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PRESIDENTIAL ADDRESS

Snakes Alive

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It would seem that I was predestined to be a zoologist, since I have always been interested in animals. Most of my earlier memories are of animals—a stuffed buffalo in a museum, a live tiger in a zoo, a cecropia moth on the side of a shed. Of all the animals, I was (and still am) most intrigued by those feared, misunderstood and yet fascinating creatures, the snakes. With the possible exception of the monkey house, the reptile house draws the greatest crowd at a zoo. The average person seems to feel about snakes in the same way the late W. C. Fields was reputed to feel about women: he said that, to him, a woman was like an elephant—he liked to look at one, but he didn't want one of his own! Frankly, snakes are not particularly good as pets, since, although most of them will become quite placid and accustomed to handling in captivity, they are not in the least demonstrative, nor do they generally show any signs of recognizing individuals. However, as subjects of observation and study, snakes are particularly interesting.

Snakes demonstrate the basic characteristics of the reptiles, in that they are air-breathing, terrestrial, scaly-skinned, basically oviparous, poikilothermic animals. They share the order Squamata with the lizards, from which the snakes are probably derived. In general, the snakes may be distinguished from the lizards by the absence of limbs, lack of external ear-openings and the lack of functional eyelids. Of course, as is common in most biological studies, exceptions are the rule. For instance, limbs are not present in any of the snakes, but a rudimentary pelvic girdle, associated with a pair of small spurs located on either side of the vent, is found among the Boidae. No snake has external ear-openings, but then neither do the earless lizards of the genus *Holbrookia*. And well-known to herpetologists are the legless lizards (or "glass snakes"—so-called because of their tendency, in common with many other lizards, of dropping their tails in emergencies). No snake has movable eyelids, their eyes being protected by transparent scales, while lizards, as a group have movable eyelids. An exception is seen among the African chameleons, in which the eyelids are fused together, leaving a little permanently-open "port-hole" over the pupil, protected by a transparent scale.

There are over 2,000 species of snakes found throughout the tropical and temperate regions of the world (except for Hawaii, New Zealand and, of course, Ireland). Since the snakes are poikilothermic ("cold-blooded"), their temperature varies with the environmental tempera-

ture. Snakes decrease in numbers in the colder regions of their range and are entirely absent in the more frigid regions of the world. Since no energy is required to maintain a constant temperature (exception: female pythons coil around their clutch of eggs and raise their body temperature a few degrees over that of the environment), snakes are able to survive with relatively fewer feedings. Once a week or even less is quite adequate. All snakes are carnivorous (for once, no exceptions are known), swallowing the prey whole. A snake has plenty of small, thorn-like recurved teeth (typically, four rows of upper teeth and two rows of lower teeth) that are designed for grasping and holding rather than chewing. The bones of the skull and jaws are connected by elastic ligaments in such a way that a snake can swallow an animal several times larger than its own head. The prey (some species prefer warm-blooded forms, some cold-blooded, while others will take either) is detected by sight, smell or, in the case of the pit vipers and some other species, by heat-sensitive receptors. The prey is then subdued by being seized by the jaws and engulfed (a garter snake with an earthworm), by constriction (a rat snake with a mouse), or by the injection of poison (a rattlesnake with a rabbit). Incidentally, there is no truth in the idea that a snake will eat only prey that it has killed—most of our snakes in captivity are fed dead animals (many thawed out after being stored in a deep-freeze).

The poison of venomous snakes is used primarily in subduing prey (it also aids in the digestive process) rather than as a defensive mechanism. The venom itself is modified saliva, delivered from the glands by way of ducts to the paired fangs. The fangs of the vipers, whose venom is primarily haemotoxic, are long, hollow and fold backward against the roof of the mouth, while the fangs of the cobras and their relatives, whose venom is primarily neurotoxic, are smaller, grooved and permanently erect. The fangs, in common with snake teeth in general, are regularly shed and replaced by new ones. The dangerously-poisonous snakes of continental United States include copperheads, cottonmouths, a number of species of rattlesnakes and coral snakes. The first three are vipers (pit vipers), while the coral snake is related to the cobras. Indiana supports two species of rattlesnakes (*Crotalus horridus* and *Sistrurus catenatus*) and copperheads (*Agkistrodon contortrix*). No coral snakes nor cottonmouths (despite almost universal opinion to the contrary) have ever been found as native populations in Indiana. It is necessary to make this qualifying statement, since even more exotic forms (boa constrictors, anacondas, etc.) are occasionally found as escapees or releases of captive specimens.

Since they do not possess external ear openings, it is doubtful if snakes can hear air-borne sounds, but they are definitely sensitive to vibrations of surfaces with which they are in contact. In other words, the traditional flute-playing Indian snake charmer is attracting the cobra by swaying his body rather than by his flute music. Snakes do have functional eyes, except for some of the burrowing forms in which the eyes are more or less degenerate. The pupils are round, in general, in those species that prowl by day and elliptical in the

night-prowlers (which includes the pit vipers). The sense of sight is, in any case, secondary to the sense of smell. The nasal cavities may be involved in the usual way, but the forked tongue, which can convey odorous particles to two tiny structures (Jacobson's organ) in the roof of the mouth which are an extremely sensitive means of detecting air-borne particles as well as similar particles from surfaces, is most important in such functions as sex recognition, trailing prey and recognizing food. The delicate tongue, of course, also serves as a sensitive feeler.

The elongate body of a snake is remarkably flexible, due to the great number of vertebrae (several hundred, as a rule). A pair of ribs is associated with each of the vertebrae, except for those in the neck and the tail. The viscera are elongate and linear in arrangement, with the left lung being either much smaller or absent (except for the Boidae, which have well-developed paired lungs). The most common method of locomotion in snakes is accomplished by undulating the body in S-curves, with the outer surfaces of the curves serving as pushing points. An exaggeration of this technique is seen in the side-winding locomotion of some desert species. Heavy-bodied snakes may also move in a straight line by expansion and contraction of the belly surface, with the over-lapping belly scales moving in wave-like ripples while pressing against the ground surface. Snakes are not capable of great speeds, despite stories frequently told. The fastest racers have been clocked at only three and a half miles an hour, and that in short spurts only. Many snakes regularly climb shrubs and trees, and all snakes seem to be able to swim if placed in water. Of course, some species stay in or near the water most of the time, and the sea snakes, which are incapable of making any progress on land, never leave the water.

The majority of snakes are oviparous, and, with few exceptions (female pythons, as mentioned before), the eggs are deposited in a suitable medium (rotting wood, moist soil, etc.) and left without any further care. Some snakes (water snakes, garter snakes, pit vipers, boa constrictors and others) are ovoviviparous, in that the fully-formed eggs are retained within the body of the mother until development is complete. The presence of fully-developed, active young in the ruptured body of a slaughtered female snake is undoubtedly responsible, at least in part, for the belief that a mother snake will swallow her young to protect them. The sight of a large cannibalistic snake, such as a king snake or a black racer, in the process of swallowing a smaller snake is another possible basis for this superstition. The copulatory organ of a male snake is bifurcated and is withdrawn into a sac at the base of the tail. The extrusion of this structure due to heat has given rise to another superstition, namely that a snake will "grow legs" if it is thrown into a fire. Snakes are the subjects of many other interesting superstitions: a snake will avenge the death of its mate (snakes do not form permanent alliances); snakes will suckle cows (Ha! With all those sharp teeth?); hoop snakes have a poisonous fang at the tip of the tail (there are the mud snakes of the southern states that use

a spinous tail tip to hold down slippery salamanders while dining on them); a snake won't die until sundown (great innate vitality, but sundown has nothing to do with its termination); and many others.

Records are always fascinating. The longest snake ever accurately measured seems to be a reticulated python—about 35 feet (just try to accurately measure a living snake that size!). There are unsubstantiated stories of anacondas exceeding that length, but approximately 25 feet seems to be the greatest recorded length of an anaconda. The longest poisonous snake? The king cobra, with a maximum length of about 17 feet wins hands down. The most poisonous snake? Probably the Australian tiger snake, whose venom is rated as the most toxic—drop for drop—of any known species of venomous snake.

This brief, incomplete and possibly more or less inaccurate account of reptilian facts and fables was illustrated by several living specimens (including a legless lizard, several species of rat snakes and a boa constrictor named Alexander) and colored slides, particularly of poisonous snakes.