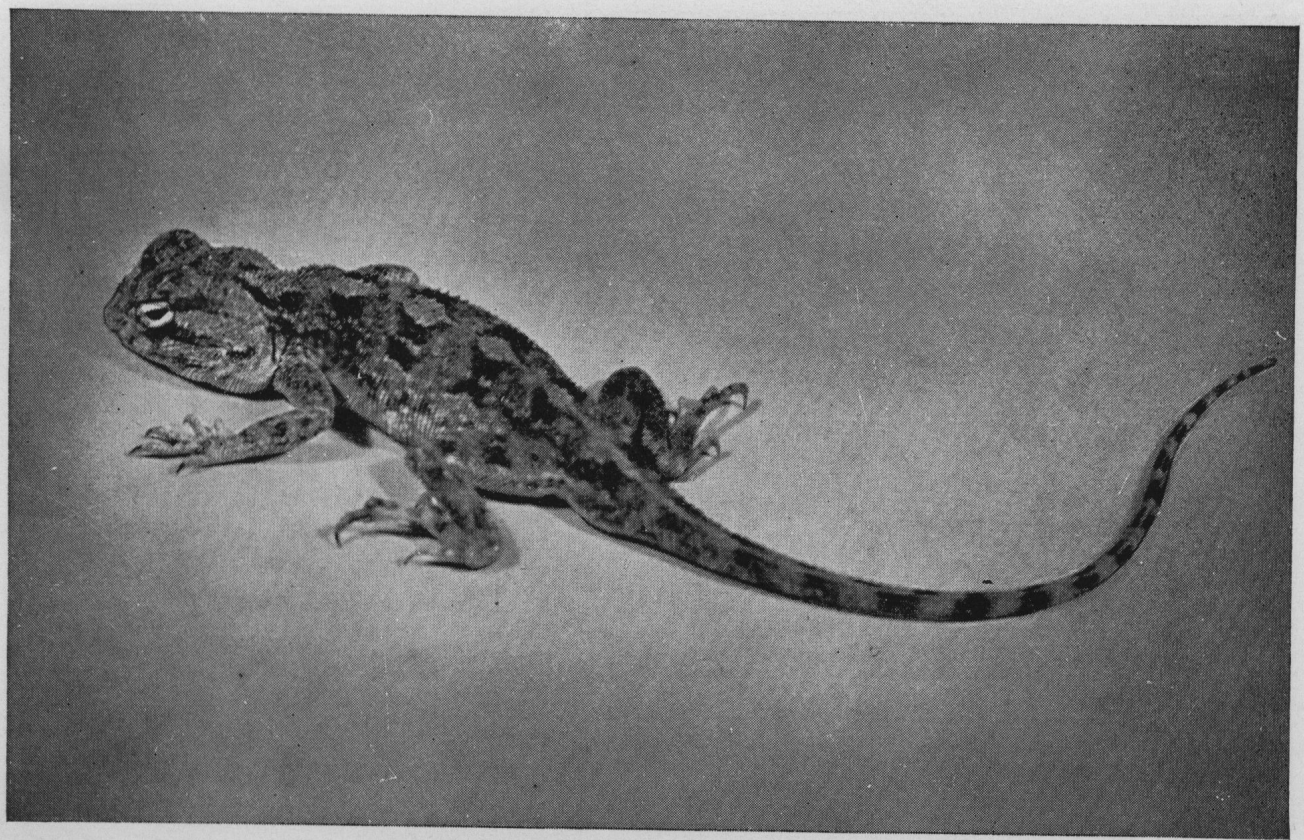
5. The same species from Paraguay. It is interesting to note the difference in the markings and in the length of the snout of the two caimans, which come from somewhat different environments. The Broad-nosed Caiman rarely attains more than 10 feet.



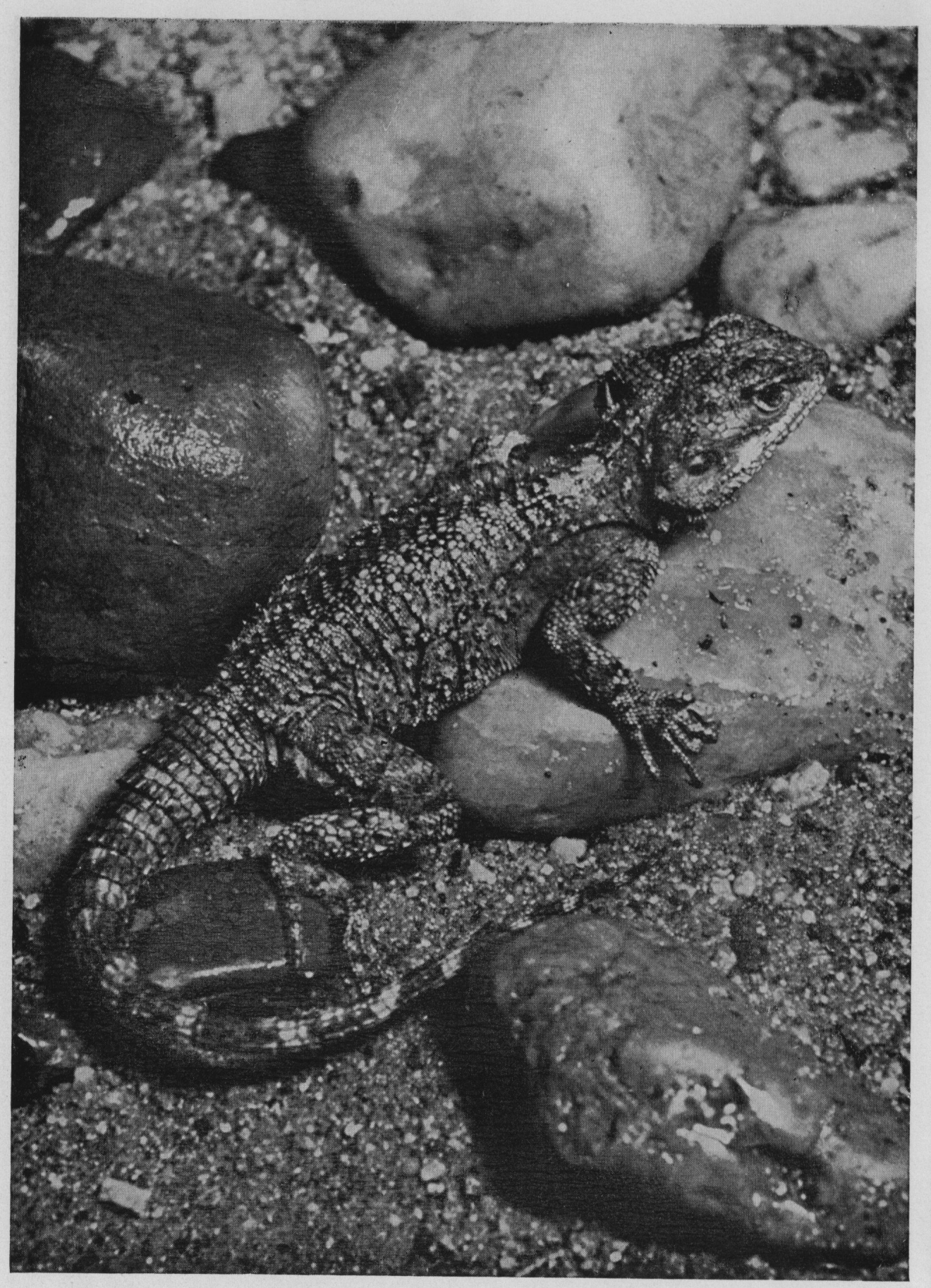
6. The Moorish Gecko *(Tarentola mauritanica)* enlivens ruins, rubbish heaps and houses in the Mediterranean area, especially N. Africa. By means of a special suction arrangement on its toes it can run with unusual confidence even over smooth walls and ceilings. It attains an average length of 6—7 inches.



7. When caught, the gecko resists obstinately and attempts to bite its captor. This frightens no one, however, as its little teeth are too weak to harm anything but its prey—flies, spiders and small lizards.



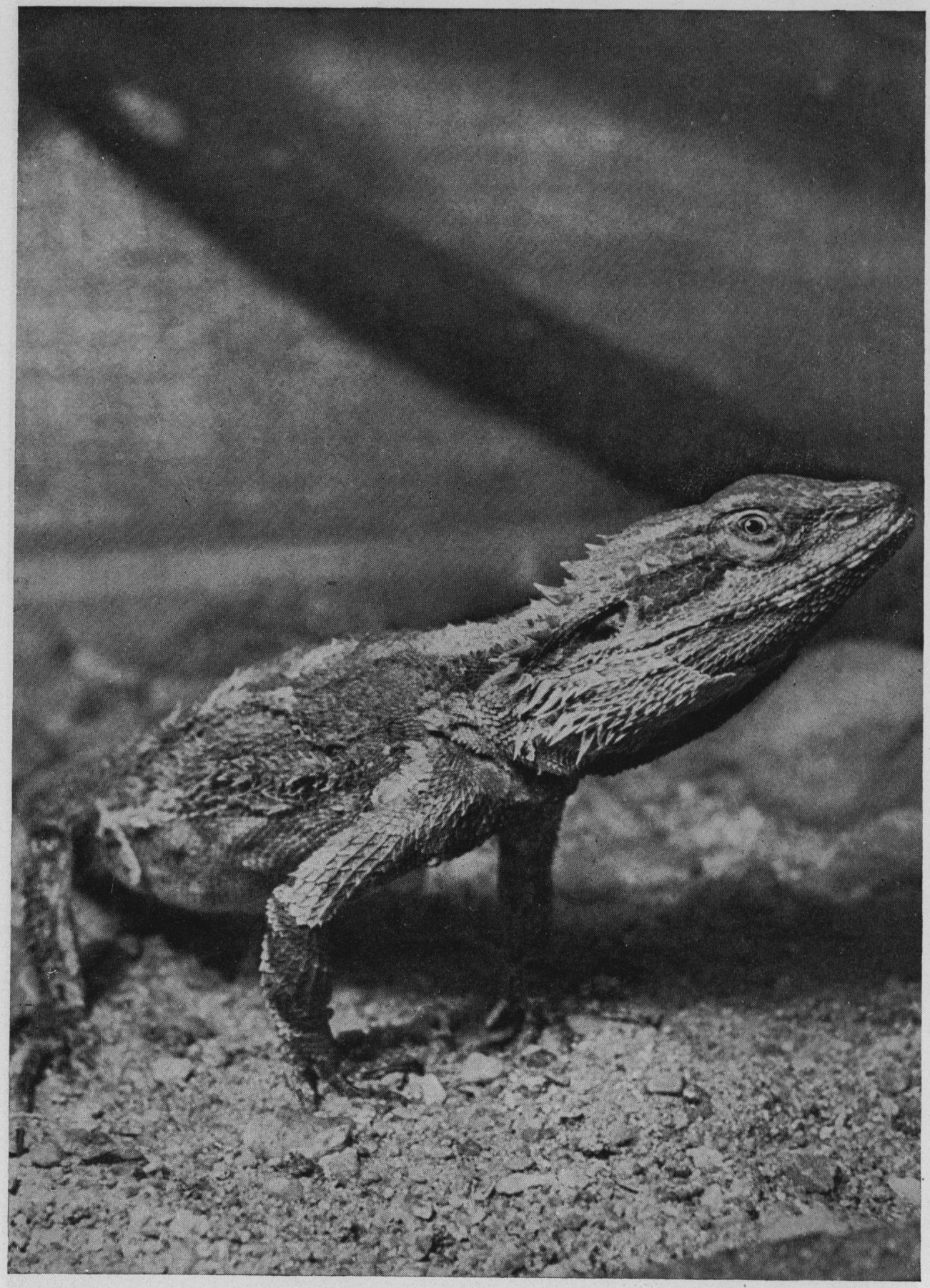
8. This small, but pretty N. African agama belongs to the species *Agama mutabilis*. If annoyed, it makes a rhythmical bowing movement with the front part of its body. It inhabits semi-desert areas and hides among piles of stones. It attains a length of about 8 inches.



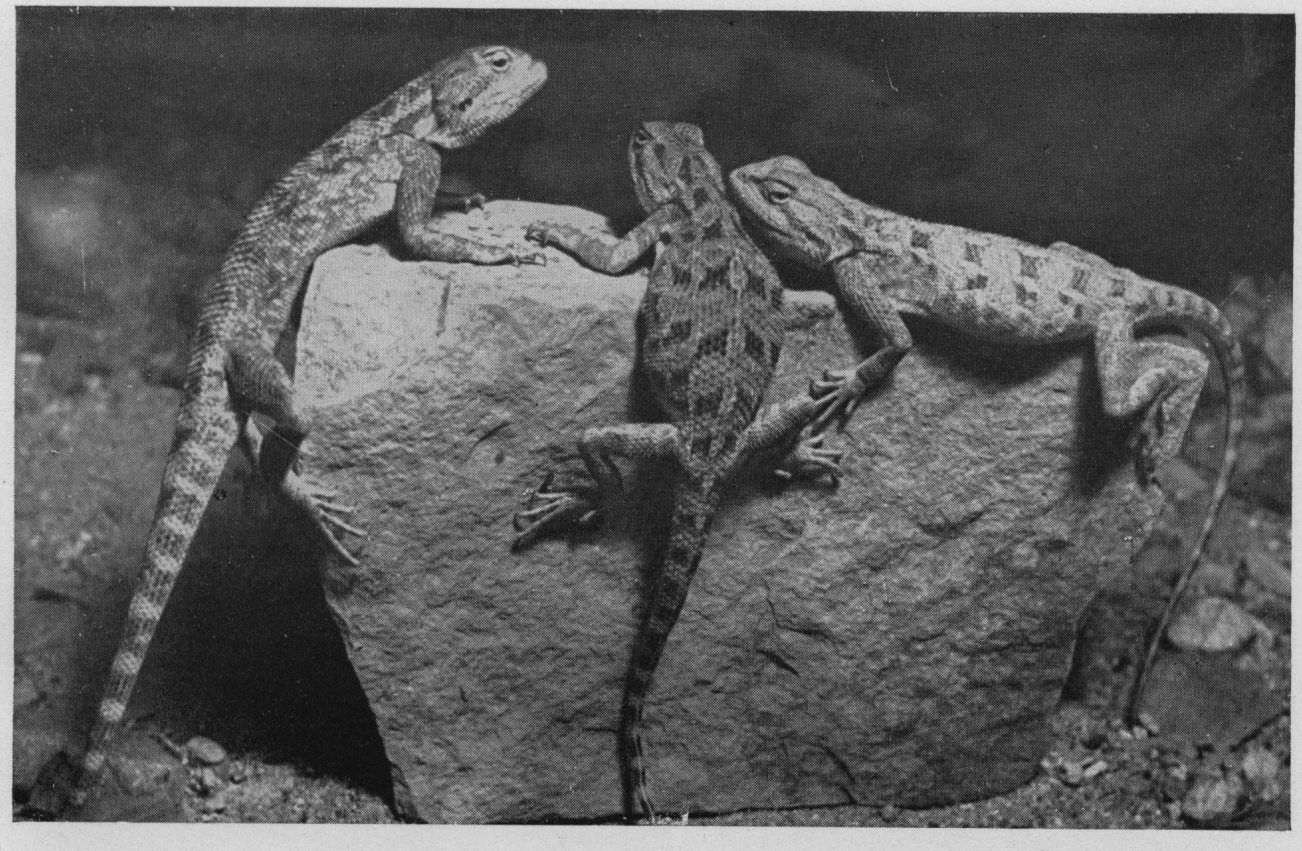
13. The Hardun *(Agama stellio)* is found in E. Mediterranean areas. It is very plentiful, especially in Egypt. It is black or black-brown and its appearance is in no way striking, but it is extremely swift and agile. It attains a length of 12 inches.

14. The fine Australian Bearded Lizard *(Amphibolurus barbatus)* is one of the hardiest reptiles to keep. When in danger, it inflates its spiny ruff and looks quite terrifying, but at heart it is a friendly, harmless insectivore. It attains about 20 inches.

15. The Bearded Lizard is slate grey to yellow-grey and old males have black necks. The spines with which some parts of the body are ornamented are soft and their only purpose is to inspire fear. The lizard in the photograph is a female.



16. A large male Bearded Lizard turns a jaundiced eye on the camera. There is something about it he doesn't like. His annoyance is also heightened by the fact that he is shedding his skin and has not yet rid himself of all the parts of the old skin (the light patches).



17. *Agama sanguinolenta,* from Central Asia. This is an active and prettily coloured lizard, with much the same habits as the N. African *Agama mutabilis.* It is, however, a little larger.

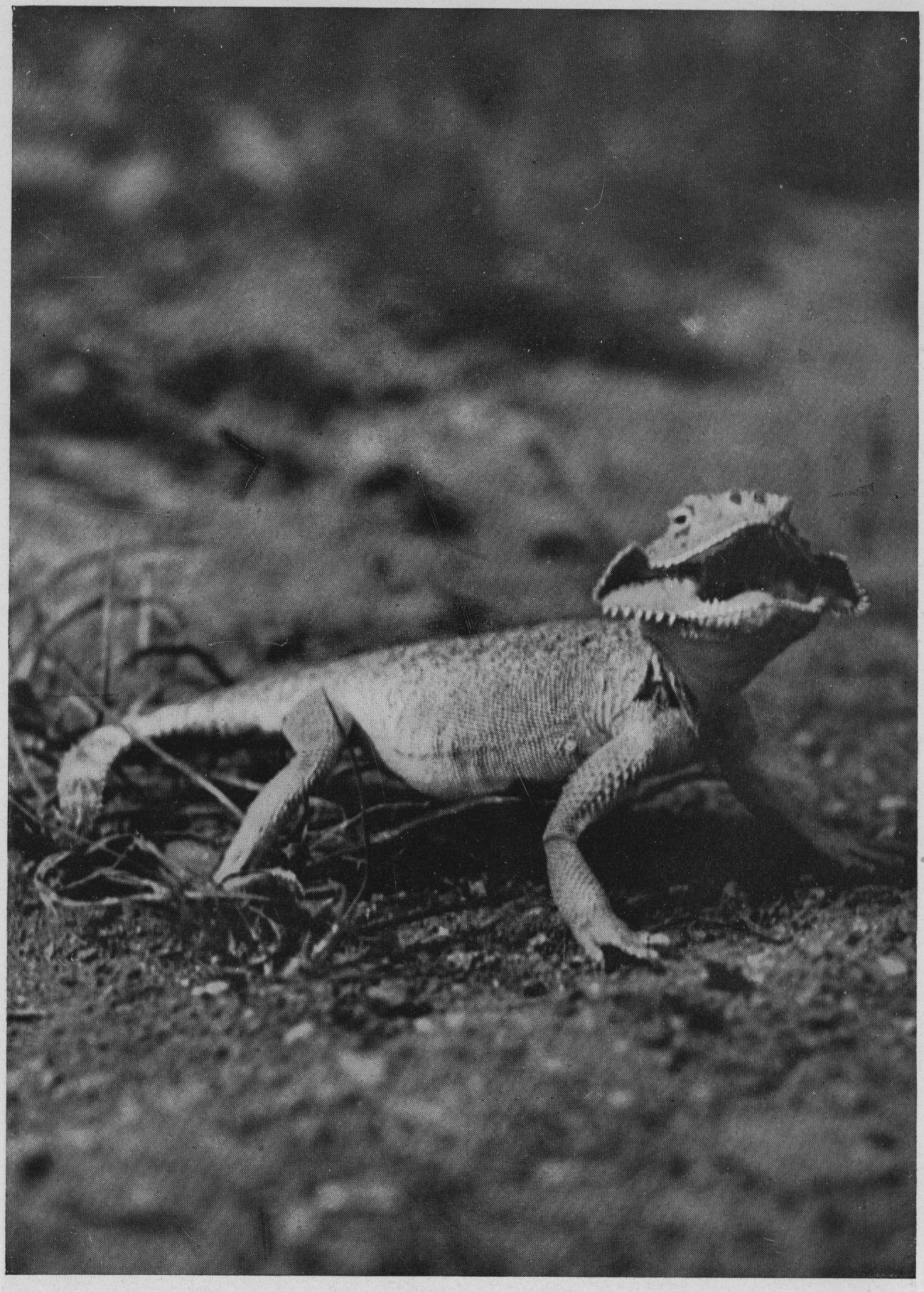
18. It is interesting that the males of this species are not so brightly coloured as the females. They are able, however, to expand their throat, which is coloured blue.

19. A female of the species *Agama sanguinolenta*. At low temperatures its colouring is, on the whole, inconspicuous. When warm, the light grey-brown or yellow-grey basic colour has brick-red blotches.

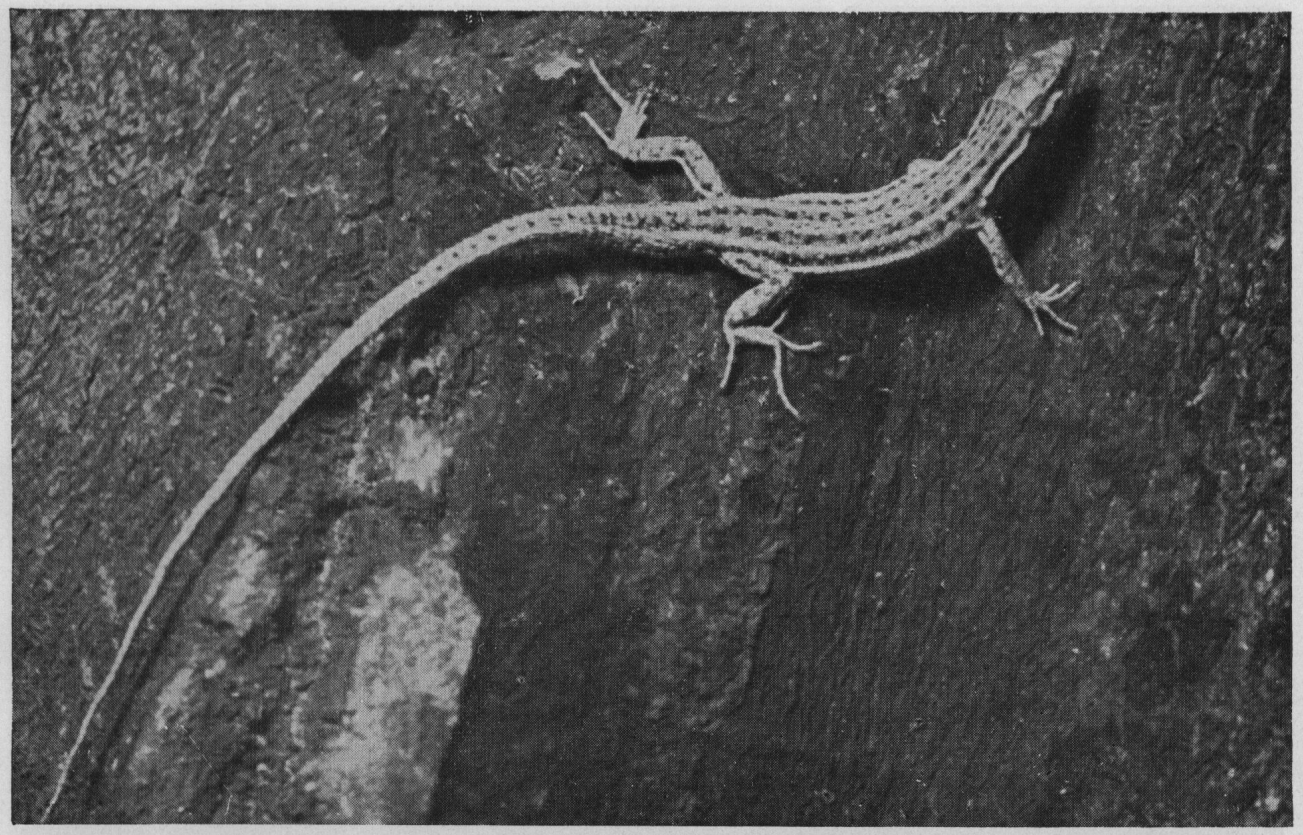
20. The most interesting agamid is perhaps the handsome, yellow-brown or pinkish brown *Phrynocephalus mystaceus*. It grows to a length of 10 inches and can burrow and hide itself in loose sand. When at rest it looks quite innocent.

21. When *Phrynocephalus* feels itself in danger, the sweet little creature turns into a positive devil. It opens its jaws, with their powerful teeth, and begins to twirl the black end of its tail.

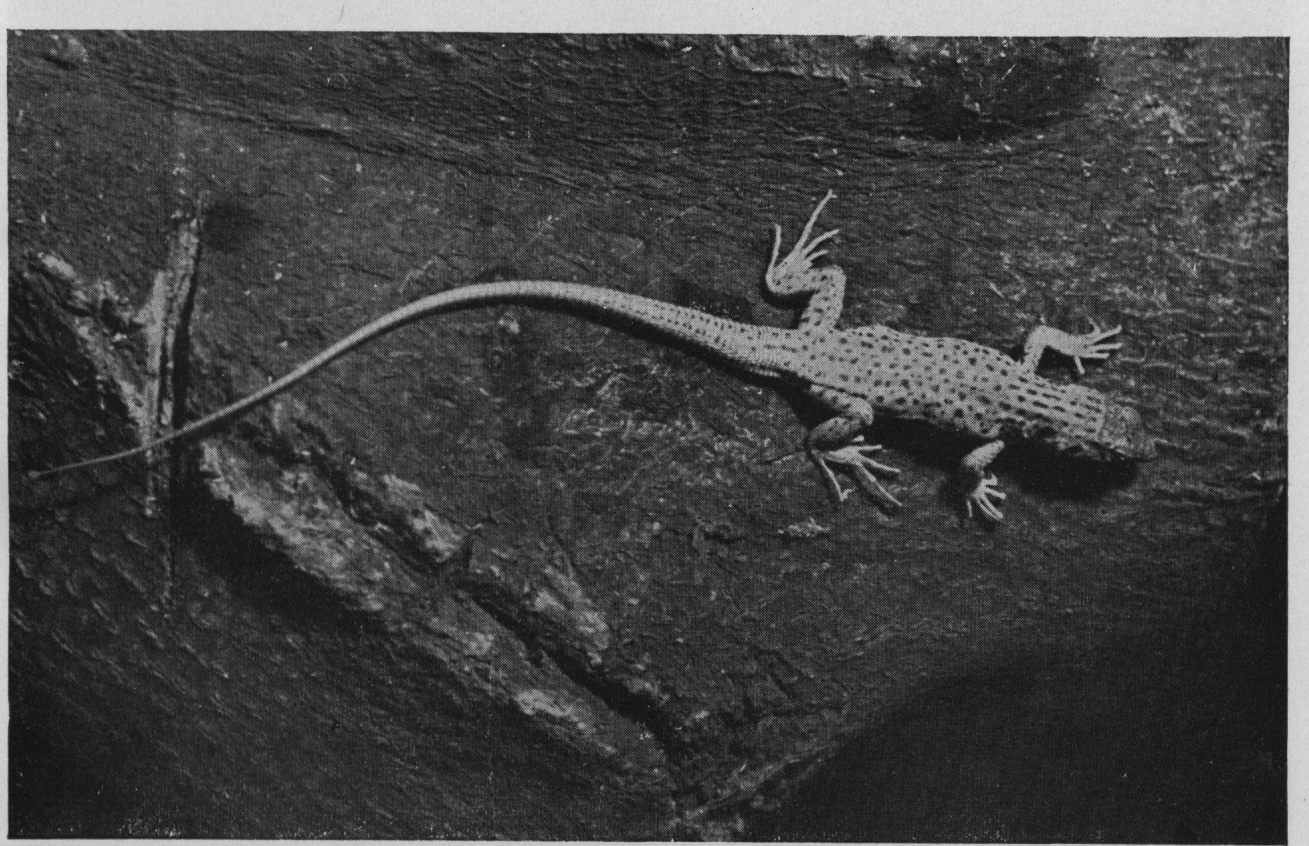
22. Suddenly there stands before us a strange monster with enormous ears, which inspires fear not only in man, but also in animal enemies. The fearsome appendages are not actually ears, of course, but flaps of skin which are barely noticeable when the animal is at rest.



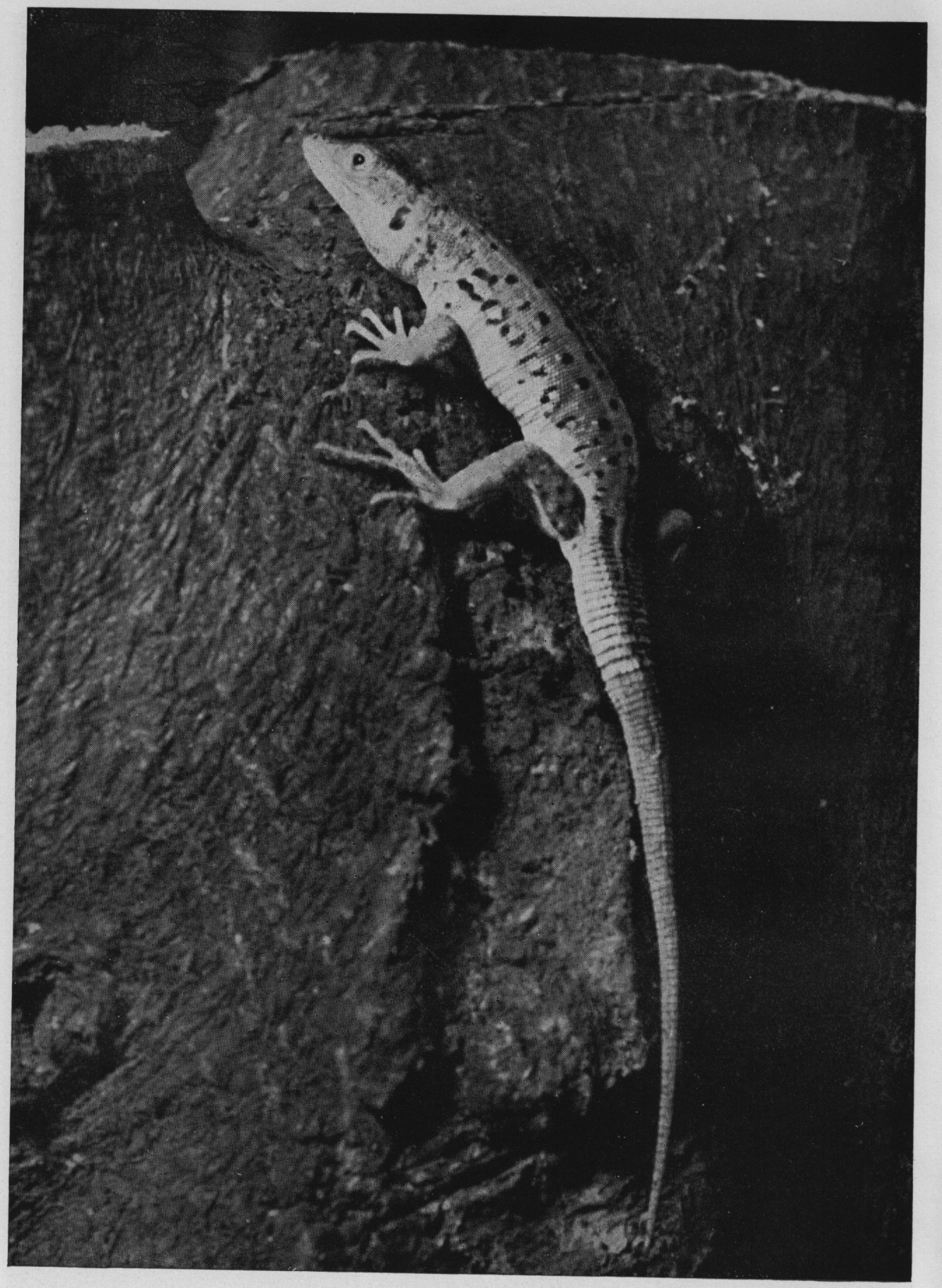
23. The infuriated *Phrynocephalus* does not run away, but bravely jumps towards the enemy. If it succeeds in getting its teeth into something, it clamps down its jaws, shuts its eyes and remains hanging there. As it has a strong bite, the experience is not a pleasant one.



24. In the steppes and deserts of Central Asia a number of interesting reptiles, both large and small, are to be found. This photograph shows the slender and extremely agile lizard *Eremias arguta arguta,* which is olive brown-yellow in colour and is one of the most nimble reptiles.

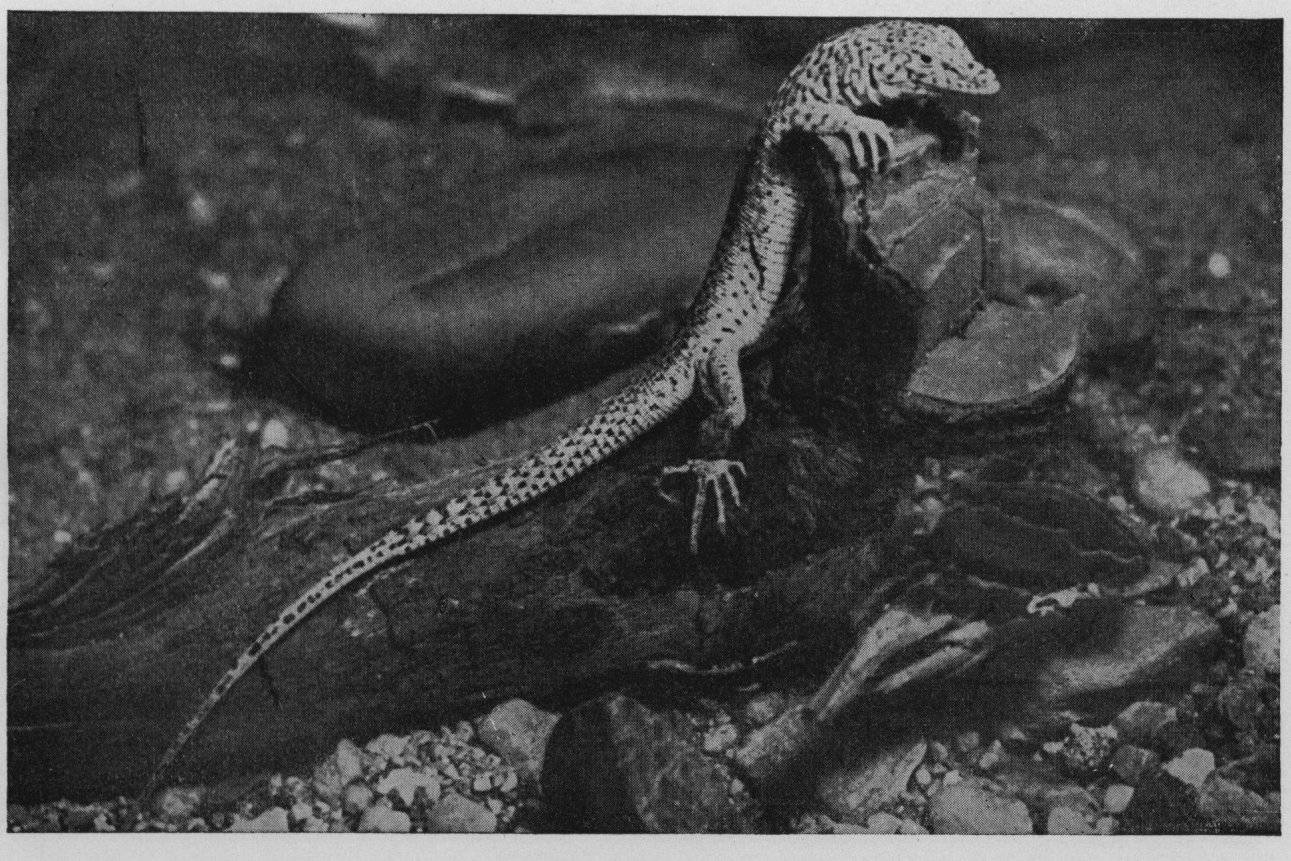


25. Lizards of the genus *Eremias* are abundant in the semi-deserts of N. Africa and Asia. The one shown in this photograph is a young lizard of the species *Eremias velox* from Central Asia, which is still quite densely spotted on the back. In very young lizards these spots are fused into coherent longitudinal bands. Actual size.

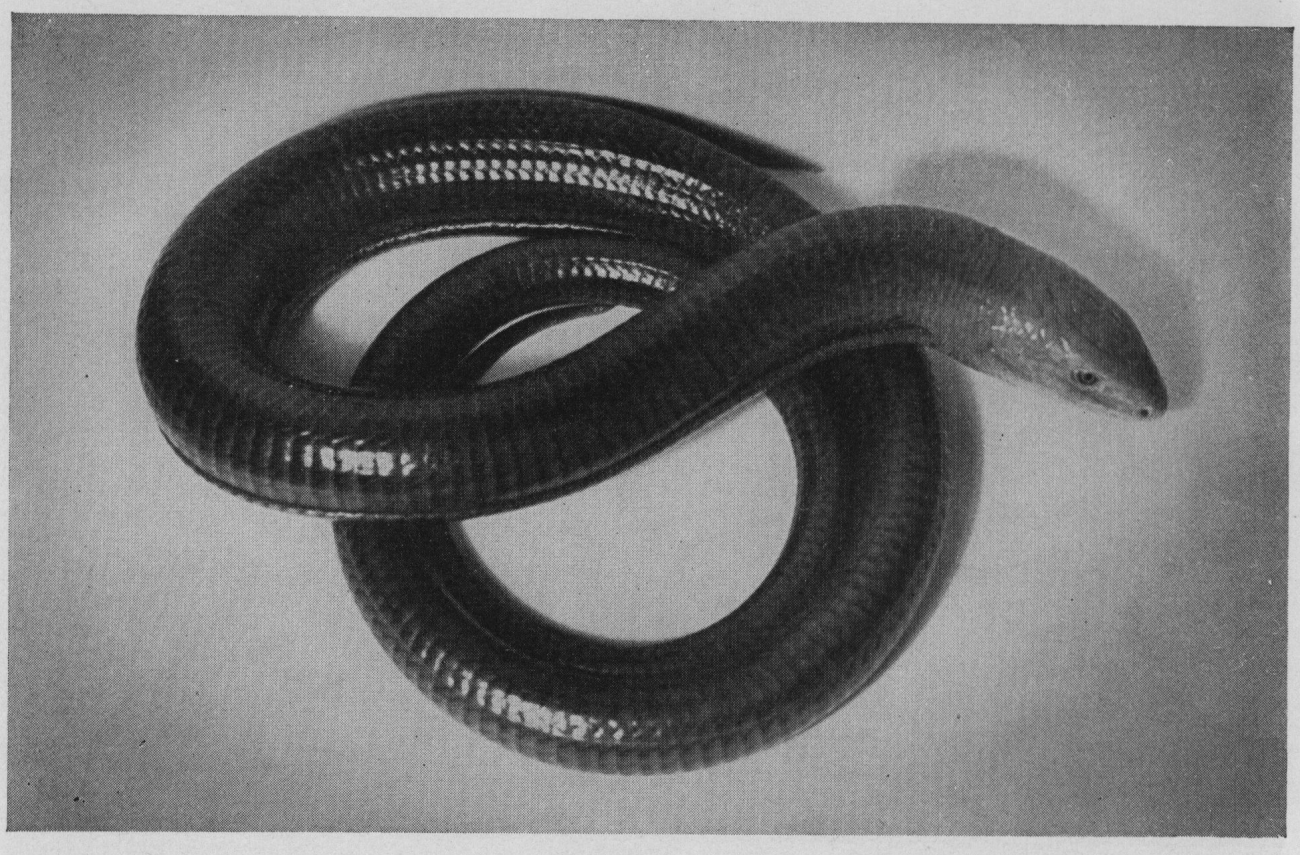


26. *Eremias velox,* fully grown male. Along the sides there are steel-blue spots, bordered in black. The small blotches on the back found in young specimens merge into large, sparsely distributed markings.

27. *Eremias grammica.* A beautiful lizard from Central Asia, with yellow-grey colouring and gold spots. It runs nimbly over loose sand, in which it also burrows holes to spend the night.

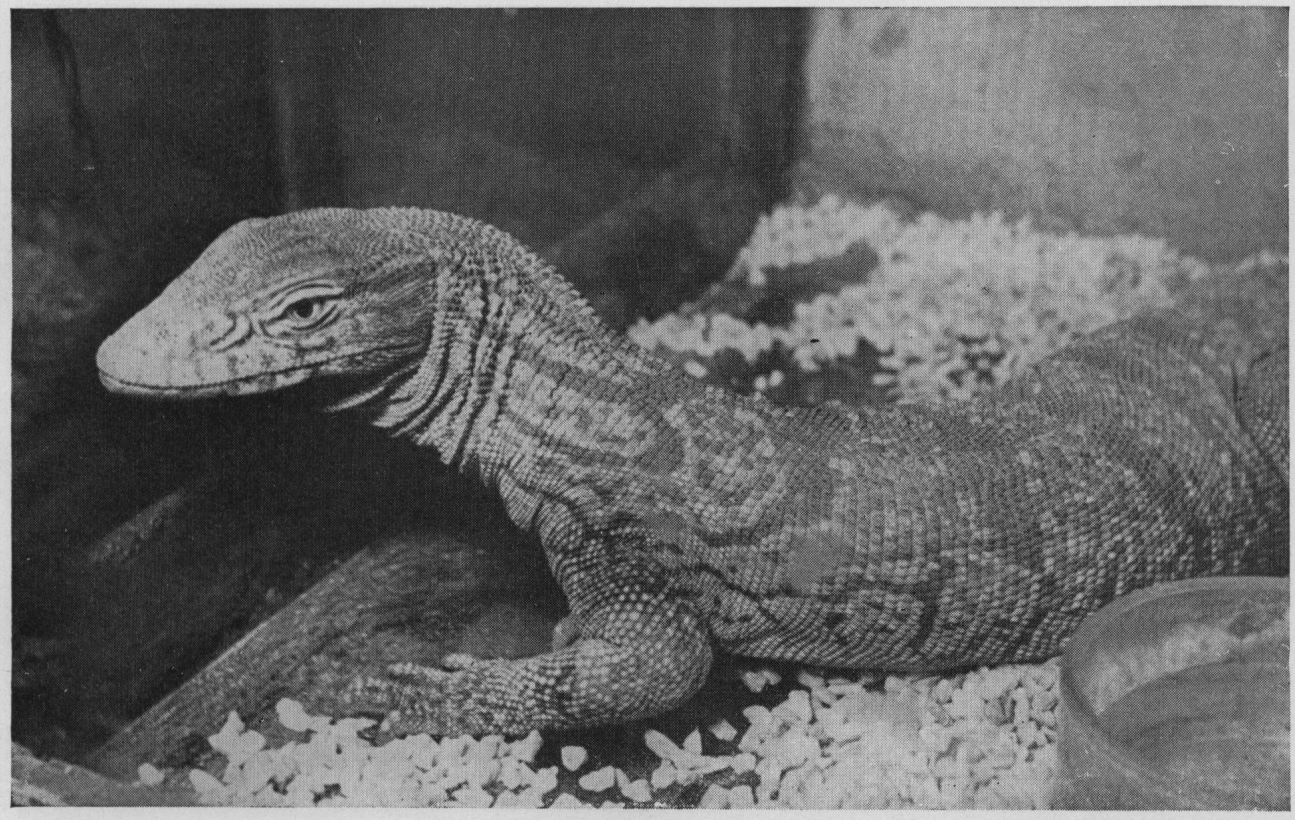


28. In our terrarium this lizard with the striking appearance was not very active. It immediately caught weevil grubs or crickets, but quickly returned to its favourite spot, where it remained for long periods without moving.

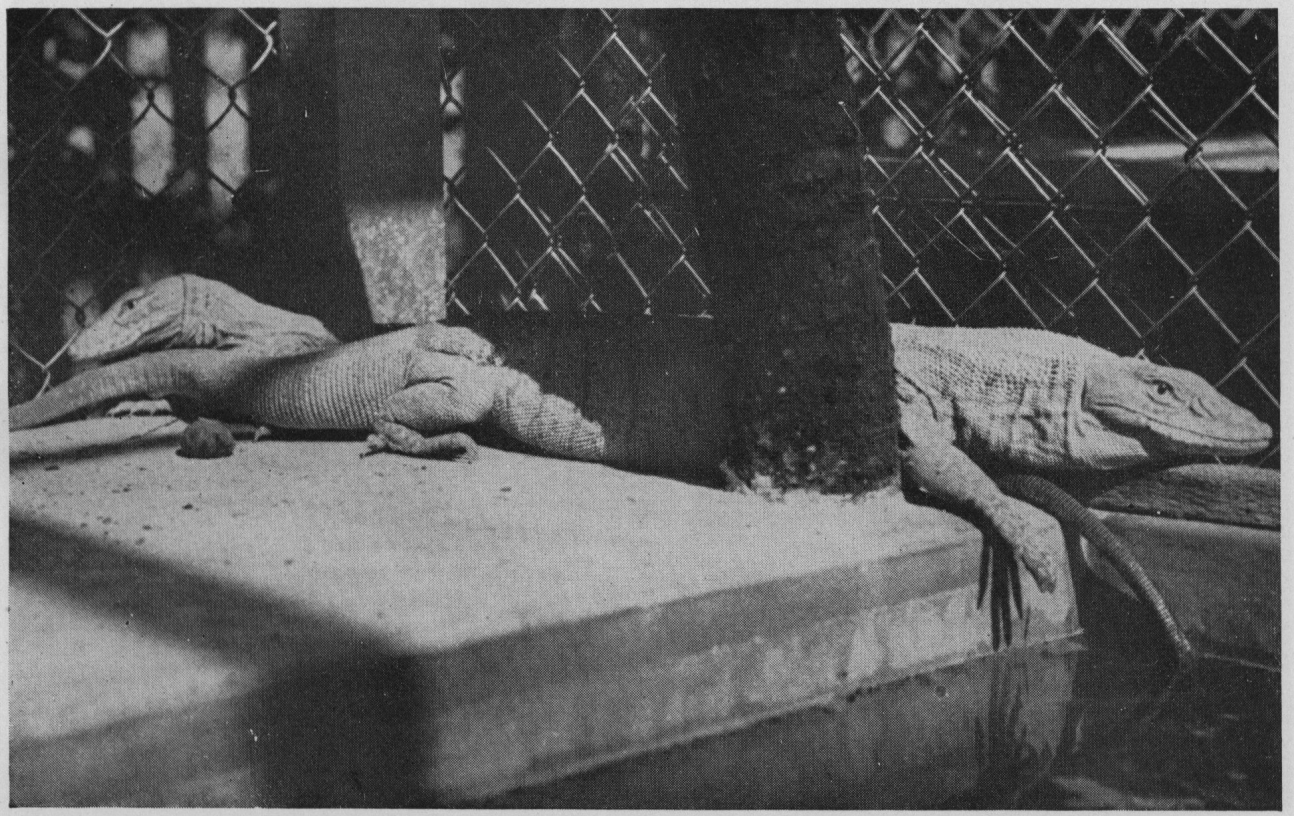


29. The Anguidae are not all as small as this one. The biggest ones are those of the species *Ophisaurus apodus,* the European Glass Snakes, which are very popular with terrarium enthusiasts and are found from Istria and Dalmatia to Turkestan. It is not so gentle as the ordinary slow-worm, as it catches mice and lizards and even attacks vipers.

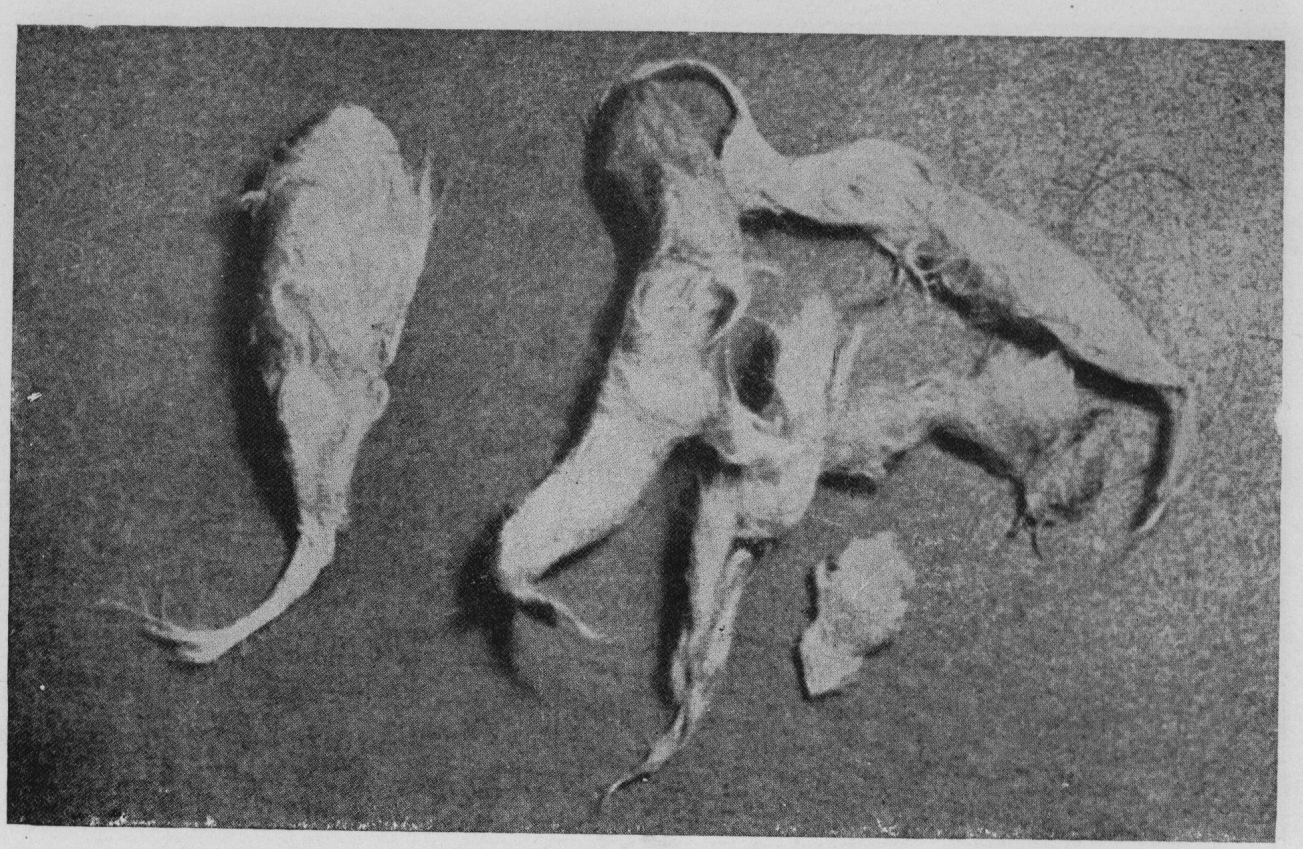
30. The European Glass Snake easily adapts itself to changed conditions in captivity and can live for many years in the terrarium. It often grows to a length of 4 feet and its colouring is yellow-brown or reddish brown with a metallic lustre.



31. The Monitors are true beasts of prey. They are well equipped for this mode of life and are also endowed with acute senses. The photograph shows the African form, the Desert Monitor *(Varanus griseus)*, from Tunis. The Monitor can swallow prey as large as that of snakes. It attains a length of over 5 feet.



32. The Desert Monitors do well in the herpetological station. They require warmth more than sand. Although their natural habitat is sometimes in areas where there is little moisture, in the terrarium they like a sufficient supply of water.

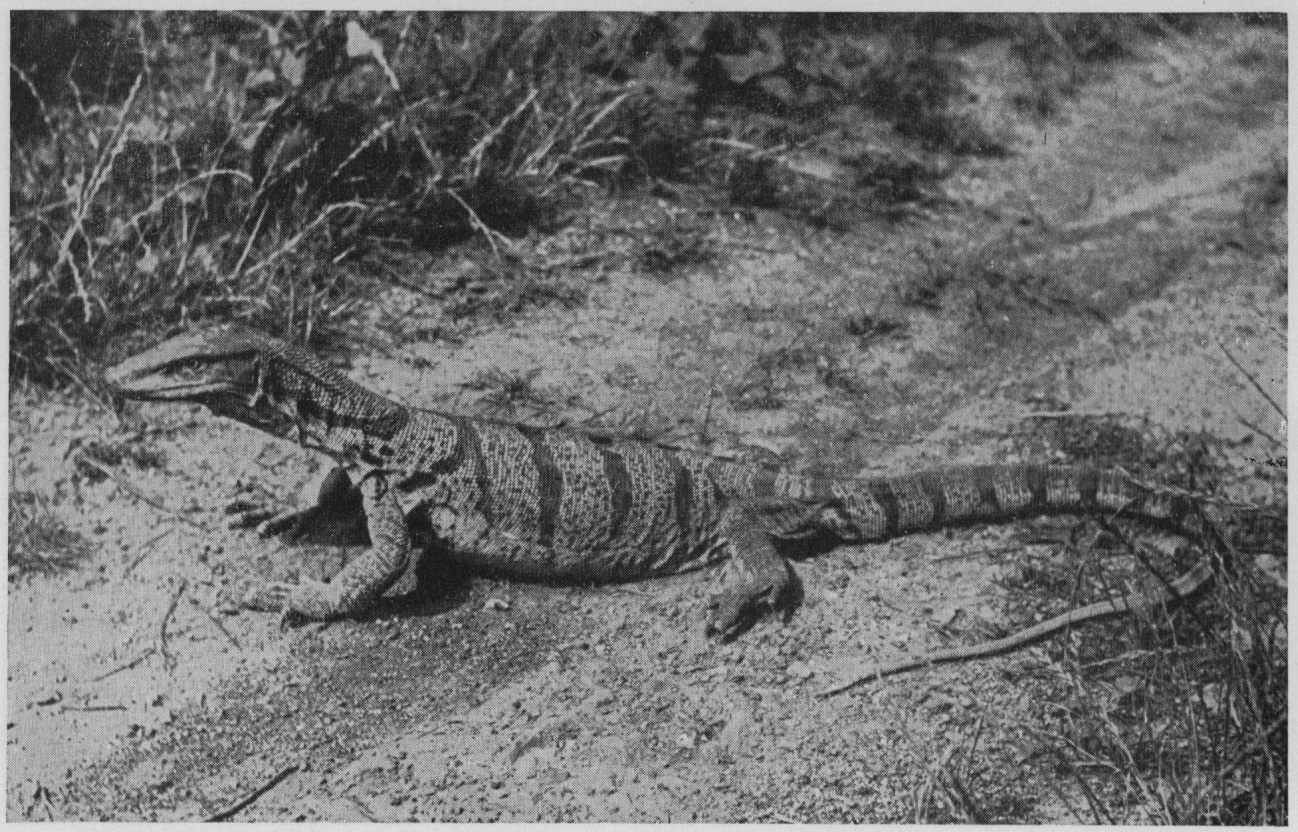


33. The Desert Monitor is not able to regurgitate the fur and feathers of its prey in the same way as owls or herons, and therefore excretes them in the normal way. Firm bunches of fur can be taken from the monitor's faeces, which are fairly similar to those ejected by birds.

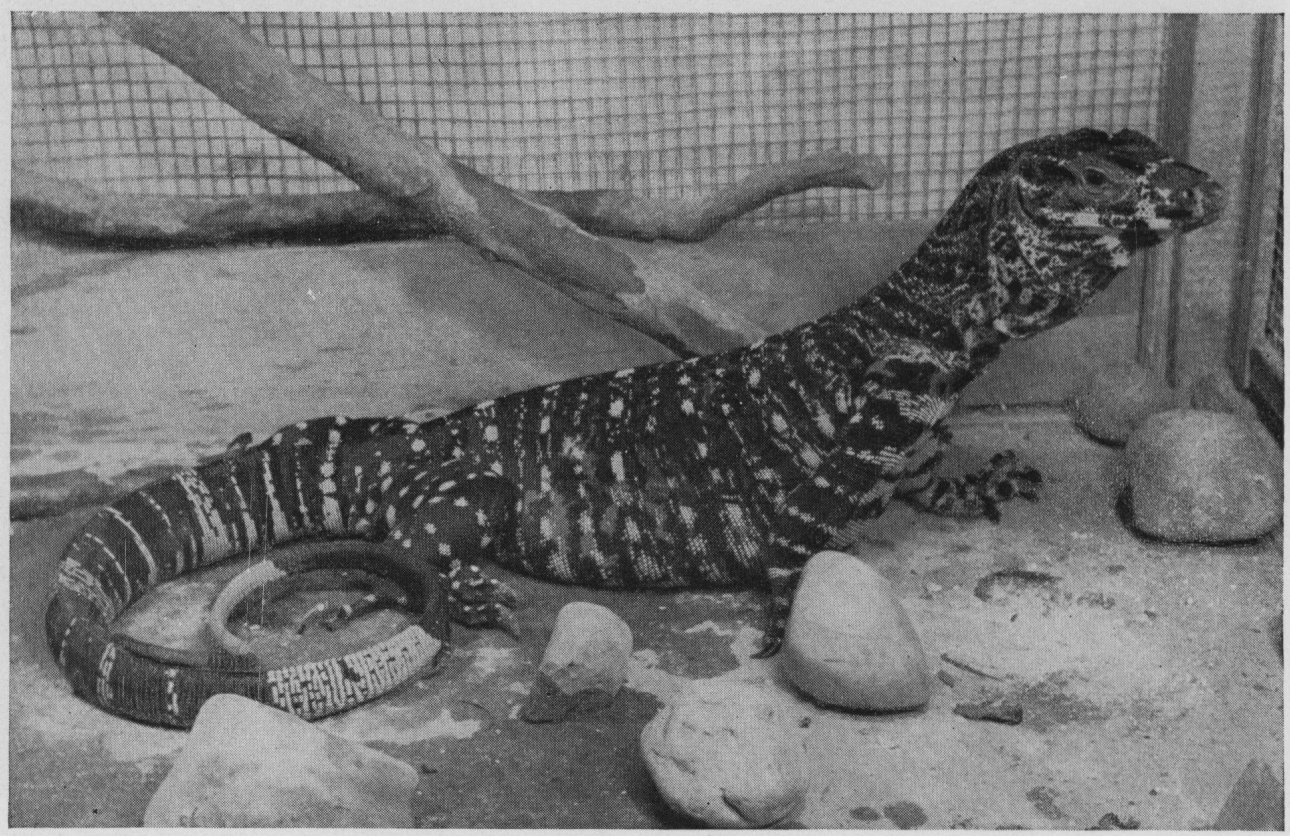
34. In the summer, female monitors lay up to 20 white eggs with a leathery shell in deep holes in the sand, where it is slightly moist so that the eggs do not dry up. The photograph shows two such eggs, about 2/3 of their natural size.

35. Desert Monitors from Africa after their arrival by air. At the moment they are in quarantine and are resting after their tiring journey.

36. A typical landscape from S. Tunisia, of the type inhabited by monitors. The sand under the islands of shrubs is riddled with the burrows of desert rodents of the genus *Gerbillus*, which form the chief prey of the monitors, apart from other lizards.

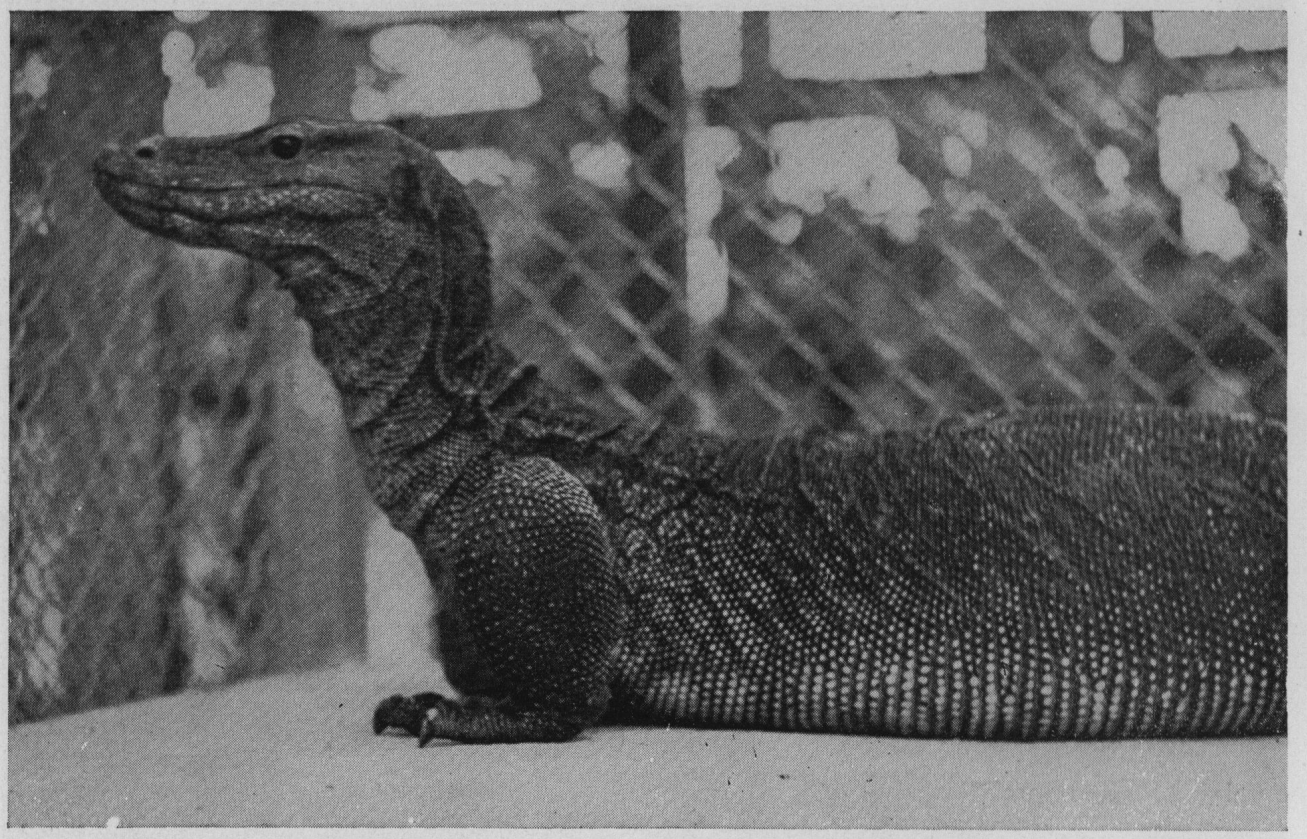


37. A big Desert Monitor from Central Asia *(Varanus griseus caspius)*. It is more ornamental than the African monitors of the same species; it has a more elongated and powerful head and the tail is partly flattened laterally.

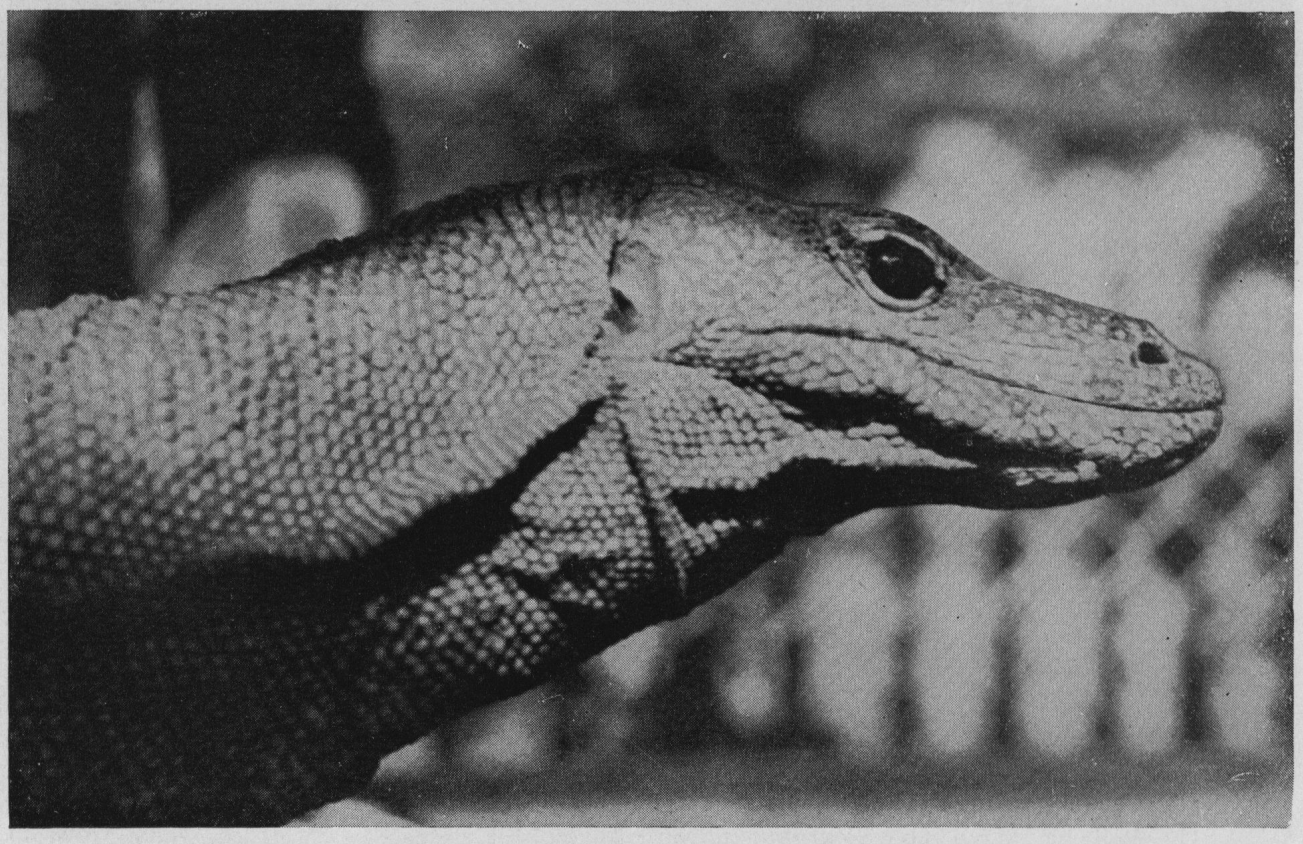


38. The Australian Monitor *(Varanus varius)* is one of the most beautifully marked reptiles. It is glossy black with rich yellow markings. It grows to over 6 feet and is strong and aggressive.

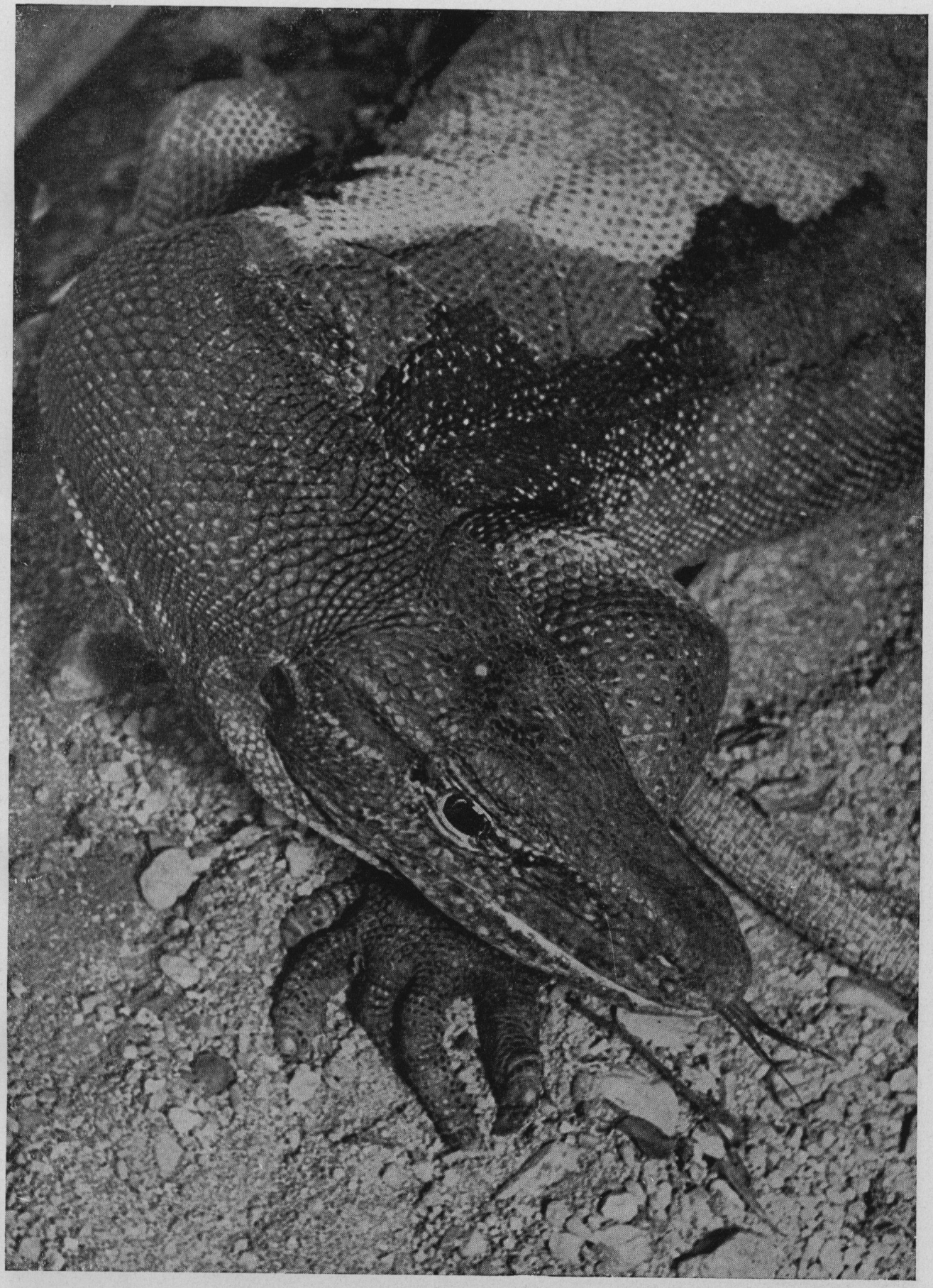
39. The Water Monitor *(Varanus salvator salvator)* is a large, heavy lizard, which grows to over 10 feet; it inhabits tropical S. E. Asia. Older animals lose their brilliant spots and usually have plain black-brown backs. The monitor shown in this photograph measures about 5 ft. 4 in., together with the tail, and weighs almost 36 lb.



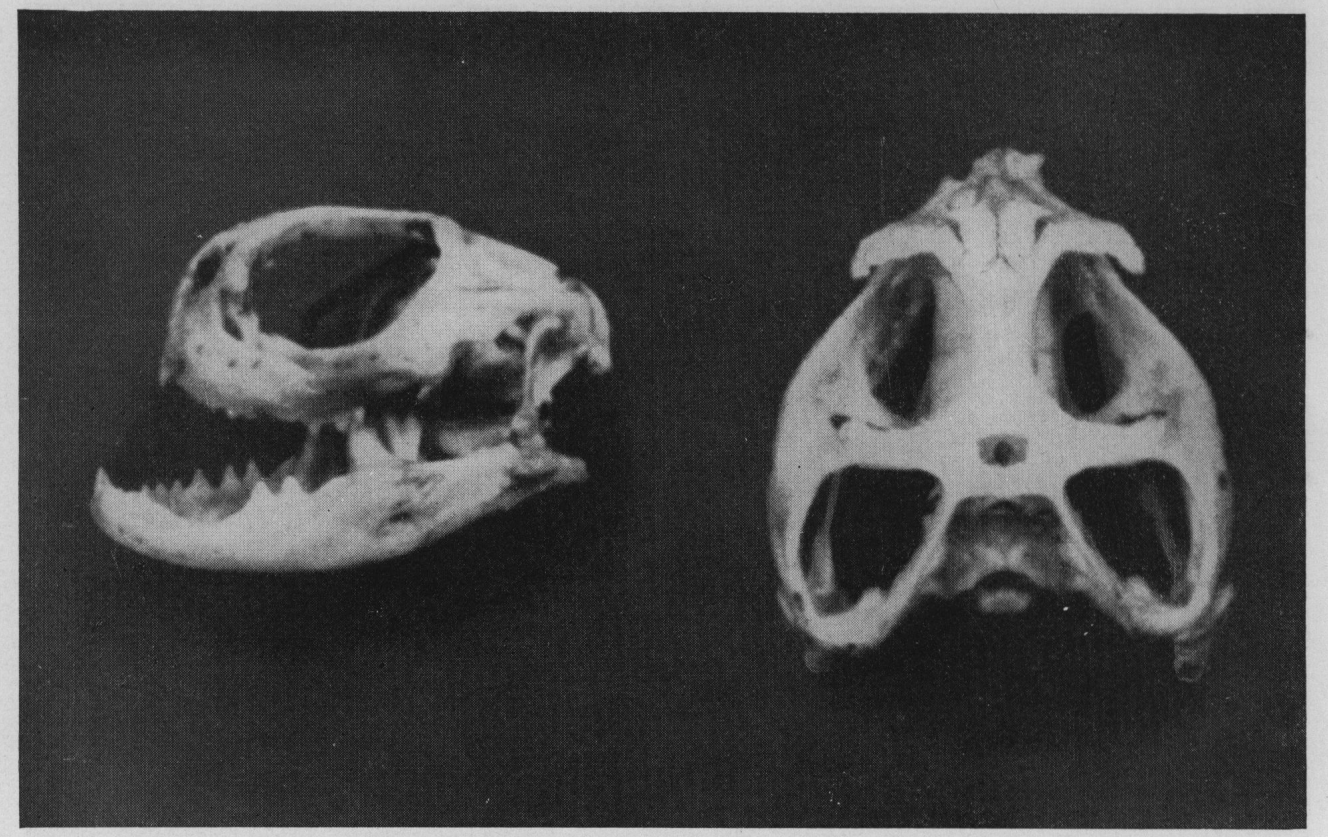
40. The strongly-built Water Monitor is a typical example of the reptiles which lived in past ages on the earth. Their appearance and manner of locomotion are reminiscent of the lizards which lived in the Jurassic and Cretaceous periods, which died out many millions of years ago.



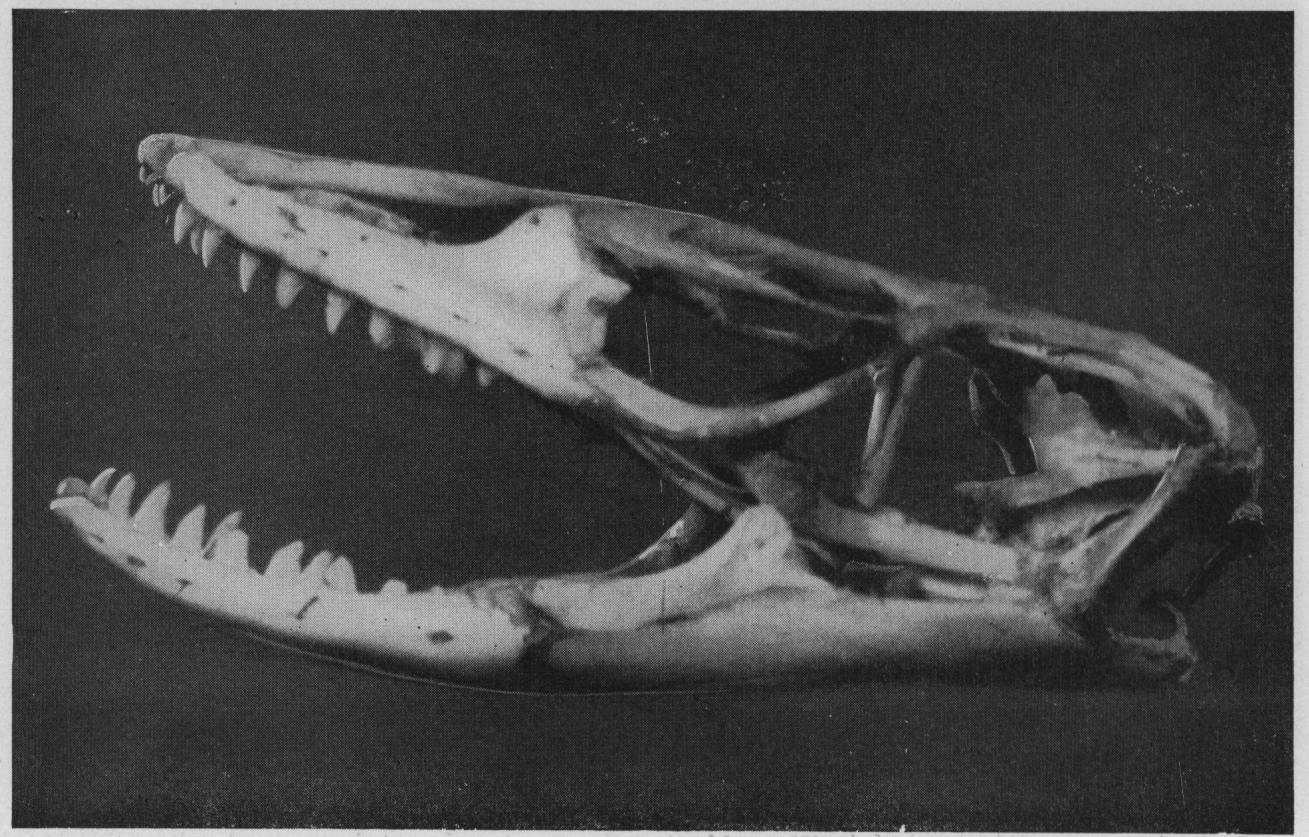
41. In spite of the signs of its ancient origin which are to be found on its body, the Water Monitor has considerable powers of perception and knows how to apply its experiences. There is evidence of this in its bright, intelligent expression, although the form indicates great rapacity and strength.



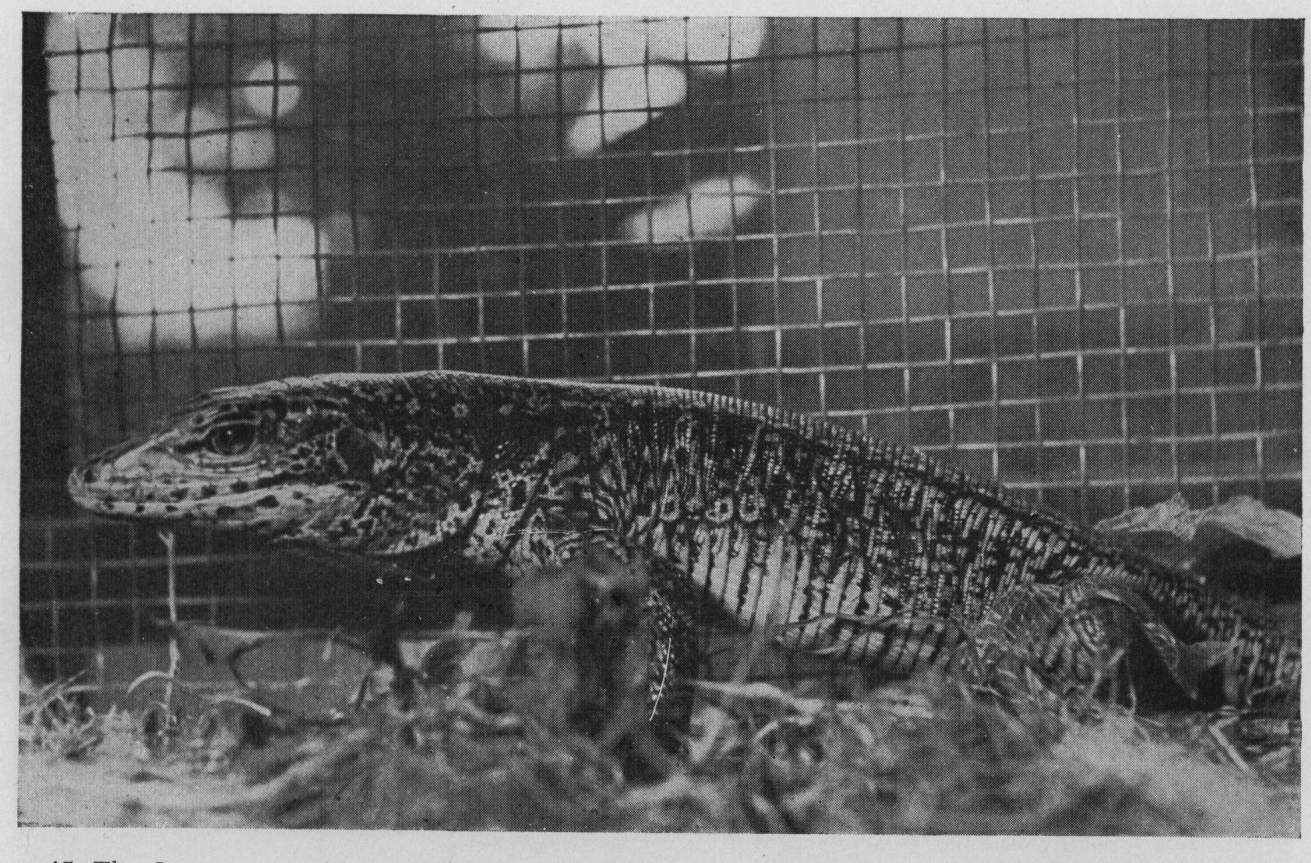
42. On the crown of the head of the Water Monitor the remains of a third eye are clearly visible; this was well developed in the monitor's ancestors in the Permian era. The photograph shows that the monitor is in process of shedding its old skin.



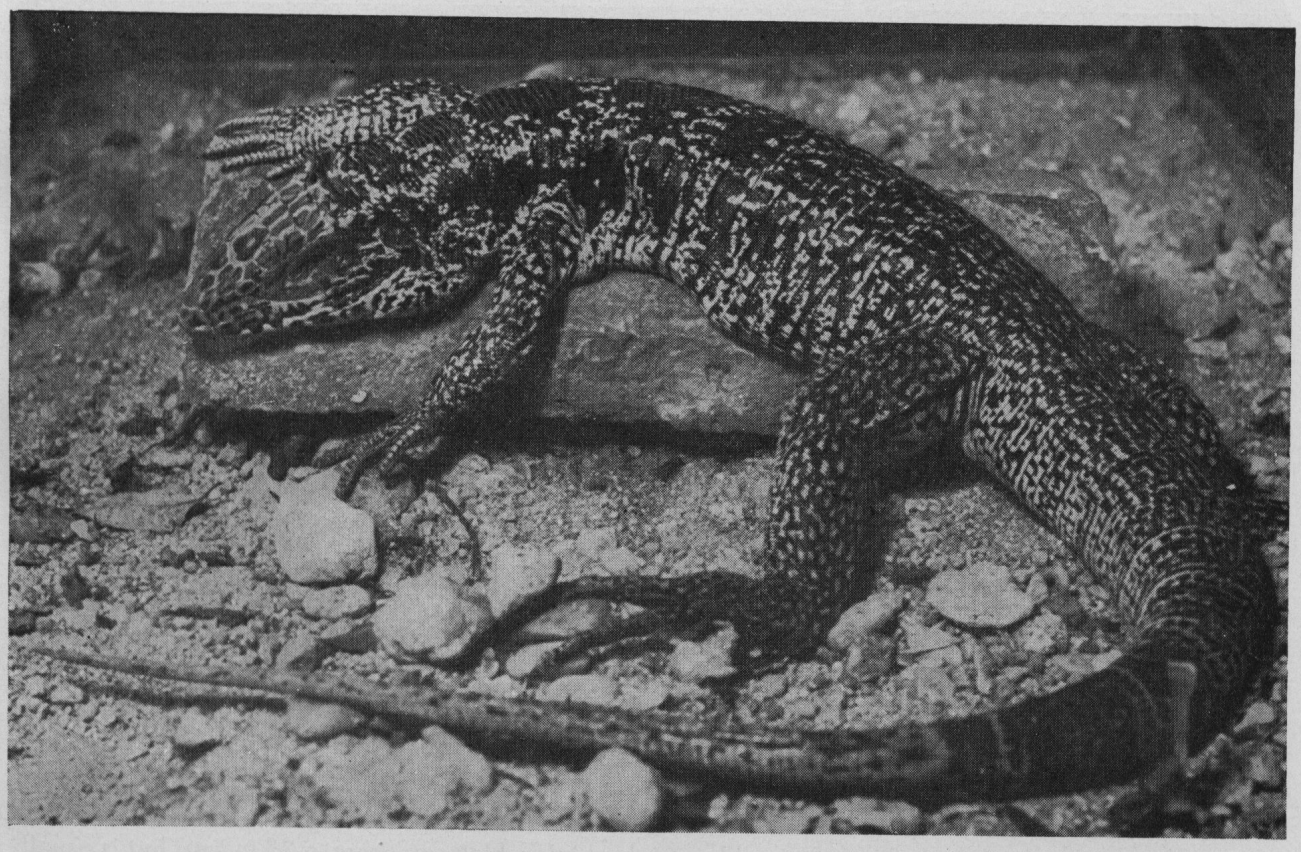
43. The skull of the agamid *Phrynocephalus mystaceus,* from the side and from above. The lower jaw extends considerably beyond the upper jaw; the teeth are very strong and are of two or three types. On the crown of the head there is an opening connecting the upper part of the middle brain with an eye, which is now, however, only vestigial and does not penetrate the skin. Enlarged about $\times 2$.



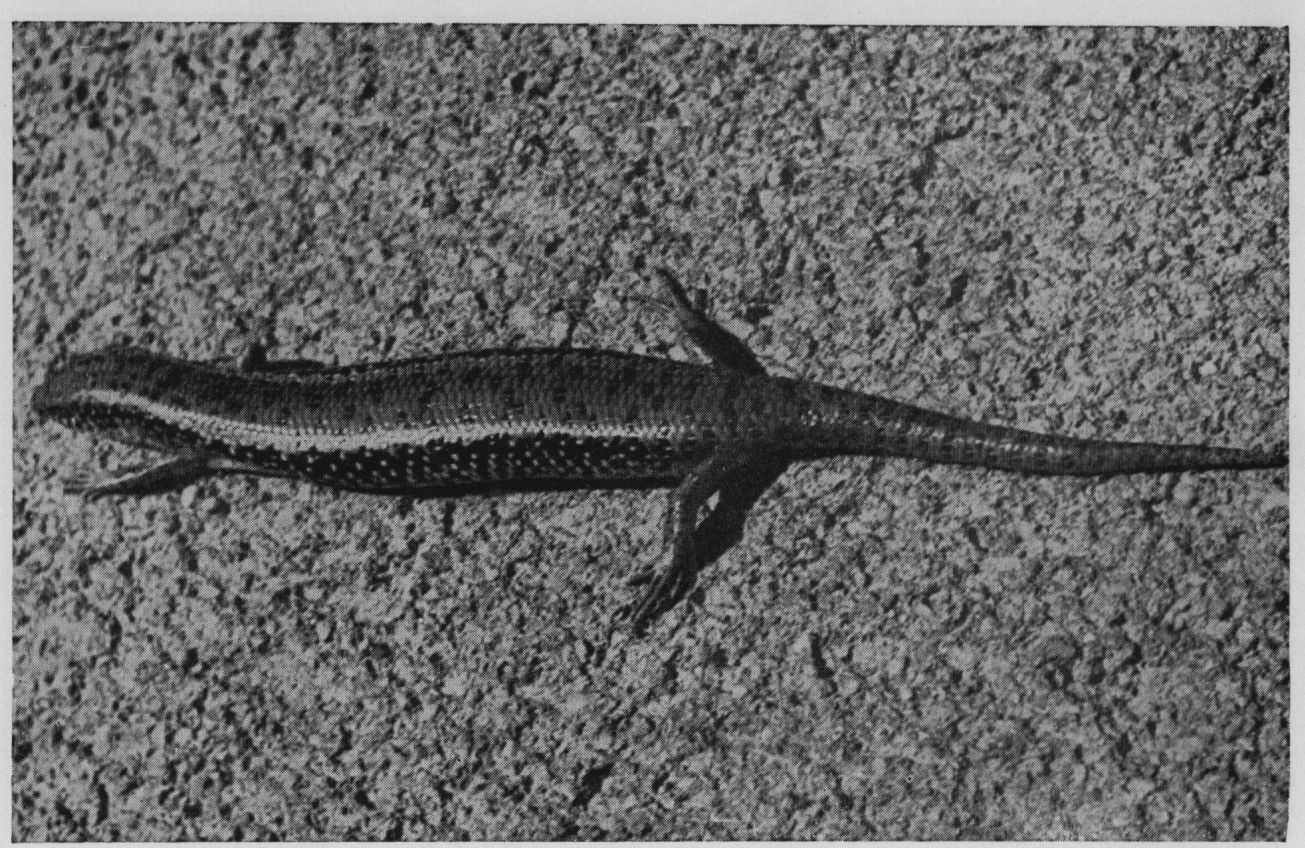
44. The skull of the Desert Monitor *(Varanus griseus).* This also has an ancient form. In particular, the power of the jaws and the strong, sharp teeth should be noted. Enlarged by about 1/3.



45. The Jacruaru *(Tupinambis nigropunctatus)*, a very rapacious lizard from S. America. It grows to a length of about 4 feet and is beautifully marked in black and yellow. Its habits and behaviour are similar to those of the monitor, except that it is not able to swallow such large prey. It is fond of fruit.

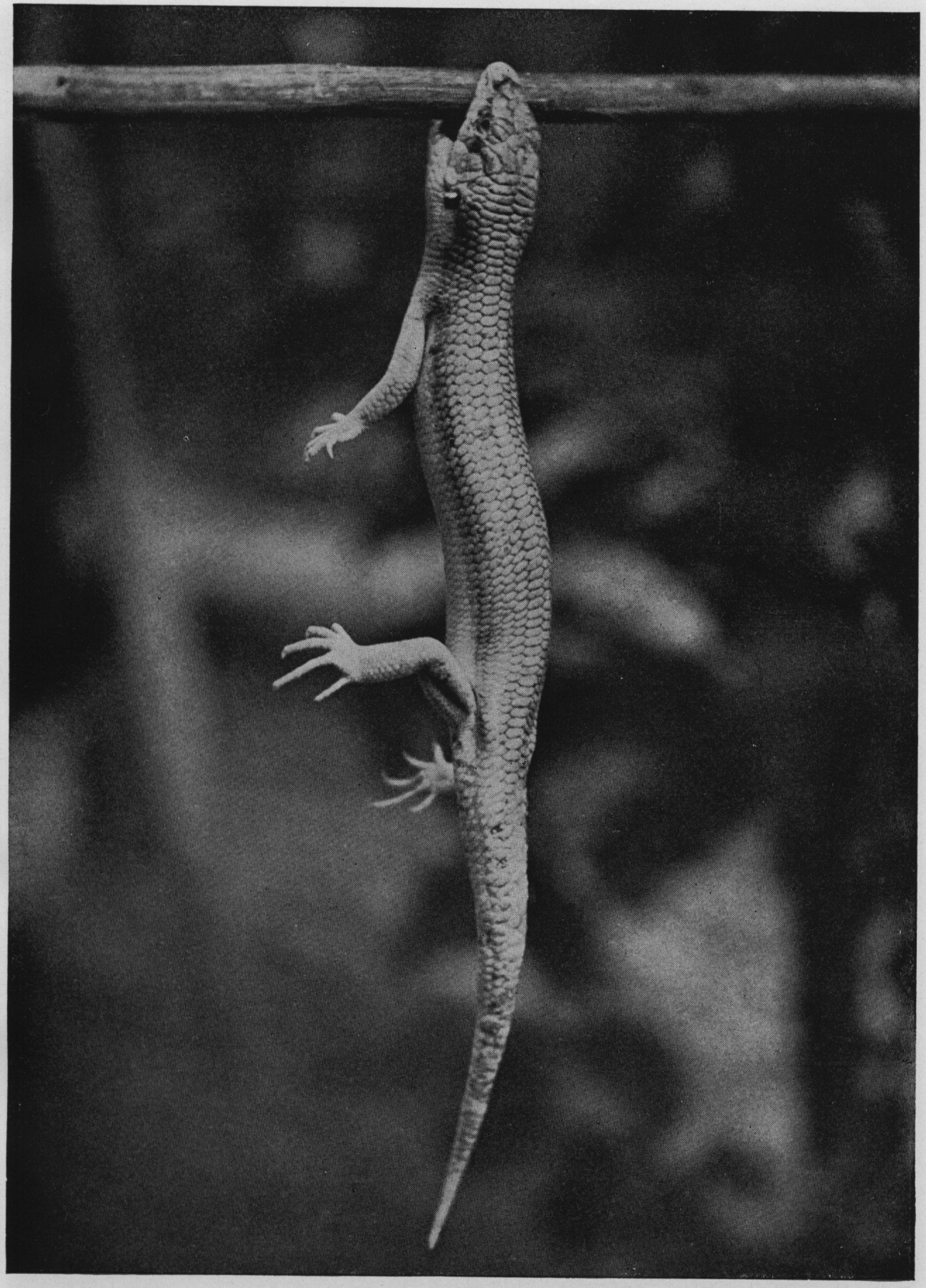


46. An old jacruaru will lie for hours in a warm bath or in the sunshine. It takes food well in captivity but does not grow so accustomed to its keeper as the monitors.



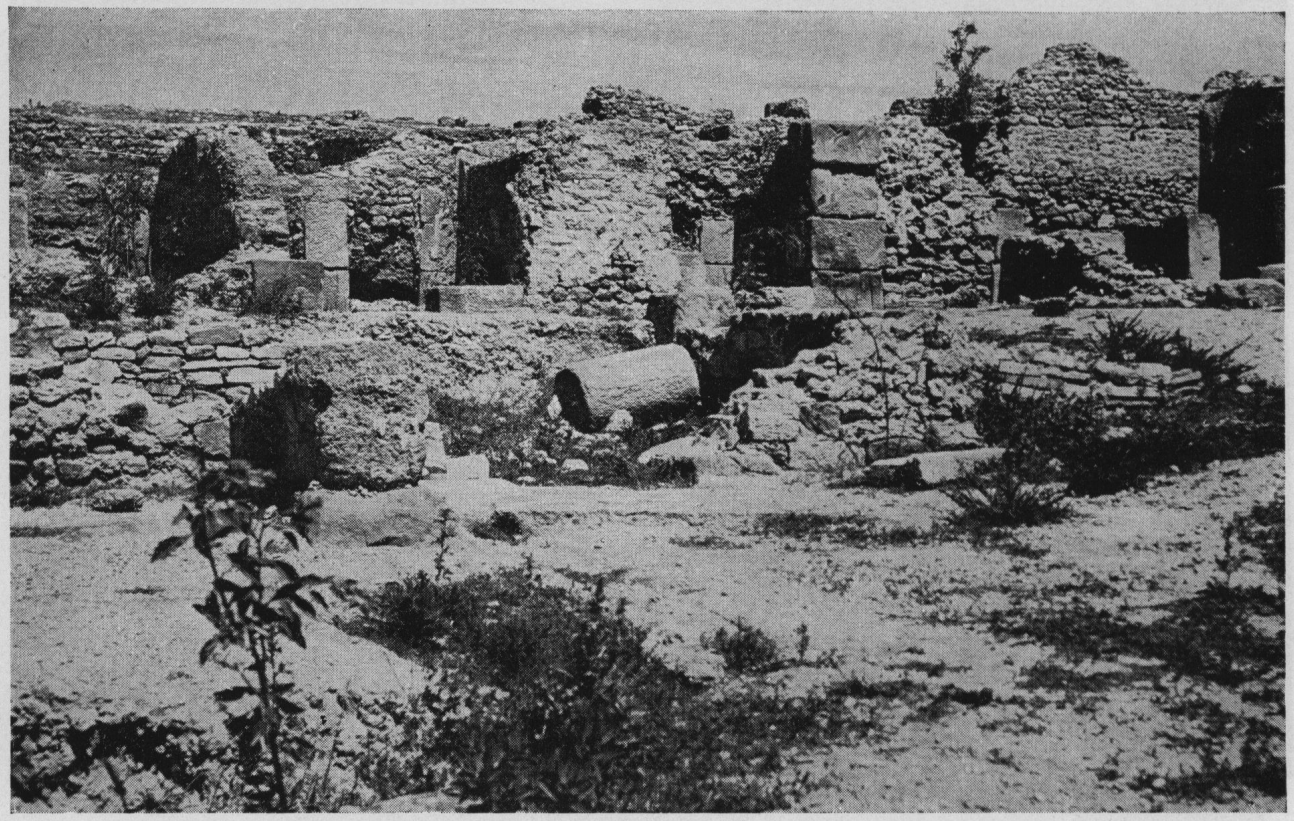
47. The skink *Chalcides ocellatus* inhabits N. Africa, Arabia, Syria, Iran and Hither India and is abundant in the neighbourhood of towns, roadside ditches and rubble heaps. It is easy to keep in a terrarium and often reproduces in captivity. It measures about 10 inches.

48. *Eumeces schneideri* is a very presentable, sturdy skink, which can grow to 25 inches, but is usually shorter. Its back is brick-red with yellow markings, its sides rich yellow and its abdomen white. It lives in islands of shrubs in N. Africa.



49. Skinks of the species *Eumeces schneideri* soon grow tame in captivity, but if they are annoyed they bite. The photograph shows an infuriated skink which has bitten into a wooden stick and has let itself be lifted into the air. This animal is about to shed its skin and the bright markings are not in evidence.

50. Near the city of Tunis are the ruins of Carthage, which are the home of countless geckos, lizards and skinks. The photograph shows a typical site where geckos of the species *Tarentola mauritanica* ran up and down old columns and modern telegraph poles.

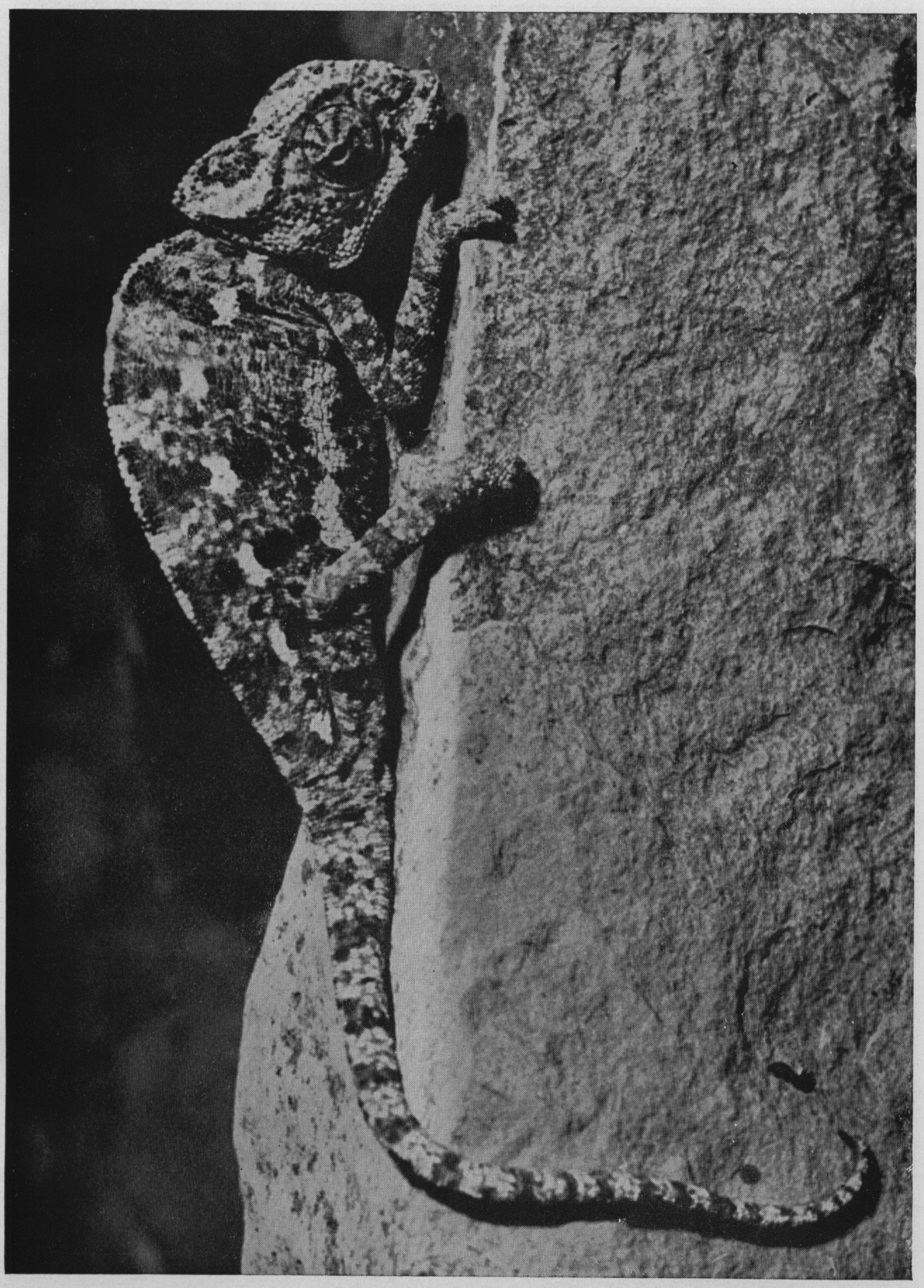


51. In the ruins of the Punic and Roman ruins of Carthage, the only inhabitants today are small reptiles. Occasionally this scene of ancient battles is visited by a party of tourists accompanied by an Arab guide, but otherwise peace and quiet reign there. Such an environment is ideal for the skinks of the species *Chalcides ocellatus*.

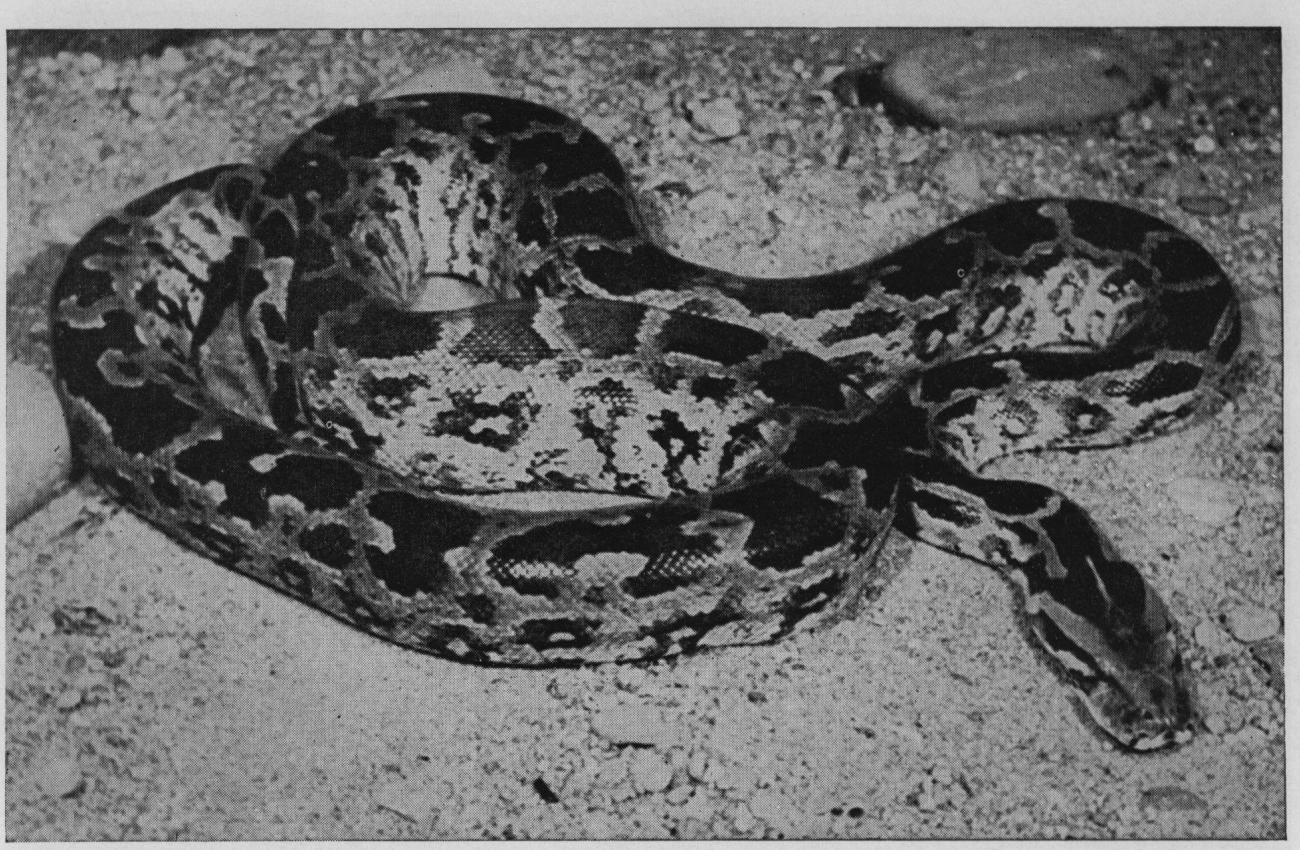
52. *Mabuya aurata affinis* from Central Asia. This is a small, gentle, pretty skink with a bronze sheen, which, in contrast to the majority of the other members of the family, prefers hunting its prey in the grass.

53. *Eumeces schneideri* from Palestine is slenderer and more nimble than the N. African form. It is a metallic brown with longitudinal rows of pale yellow spots and a yellowish white abdomen.

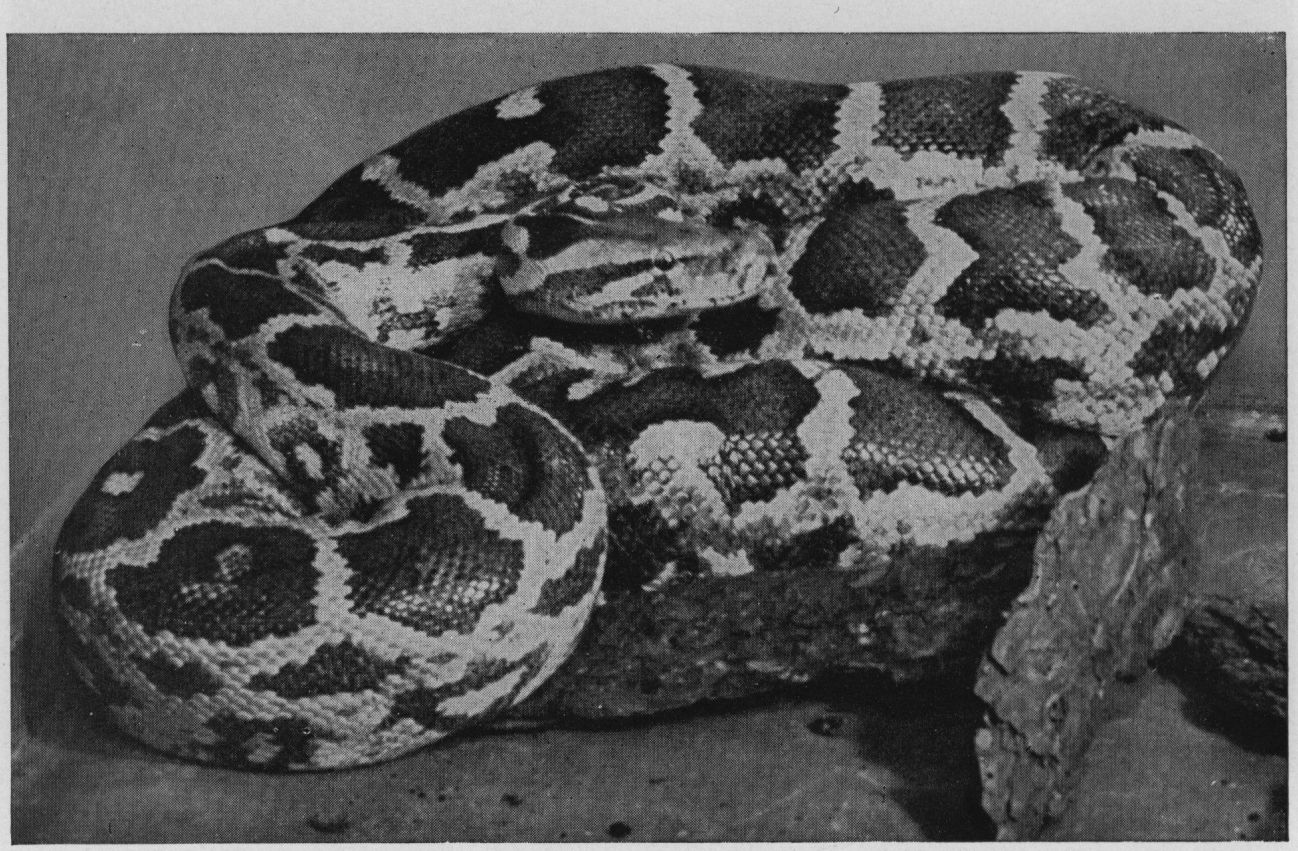
54. Our strange friend the Chameleon *(Chamaeleo chamaeleon)* climbs solemnly up the stem of a young lemon tree. It keeps one eye on the road, while the other watches what is going on around; at the same time it does not forget to hold on by its tail. The lemon plant is green and so the chameleon has also changed its colour to green.



55. The chameleon has climbed up the wall, changing its green colouring to grey, with light and dark blotches. In this particular case, however, the camouflage has not turned out too well, as it makes the chameleon conspicuous rather than inconspicuous.

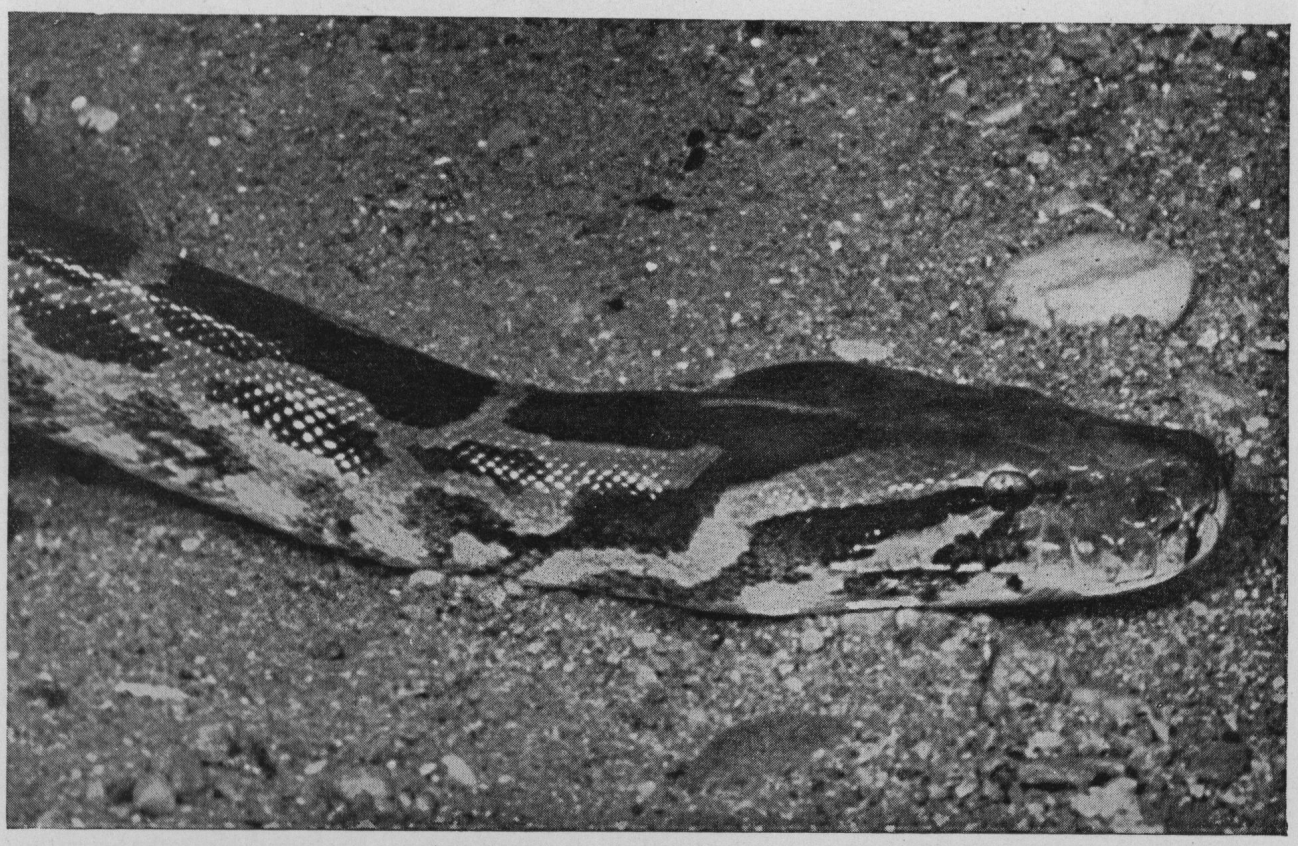


56. The biggest snakes belong to the family of the *Boidae*. The best known among them is the Indian Rock Python *(Python molurus molurus)*, which is often kept in menageries and zoological gardens. In rare cases it grows to a length of 17—18 feet; its home is in India. This photograph shows an Indian Rock Python from the neighbourhood of Madras.

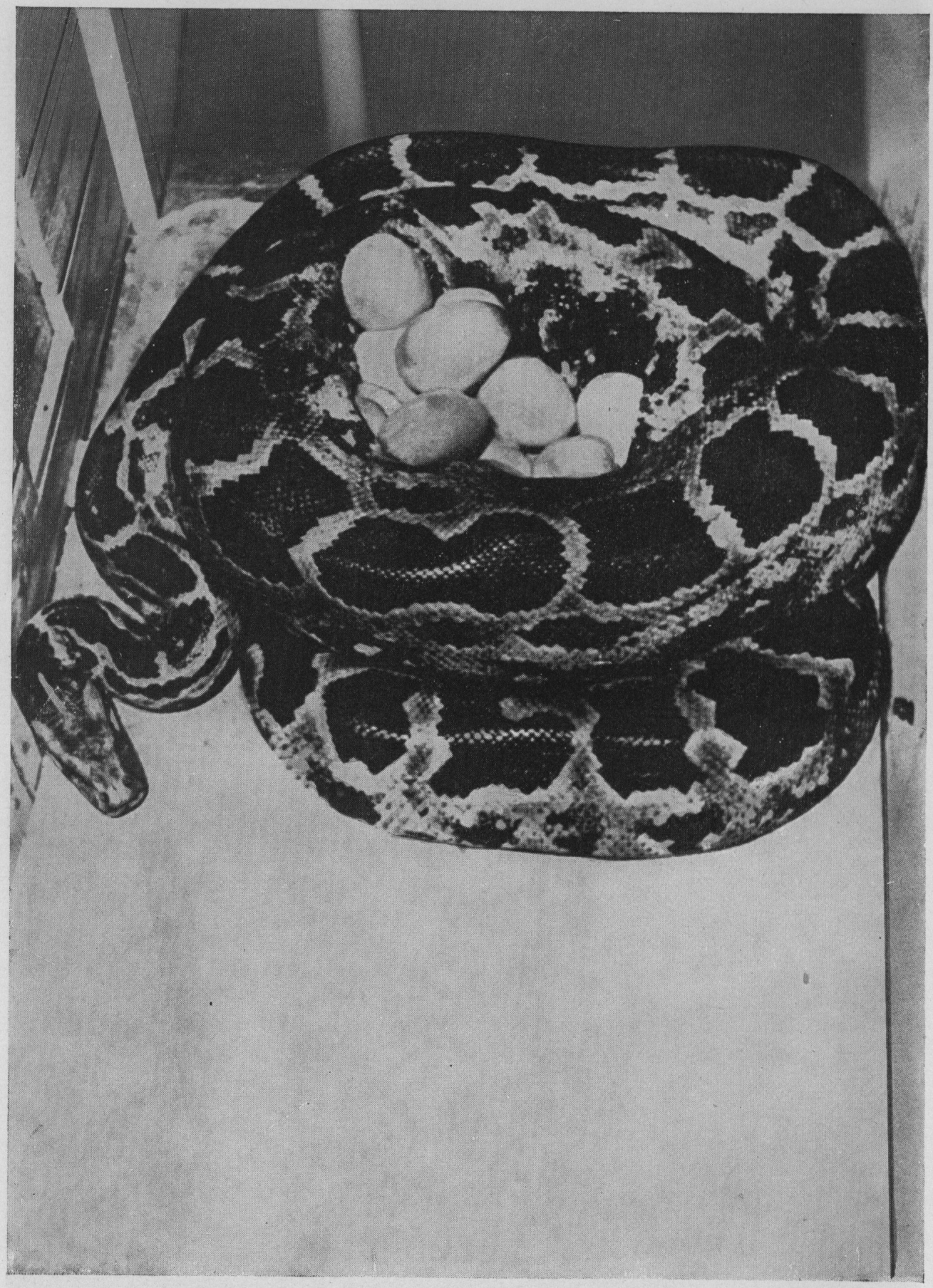


57. An Indian Rock Python from the neighbourhood of Bombay. The markings on the back and sides are much larger and more clearly defined than in the specimen from Madras.

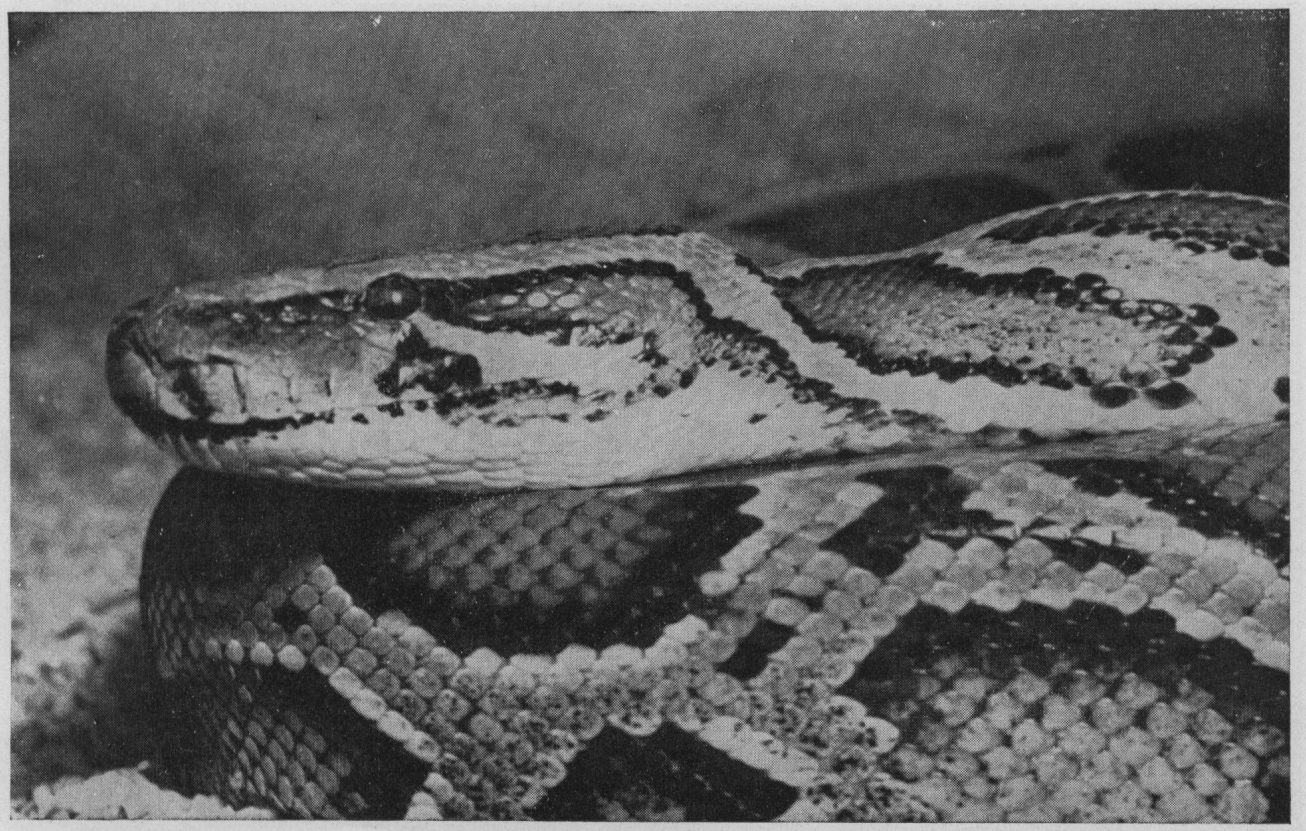
58. It is unbelievable through what small openings even a big snake can pass, and into how small a space it can compress itself. A 10-foot Indian Rock Python crawled into the hollow trunk of a tree by way of a crack which measured less than 3 inches at its widest point. The circumference of the python's body (in the middle) was 15 inches.



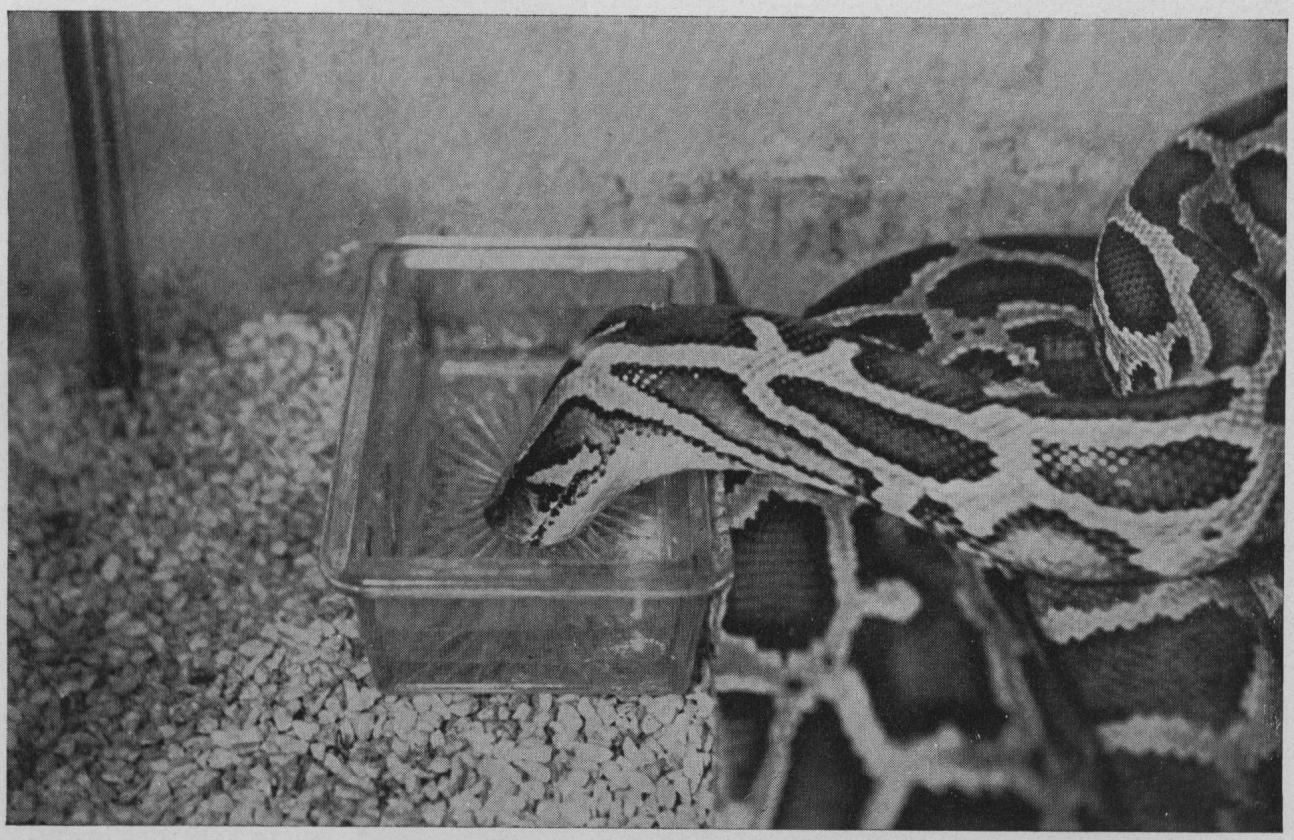
59. The head of the Indian Rock Python.



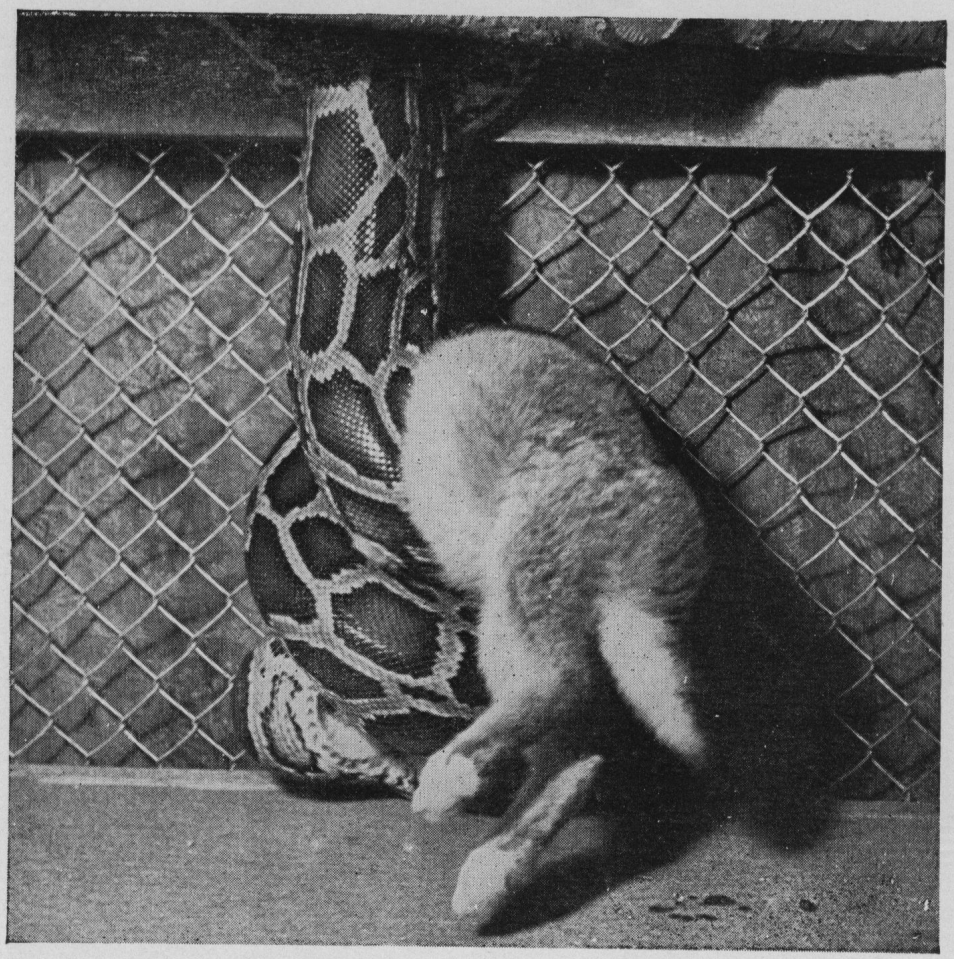
60. A female Indian Rock Python laid a large number of eggs and coiled itself round them, so as to protect them with its body and provide the necessary microclimate for the period of development. At this time the python's body temperature is raised by several degrees. The young hatch out in approximately 60 days, but only about half of them are viable. Newly hatched pythons are very slim, otherwise they completely resemble fully grown pythons. They catch mice, suffocating them in the usual manner.



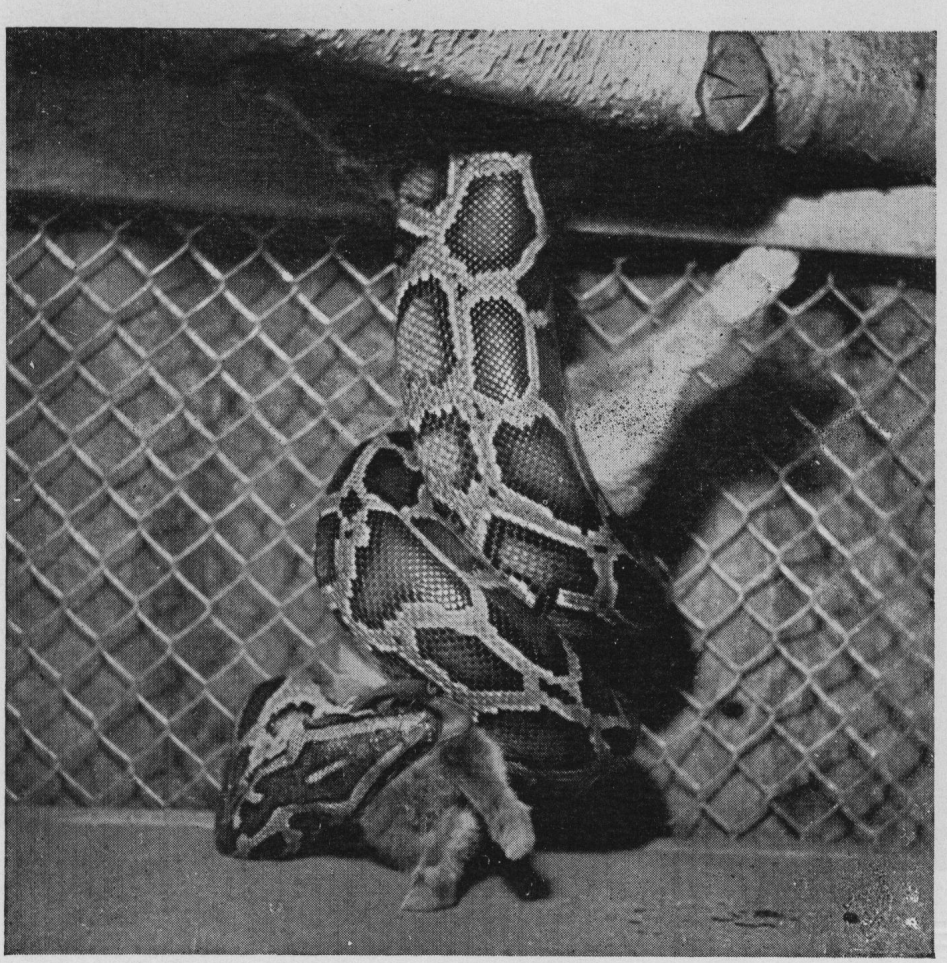
61. Still more handsome than the typical species is the dark Indian Rock Python *(Python molurus bivittatus)*, which inhabits Indo-China and Malaya. It is one of the biggest snakes and can attain a length of over 30 feet. The dark Indian Rock Python is pale yellow or yellowish brown with dark brown and olive brown markings.



62. The dark Indian Rock Python has been given water and is drinking. Snakes can distinguish old, contaminated water from fresh water, which they prefer.

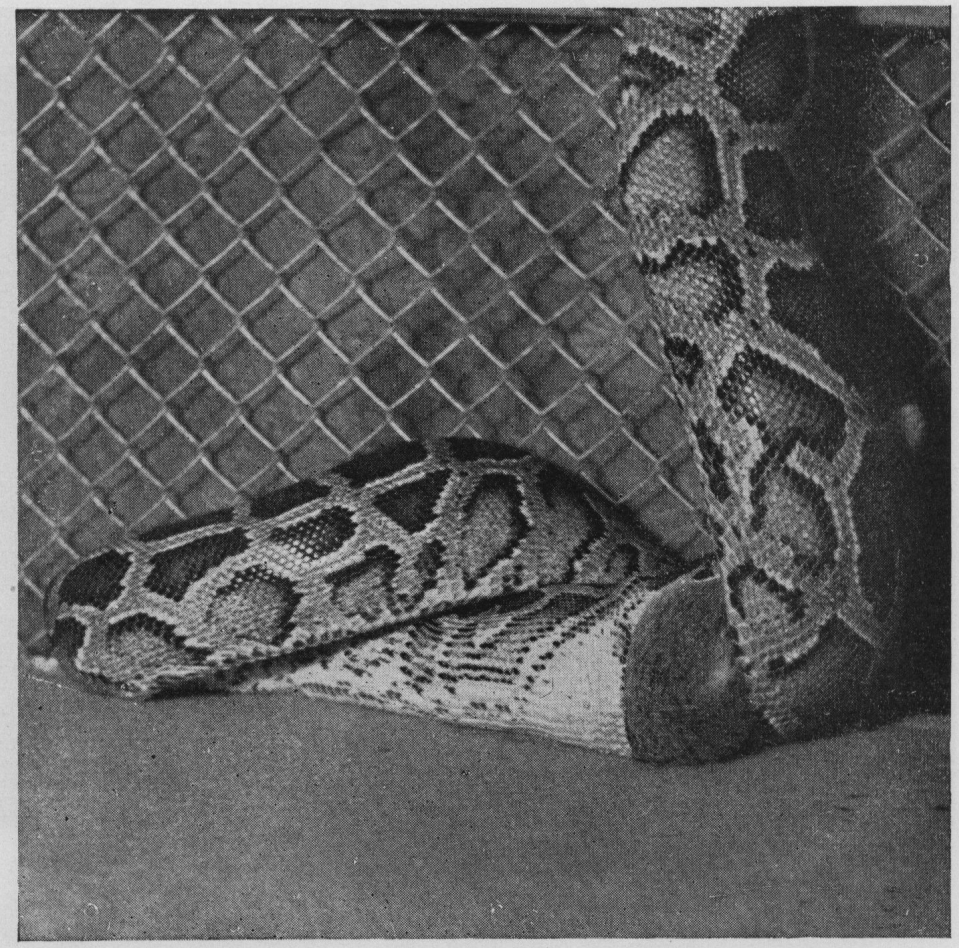


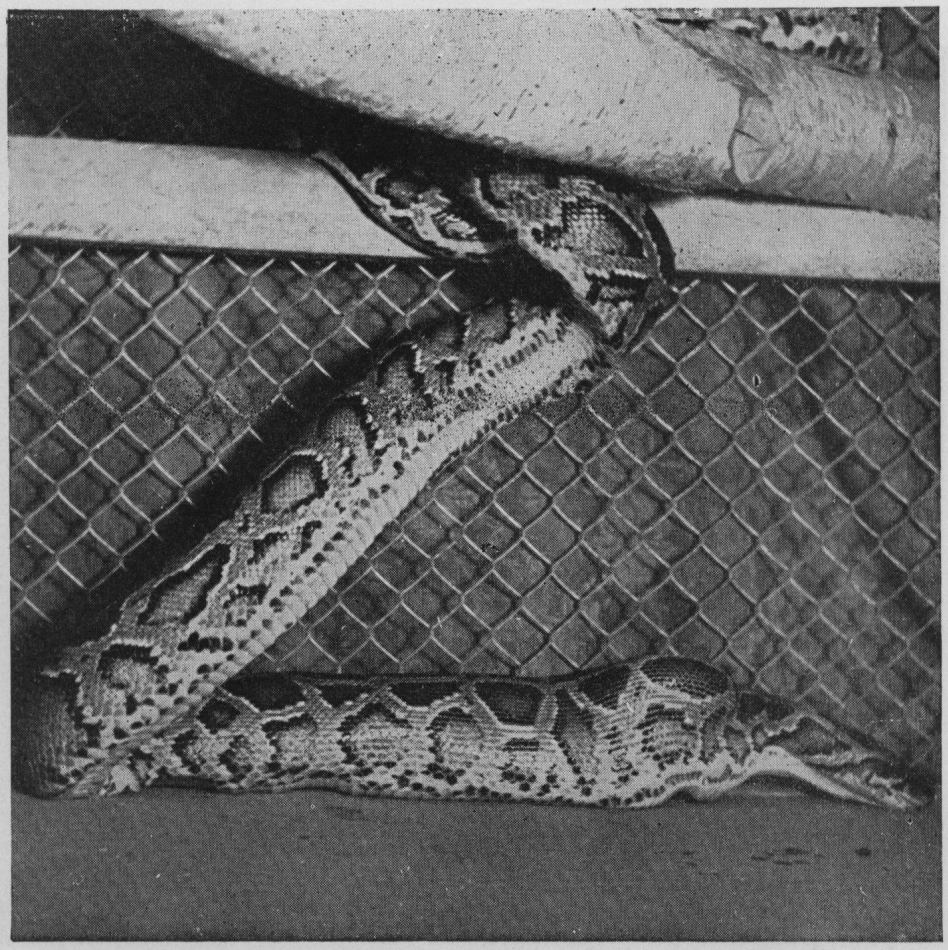
63. A dark Indian Rock Python measuring 10 feet has been given a live rabbit weighing over 6 1/2 lb. The photograph has caught the moment when the rabbit is seized by the snake and wrapped round in its coils. The snake is holding the rabbit in its jaws behind the ear and is suffocating it with its tremendous strength.



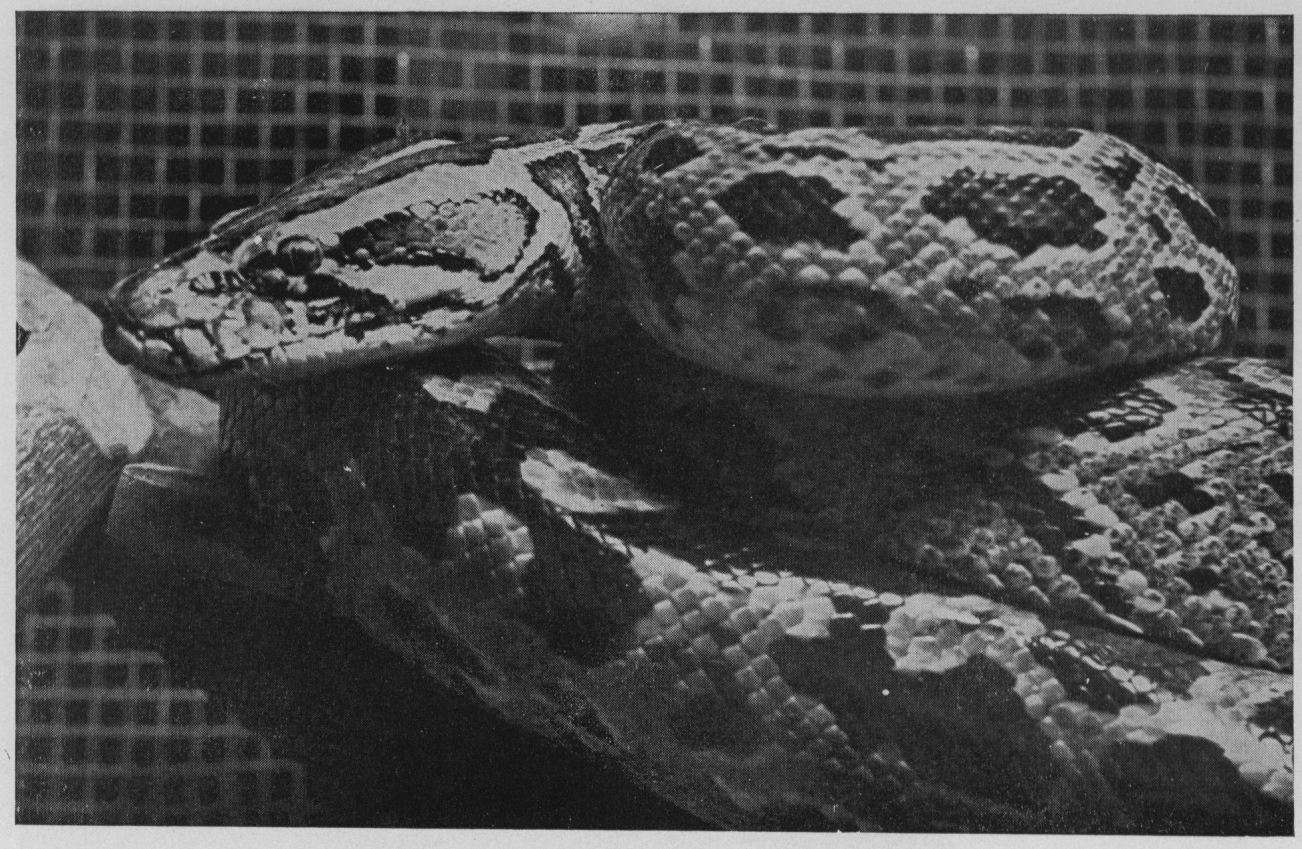
64. The second phase in catching prey. After two minutes the python ascertains that the rabbit is dead, moves it into a convenient position and begins to swallow the head. Swallowing at first goes slowly, but when the fore part of the body has gone down far enough for the snake to be able to shift it by the pressure of its neck, the process is speeded up.

65. The snake has now swallowed more than half the rabbit and is forcing its jaws over the widest part, using the fore part of its own body to help push its prey into the oesophagus. The abundant amount of saliva which is secreted during swallowing helps the bulky morsel to slip down better.



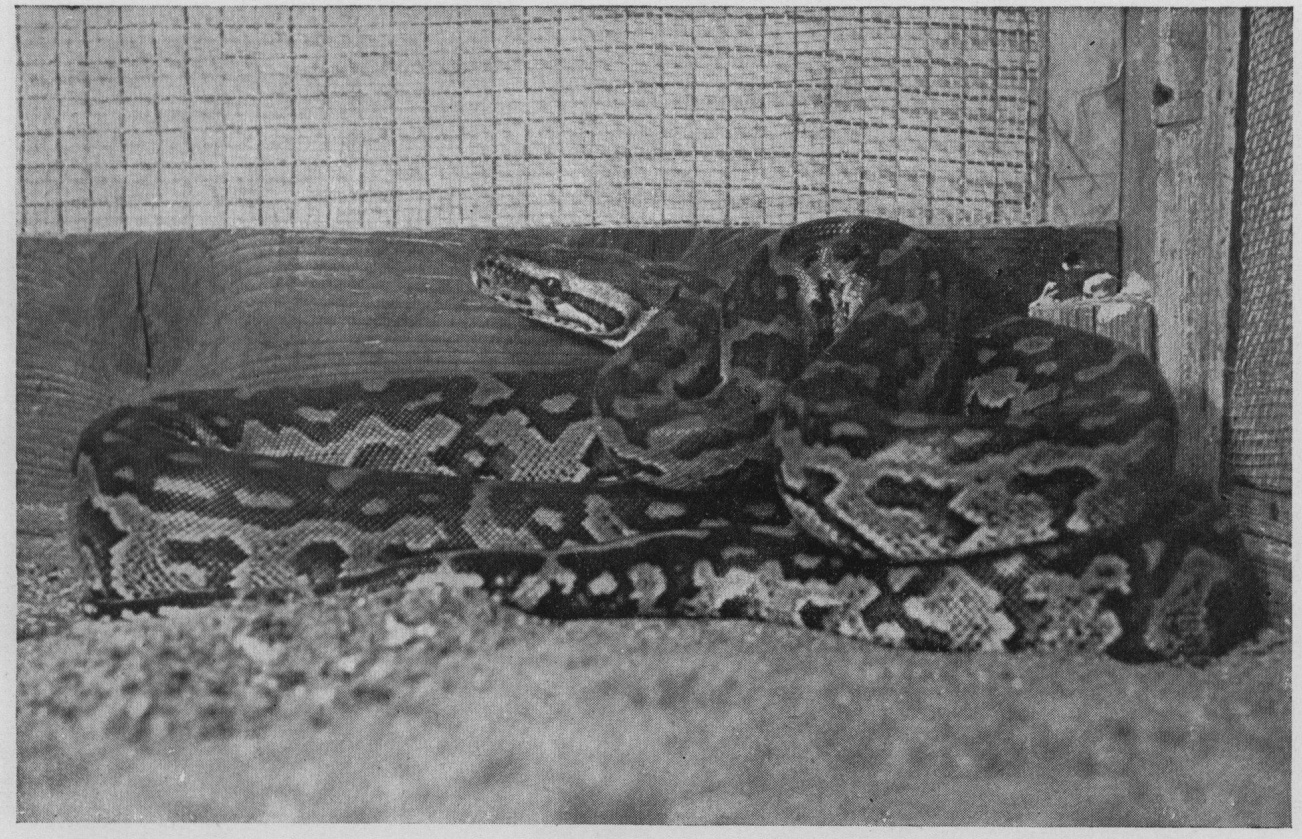


66. The final phase. By means of writhing movements, the snake pushes its prey still further. It then stretches its jaws a few times and climbs up on to a strong branch where it blissfully settles down to digest its meal; this usually lasts for several days. Less than half an hour has elapsed from the time the rabbit was seized to the time it was swallowed.

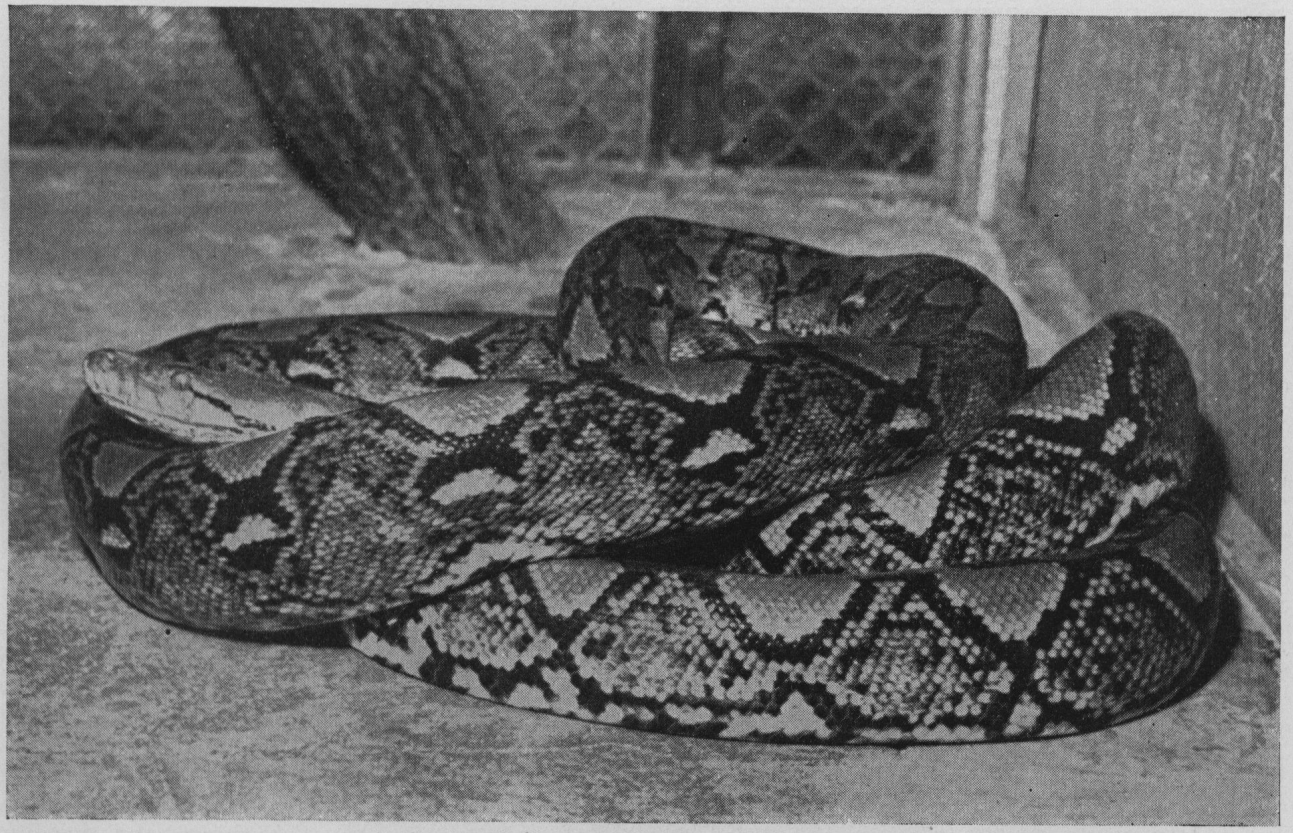


67. A dark Indian Rock Python from Java.

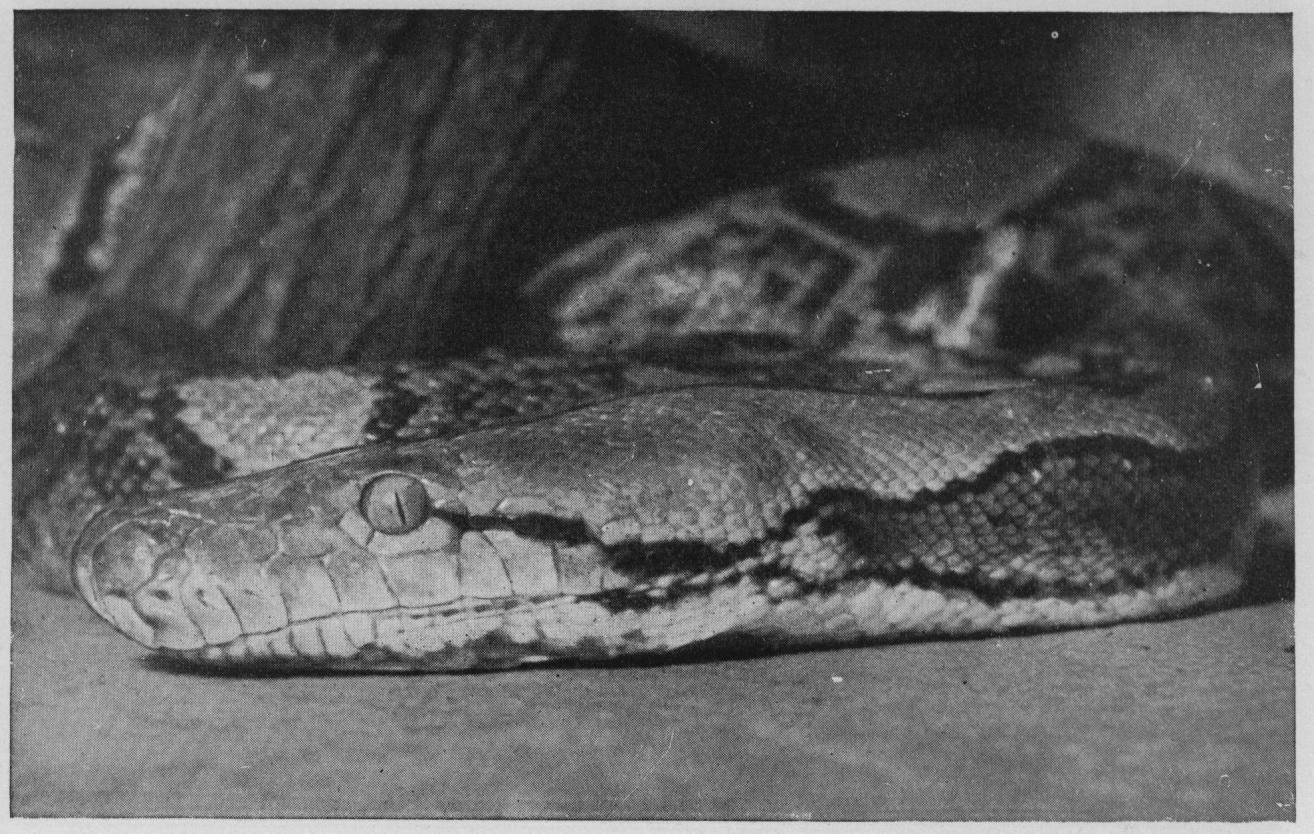
68. Dark Indian Rock Pythons from Java are rarely sent to zoological gardens in Europe. The one in the photograph measures about 6 1/2 feet.



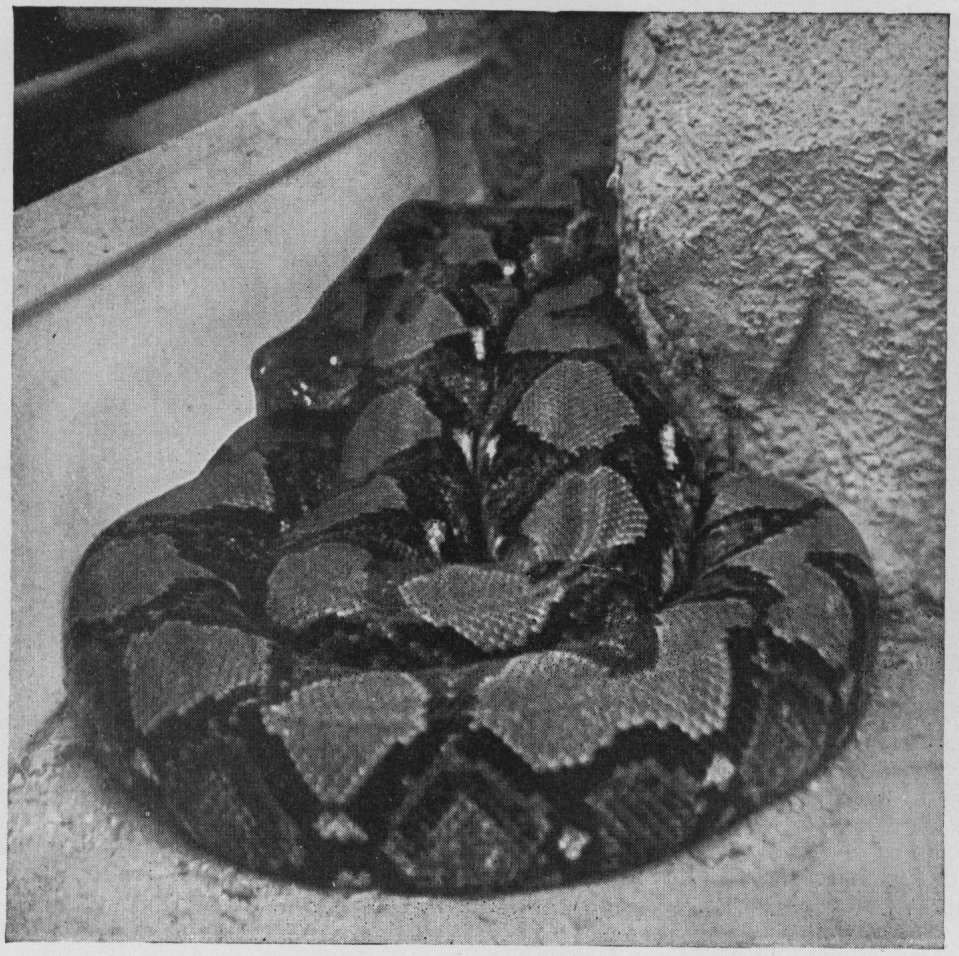
69. The African Rock Python *(Python sebae)* is the African counterpart of the Indian Rock Python. It attains as much as 27 feet, but larger specimens today are rare. It is a slender, agile python, with simple but elegant colouring. It is more difficult to keep in captivity than the previous species.



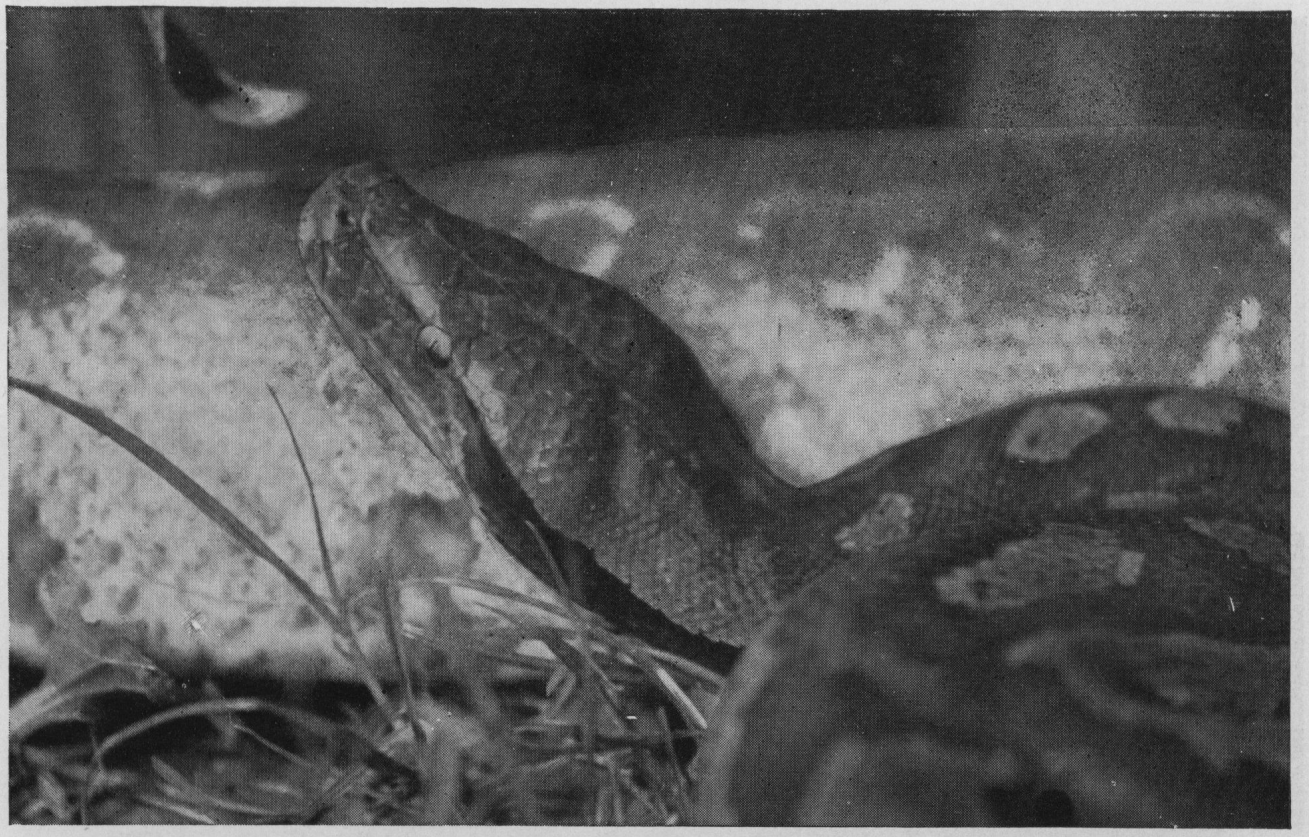
70. The Reticulated Python *(Python reticulatus)*, from India, Malaya and Indo-China, is acknowledged to be the longest snake in the world. It does not, however, attain more than about 33 feet. The photograph shows the Malayan form.



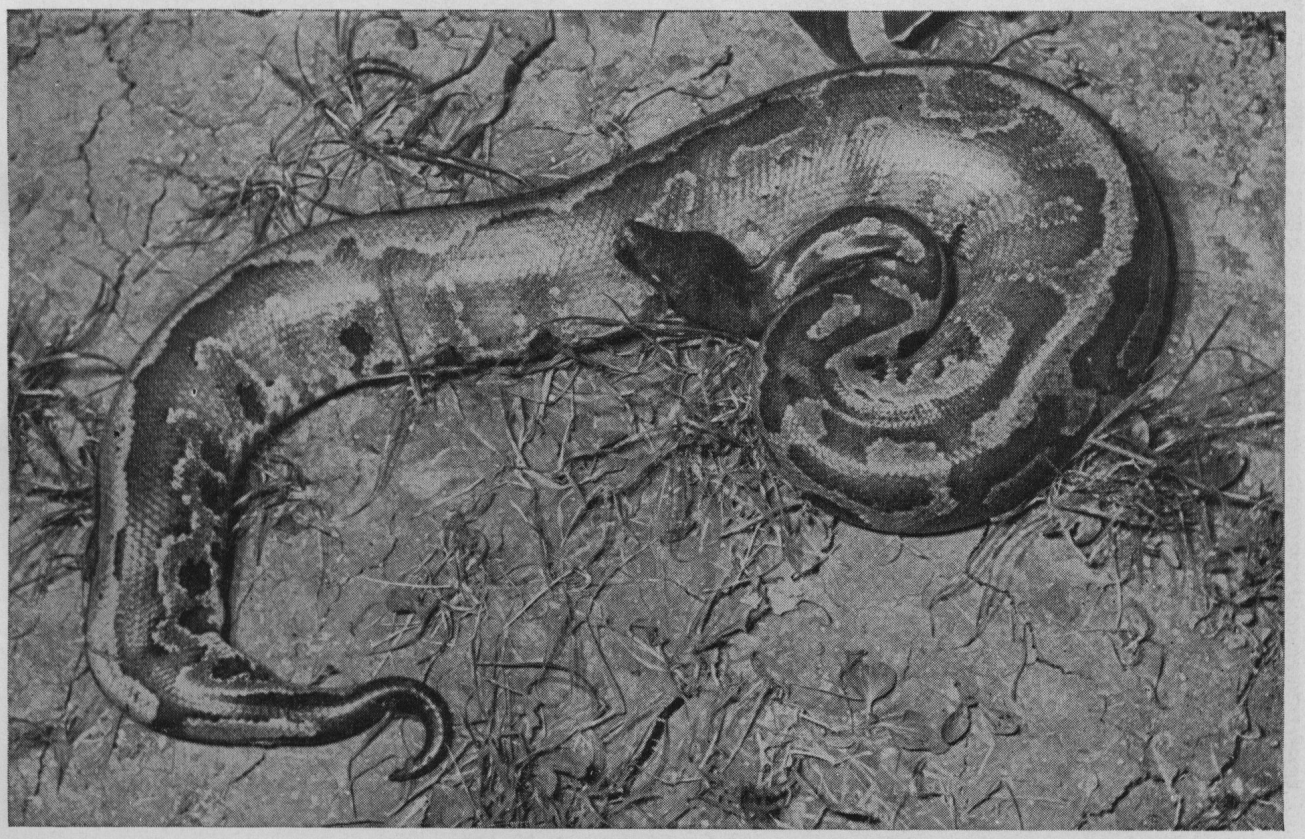
71. The head of the Reticulated Python. Note the relatively large eye, with which the snake warily watches everything that is happening in its immediate vicinity. The rostral plates of the upper lip contain deep, rounded pits, which are characteristic of this genus.



72. A Reticulated Python from Java. This specimen is 12 years old and measures over 16 feet. The Reticulated Python is dangerous not only to animals, but also to man. It haunts harbours and the outskirts of large towns, without being affected by the busy atmosphere.

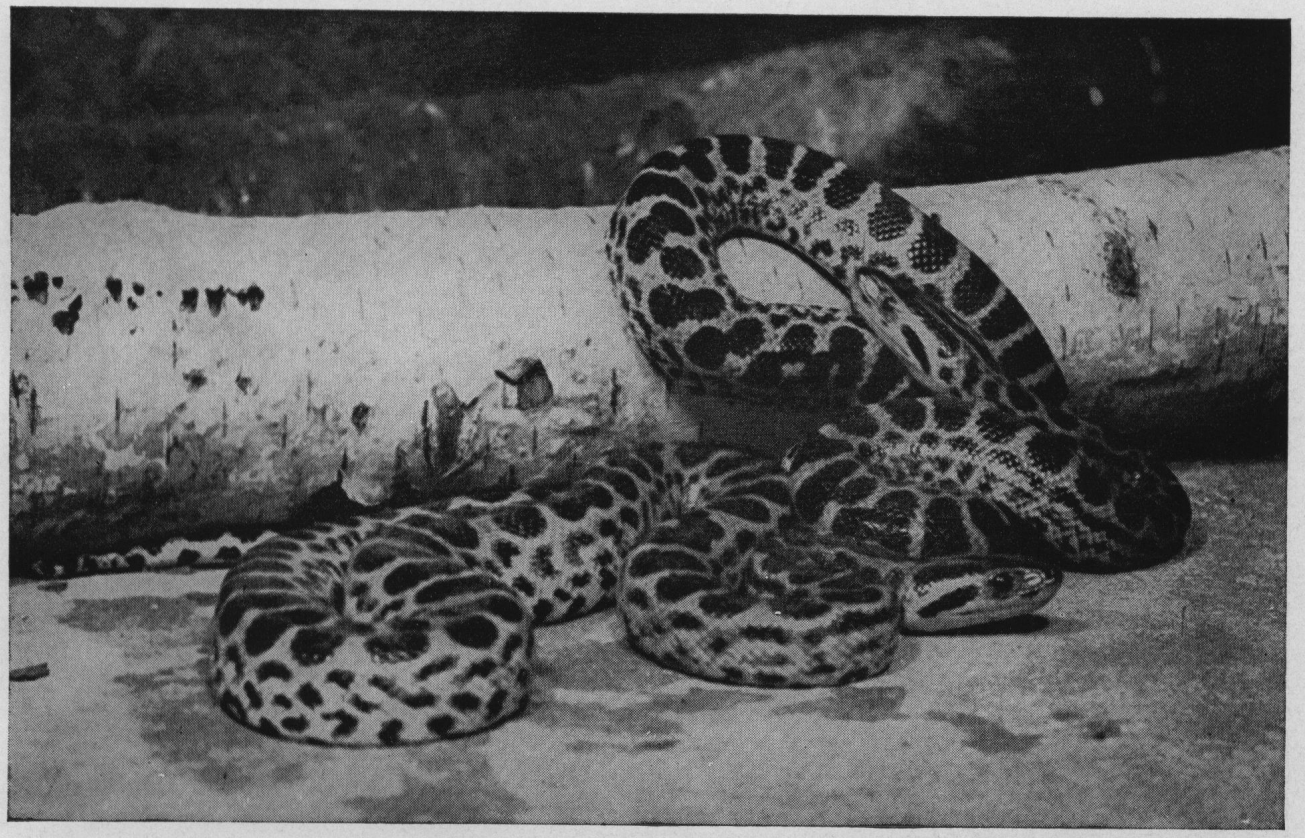


73. The head of the Short Python *(Python curtus)*. This specimen is from Indo-China; it is a small, but very strong python, which lives in the dense undergrowth of tropical forests. It grows to about 5 feet.

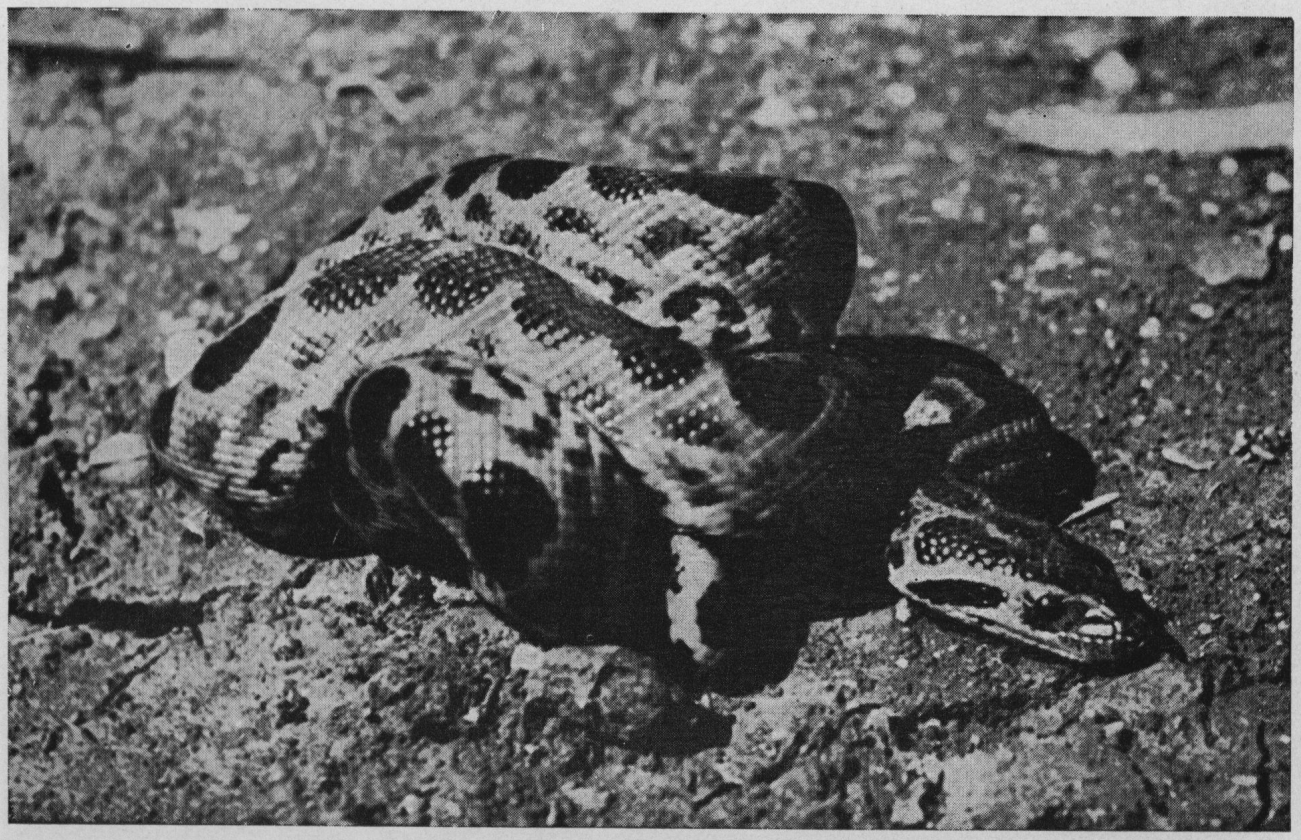


74. The Short Python has a relatively thin neck, but a very stout body. When provoked, it is unable to dart out its neck, which is hampered by the weight of the body, and so the whole body darts out, so that the snake appears to leap.

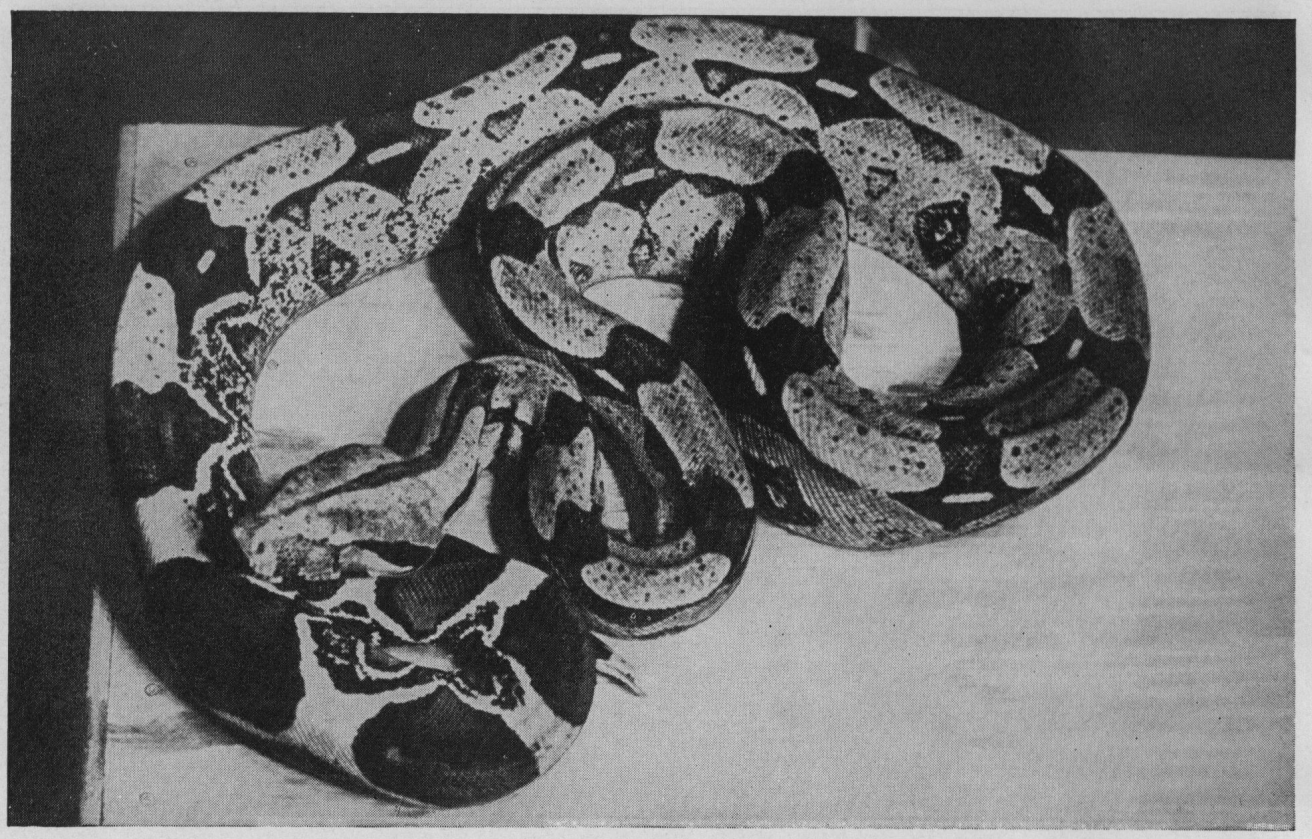
75. Some specimens of Short Python have brilliant colouring—yellow, pink, grey and black. The sight of a Short Python at rest is unforgettable. It is a pity that this snake is somewhat difficult to rear in captivity.



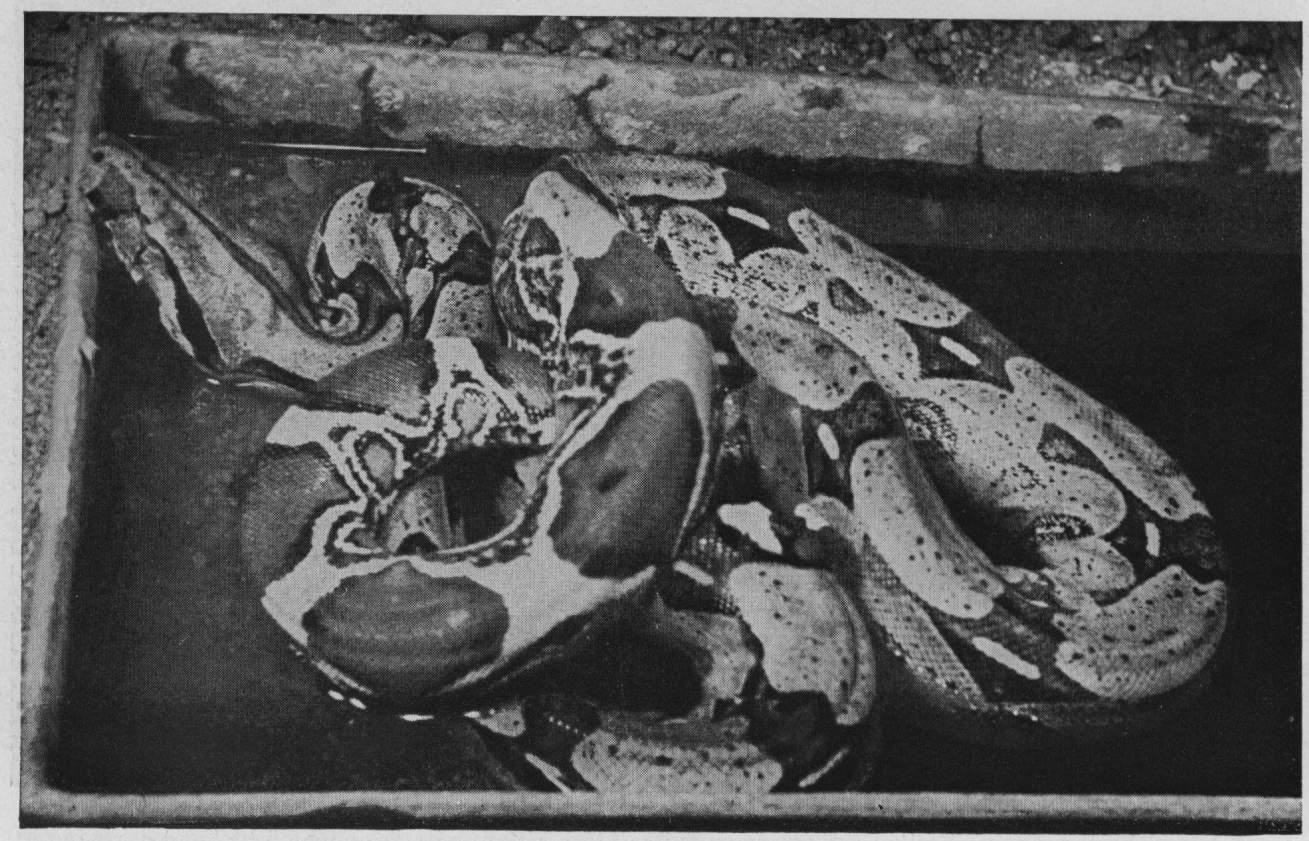
76. An old female Yellow Anaconda *(Eunectes notaeus)*, while awaiting transport to Europe from the Argentine, gave birth to 23 young ones, which were immediately sent on. The photograph shows two of these at the age of four months, when they already measured 26—28 inches. The Yellow Anaconda attains a length of 17 feet.



77. When in danger, the Yellow Anaconda coils itself into a tight ball, from which its head darts out at the enemy. The jaws are equipped with powerful teeth. The photograph shows an infuriated anaconda which has just drawn back its head into the original position after making an attack.

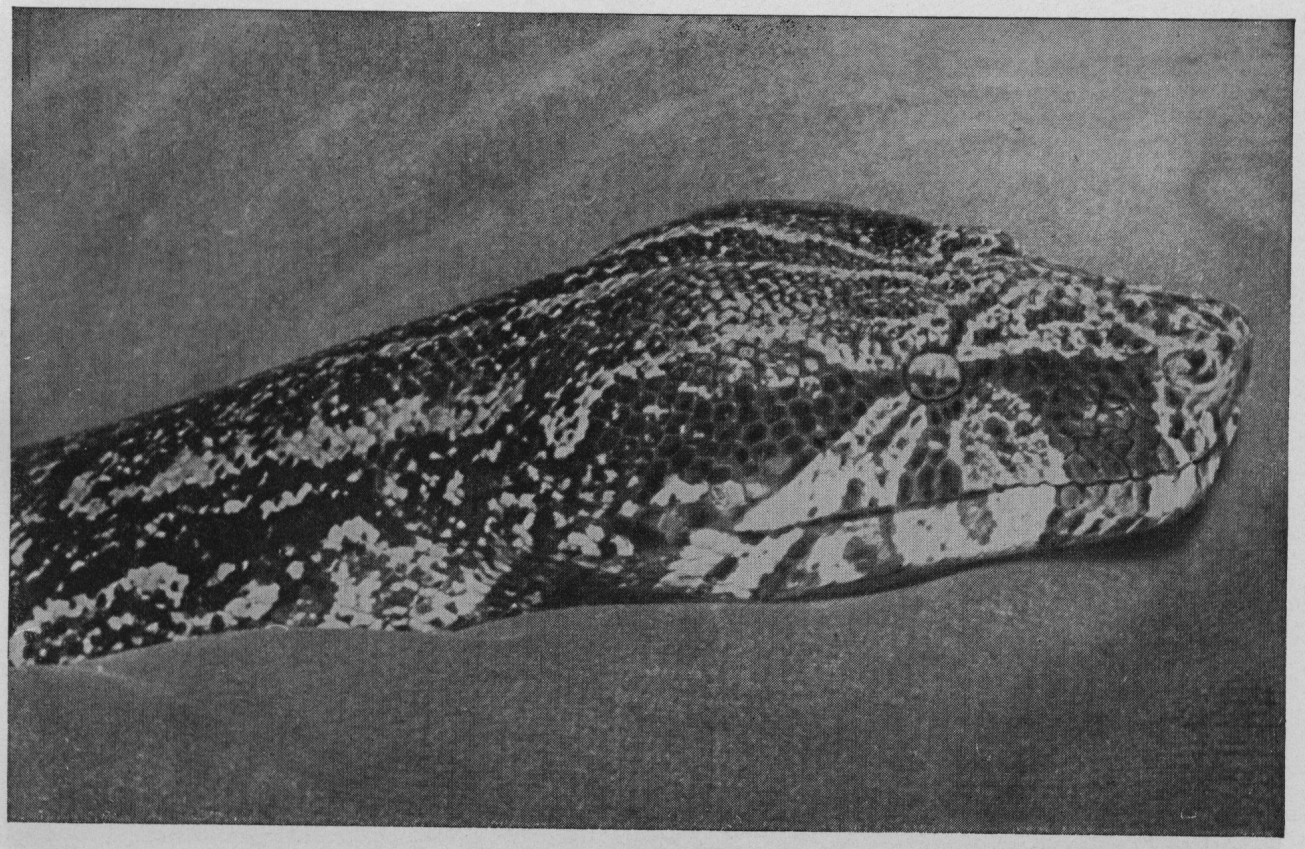


78. In addition to the Indian Rock Python, visitors to zoological gardens are also acquainted with the Boa Constrictor *(Boa constrictor constrictor)*. This snake sometimes attains 17 feet, but specimens over 10 feet are rare. The Boa Constrictor inhabits a wide area of S. America and is beautifully marked, especially the tail.

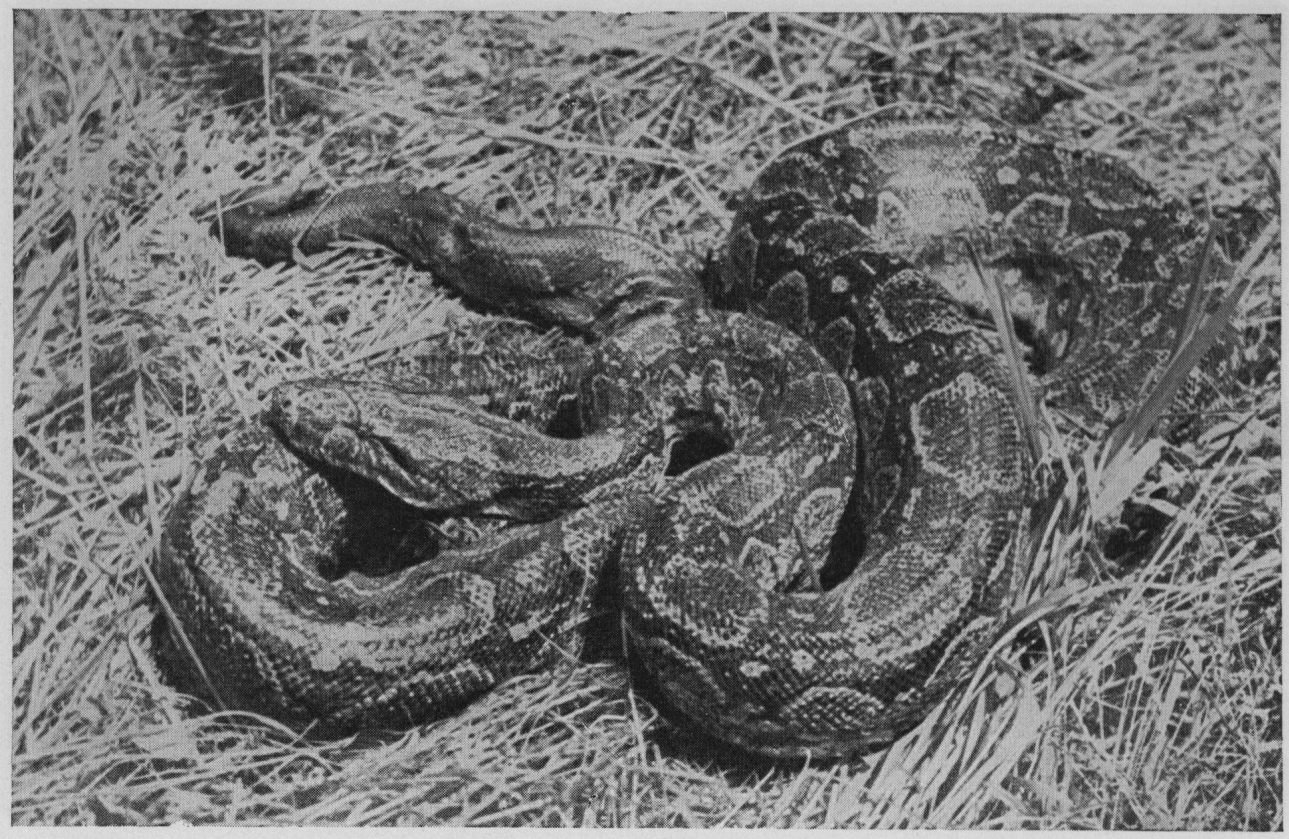


79. The Boa Constrictor is fond of a warm bath, although in its own country it prefers living in dry places.

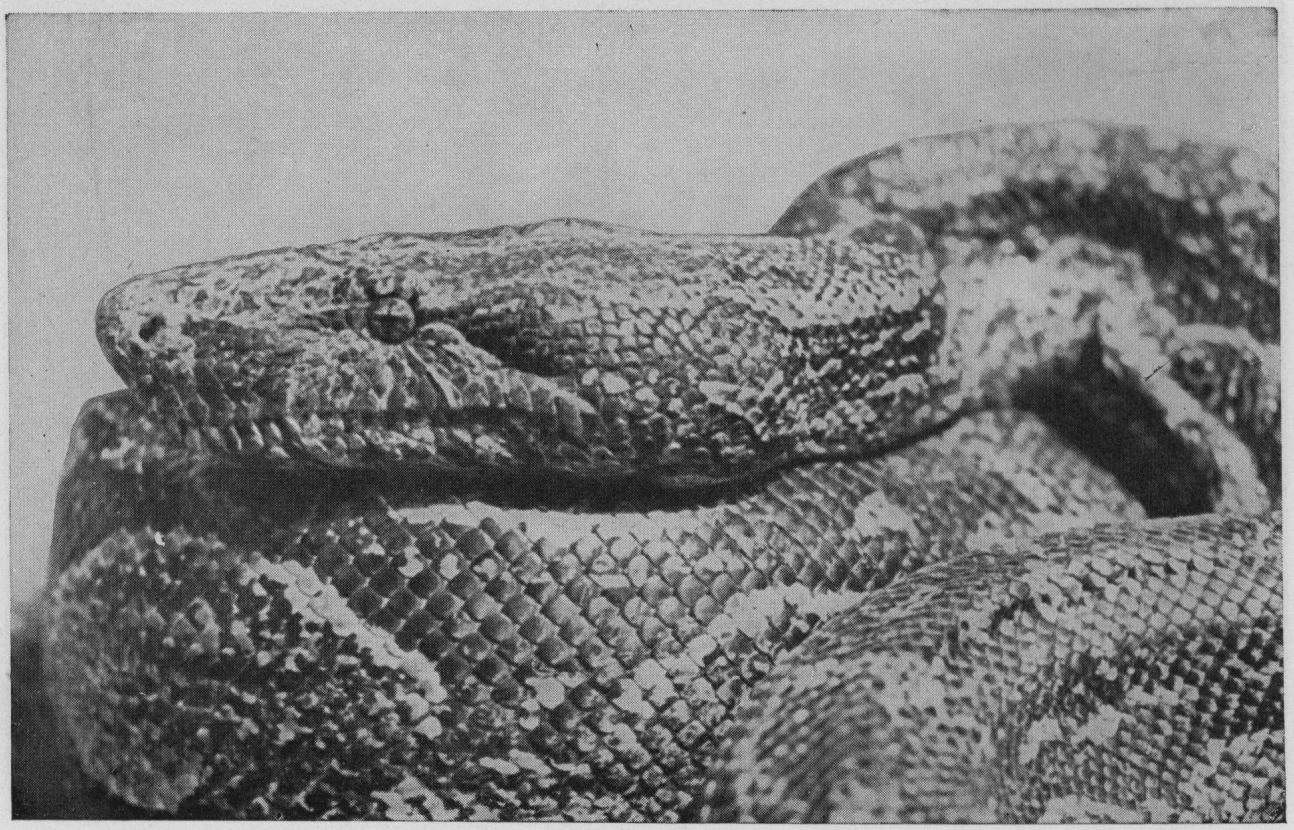
80. The Emperor Boa *(Boa constrictor imperator)* is a special northern subspecies of the Boa Constrictor. The markings on its back are denser and its colouring is not so striking. It is found in Central America.



81. In the N. W. Argentine and Paraguay, the Boa Constrictor has its counterpart in the Argentinian Boa *(Boa occidentalis)*. The head is higher and broader and the basic colour is light tan to black-brown with a silvery white or whitish yellow design. The photograph shows the Paraguayan form.

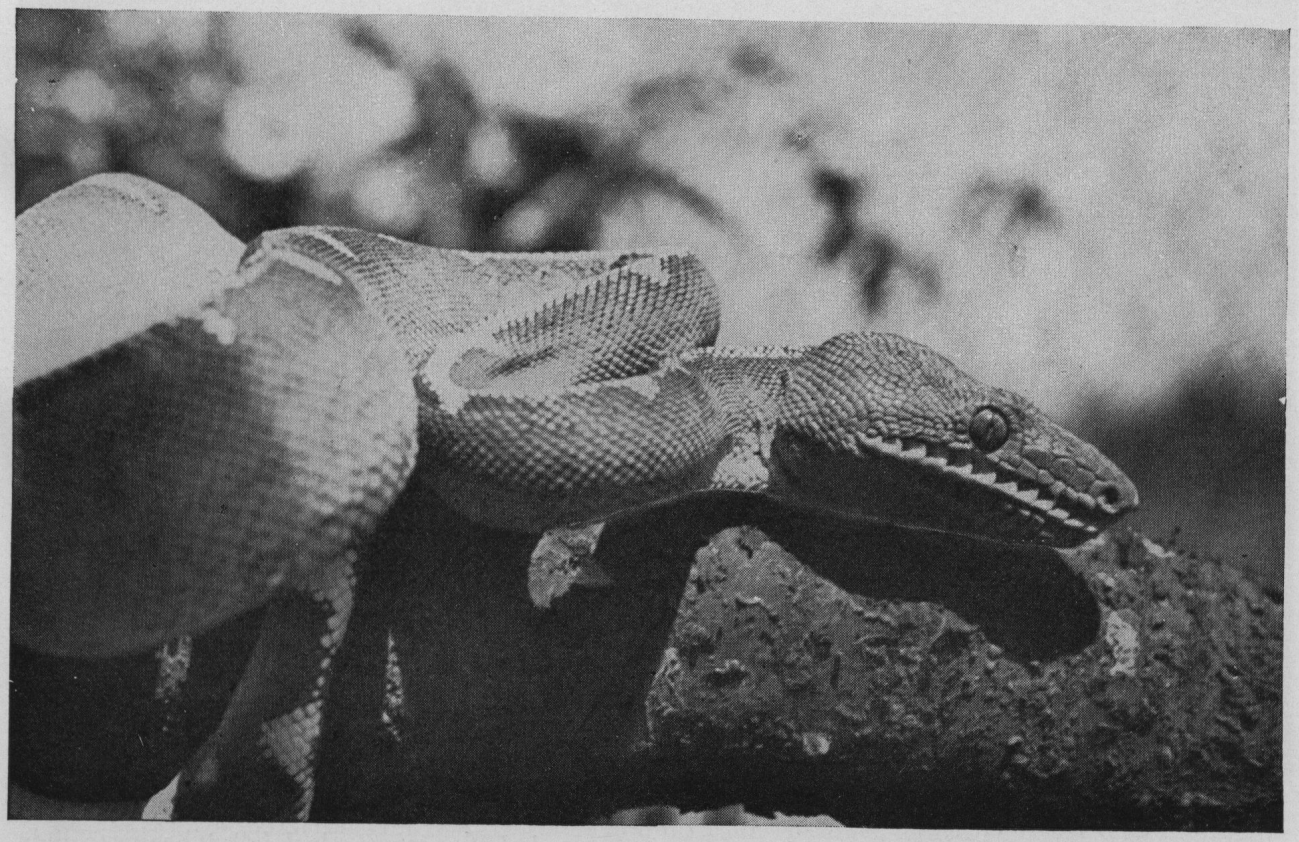


82. The southern (typical) form of the Argentinian Boa. This snake has a comparatively mild disposition and feeds chiefly on birds.

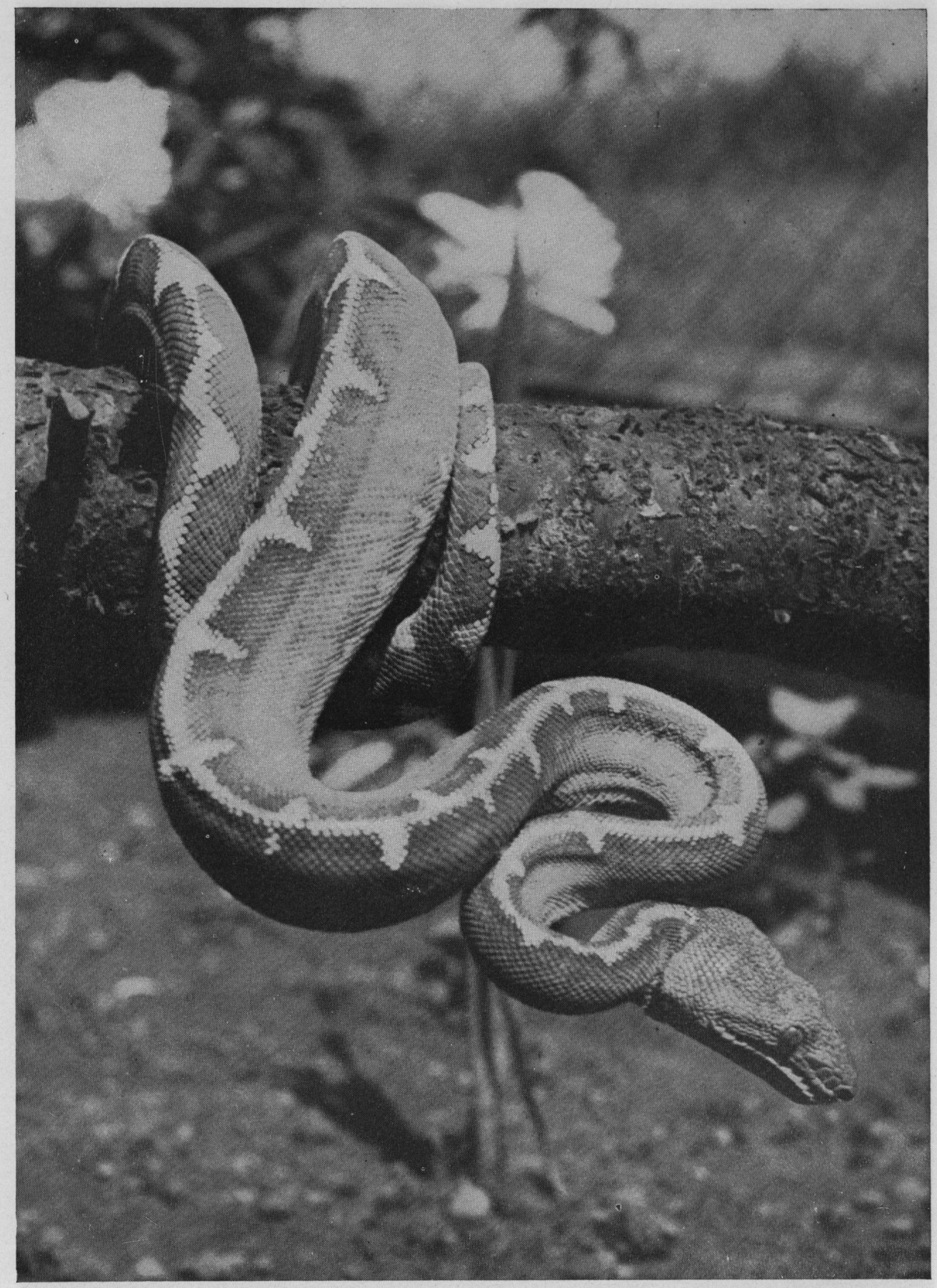


83. The typical form of the Argentinian Boa has an unusually shaped head, resembling that of a python. There are striking morphological differences among the various forms of Boas.

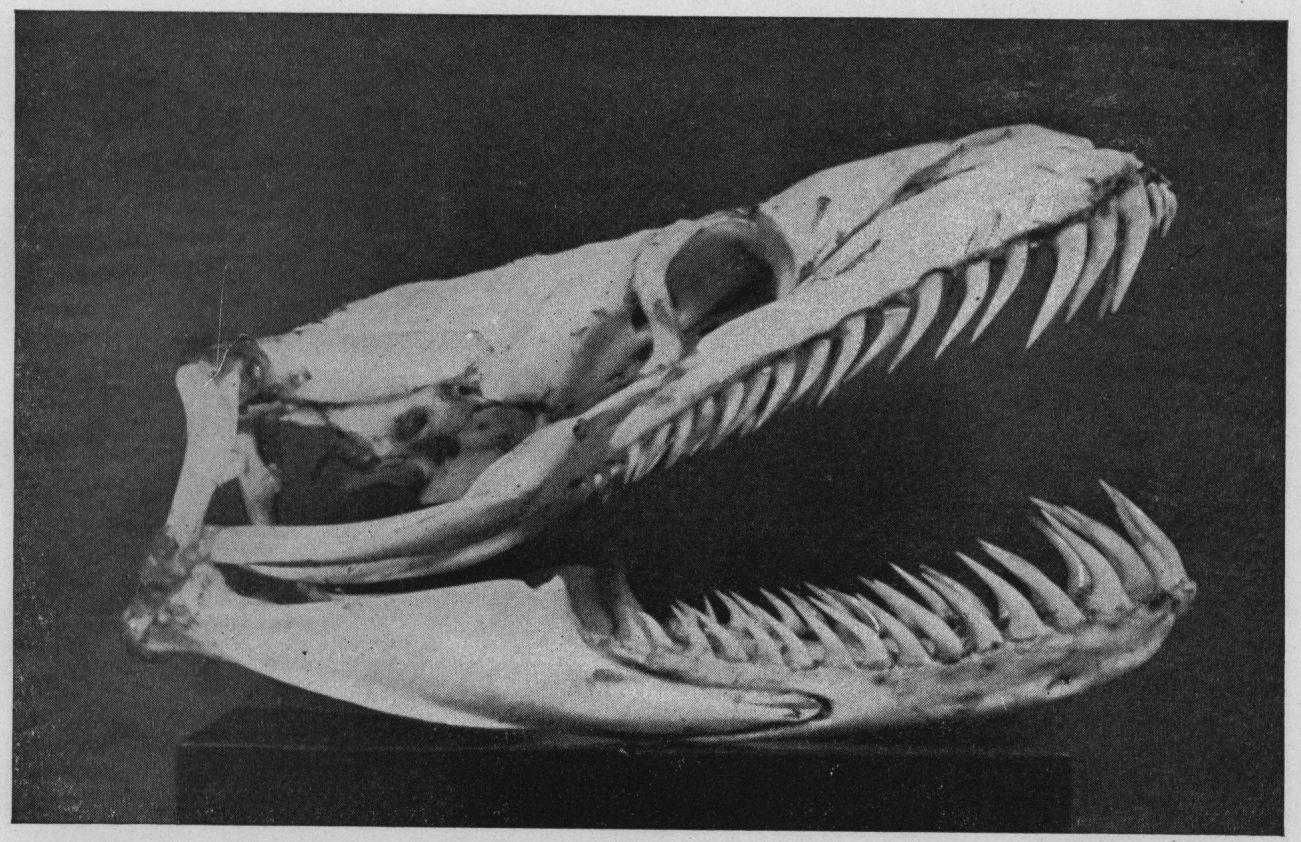
84. The Green Tree Boa *(Corallus caninus)* is a very striking snake. The body is markedly flattened laterally and adapted for life in trees. The colouring is a fresh green, with white (and often black) markings; the abdomen is yellow. This snake grows to over 6 feet and inhabits the tropical forests of S. America.



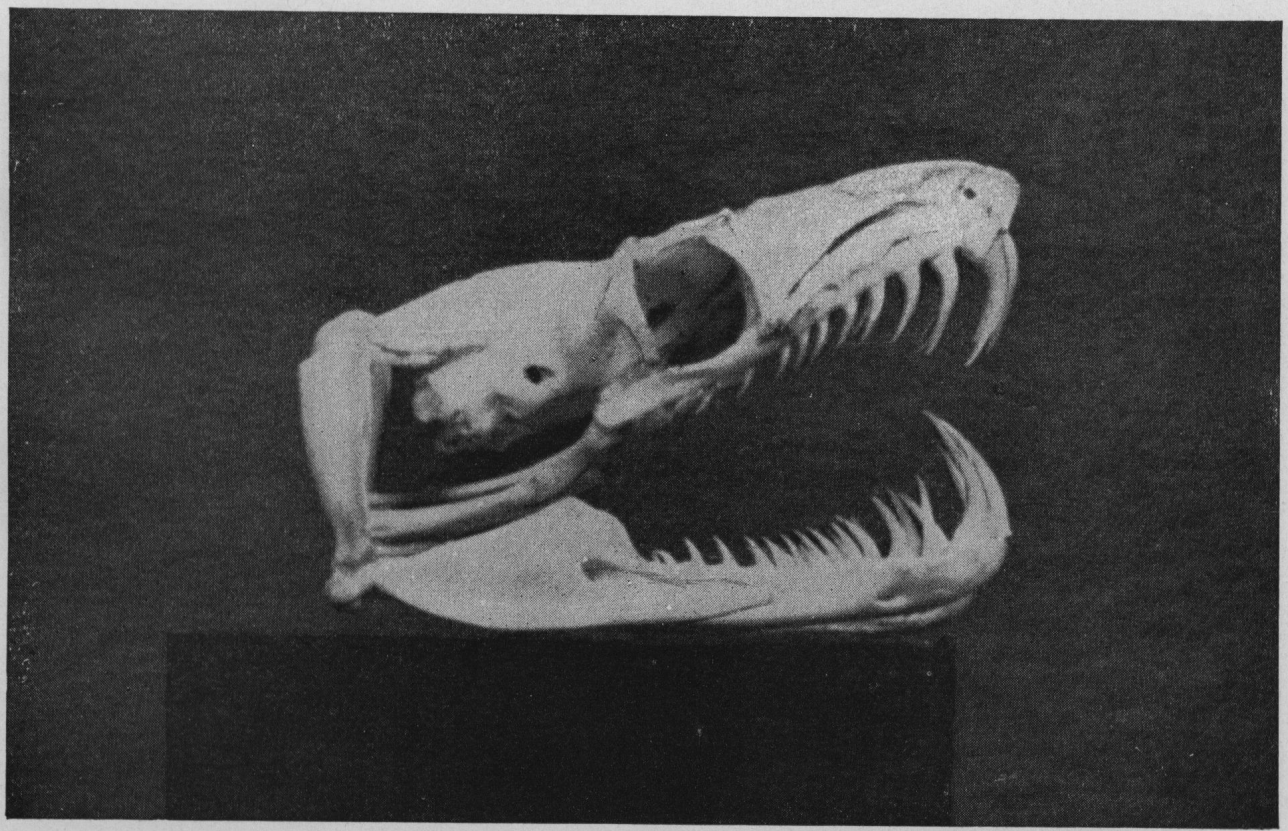
85. The Green Tree Boa appears to be very gentle, but it is always ready to bite fiercely as soon as its green eyes catch sight of an intruder.



86. All day the Green Tree Boa remains on a selected branch, but as soon as dusk falls it begins to glide about. It coils itself with wonderful adroitness over the branches, looking for a way out of the terrarium. It usually catches its prey, however, in the daytime.

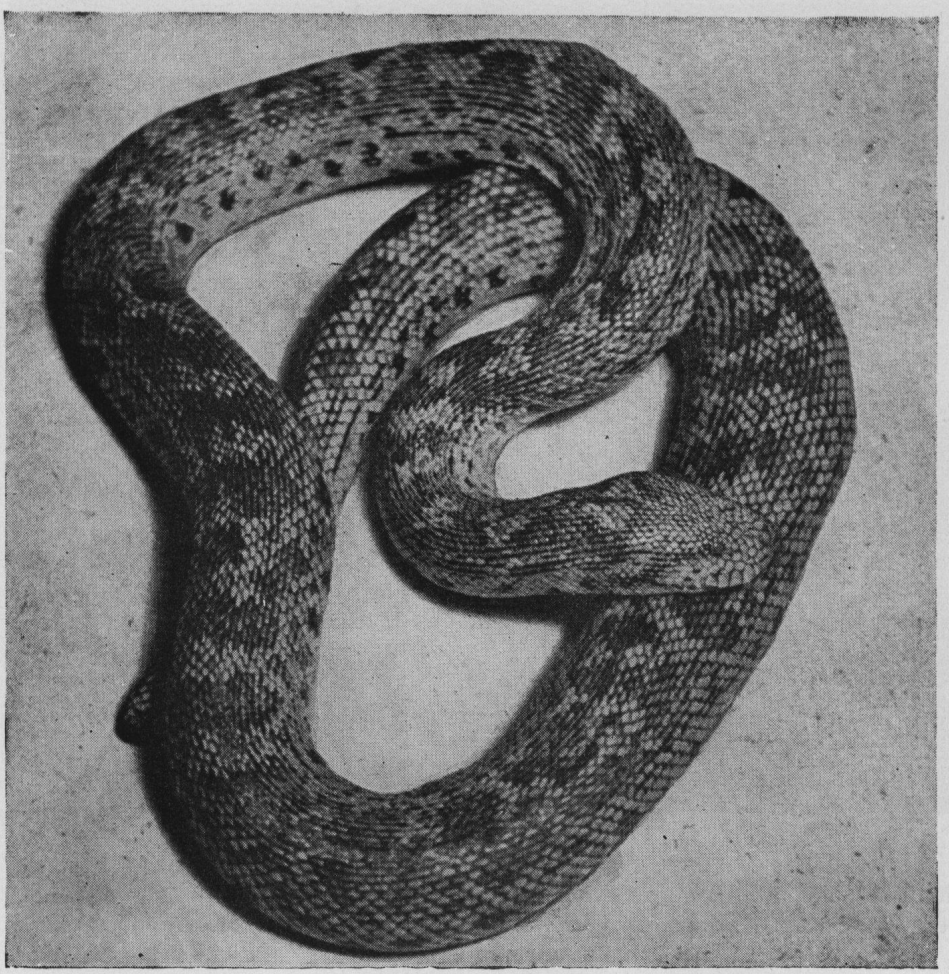


87. The skull of the Reticulated Python *(Python reticulatus)*. On and between the jaws there are many long, resilient, sharp teeth, whose bite is very painful and does not easily heal. This is the skull of a python which in life measured 14 feet. Actual size.

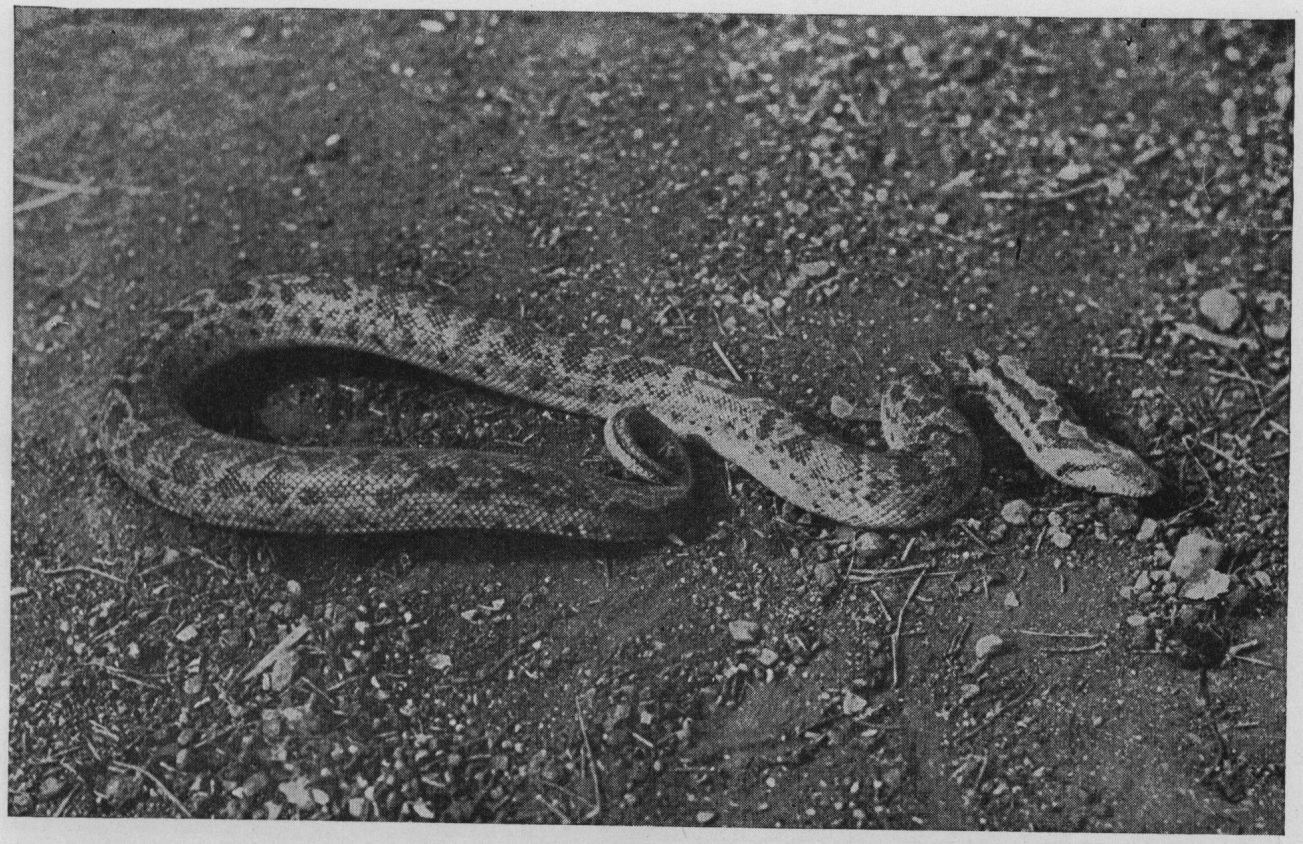


88. The skull of the Green Tree Boa *(Corallus cani ius)*; this specimen measured 6 feet. The front fangs in particular are markedly long and the skull is on the whole developmentally more advanced than that of the python. The bite of the Green Tree Boa is exceptionally painful and is therefore feared. Size: enlarged by about 1/4.

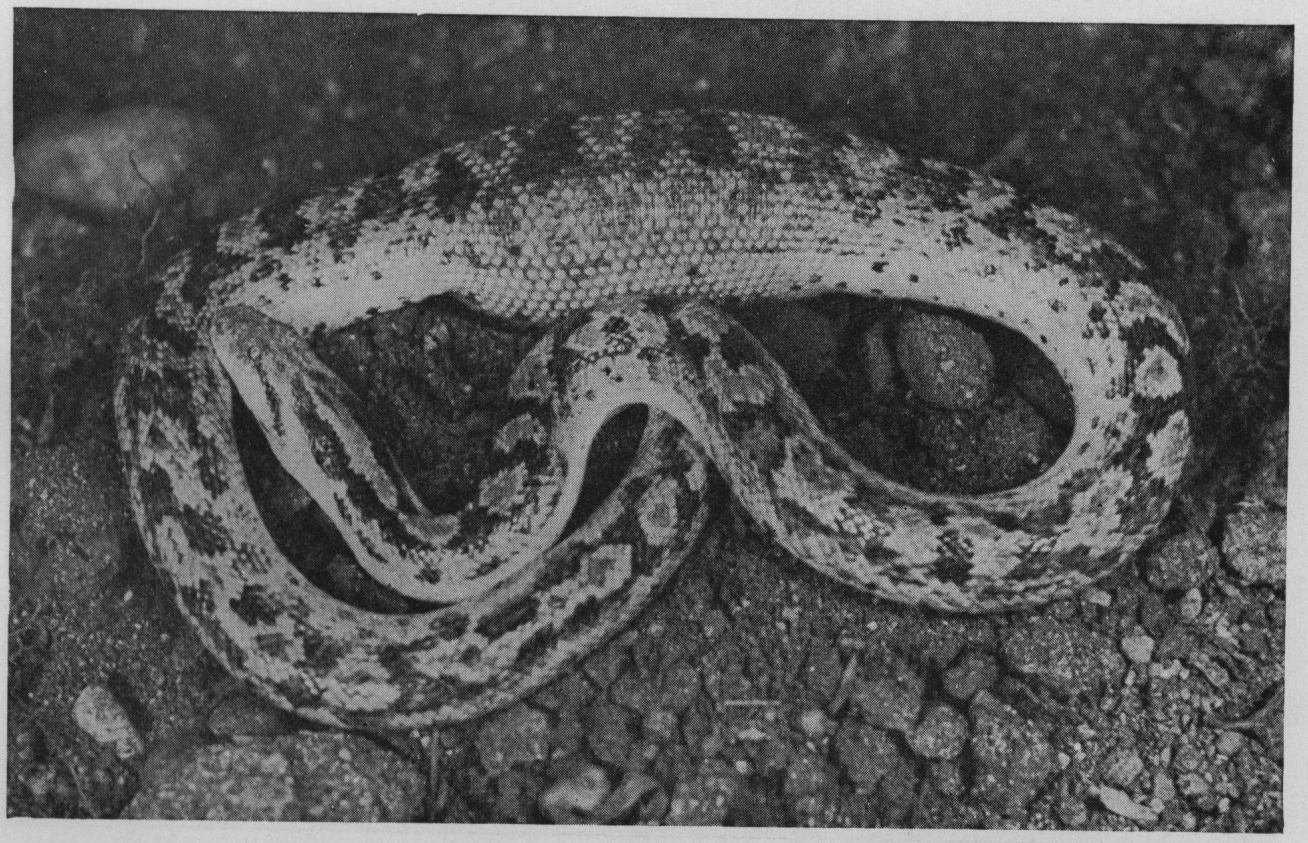
89. Spotted Sand Boa *(Eryx jaculus turcicus)*. This is a small boa, attaining only 24—32 inches, which inhabits sandy areas of the S. E. Balkans, N. Africa and the adjoining parts of Asia to beyond the Caspian Sea. It catches mice and lizards.



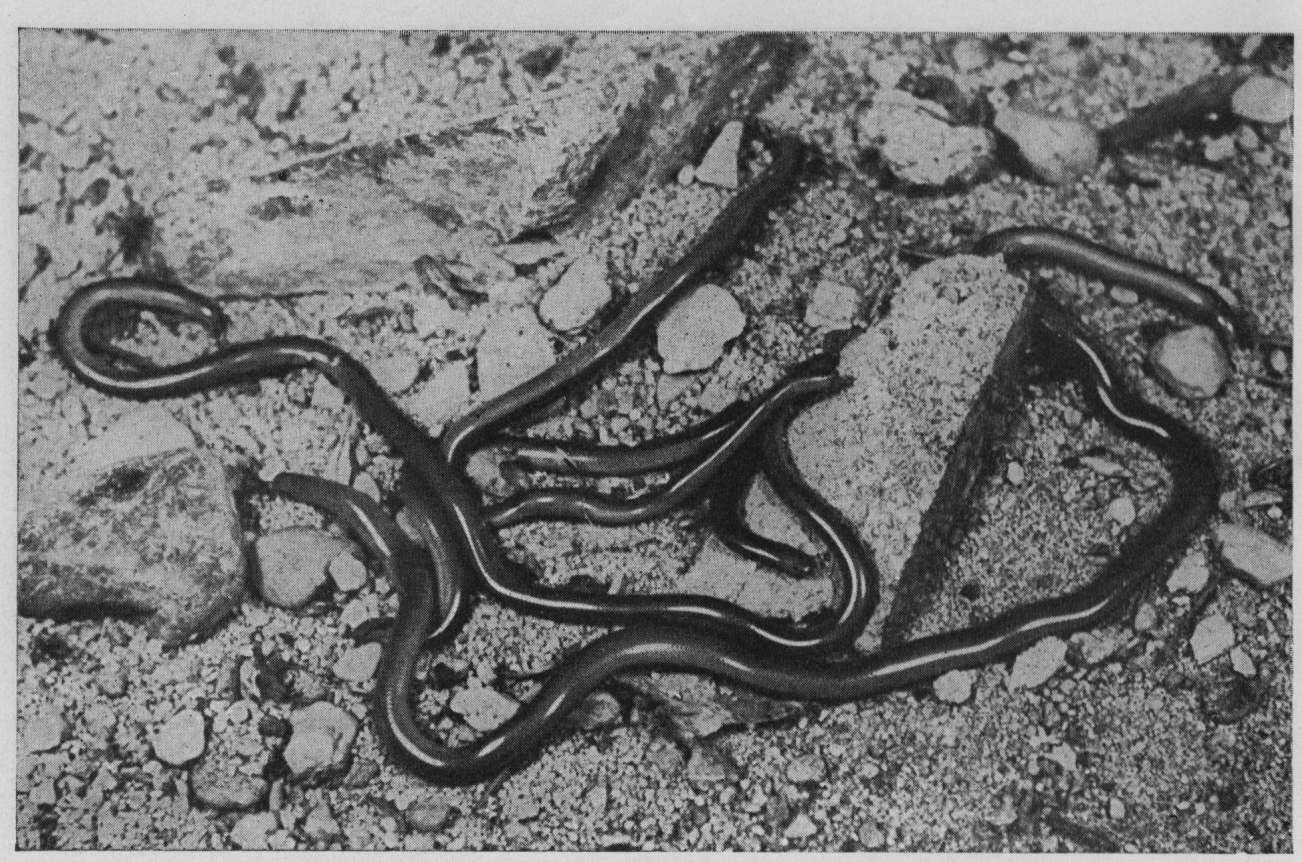
90. One of the largest Sand Boas is the Eastern Sand Boa *(Eryx tataricus tataricus)*, to be found in Tadzhikistan and Uzbekistan. It grows to over 3 feet. It lives more like the true boas, rather than in sandy areas.



91. The Desert Sand Boa *(Eryx miliaris)* from Central Asia is one of the smaller species; it is very adept at burrowing itself into the sand. The photograph shows a female, which is less strikingly coloured than the male.

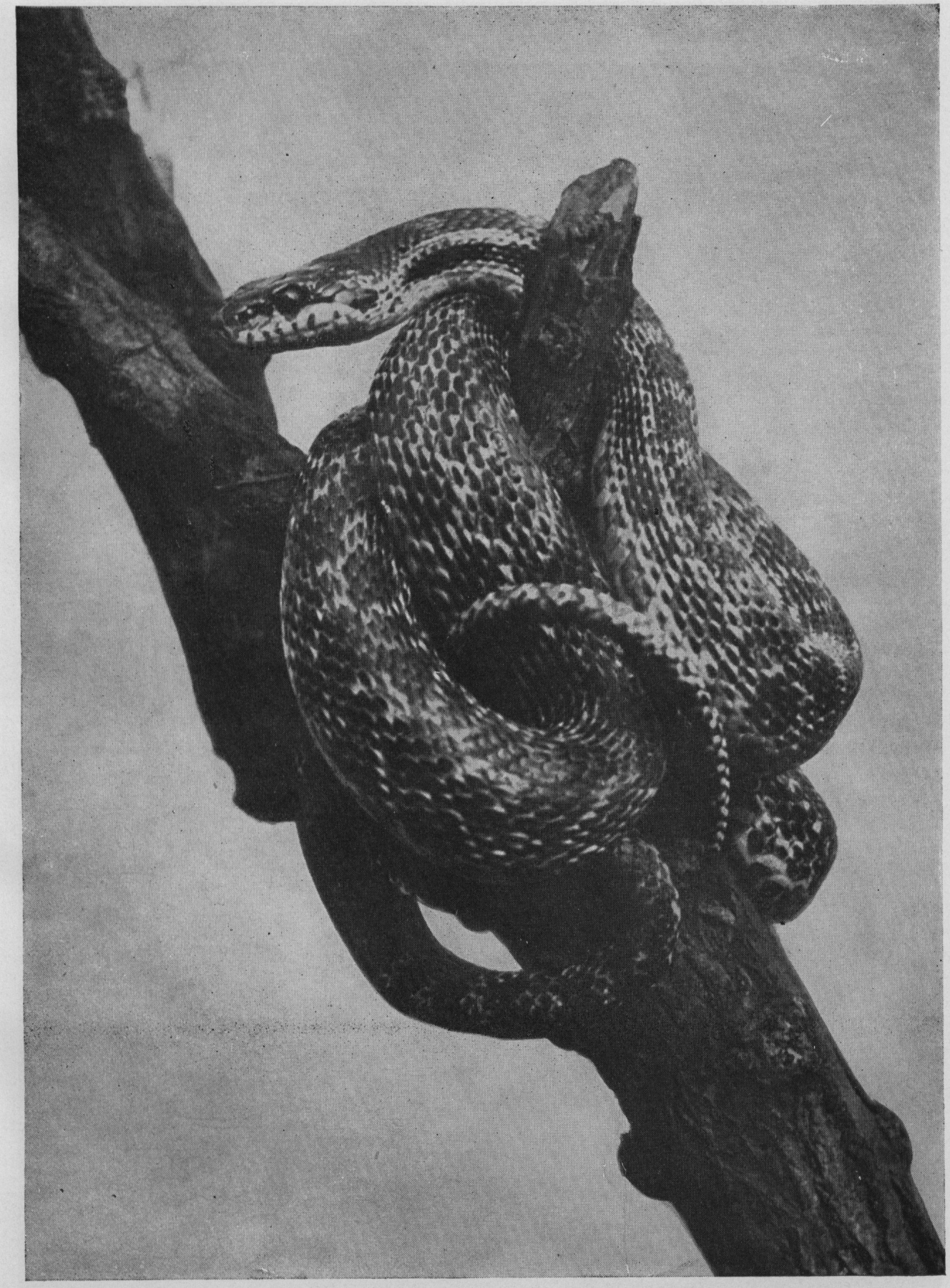


92. The male of the Desert Sand Boa has beautiful, irregular markings in the form of dark patches. The one shown here has just eaten a sparrow.

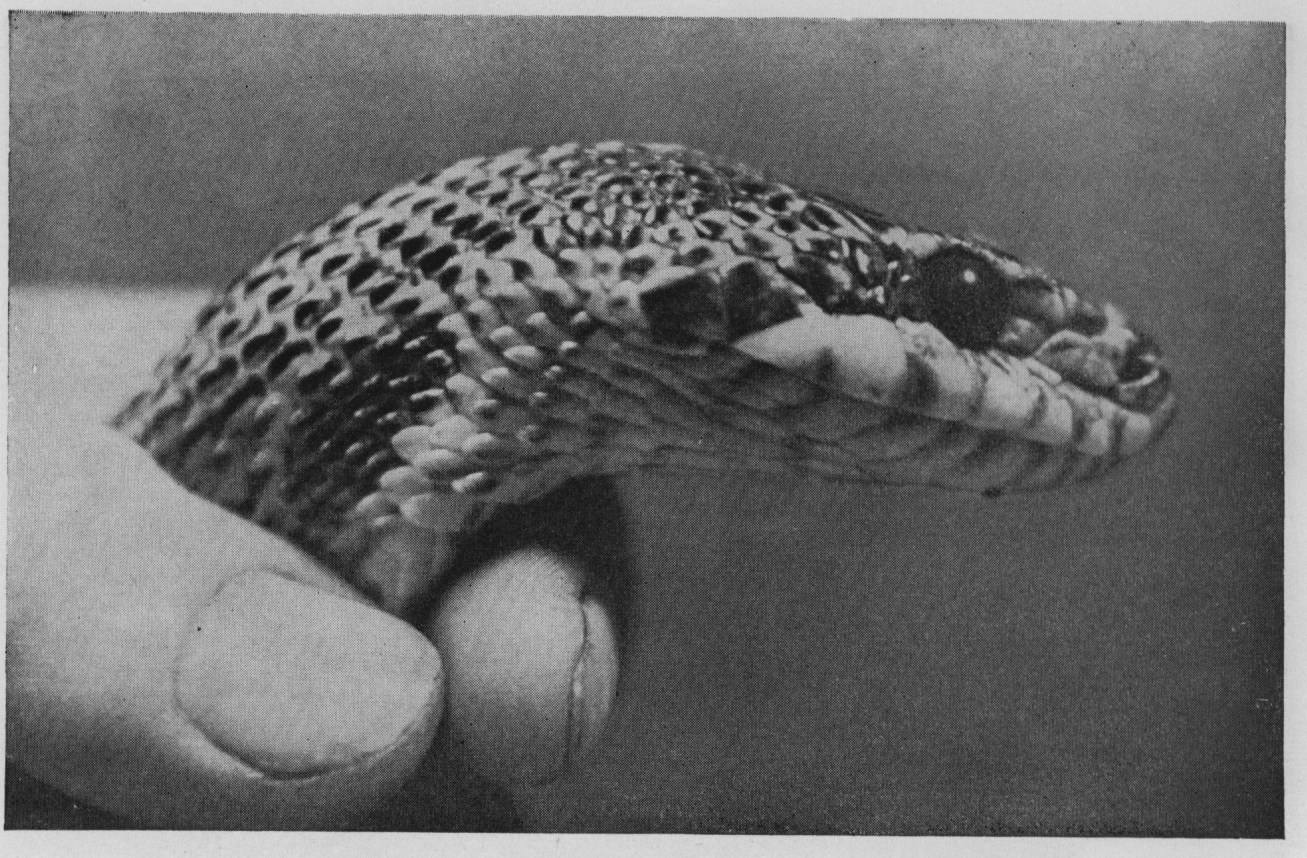


93. These small, pinkish brown, shining snakes, which so strongly resemble earthworms, are some of the strangest of the reptiles. They belong to the family of the *Typhlopidae* and to the species *Typhlops vermicularis.* They are almost blind and differentiate only light and darkness; they live hidden beneath stones and feed on ants' eggs.

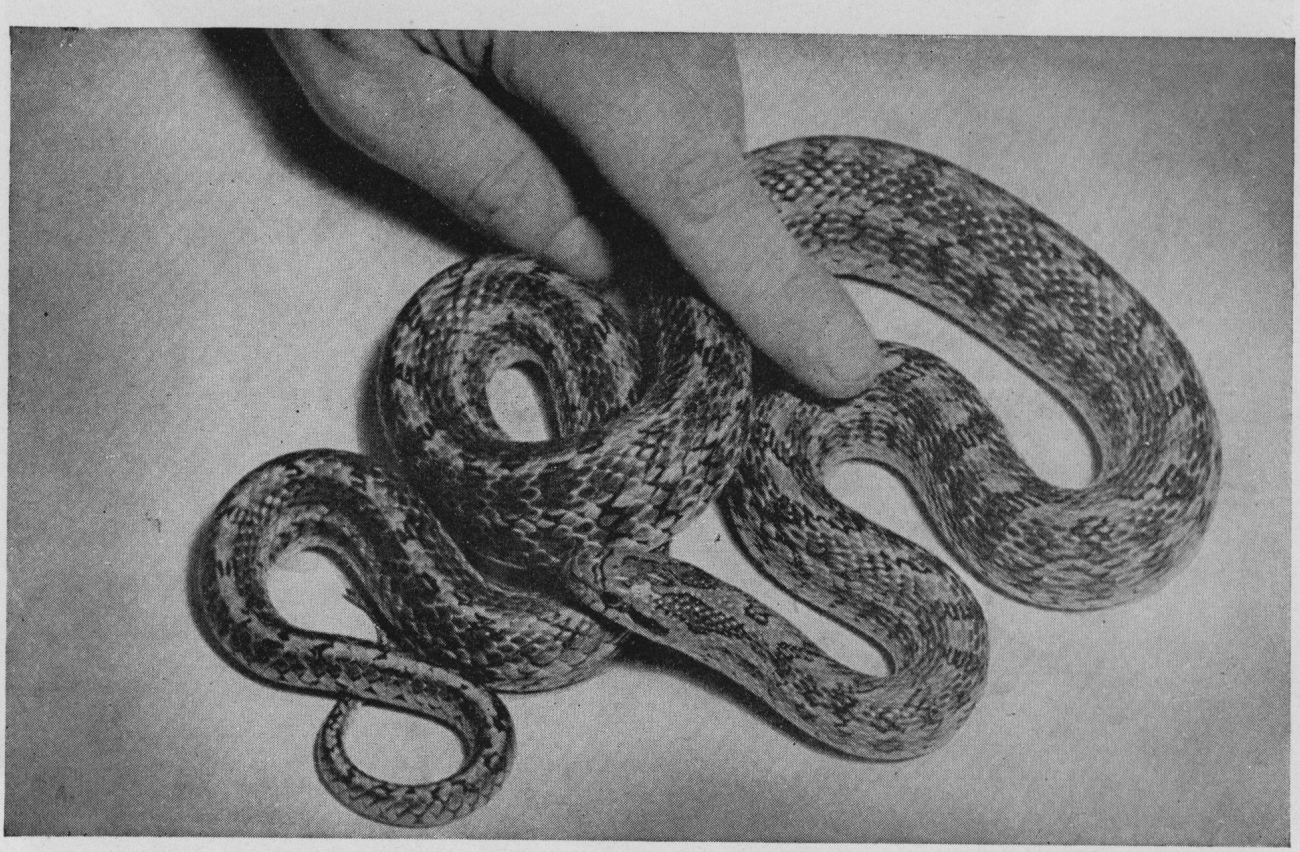
94. Rudimentary eyes, like two minute black dots, can be seen on the head of the *Typhlops.* The species *Typhlops vermicularis* is found from the Balkan Peninsula to Central Asia.



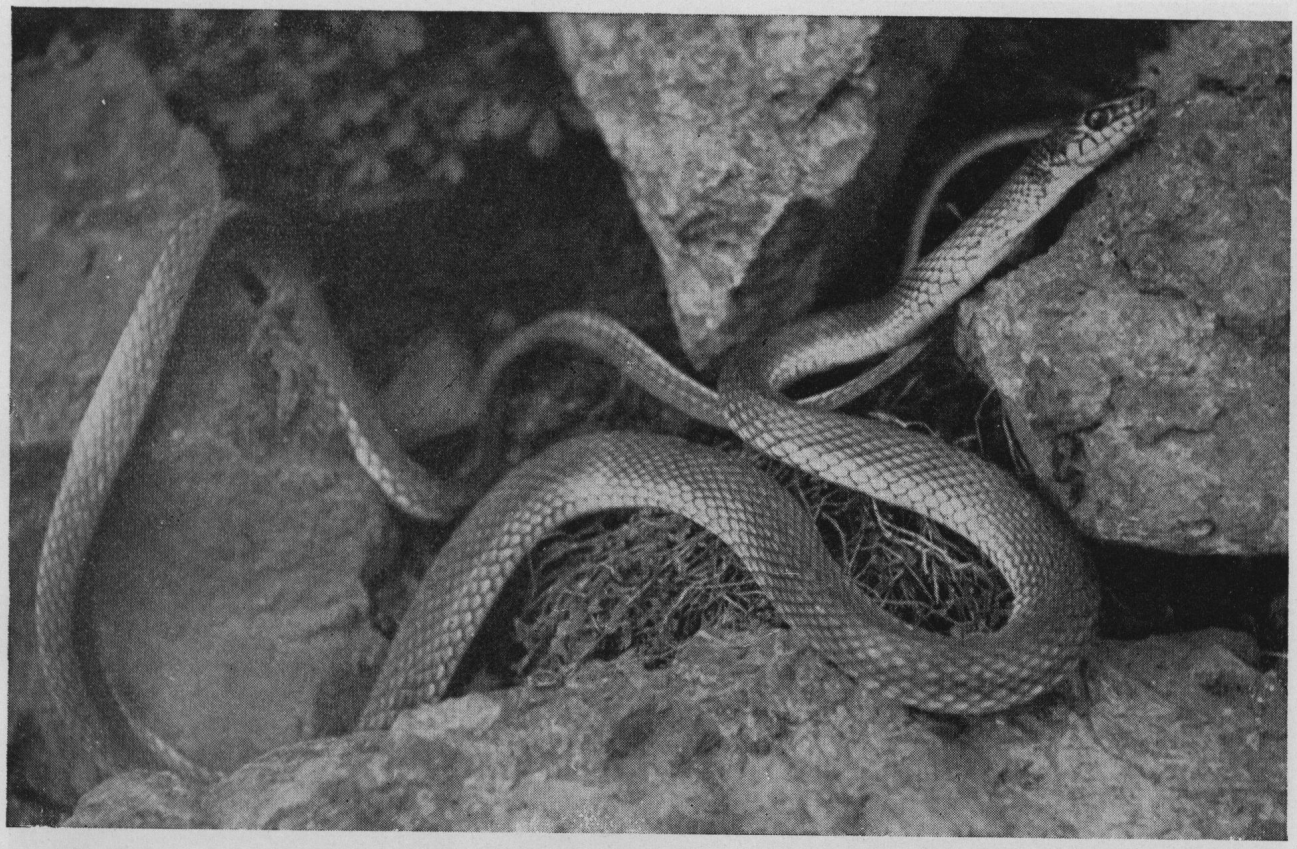
95. *Elaphe quatuorlineata sauromates* is a strong Colubrid snake with pleasant markings, which is found from the Balkan Peninsula across Turkey into N. Iran and also in the S. European part of Russia to beyond the Caucasus. It attains a length of 5 feet.



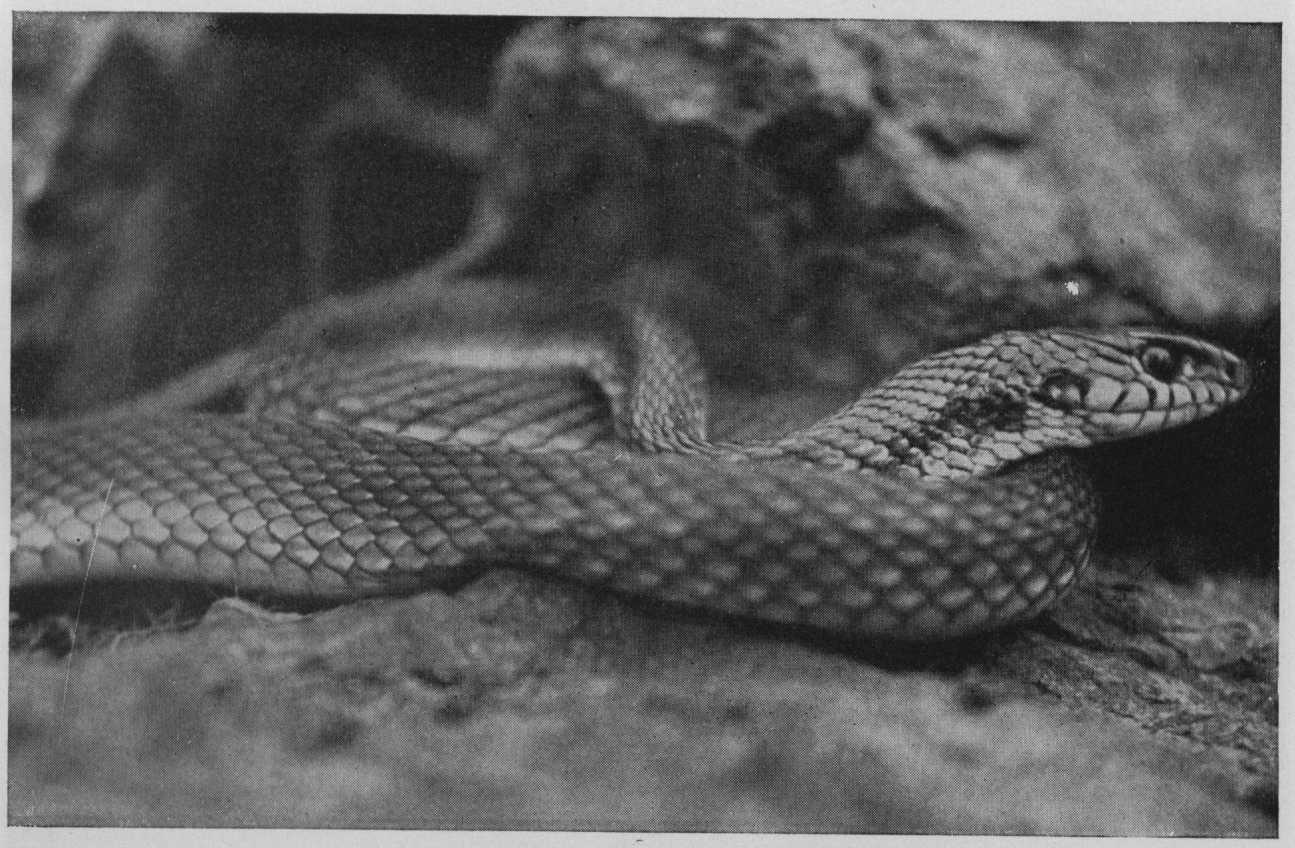
96. The head of *Elaphe quatuorlineata sauromates*. The markings are black on a yellow to orange base; the abdomen, throat and upper labial plates are yellowish. The eye is unusually large, with good vision.



97. We have several times received a large number of snakes of the species *Elaphe dione*, which are found as far afield as the Far East and China. They are pretty Colubrid snakes and very well suited for keeping in a terrarium. They grow to about 3 feet and live on lizards and mice.

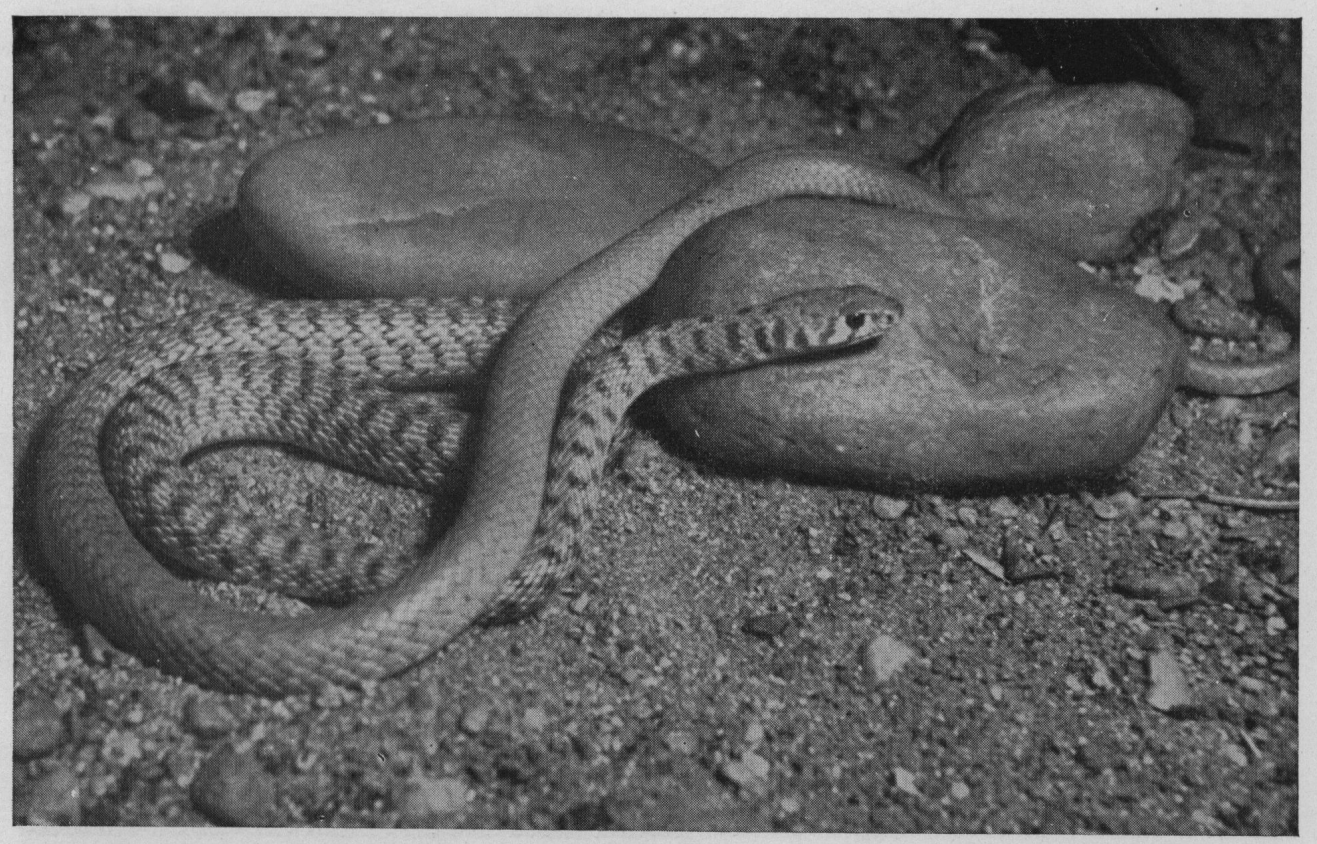


98. The Caspian Whip Snake *(Coluber jugularis caspius)* is often kept in zoological gardens and terraria. It sometimes grows to 8 feet, but is always very slender. It is found in Hungary, the Balkans, Turkey, Iran and the south of Russia to beyond the Caucasus.

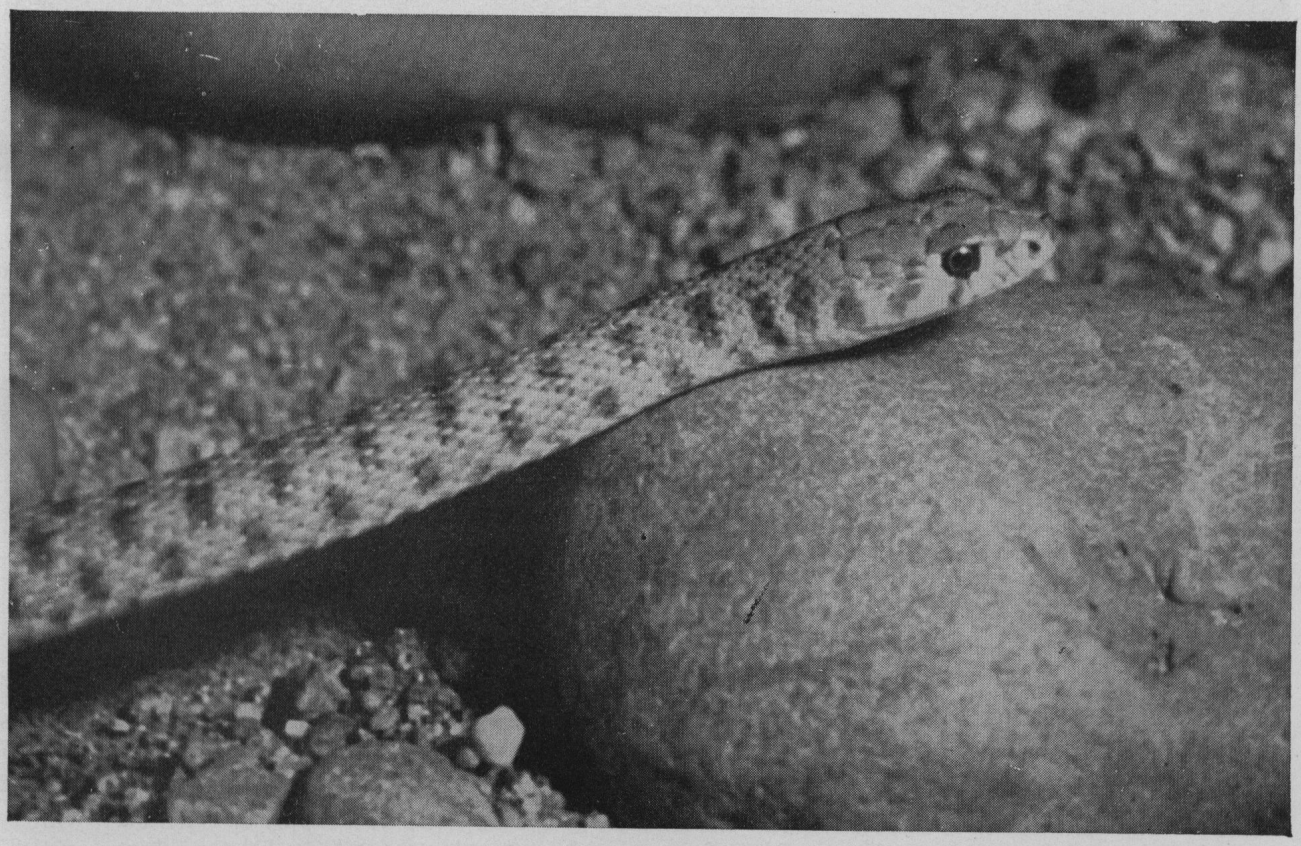


99. Viewed at close quarters, the Caspian Whip Snake is a pleasant-looking snake, with plain, brownish-yellow colouring. When disturbed it can escape very swiftly, but when in a tight corner it can attack just as swiftly, biting violently. Its bite, however, is harmless.

100. *Coluber rhodorhachis rhodorhachis* is a pretty snake from the group of the racers, which is distributed over a wide area; they are found in Egypt, Syria and Arabia, as far as the Himalayas and Turkmenistan. It is light grey-brown and attains about 3 feet in length. It has a brick-red band the length of the spine.



101. The racer *Coluber rhodorhachis ladacensis*, from Turkmenistan. It has a pleasant appearance, is very agile and is a useful acquisition for any terrarium.



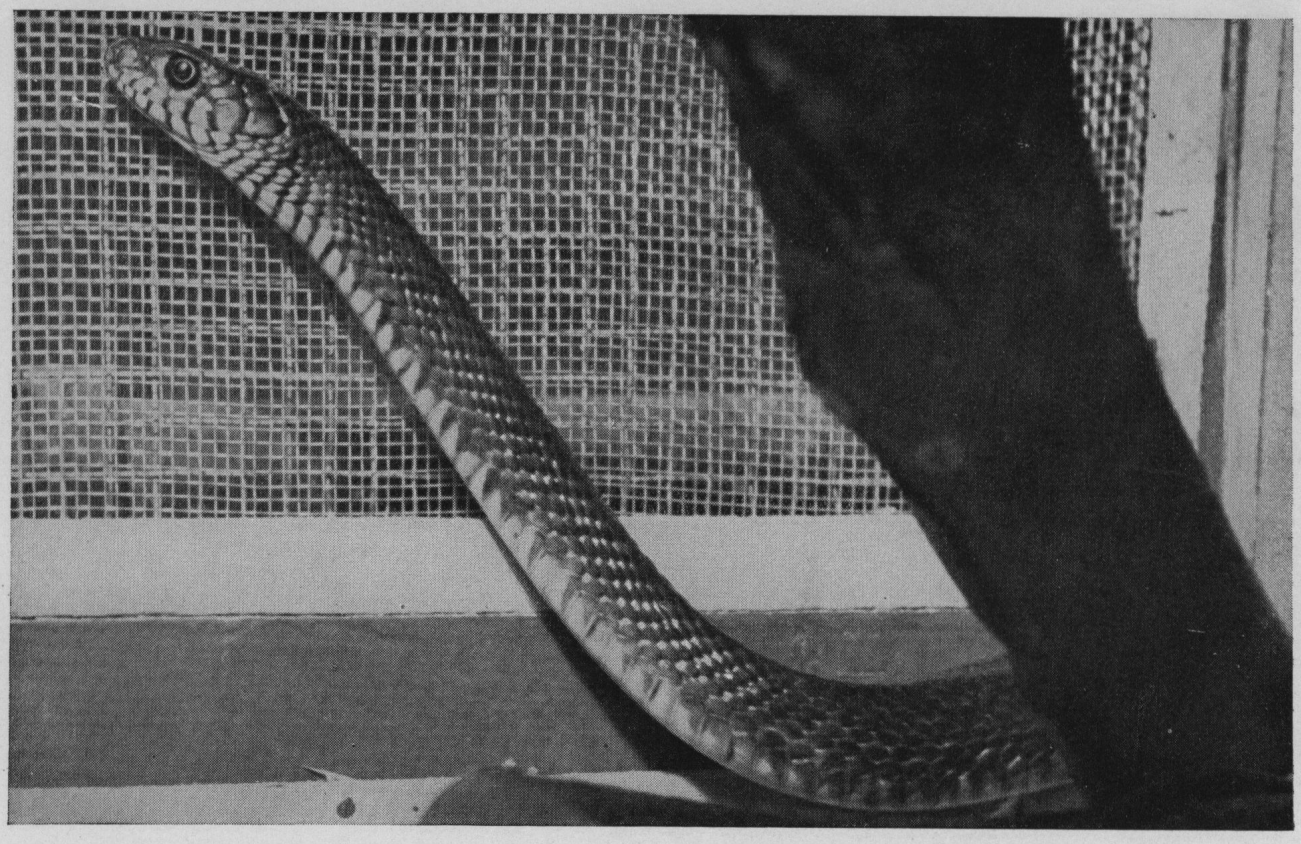
102. The head of *Coluber rhodorhachis ladacensis*. The forehead is oblique. This snake mainly catches lizards, which it seizes on the run, as it can attain considerable speed for short distances.

103. *Coluber karelini.* A lithe and nimble racer from Central Asia. Note the wedge-shaped, pointed snout. This snake is brownish grey with black cross-bands and grows to only 32 inches. It also inhabits Iran, Beluchistan and Afghanistan. It lives on lizards.

104. The large decorative snakes include the Diadem Snake *(Spalerosophis schiraziana),* which is also a native of Central Asia. It is a yellow-brown colour, tinged with pink, and the markings on the back and sides are brown. The plates between the eyes form a shining band. The snake measures up to 6 feet and feeds on lizards, smal birds and mice.

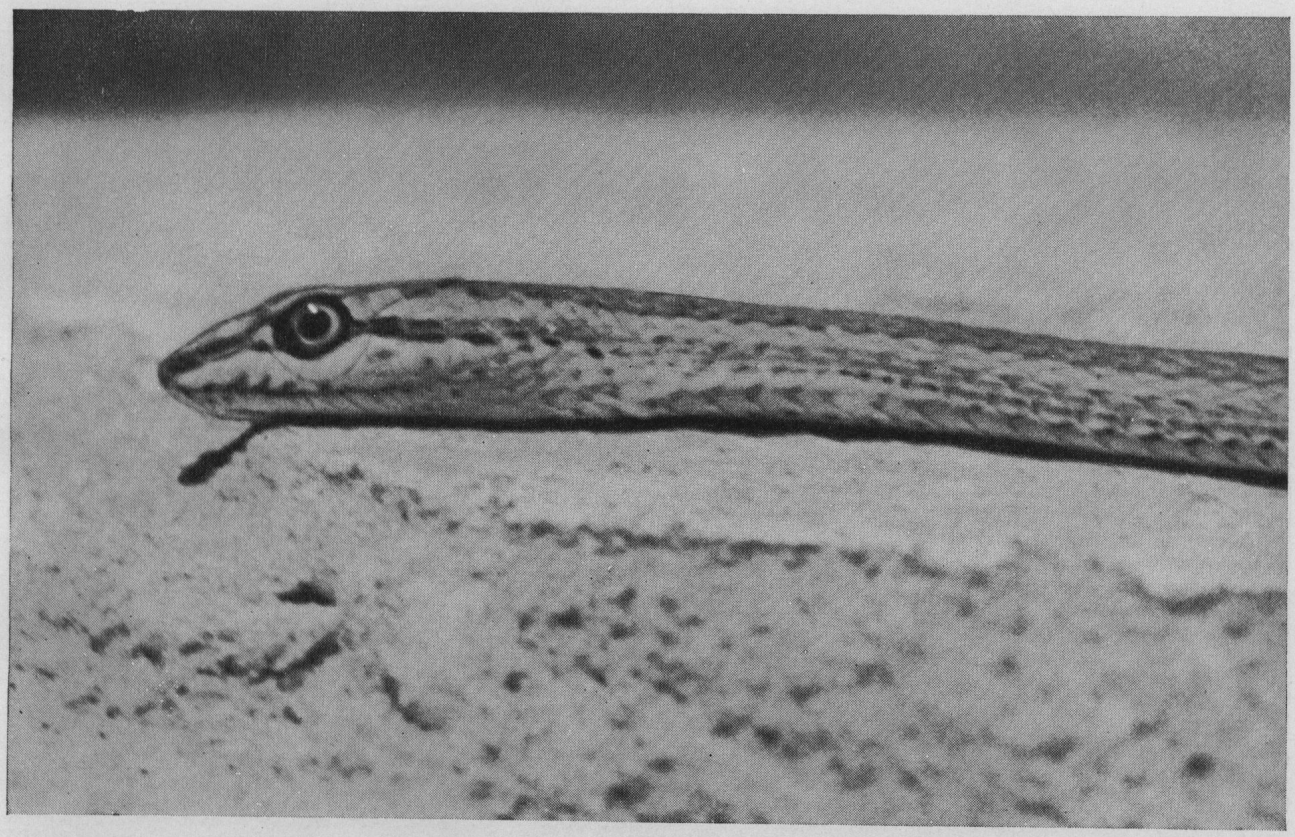
105. The Algerian Racer *(Coluber algirus)* is light greyish yellow or yellow-brown, with dark cross-bands. The head is bluish grey on top. This snake inhabits Algeria and Tunisia and measures about 3 feet.

106. This picture was taken at the moment when an Algerian Racer had caught a vole which had been thrown to it. It holds its prey firmly by the head, entwining it only loosely with one coil. The racers are not usually able to coil themselves round their prey so well as snakes of the genus *Elaphe* and others.

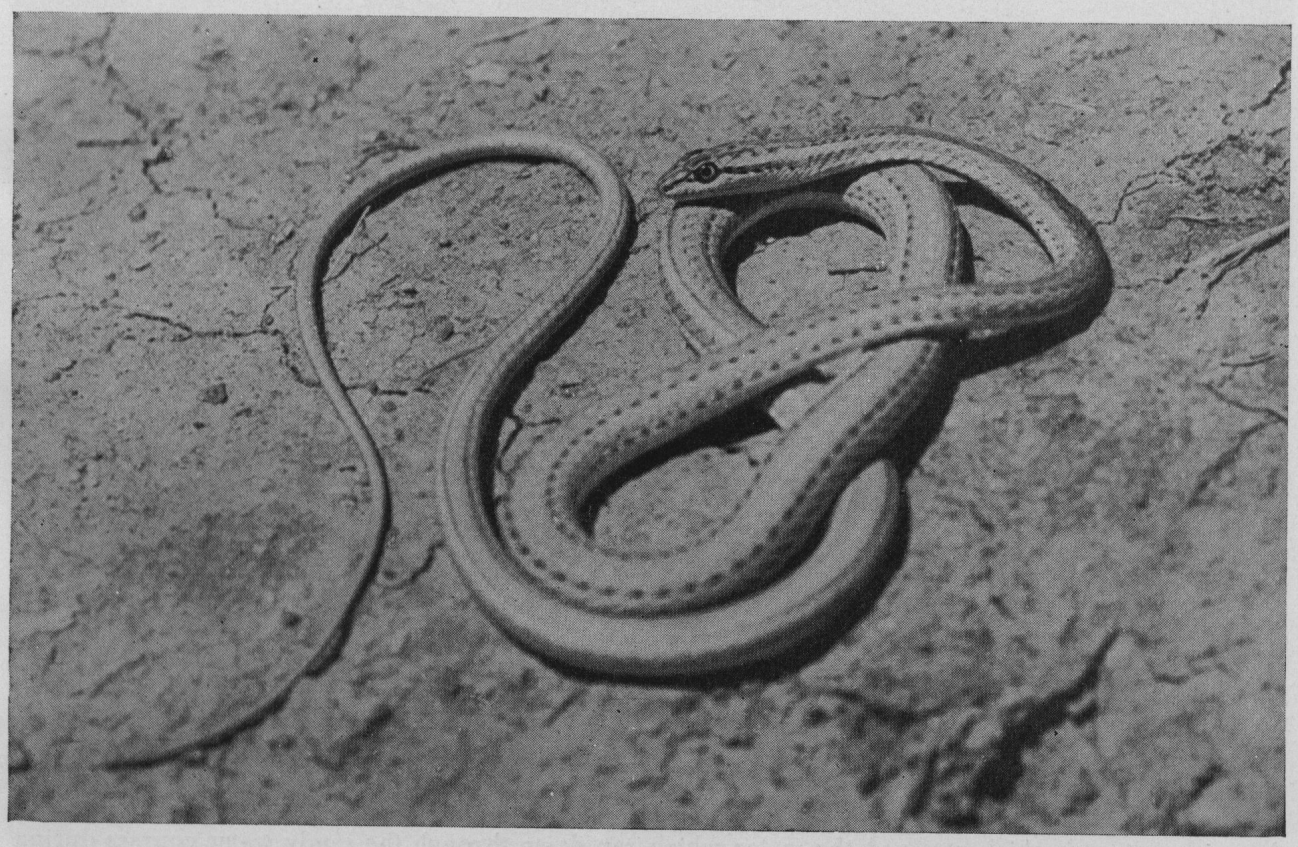


107. *Ptyas mucosus* is the largest non-venomous Colubrid snake; it attains a length of 14 feet. The average length, however, is from 7—10 feet. In appearance it somewhat resembles the Caspian Whip Snake, but is much more powerful. It is usually a glossy chestnut brown, but is sometimes yellowish brown or entirely black. It catches toads and small rodents.

108. The black form of *Ptyas mucosus*. We obtained a large number of these snakes from Central Asia, but they are also found in Malaya and S. China.

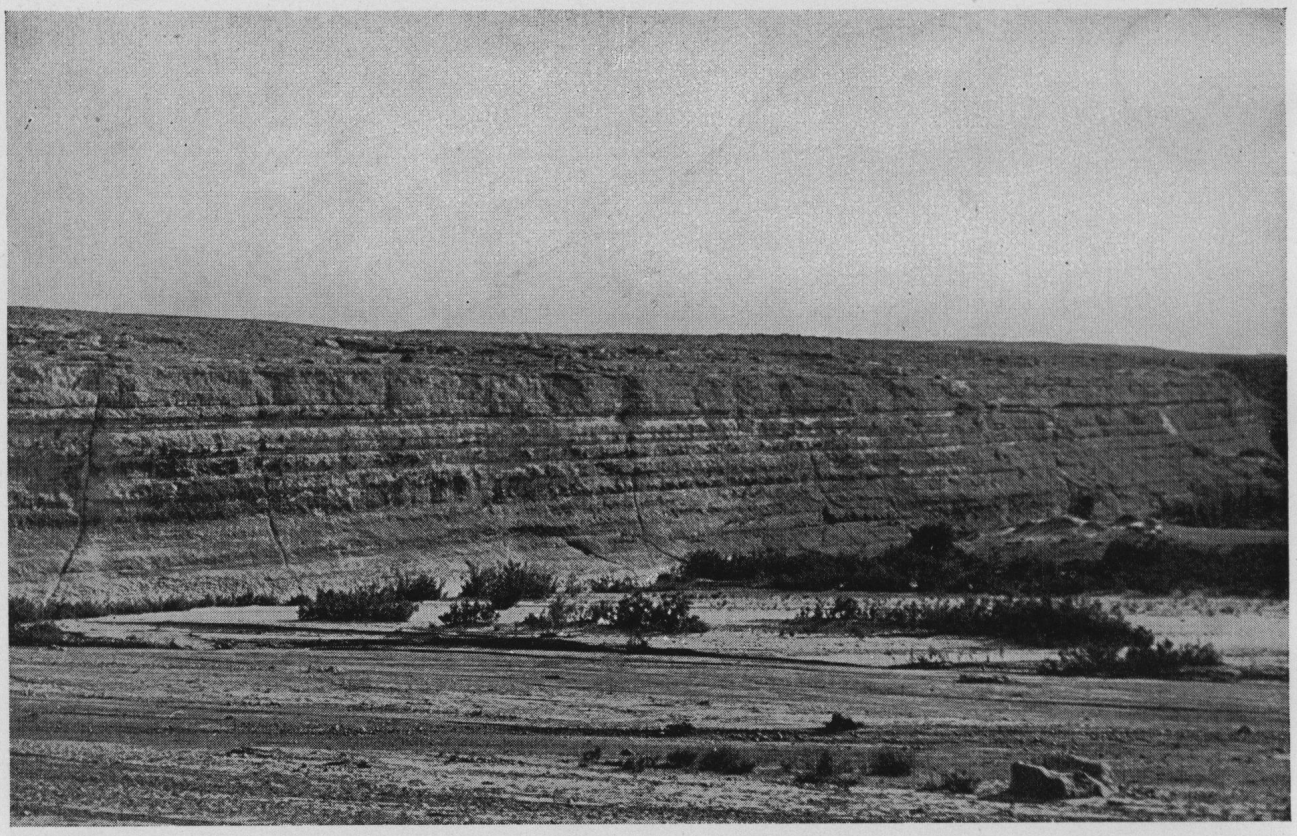


109. An unusually active snake, whose movements are, however, somewhat jerky, is *Psammophis schokari,* from N. Africa. It has grooved and enlarged rear fangs in the upper jaw. It catches lizards and coils itself round them, but at the same time bites them with its enlarged fangs.

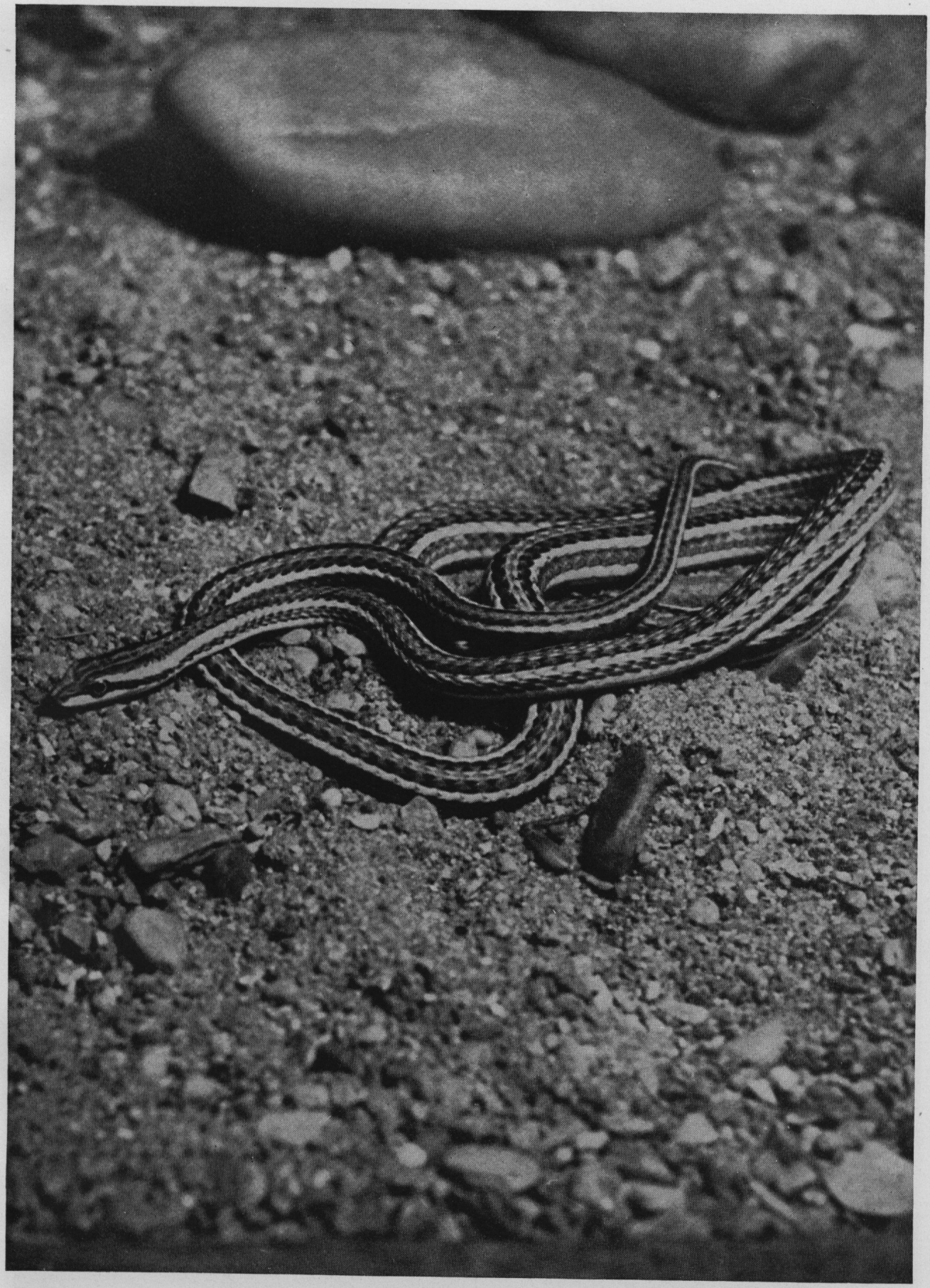


110. *Psammophis* is light grey or greyish brown and sometimes has longitudinal stripes. The large eye is particularly striking. It grows to a length of about 3 feet.

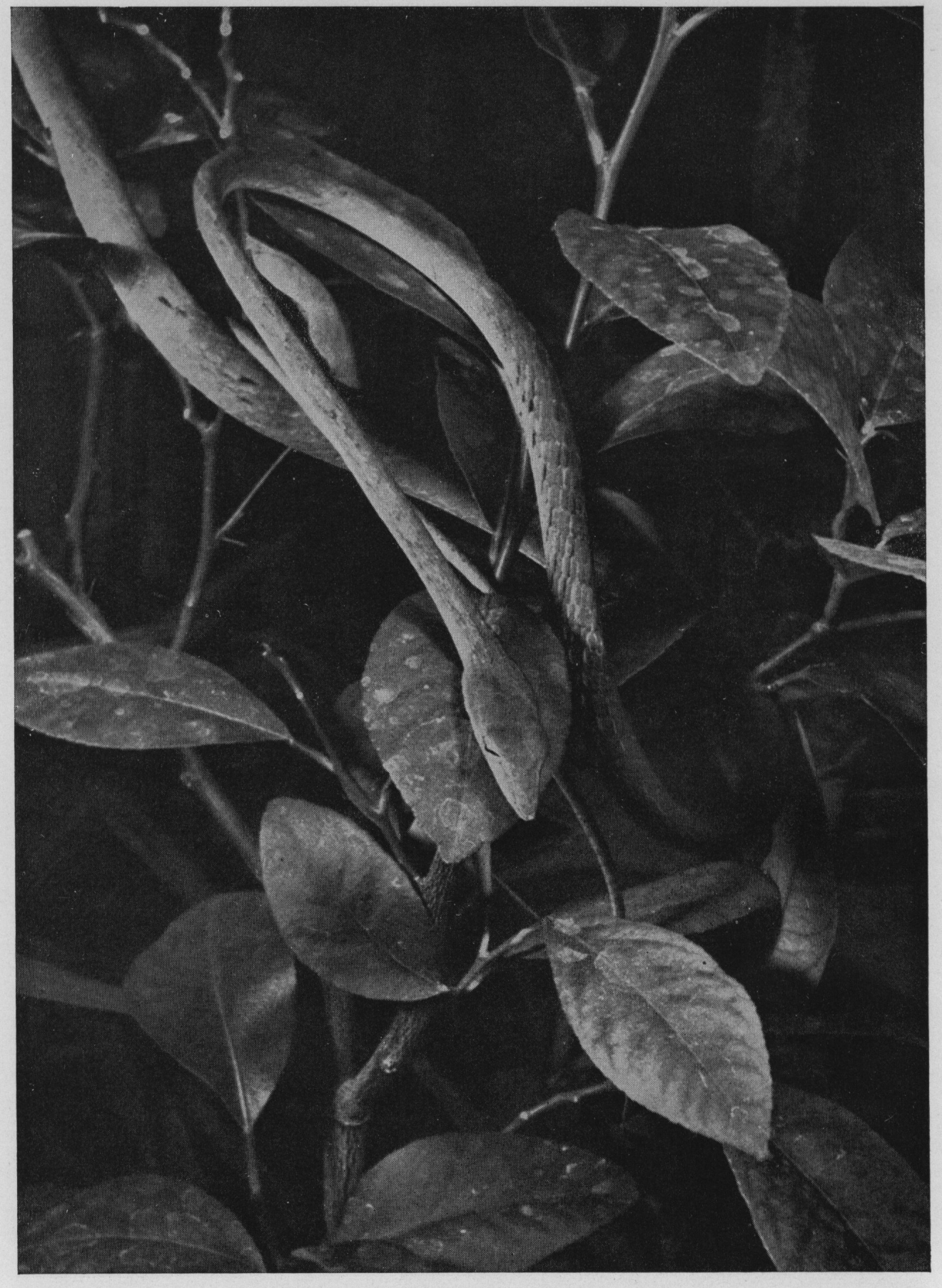
111. The typical habitat of the Algerian Racer *(Coluber algirus)*. It usually lies coiled up on stones or under stones. (S. Morocco.)



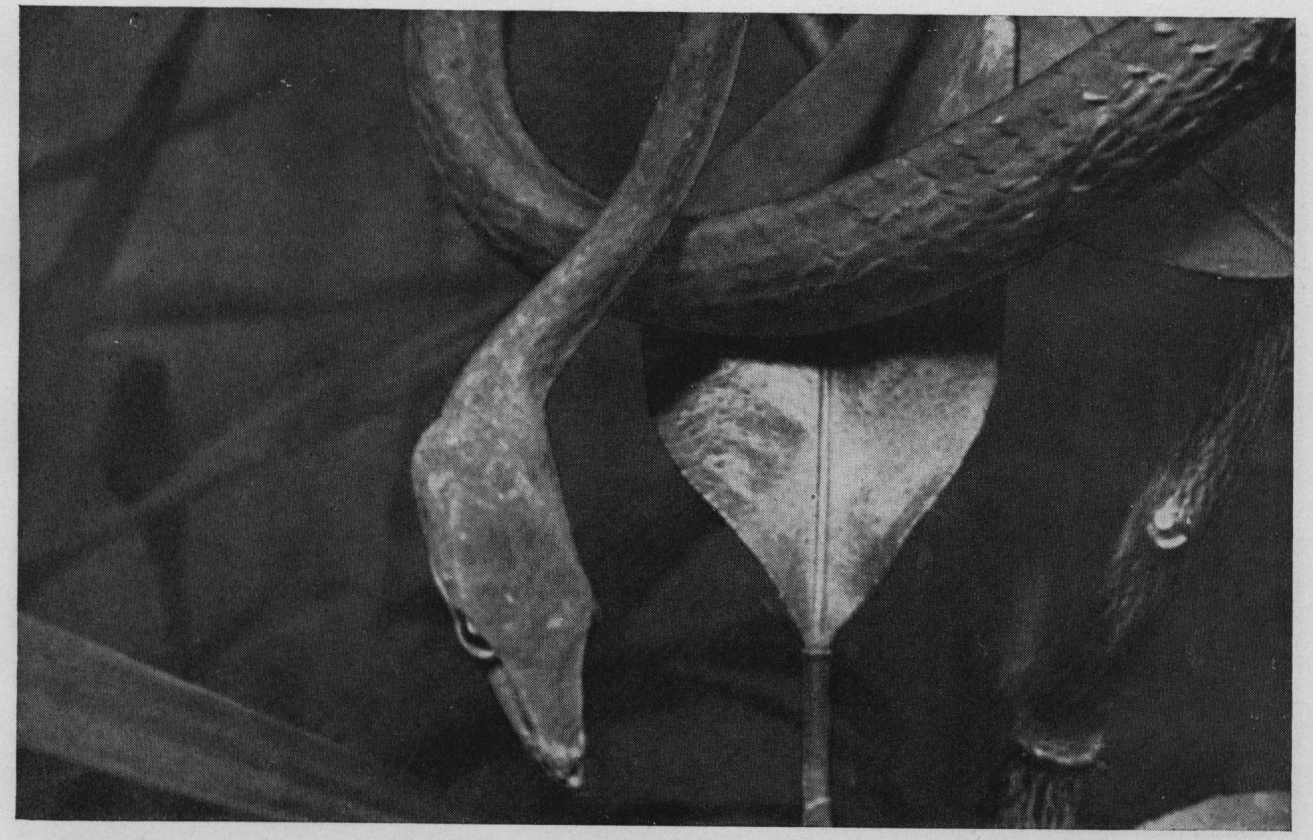
112. The type of country in which *Psammophis schokari* is most commonly found. In the foreground there is a swamp, which retained the water which ran down through the sandy water courses during the spring rains and will soon dry up again. In the background there is a massif of cliffs. (Neighbourhood of Gafsa.)



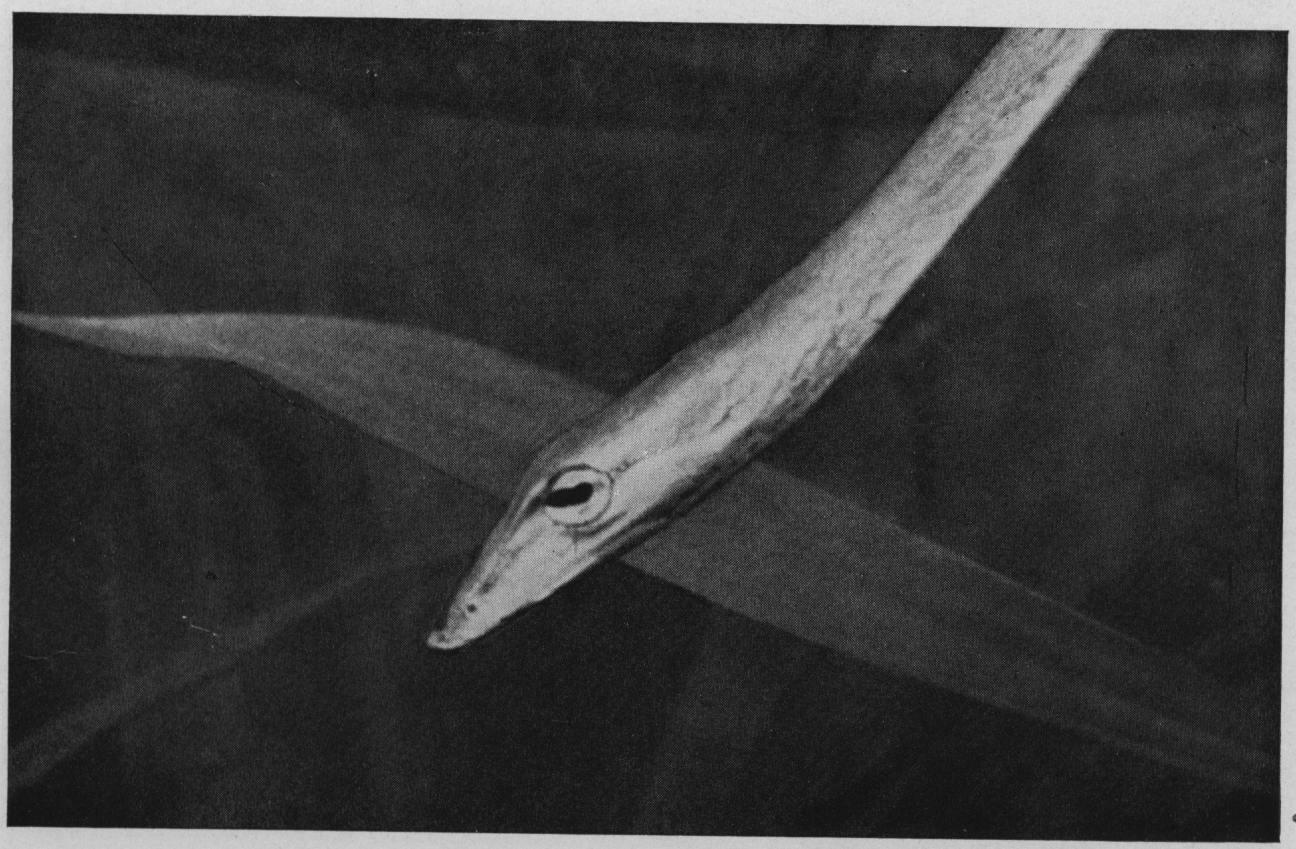
113. *Taphrometopon lineolatum* represents the genus Psammophis in Central Asia. It is less agile, but has more striking markings, with longitudinal lateral stripes with a golden sheen. Length about 3 feet.



114. The Long-nosed Tree Snake *(Ahaetulla mycterizans)* has indeed a most unusual appearance. Its long, bright green or blue-green body is no thicker in the middle than a goose-quill. It attains a length of 5 feet and is found in Ceylon, India, Malaya and Indo-China. It feeds on small birds and lizards.



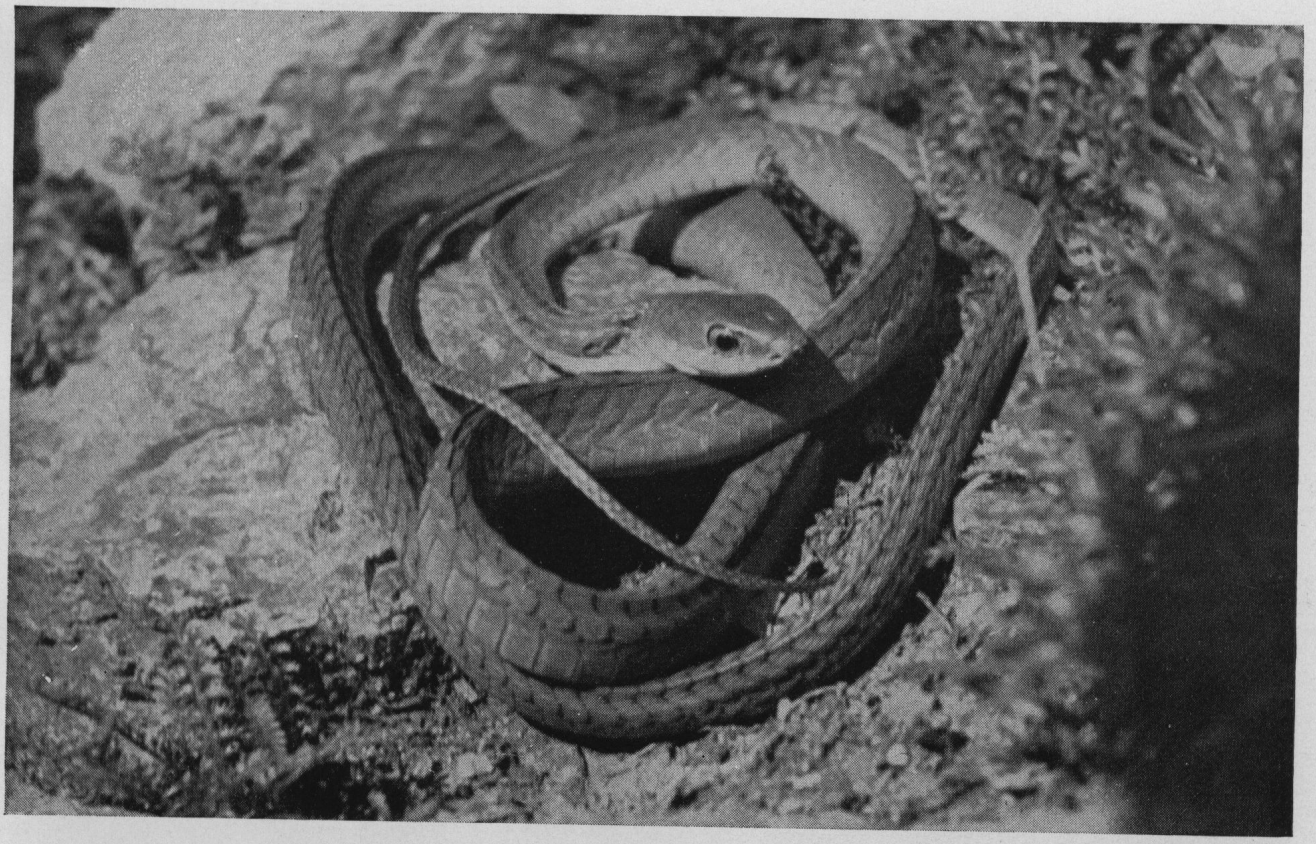
115. The Long-nosed Tree Snake has a small narrow snout. The head is broad as compared with the neck, indicating that in spite of its slenderness the snake can swallow fairly large prey.



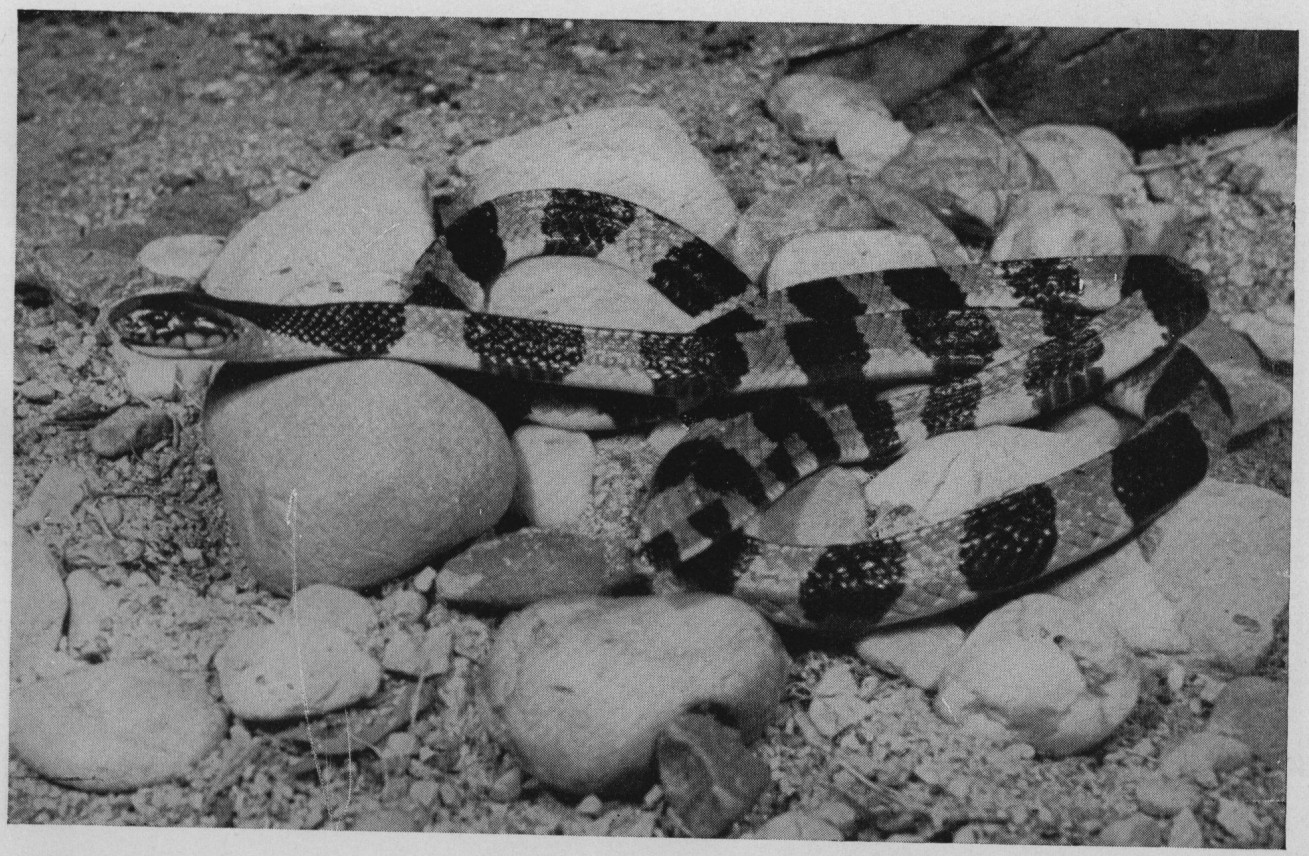
116. The Long-nosed Tree Snake has a remarkable eye. It is pale yellow, with a horizontal pupil which expands and contracts at will. This snake also has good protective colouring and even a practised eye can hardly see it among the dense tropical foliage.

117. The Mangrove Snake *(Boiga dendrophila)* is a big snake with splendid colouring. It inhabits tropical forests in Malaya, S. Indo-China and the East Indies, where it lives in the trees. Its back is a glossy ebony black, decorated with fiery yellow stripes. It measures up to 7 feet.

118. The Mangrove Snake rarely comes down to the ground. In captivity, however, it likes to make use of an occasional moment of partial freedom to bask in the sunshine. This snake catches birds, lizards and other species of snakes; it kills its prey with its fairly potent venom.

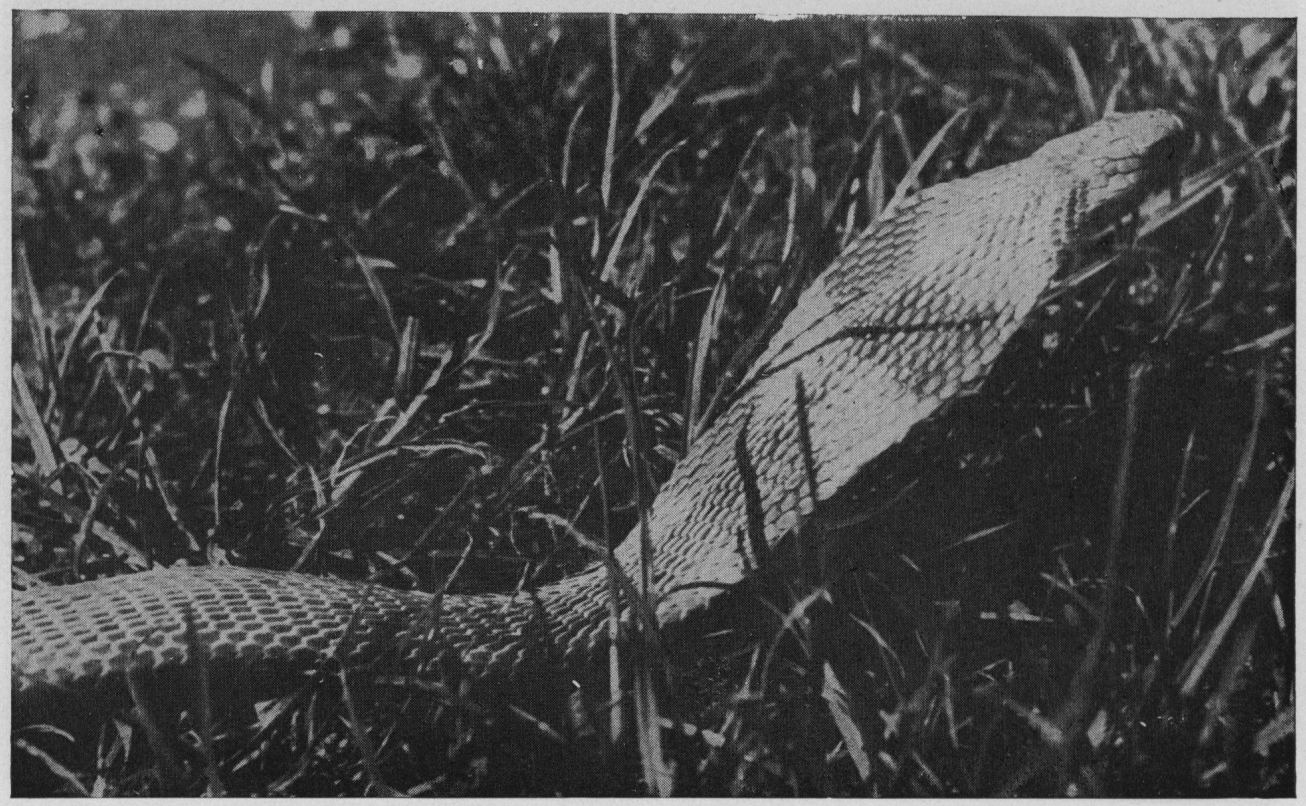


119. The only Colubrid snake with venomous rear fangs which has caused death in man is the Boomslang *(Dispholidus typus)*. It lives in the tropical regions of S. and S. W. Africa. It grows to about 5 feet in length and appears in several types of colouring. The snake in the picture is green.



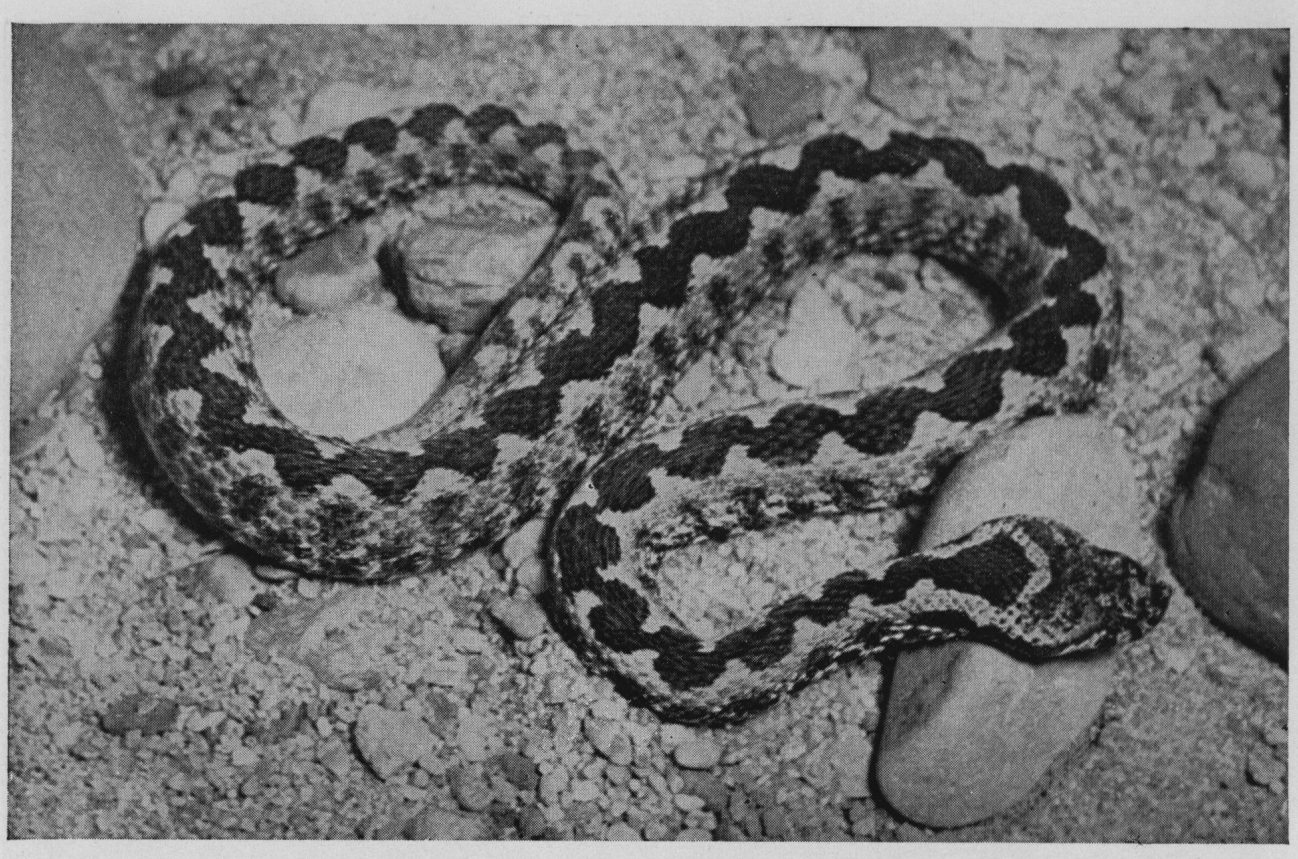
120. The Banded Krait *(Bungarus fasciatus)*, which comes from India, is one of the deadly venomous snakes of the family *Elapidae*. It grows to a length of over 5 feet and has striking colouring—bright yellow and glossy black. It feeds on lizards and snakes.

121. This snake, which has reared itself into the characteristic defence position, is the Central Asian Cobra *(Naja naja oxiana)*. It differs from the Indian subspecies by the absence of the spectacle markings on the hood; it is plainly coloured in one colour, yellowish grey.



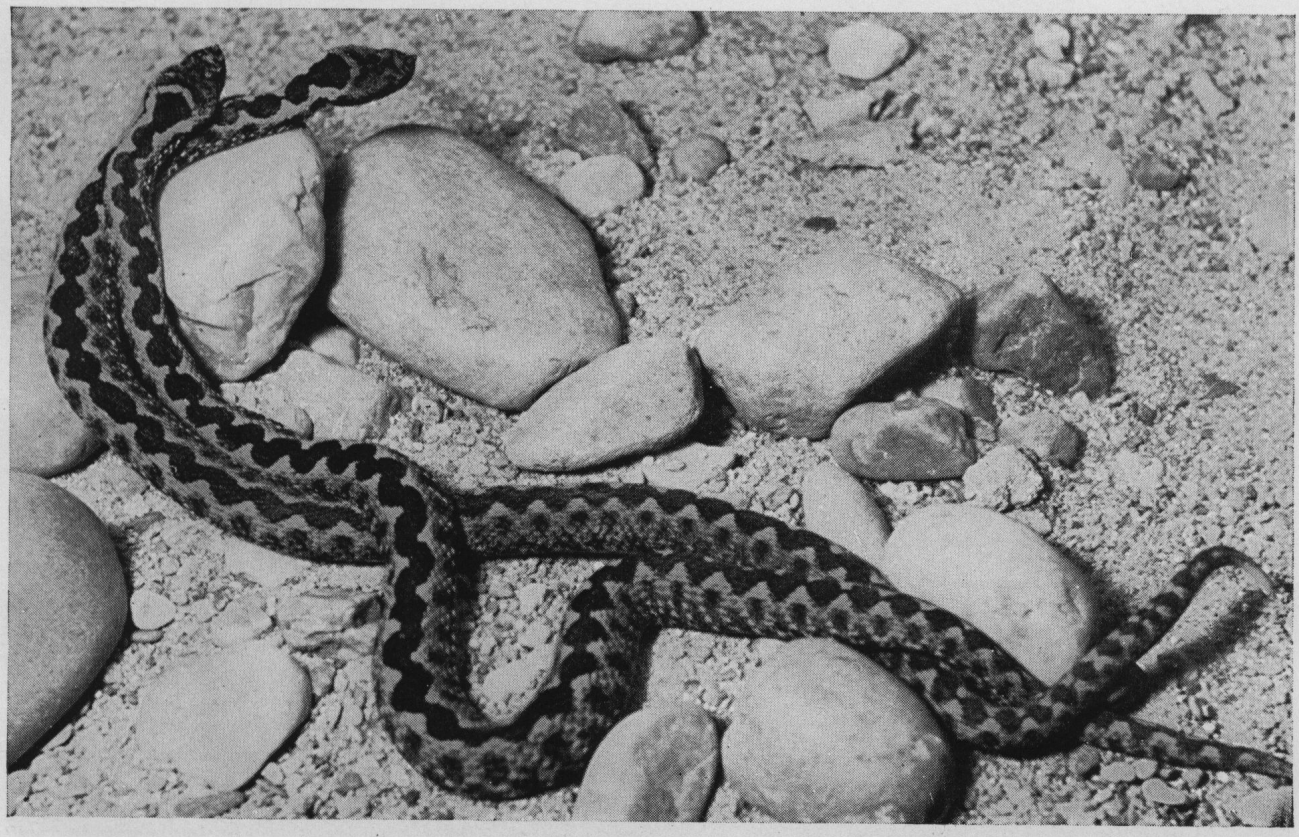
122. The cobra sees that the danger is past and gradually sinks to the ground. At the same time its expanded neck returns to its normal proportions. Cobra venom is very potent. The cobra catches rodents, birds, lizards and snakes.

123. The Nose-horned Viper *(Vipera ammodytes ammodytes)* is a handsome but dangerous snake, inhabiting S. E. Europe. Adult snakes of this species can measure about 3 feet. The colouring is quite varied. The males attain greater size than the females. This snake catches mice, lizards and small birds.



124. *Vipera ammodytes montandoni* is one of the subspecies of the Nose-horned Viper, which occurs particularly in Bulgaria. It has more conspicuous markings than the typical snake and the horn on the point of its nose is erect.

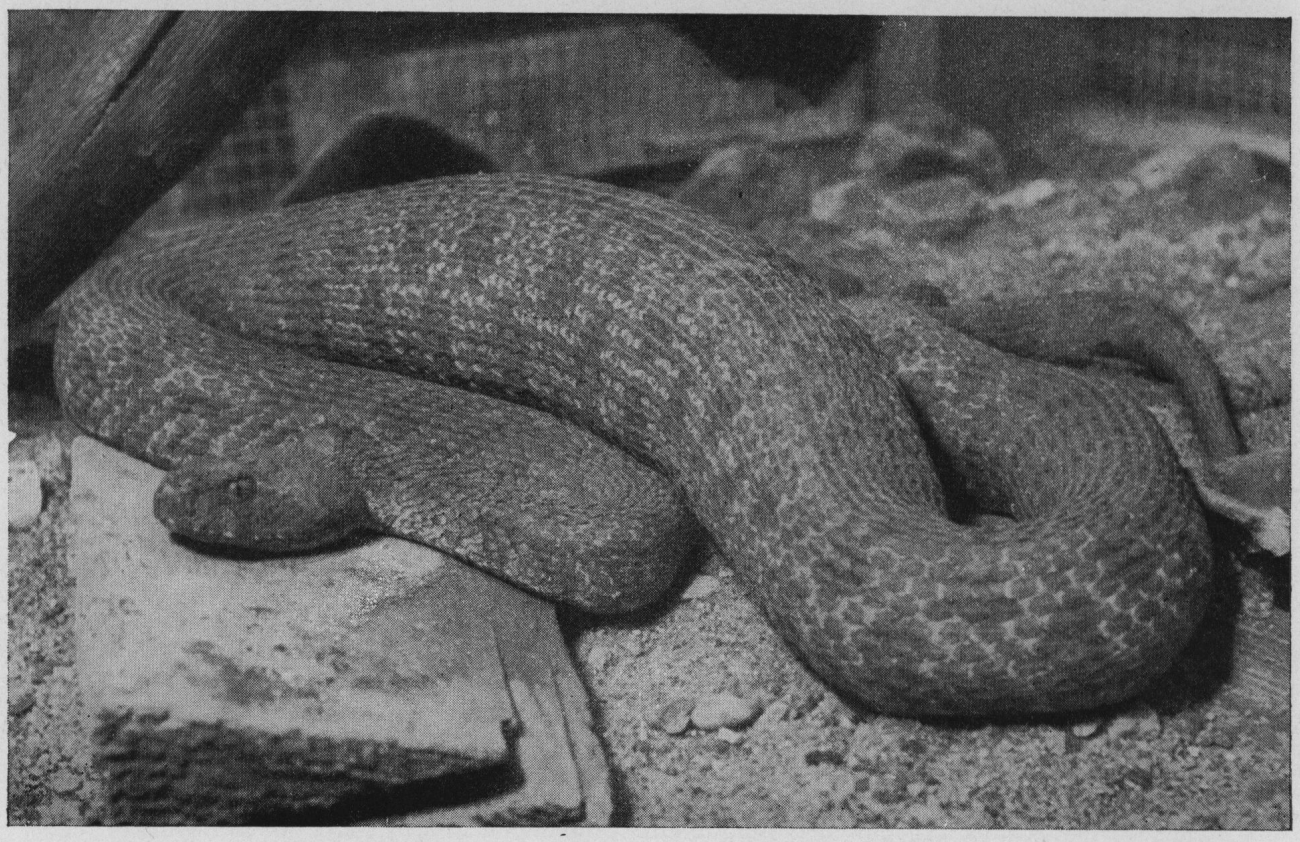
125. The head of the viper *Vipera ammodytes montandoni*. The appearance of Viperine Snakes and Pit Vipers differs considerably from that of Colubrid snakes. Nose-horned Vipers do very well in the terrarium and can live to a good old age. Note the horn on the point of the nose, distinguishing this snake from the Common Viper.



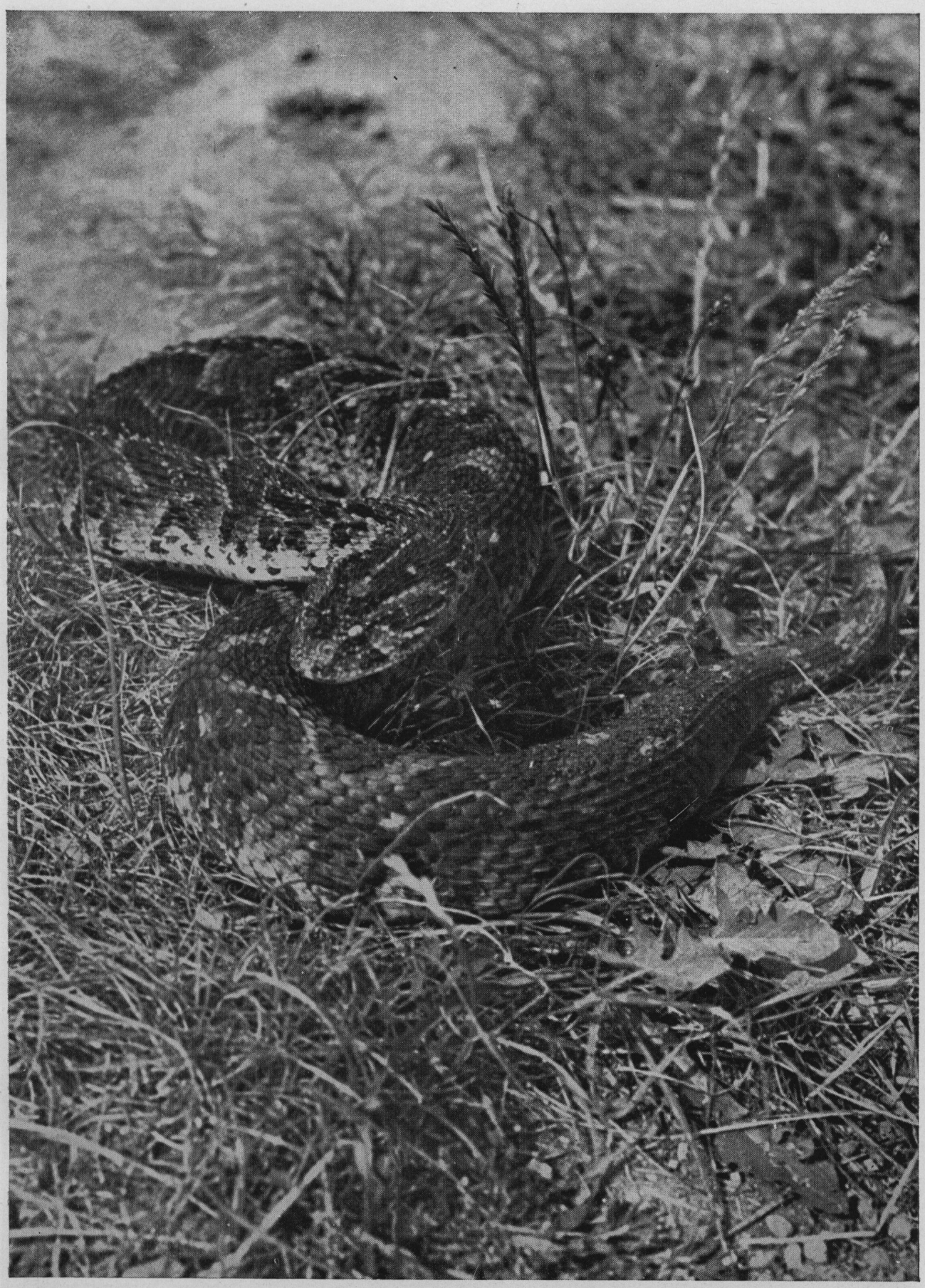
126. Two specimens of *Vipera ammodytes montandoni* mating. The male (with the more conspicuous markings) is being most affectionate to the female.

127. *Vipera palestinae* has more striking markings on the head and neck; on the rest of the body they are less clearly distinguishable. This snake attains 4 feet and inhabits S. E. Turkey, Syria and Palestine.

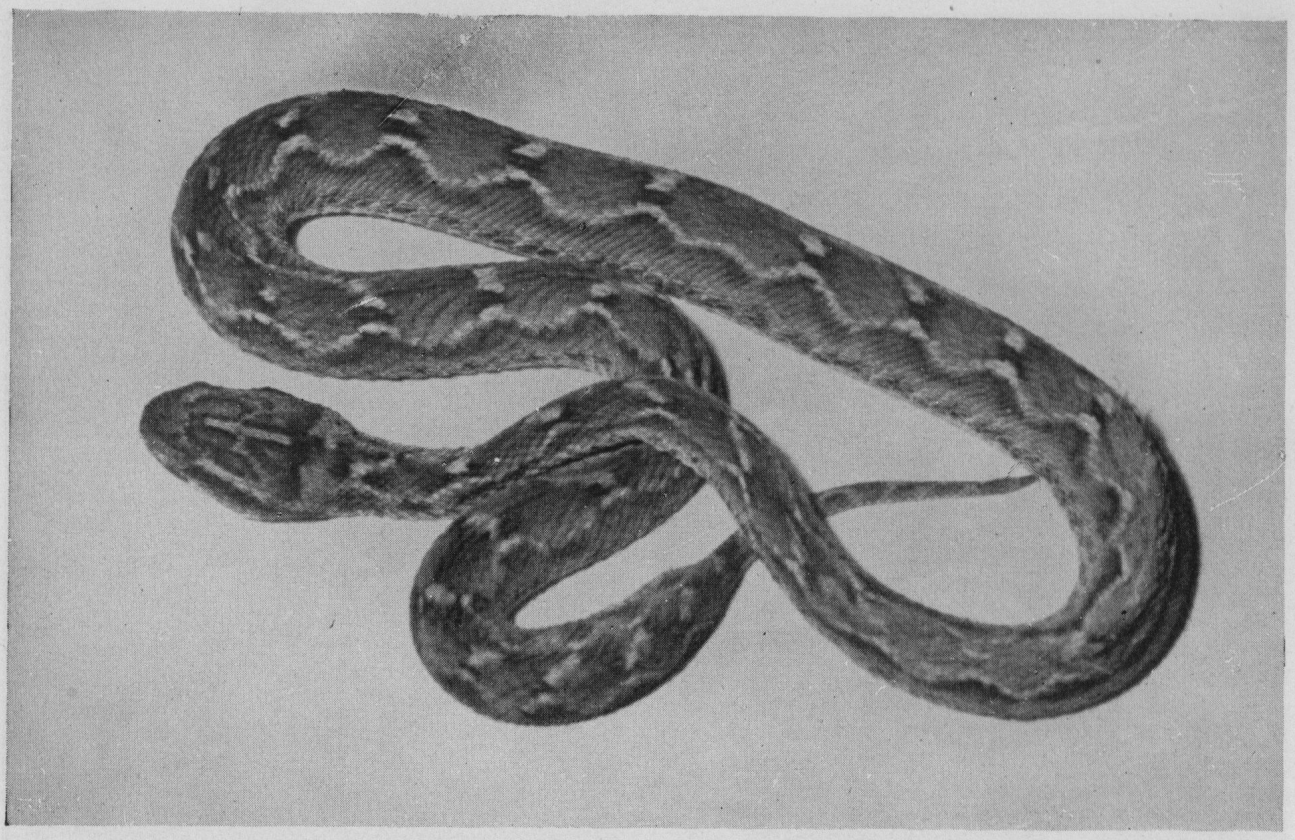
128. The Levantine Viper *(Vipera lebetina)* is a large viper inhabiting N. Africa, S. W. Asia, Transcaucasia, Beluchistan and Kashmir. It is found quite high up in the mountains. Its colouring is an inconspicuous grey-brown or slate grey. The photograph shows a male of the subspecies *Vipera lebetina obtusa* from Russia.



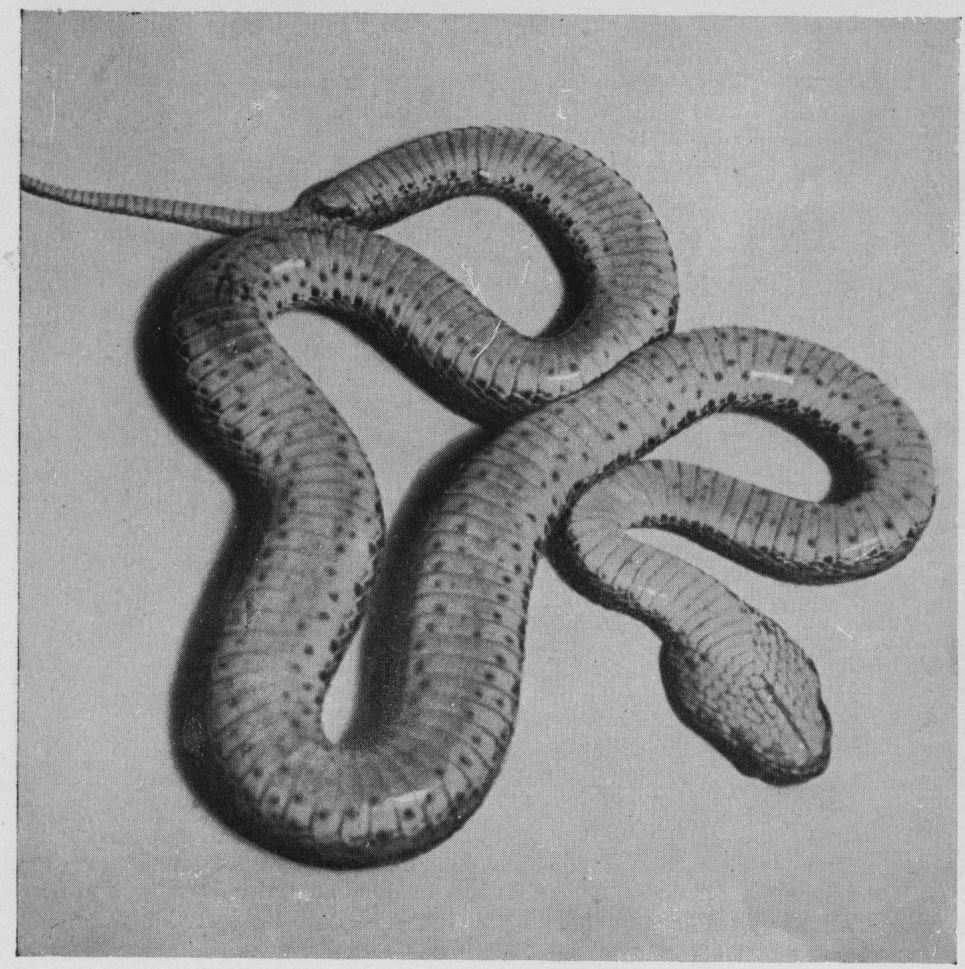
129. This female of the Levantine Viper *(Vipera lebetina obtusa)* has swallowed a guinea-pig and has settled down to digest it in peace. These snakes have a very potent venom.



130. The Puff Adder *(Bitis arietans)* from S. W. Africa. It is a stout snake, with black and yellow colouring. It is a lazy, sluggish snake, which bites, however, when in immediate danger. Its venom is very potent.

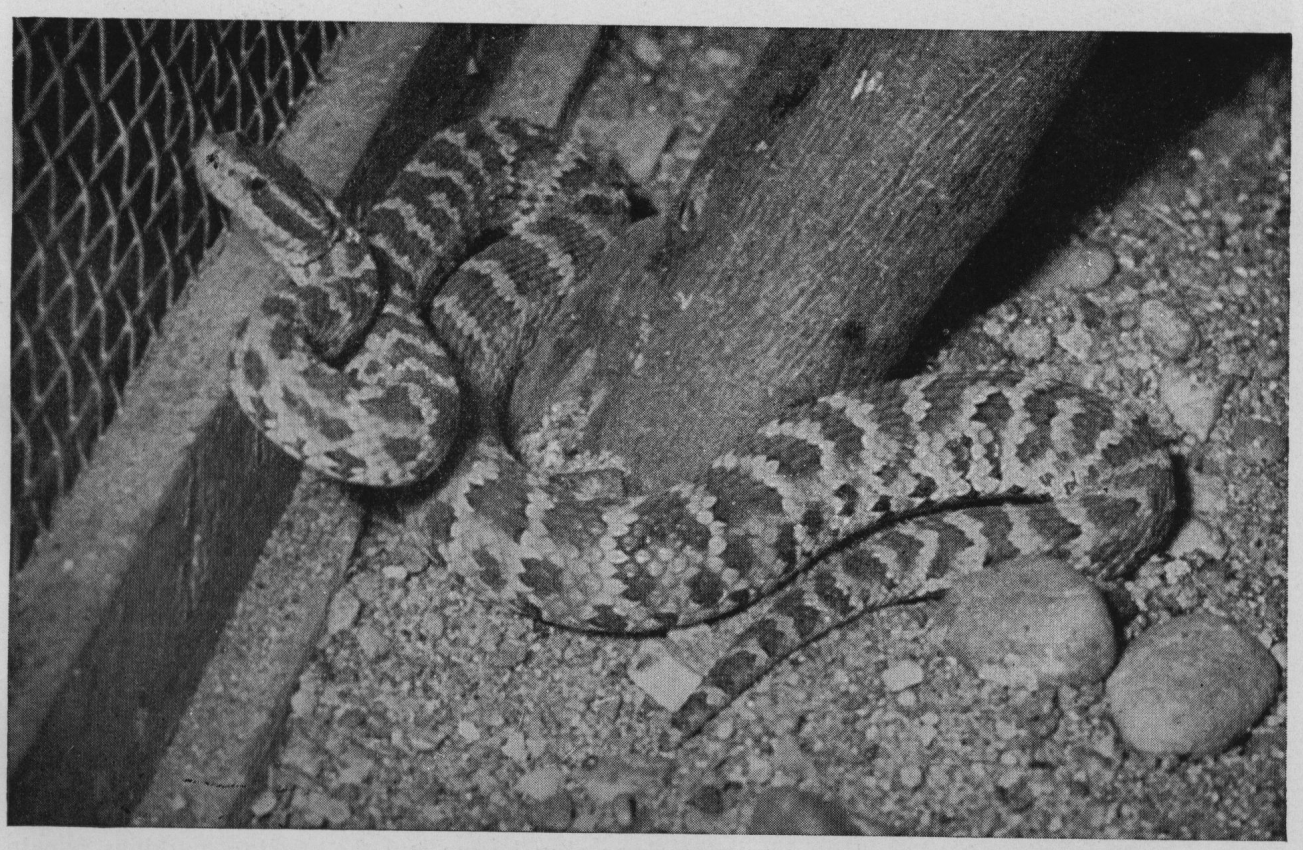


131. The Carpet Viper *(Echis carinata)* is one of the most feared snakes of the deserts of N. Africa and the grasslands of E. Africa and also of a large part of S. W. and S. Asia. In Russia it is found in Turkmenistan, Uzbekistan and Tadzhikistan. It is the same length as the Common Viper, black-brown in colour with white markings, and is very inclined to bite.

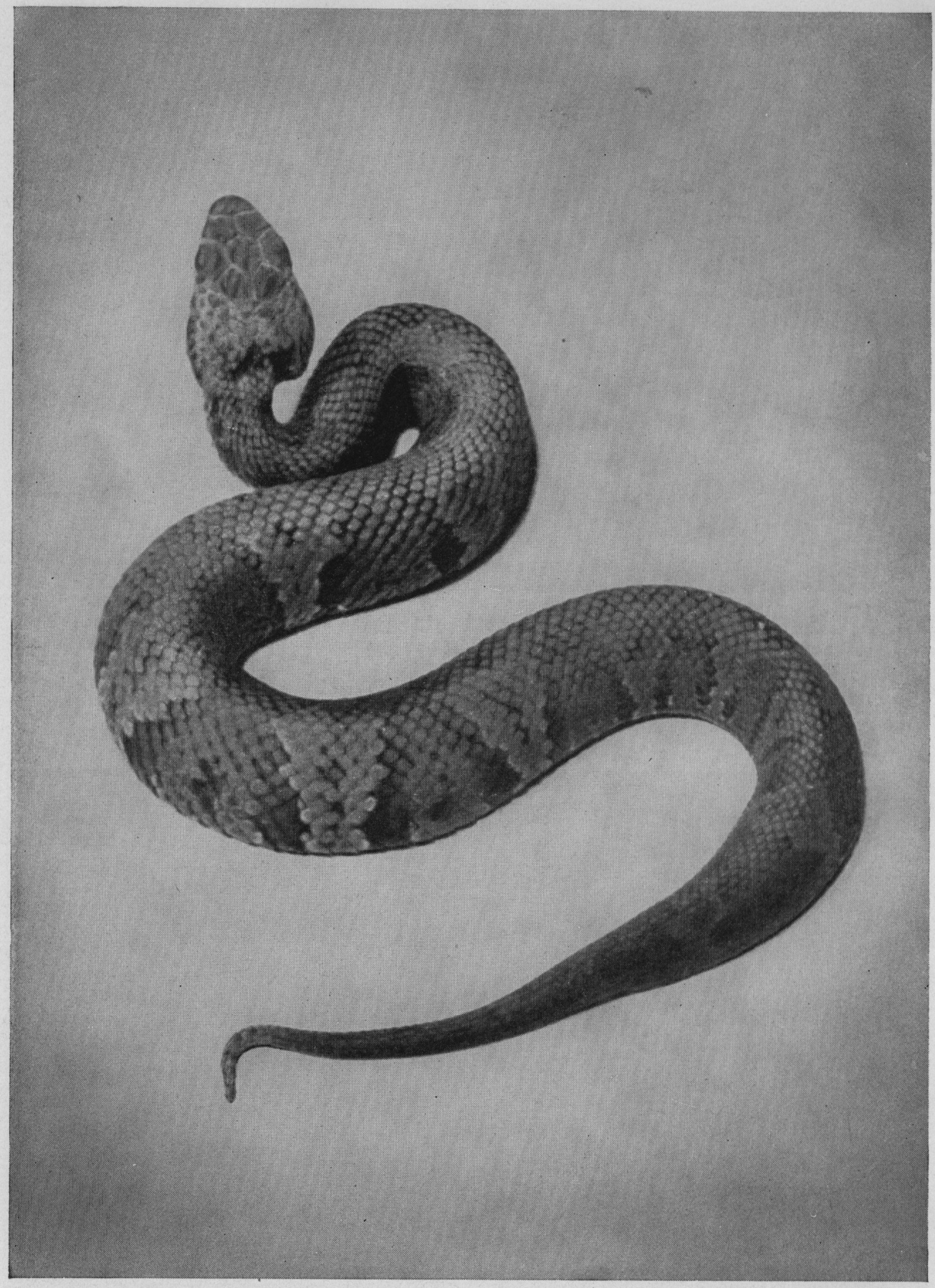


132. Abdominal view of the Carpet Viper. As in all snakes, the underside of the viper's body is covered by transverse abdominal plates. The skin is wrinkled between the two halves of the lower jaw, in order to permit the widest possible expansion when swallowing prey.

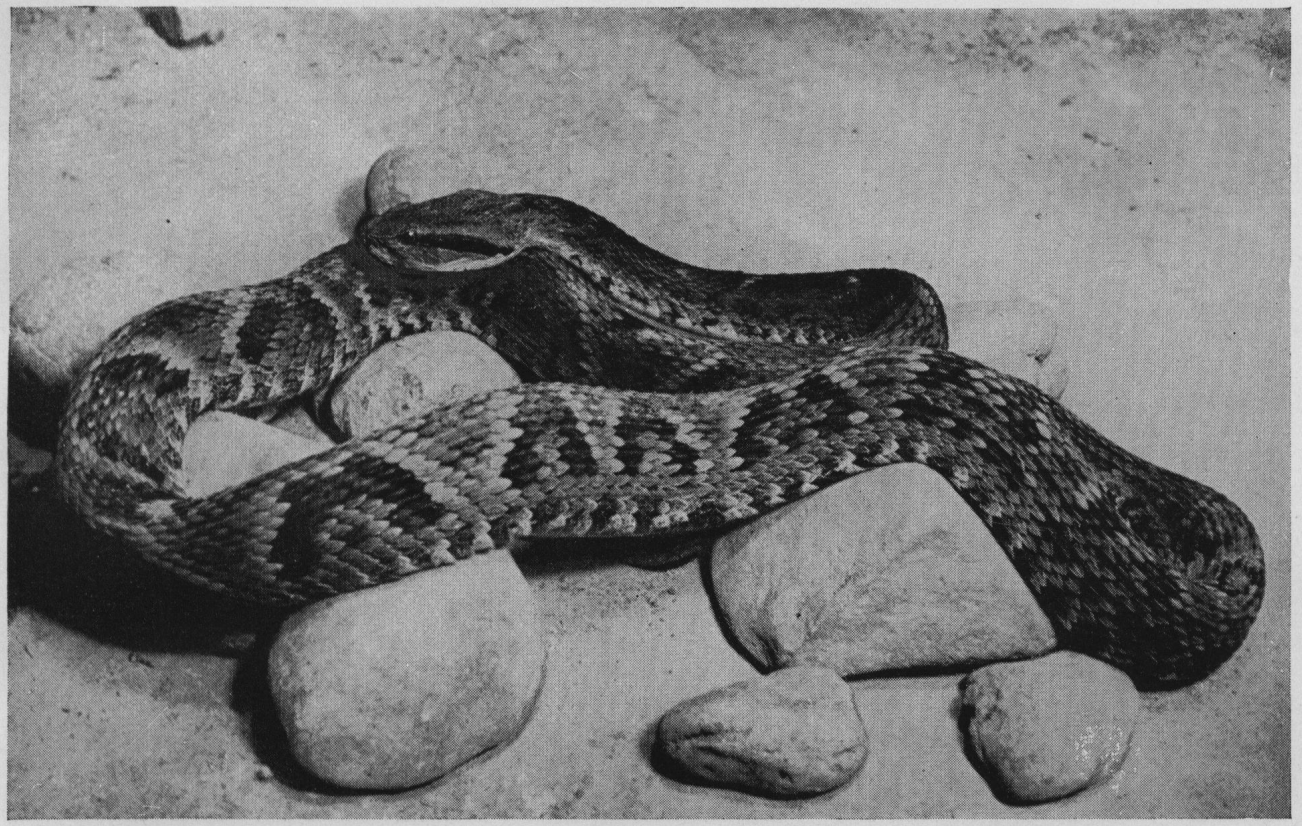
133. The Carpet Viper will lie for hours without moving on the warm sand under the lamp. It looks innocent enough, but in actual fact is one of the most feared snakes.



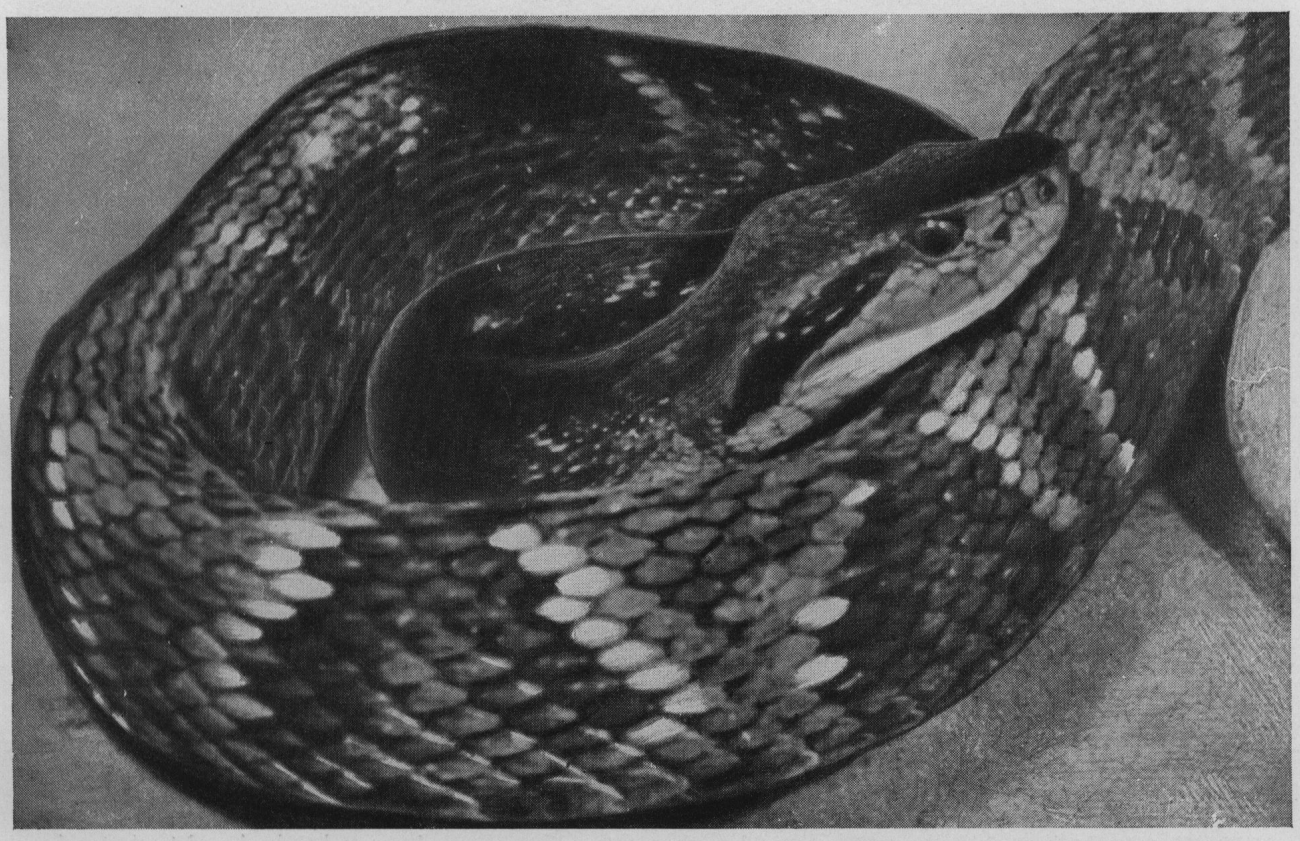
134. The Siberian Halys *(Ancistrodon halys caraganus)* is a small, pretty Pit Viper. It is found in Kazakhstan. It attains a length of 30 inches and feeds on mice.



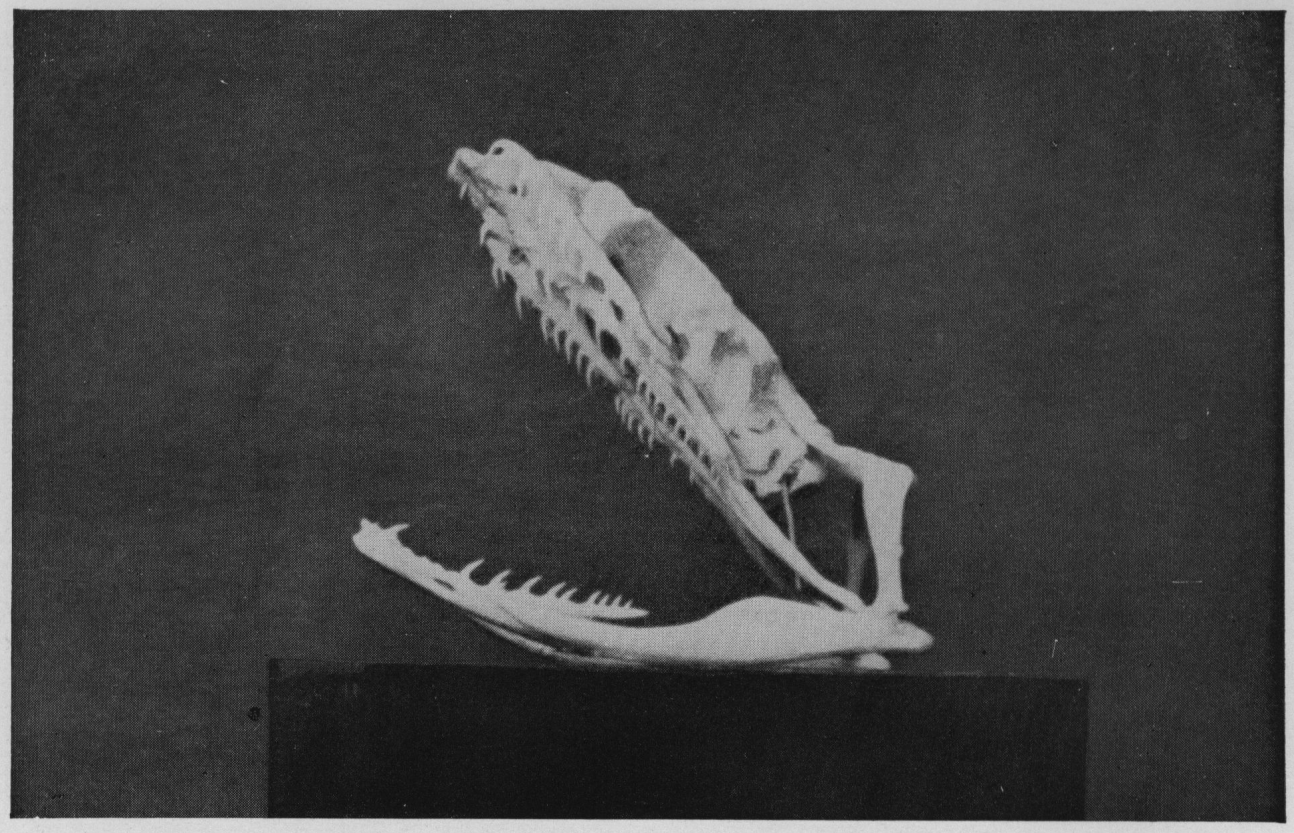
135. The Water Moccasin *(Ancistrodon piscivorus)* is the most feared snake of the swamps of Florida. It bites on the slightest provocation and its venom is deadly. This snake is conspicuously coloured only when young; later it is a velvety brown-black or olive brown and the striking markings remain only on the abdomen. It catches fish, frogs and mice. In the terrarium it accepts food straight away. It attains an average length of 4 feet.



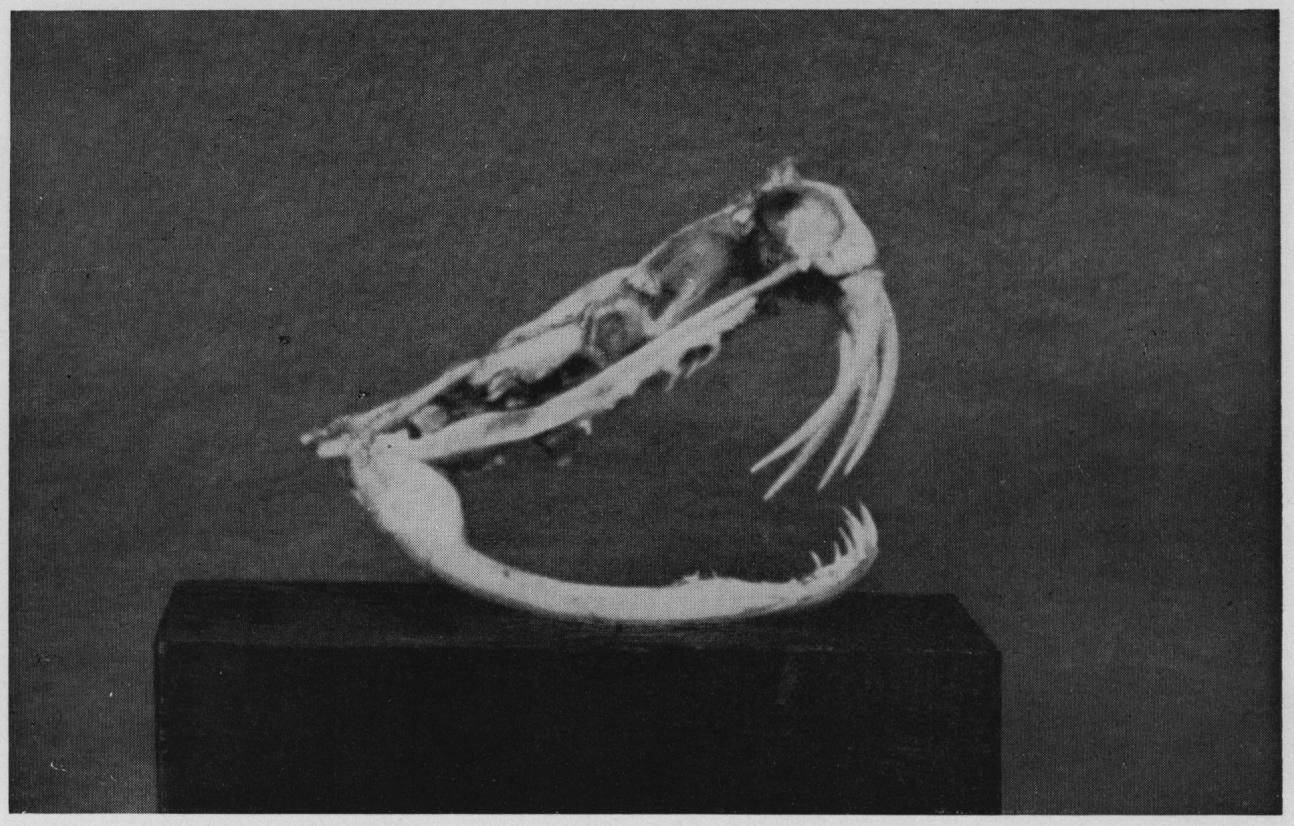
136. The Jararaca, the well-known venomous snake of S. America. It is a slender snake of the family of the Pit Vipers and attains a length of about 5 feet. Its poison fangs are strikingly developed. It catches small rodents. The photograph shows the species *Bothrops jararaca.*



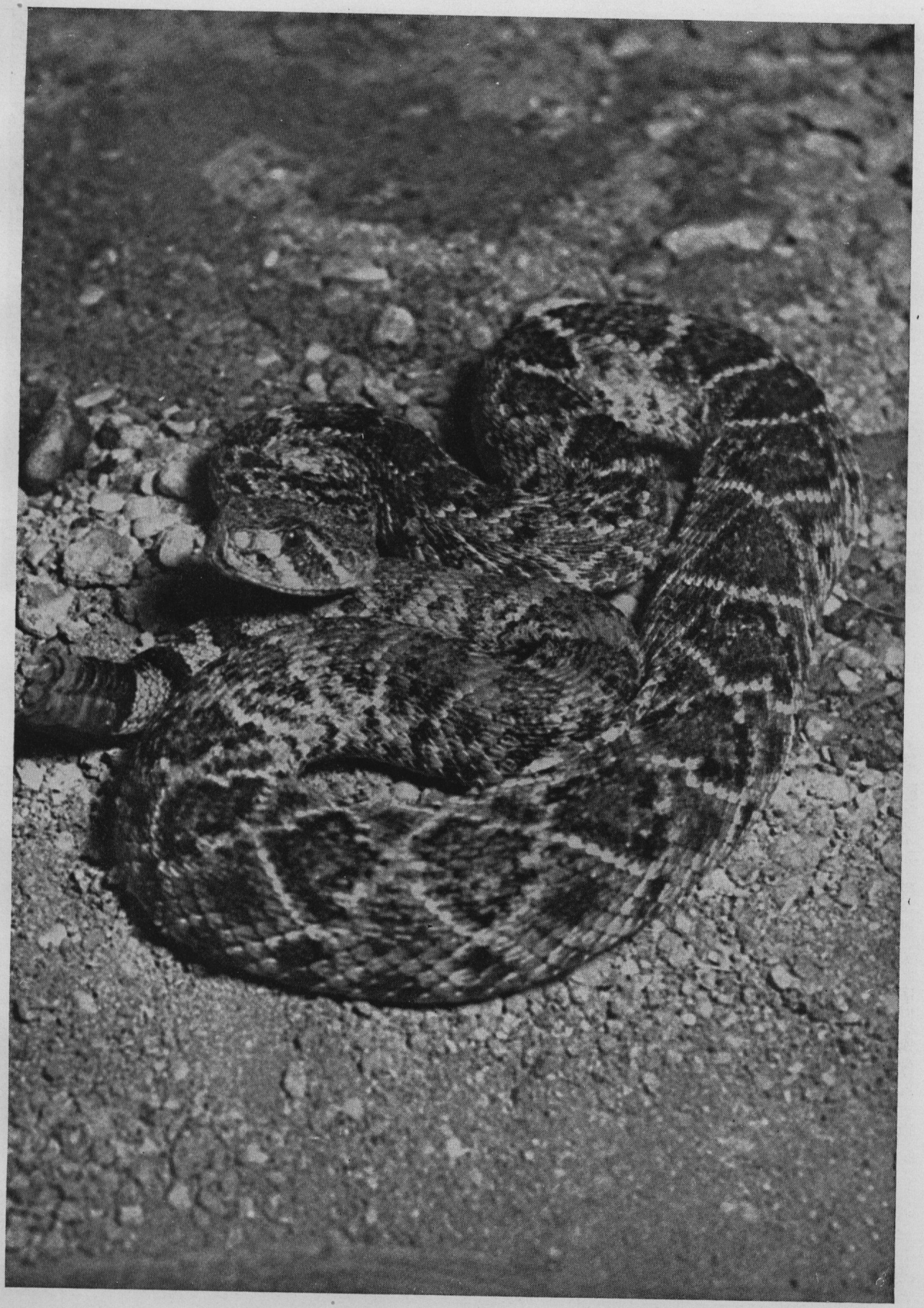
137. The Jararaca is perhaps the most numerous snake in the world and even today is found in some parts of Brazil in unusual numbers. Its bite has already killed many people who did not have access to the antitoxic serum in time.



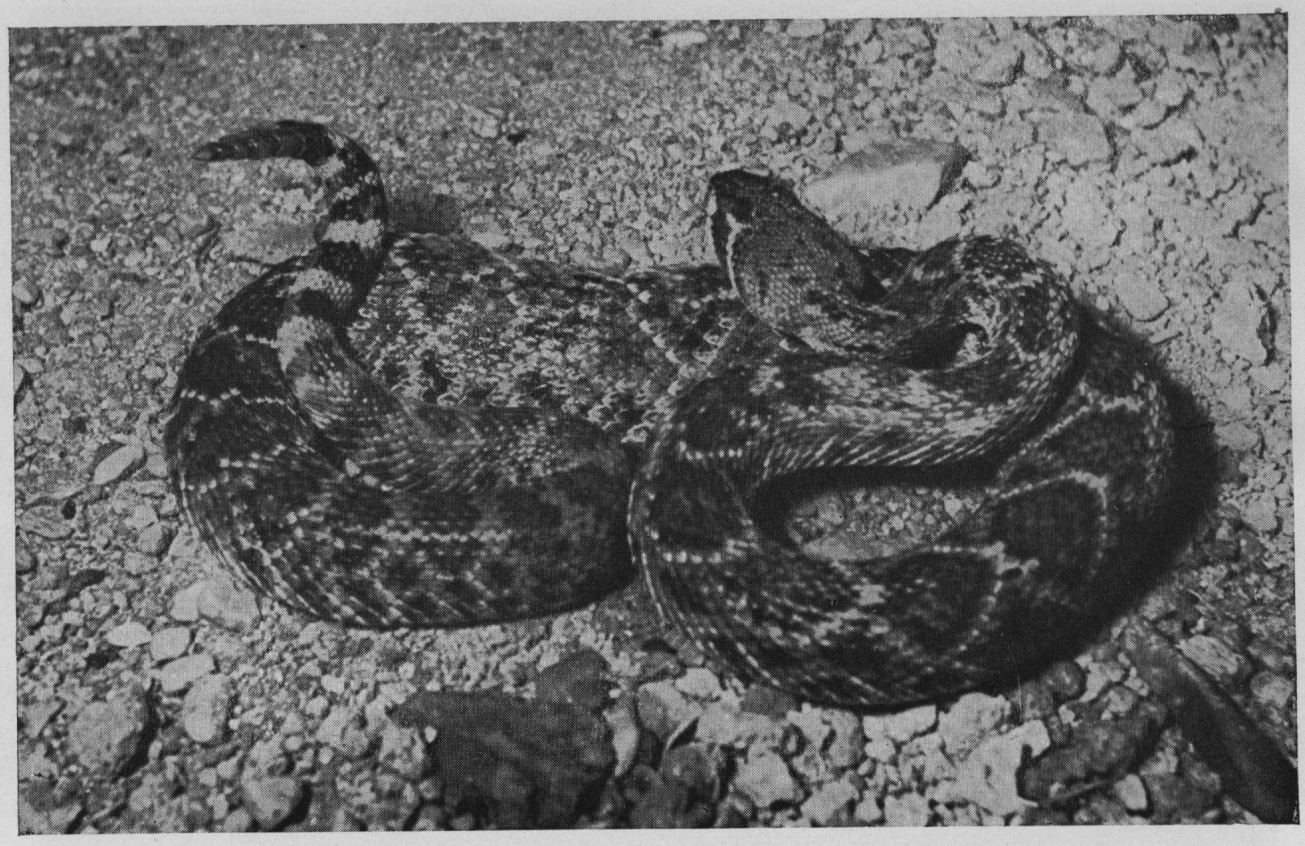
138. The skull of the non-venomous Colubrid snake *Elaphe quatuorlineata sauromates*. The teeth form a more or less even row and the bones of the skull are quite massive. Enlarged ×2.



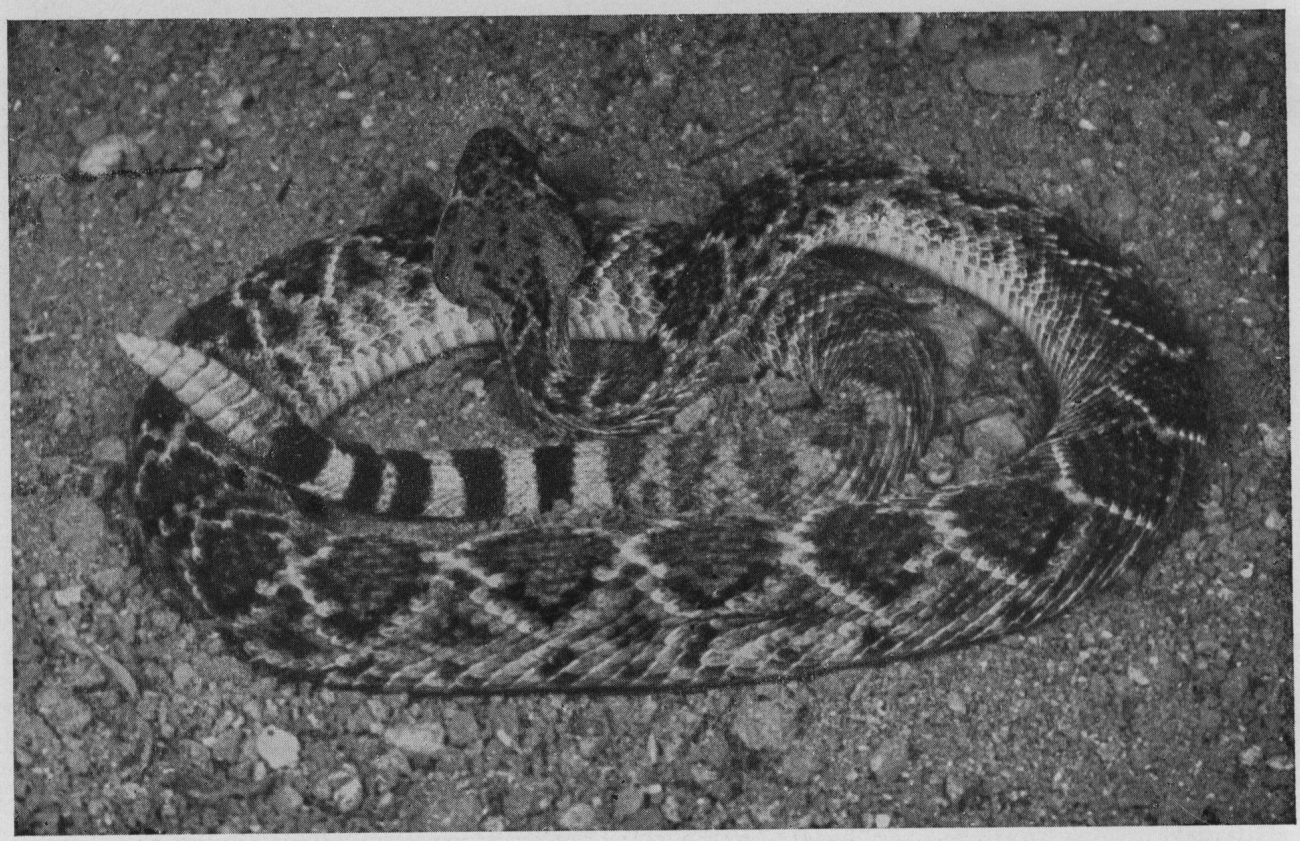
139. The skull of the Jararaca. The terrible outer poison fangs are about to be shed and in their place new fangs appear, which are prepared from both sides internally. The poison fangs are shed irregularly, but at least once every 2—3 months, as in all the other Viperine snakes and Pit Vipers. The bones of the skull are thin. Enlarged ×2.



140. The Western Diamond Rattlesnake *(Crotalus atrox).* A big, handsome, true rattlesnake, which grows to over 8 feet. The back is grey or brown-grey with a silvery or yellowish white diamond pattern. The snake is at its most splendid just after shedding its skin. It is found in the south eastern parts of N. America and lives mainly on rodents.



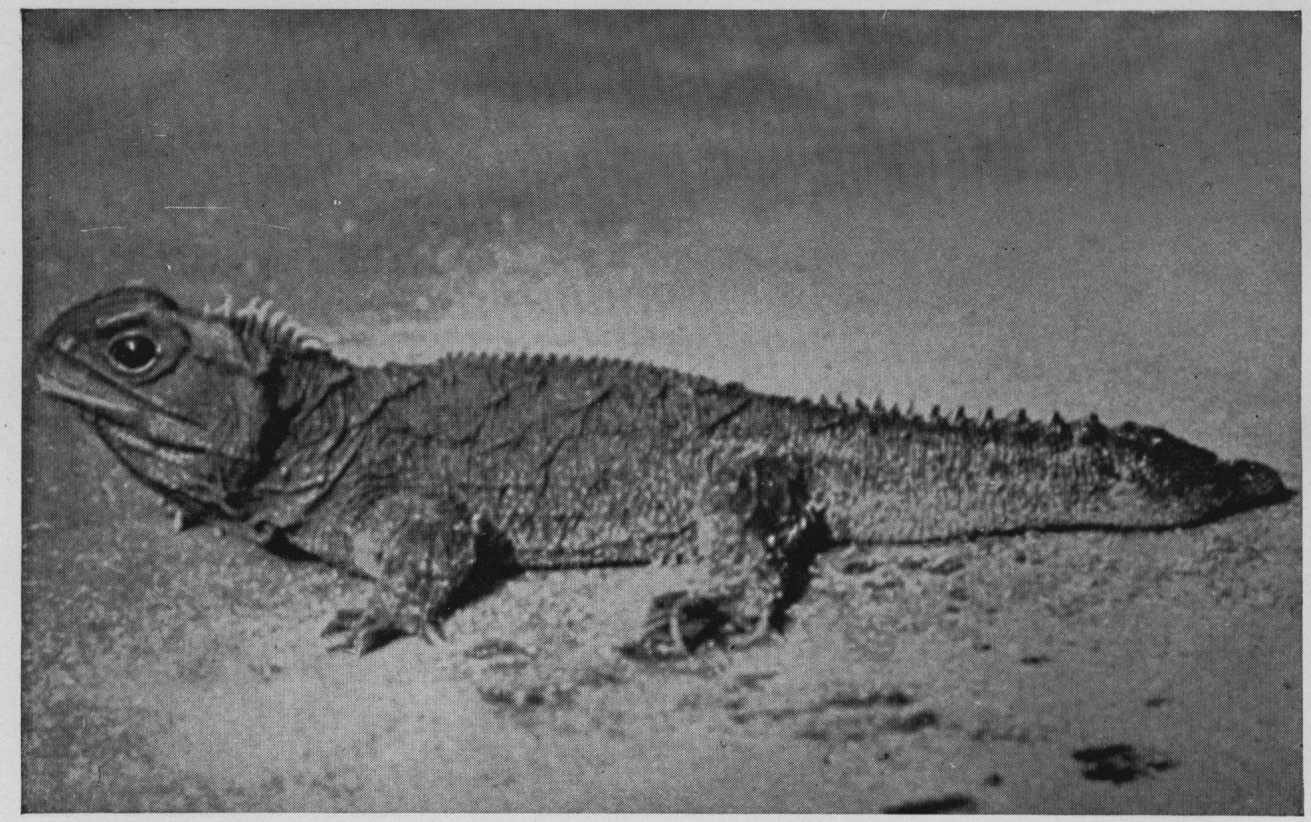
141. The Western Diamond Rattlesnake using its rattle. The tail, with its conspicuous black and white bands, terminates in a rattle, which when sharply vibrated produces the characteristic rattling sound.



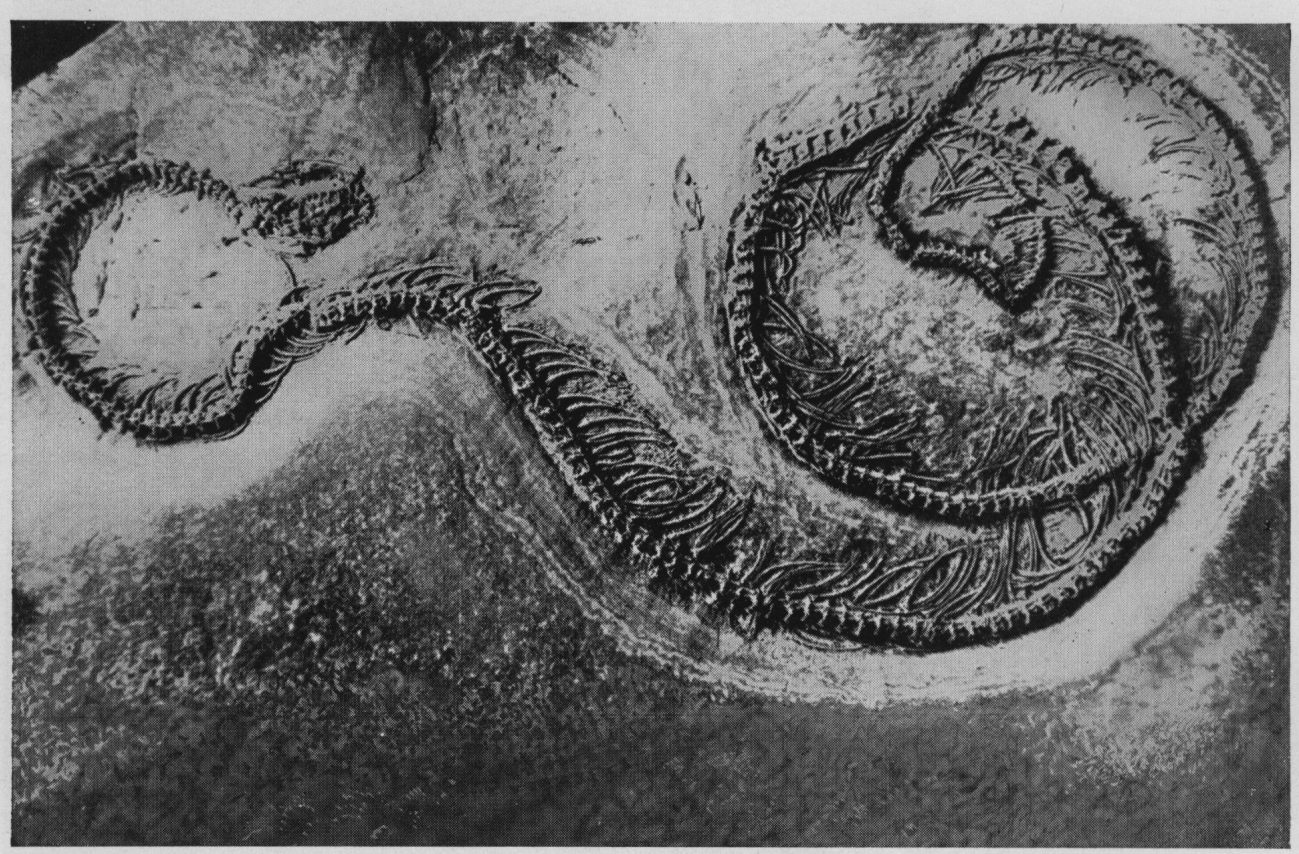
142. The Western Diamond Rattlesnake just after shedding its skin. The colouring and the markings are very bright, but in a few days will be much duller.

143. The most venomous snake of S. America is the Brazilian Rattlesnake, or Cascavela *(Crotalus terrificus terrificus)*. It is light brown, reddish brown or black-brown with diamond-shaped markings in golden yellow. The fully grown snake measures 5 feet.

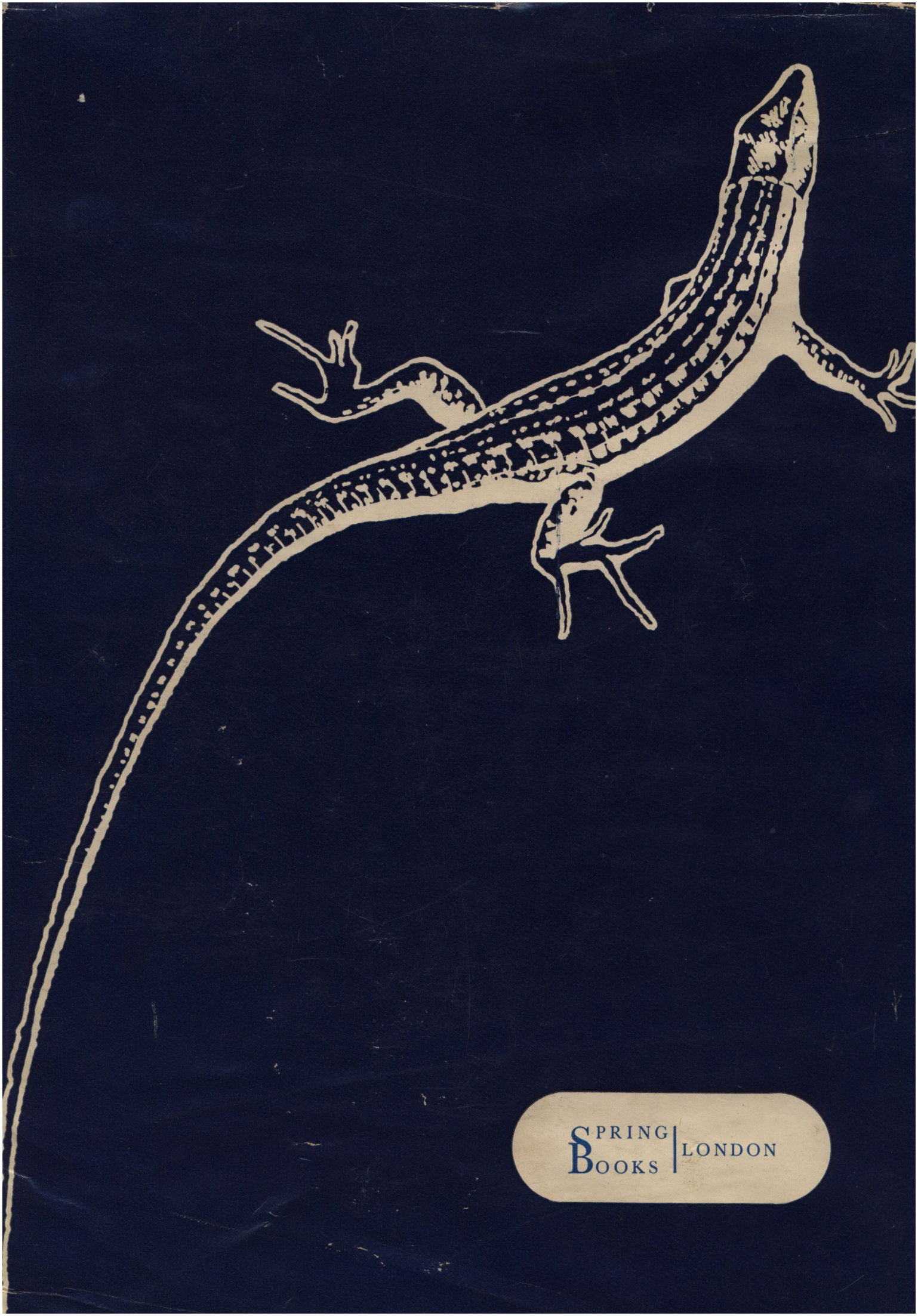
144. The Brazilian Rattlesnake is, on the whole, a clumsy snake, with a weak rattle, but with a very irritable disposition. Its bite has caused the death of many people.



145. The T u a t a r a *(Sphenodon punctatus)* is a living relic of bygone ages, which has been preserved in New Zealand. It has the best developed parietal eye of all the reptiles. The Tuatara gives us an idea of what some of the upper Permian and Triassic reptile precursors looked like.



146. The skeleton of the Eocene boa-type snake *Boavus idelmani,* which lived about 50 million years ago. This snake bears a striking resemblance to the present-day snakes of the family of the *Boidae.*



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