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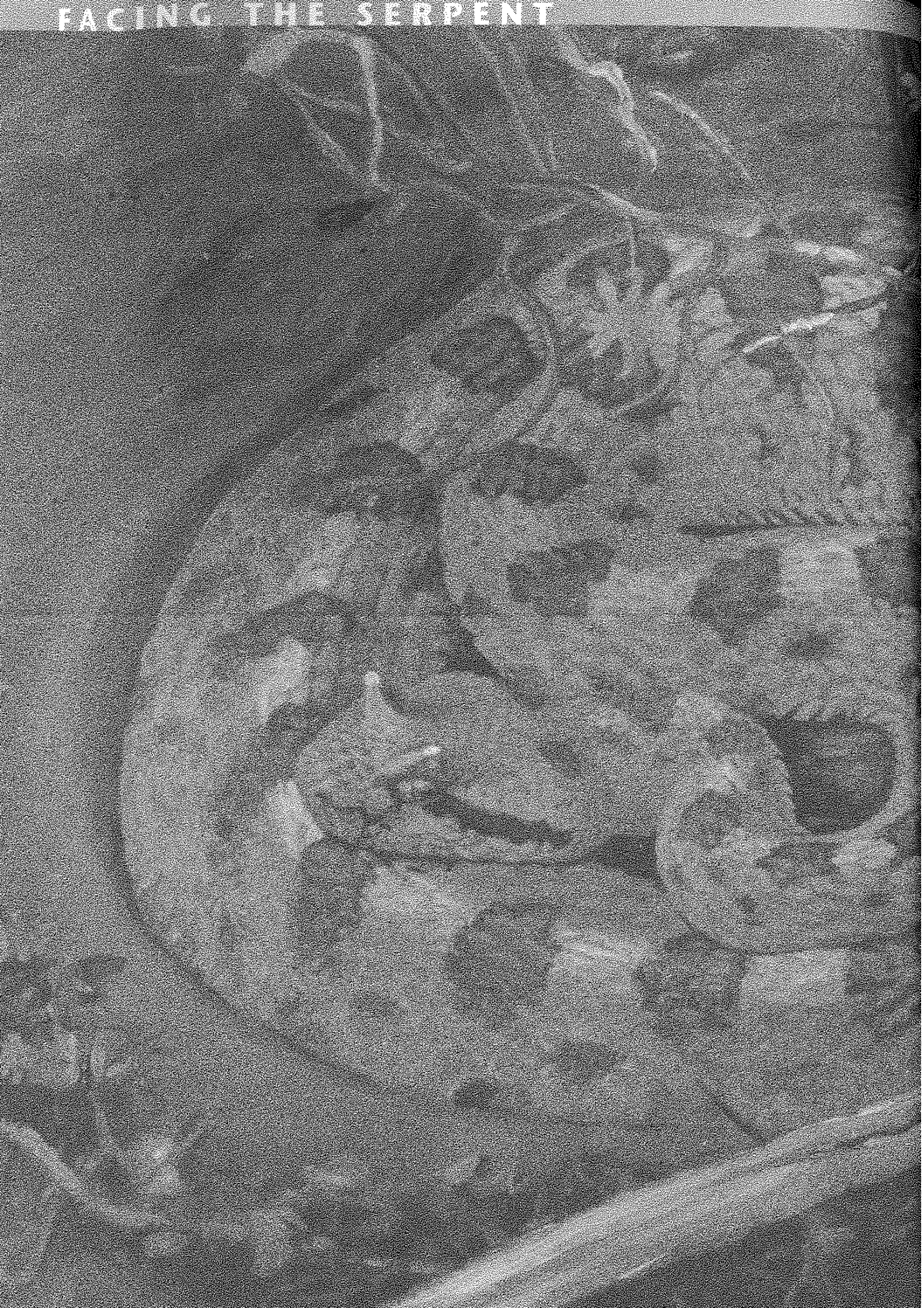

The mind is primed to react emotionally to the sight of snakes, not just to fear them but to be aroused and absorbed in their details, to weave stories about them.

The Serpent

by E.O. Wilson

WHAT IS IT EXACTLY THAT BINDS US so closely to living things? The biologist will tell you that life is the self-replication of giant molecules from lesser chemical fragments, resulting in the assembly of complex organic structures, the transfer of large amounts of molecular information, ingestion, growth, movement of an outwardly purposeful nature, and the proliferation of closely similar organisms. The poet-in-biologist will add that life is an exceedingly improbable state, metastable, open to other systems, thus ephemeral—and worth any price to keep.

Certain organisms have still more to offer because of their special impact on mental development. In 1984, in a book titled *Biophilia,* I suggested that the urge to affiliate with other forms of life is to some degree innate. The evidence for the proposition is not strong in a formal scientific sense: the subject has not been studied enough in the scientific manner of hypothesis, deduction, and experimentation to let us be certain about it one way or the other. Nevertheless the biophilic tendency is so clearly evinced in daily life and so widely distributed as to deserve serious attention. It unfolds in the predictable fantasies and responses of individuals from early childhood onward. It cascades into repetitive patterns of culture across most or all societies, a consistency often noted in the literature of anthropology. These processes appear to be part of the programs of the brain. They are marked by the quickness and decisiveness with which we learn particular things about certain kinds of plants and animals. They are too consistent to be dismissed as the result of purely historical events etched upon a mental blank slate.

Perhaps the most bizarre of the biophilic traits is awe and veneration of the serpent. The dreams from which the dominant images arise are known to exist in all societies whose mental life has been studied. At least five percent of the people at any given time remember experiencing them, while many more would probably do so if they recorded their waking impressions over several months. The images described by urban New Yorkers are as detailed and emotional as those of Zulus and Australian aboriginals. In all cultures the serpents are prone to be mystically transfigured. The Hopi know Palulukon, the water serpent, a benevolent but frightening

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ewinder, oil by Laura Cunningham

godlike being. The Kwakiutl fear the *sisiutl*, a three-headed serpent with both human and reptile faces, whose appearance in dreams presages insanity or death. The Sharanahua of Peru summon reptile spirits by taking hallucinogenic drugs and stroking their faces with the severed tongues of snakes. They are rewarded with dreams of brightly colored boas, venomous snakes, and lakes teeming with caimans and anacondas. Around the world serpents and snakelike creatures are the dominant elements of dreams in which animals of any kind appear. They are recruited as the animate symbols of power and sex, totems, protagonists of myths, and gods.

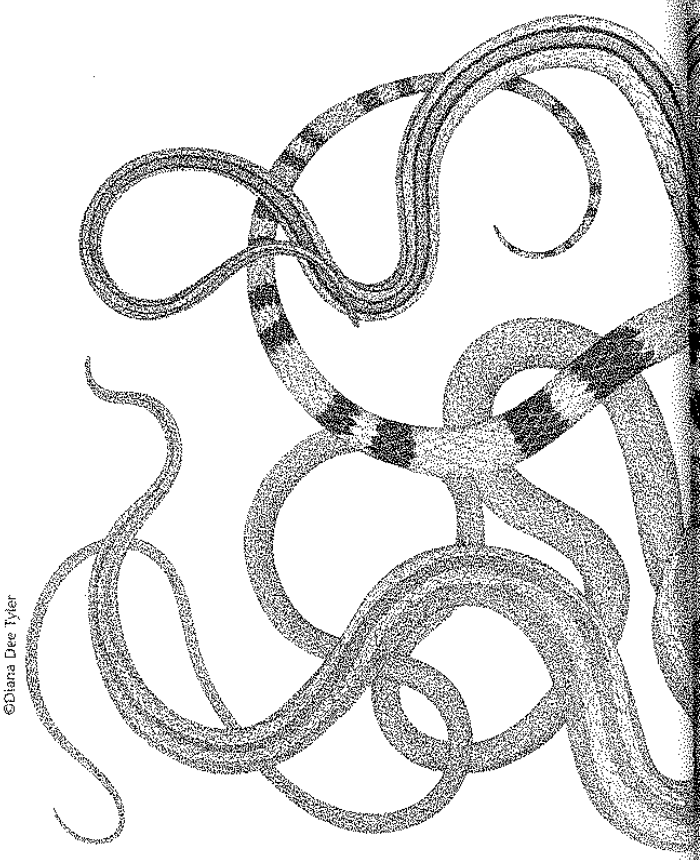
These cultural manifestations may seem at first detached and mysterious, but there is a simple reality behind the ophidian archetype that lies within the experience of ordinary people. The mind is primed to react emotionally to the sight of snakes, not just to fear them but to be aroused and absorbed in their details, to weave stories about them. This distinctive predisposition played an important role in an unusual experience of my own, a childhood encounter with a large and memorable snake, a creature that actually existed.

I grew up in the panhandle of northern Florida and the adjacent counties of Alabama. Like most boys in that part of the country set loose to roam the woods, I enjoyed hunting and fishing and made no clear distinction between these activities and life at large. But I also cherished natural history for its own sake and decided very early to become a biologist. I had a secret ambition to find a Real Serpent, a snake so fabulously large or otherwise different that it would exceed the bounds of imagination, let alone existing fact.

Certain circumstances encouraged this adolescent fantasy. First of all, I was an only child with indulgent parents, encouraged to develop my own interests and hobbies, however farfetched; in other words, I was spoiled. Second, the physical surroundings inclined youngsters toward an awe of nature. Four generations earlier, that part of the country had been covered by a wilderness as formidable in some respects as the Amazon. Dense thickets of cabbage palmetto descended into meandering spring-fed streams and cypress sloughs. Carolina parakeets and ivory-billed woodpeckers flashed overhead in the sunlight, and wild turkeys and passenger pigeons still counted as game. On soft spring nights after heavy rains a dozen varieties of frogs croaked, rasped, bonged, and trilled their love songs in mixed choruses. Much of the Gulf Coast fauna derived from species that had spread north from the tropics over millions of years and adapted to the warm local temperate conditions. Columns of miniature army ants, close replicas of the large marauders of South America, marched mostly unseen at night over the forest floor. *Nephila* spiders the size of saucers spun webs as wide as garage doors across the woodland clearings.

From the stagnant pools and knothole sinks, clouds of mosquitoes rose to afflict the early immigrants. They carried the Confederate plagues, malaria and yellow fever, which periodically flared into epidemics and reduced the populations along the coastal lowlands. This natural check is one of the reasons the strip between Tampa and Pensacola remained sparsely settled well into the twentieth century and why even today, long after the diseases have been eradicated, it is still the relatively natural "other Florida."

Snakes abounded. The Gulf Coast has a greater variety and denser populations than almost any other place in the world, and they are frequently seen. Striped ribbon snakes hang in gorgonlike clusters on branches at the edge of ponds and streams. Poisonous coral snakes root through the leaf litter, their bodies decorated with warning bands of red, yellow, and black. They are easily confused with their mimics, the scarlet kingsnakes, banded in a different sequence of red, black,



©Diana Dee Tyler

snakes: San Francisco garter, scarlet king, rough green,

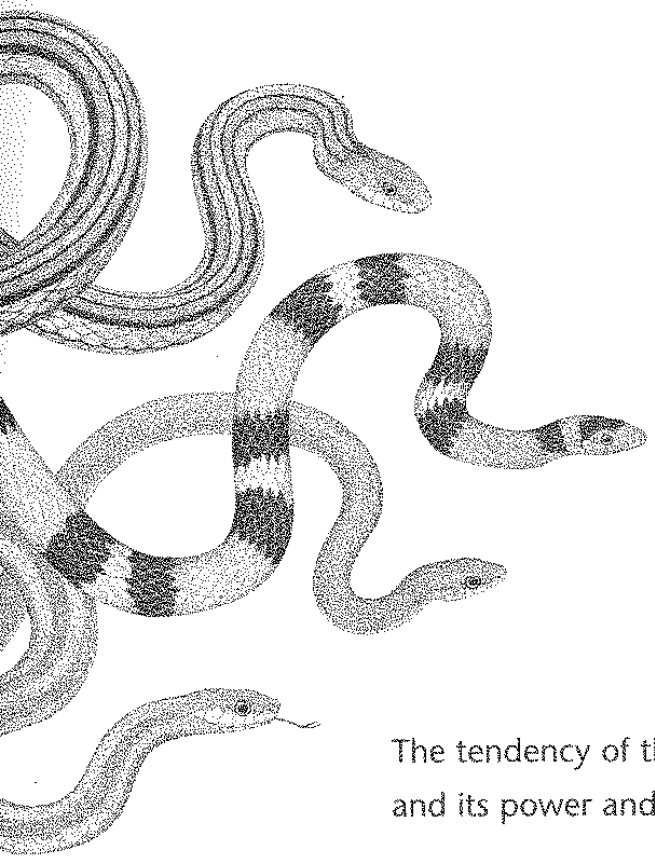
and yellow. The simple rule recited by woodsmen is: "Red next to yellow will kill a fellow, red next to black is a friend of Jack." Hognoses, harmless thick-bodied sluggards with upturned snouts, are characterized by an unsettling resemblance to venomous African gaboon vipers and a habit of swallowing toads live. Pygmy rattlesnakes two feet long contrast with diamondbacks of seven feet or more. Watersnakes are a herpetologist's medley distinguished by size, color, and the arrangement of body scales, encompassing ten species of *Natrix, Seminatrix, Agkistrodon, Liodytes,* and *Farancia.*

Of course limits to the abundance and diversity exist. Because snakes feed on frogs, mice, fish, and other animals of similar size, they are necessarily scarcer than their prey. You can't just go out on a stroll and point to one individual after another. An hour's careful search will often turn up none at all. But I can testify from personal experience that on any given day you are ten times more likely to meet a snake in Florida than in Brazil or New Guinea.

IT IS A WONDERFUL THING to grow up in southern towns where animal fables are taken half-seriously, breathing into the adolescent mind a sense of the unknown and the possibility that something extraordinary might be found within a day's walk of where you live. No such magic exists in the environs of Schenectady, Liverpool, and Darmstadt, and for all children dwelling in such places where the options have finally been closed, I feel a twinge of sadness. I found my way out of Mobile, Pensacola, and Brewton to explore the surrounding woods and swamps with a languorous intensity. I formed the habit of quietude and concentration into which I still pass my mind during field excursions, having learned to summon the old emotions as part of the naturalist's technique.

Once, deep in a swamp miles from home, half lost and not caring, I glimpsed an unfamiliar brightly colored snake disappearing down a crayfish burrow. I sprinted to the spot, thrust my hand after it, and felt around blindly. Too late: the snake had squirmed out of reach into the lower chambers. Only later did I think about the possibilities: suppose I had succeeded and the snake had been poisonous? My reckless enthusiasm did catch up with me on another occasion when I miscalculated the reach of a pygmy rattlesnake, which struck out faster than I thought possible and hit me with startling authority on the left index finger. Because of the small size of the reptile, the only results were a temporarily swollen arm and a fingertip that still grows a bit numb at the onset of cold weather.

I found my Serpent on a still July morning in the swamp fed by the artesian wells of Brewton, while working toward higher ground along the course of a weed-choked stream. Without warning a very large snake crashed away from under my feet and plunged into the water. Its movement especially startled me because so far that day I had encountered only modestly proportioned frogs and turtles silently tensed on mudbanks and logs. This snake was more nearly my size as well as violent and noisy—a colleague, so to speak. It sped with wide body undulations to the center of the shallow watercourse and came to rest on a sandy riffle. Though not quite the monster I had envisioned, it was nevertheless unusual, a water moccasin (*Agkistrodon piscivorus*), one of the poisonous pit vipers, more than five feet long with a body as thick as my arm and a head the size of a fist. It was the largest snake I had ever seen in the wild. I later calculated it to be just under the published size record for the species. The snake now



The tendency of the serpent to appear suddenly in dreams, its sinuous form, and its power and mystery are the natural ingredients of myth and religion.

and northwestern garter, pen-and-ink by D. D. Tyler

lay quietly in the shallow clear water completely open to view, its body stretched along the fringing weeds, its head pointed back at an oblique angle to watch my approach. Moccasins are like that. They don't always keep going until they are out of sight, in the manner of ordinary watersnakes. Although no emotion can be read in the frozen half-smile and staring yellow cat's eyes, their reactions and posture make them seem insolent, as if they see their power reflected in the caution of human beings and other sizable enemies.

I moved through the snake handler's routine: pressed the snake stick across the body in back of the head, rolled it forward to pin the head securely, brought one hand around to grasp the neck just behind the swelling masseteric muscles, dropped the stick to seize the body midway back with the other hand, and lifted the entire animal clear of the water. The technique almost always works. The moccasin, however, reacted in a way that took me by surprise and put my life in immediate danger. Throwing its heavy body into convulsions, it twisted its head and neck slightly forward through my gripped fingers, stretched its mouth wide open to unfold the inch-long fangs and expose the dead-white inner lining in the intimidating "cottonmouth" display. A fetid musk from its anal glands filled the air. At that moment the morning heat became more noticeable, the episode turned manifestly frivolous, and at last I wondered what I was doing in that place alone. Who would find me? The snake began to turn its head far enough to clamp its jaws on my hand. I was not very strong for my age, and I was losing control. Without thinking I heaved the giant out into the brush, and this time it thrashed frantically away until it was out of sight and we were rid of each other.

I sat down and let the adrenaline race my heart and bring tremors to my hand. How could I have been so stupid? What is there in snakes anyway that makes them so repellent and fascinating? The answer in retrospect is deceptively simple: their ability to remain hidden, the power in their sinuous limbless bodies, and the threat from venom injected hypodermically through sharp hollow teeth. It pays in elementary survival to be interested in snakes and to respond emotionally to their generalized image, to go beyond ordinary caution and fear. The rule built into the brain in the form of a learning bias is: become alert quickly to any object with the serpentine gestalt. *Overlearn* this particular response in order to keep safe.

Other primates have evolved similar rules. When guenons and vervets, the common monkeys of the African forest, see a python, cobra, or puff adder, they emit a distinctive chuttering call that rouses other members in the group. (Different calls are used to designate eagles and leopards.) Some of the adults then follow the intruding snake at a safe distance until it leaves the area. The monkeys in effect broadcast a dangerous-snake alert, which serves to protect the entire group and not solely the individual who encountered the danger. The most remarkable fact is that the alarm is evoked most strongly by the kinds of snakes that can harm them. Somehow, apparently through the routes of instinct, the guenons and vervets have become competent herpetologists.

The idea that snake aversion is inborn in man's relatives is supported by studies of rhesus macaques, the large brown monkeys of India and surrounding Asian countries. When adults see a snake of any kind, they react with the generalized fear response of their species. They variously back off and stare (or turn away), crouch, shield their faces, bark, screech, and twist their faces into the fear grimace—lips retracted, teeth bared, and ears flattened against the head. Monkeys raised in the laboratory without previous exposure to snakes show the same response to them as those brought in from the wild, though in weaker form. During control experiments designed to test the specificity of the response, the rhesus failed to react to other, nonsinuous objects placed in their cages. It is the form of the snake and perhaps also its distinctive movements that contain the key stimuli to which the monkeys are innately tuned.

Grant for the moment that snake aversion does have a hereditary basis in at least some kinds of nonhuman primates. The possibility that immediately follows is that the trait evolved by natural selection. In other words, individuals who respond leave more offspring than those who do not, and as a result the propensity to learn fear quickly spreads through the population—or, if it was already present, is maintained there at a high level.

How can biologists test such a proposition about the origin of behavior? They turn natural history upside down: they search for species historically free of forces in the environment believed to favor the evolutionary change, to see if in fact the organisms do not possess the trait. Lemurs, primitive relatives of monkeys, offer such an inverted opportunity. They are indigenous inhabitants of Madagascar, where no large or poi-

sonous snakes exist to threaten them. Sure enough, lemurs presented with snakes in captivity fail to display anything resembling the automatic fear responses of the African and Asian monkeys.

Another line of evidence comes from studies of the chimpanzee, a species thought to have shared a common ancestor with prehumans as recently as five million years ago. Chimps raised in the laboratory become apprehensive in the presence of snakes, even if they have had no previous experience. They back off to a safe distance and follow the intruder with a fixed stare while alerting companions with the *Wah!* warning call. More important, the response becomes gradually more marked during adolescence.

This last quality is especially interesting because human beings pass through approximately the same developmental sequence. Children under five years of age feel no special anxiety over snakes, but later they grow increasingly wary. Just one or two mildly bad experiences, such as the sight of a garter snake writhing away in the grass, having a rubber model thrust at them by a playmate, or hearing a counselor tell scary stories at the campfire, can make children deeply and permanently fearful. The pattern is unusual if not unique in the ontogeny of human behavior. Other common fears, notably of the dark, strangers, and loud noises, start to wane after seven years of age. In contrast, the tendency to avoid snakes grows stronger with time. It is possible to turn the mind in the opposite direction, to learn to handle snakes without apprehension or even to like them in some special way, as I did—but the adaptation takes a special effort and is usually a little forced and self-conscious. The special sensitivity is just as likely to lead to full-blown ophidiophobia, the pathological extreme in which the mere appearance of a snake brings on a feeling of panic, cold sweat, and waves of nausea.

Why should serpents have such a strong influence during mental development? The direct and simple answer is that throughout the history of mankind a few kinds have been a major cause of sickness and death. Every continent except Antarctica has poisonous snakes. Over large stretches of Asia and Africa the known death rate from snakebite is five persons per 100,000 each year or higher. The local record is held by a province in Burma, with 36.8 deaths per 100,000 a year. Australia has an exceptional abundance of deadly snakes, a majority of which are relatives of the cobra. Among them the tiger snake is especially feared for its large size and tendency to strike without warning. In South and Central America live the bushmaster, fer-de-lance, and jaracara, among the largest and most aggressive of the pit vipers. With backs colored like rotting leaves and fangs long enough to pass through a human hand, they lie in ambush on the floor of the tropical forest for the small warm-blooded animals that constitute their major prey. Few people realize that a complex of dangerous snakes, the "true" vipers, are still relatively abundant throughout Europe. The common adder *Viperus berus* ranges to the Arctic Circle. The number of people bitten in such improbable places as Switzerland and Finland is still high enough, running into the hundreds annually, to keep outdoorsmen on a sort of yellow alert. Even Ireland, one of the few countries in the world lacking snakes altogether (thanks to the last Pleistocene glaciation and not Saint Patrick), has imported the key ophidian symbols and traditions from other European cultures and preserved the fear of serpents in art and literature.

Here, then, is the sequence by which the agents of nature appear to have been translated into the symbols of culture. For hundreds of thousands of years, time enough for the appropriate genetic changes to occur in the brain, poisonous snakes have been a significant source of injury and death to human beings. The response to the threat is not simply to avoid it, in the way that certain berries are recognized as poisonous through a process of trial and error. People also display the mixture of apprehension and morbid fascination characterizing the nonhuman primates. They inherit a strong tendency to acquire the aversion during early childhood and to add to it progressively, like our closest phylogenetic relatives, the chimpanzees. The mind then adds a great deal more that is distinctively human. It feeds upon the emotions to enrich culture. The tendency of the serpent to appear suddenly in dreams, its sinuous form, and its power and mystery are the natural ingredients of myth and religion.

TO SUMMARIZE THE RELATION between human and snake: life becomes part of us. Culture transforms the snake into the serpent, a far more potent creation than the literal reptile. Culture, as a product of the mind, can be interpreted as an image-making machine that recreates the outside world through symbols arranged into maps and stories. But the mind does not have the capacity to grasp reality in its full chaotic richness; nor does the body last long enough for the brain to process information piece by piece like an all-purpose

computer. Rather, consciousness races ahead to master certain kinds of information with enough efficiency to survive. It submits to a few biases easily, while automatically avoiding others. A great deal of evidence has accumulated in genetics and physiology to show that the controlling devices are biological in nature, built into the sensory apparatus and brain by particularities in cellular architecture.

The combined biases are what we call human nature. The central tendencies, exemplified so strikingly in fear and veneration of the serpent, are the wellsprings of culture. Hence simple perceptions yield an unending abundance of images with special meaning while remaining true to the forces of natural selection that created them.

How could it be otherwise? The brain evolved into its present form over a period of about two million years, from the time of *Homo habilis* to the late Stone Age of *Homo sapiens*, during which people existed in hunter-gatherer bands in intimate contact with the natural environment. Snakes mattered. The smell of water, the hum of a bee, the directional bend of a plant stalk mattered. The naturalist's trance was adaptive: the glimpse of one small animal hidden in the grass could make the difference between eating and going hungry in the evening. And a sweet sense of horror, the shivery fascination with monsters and creeping forms that so delights us today even in the sterile hearts of the cities, could keep you alive until the next morning. Organisms are the natural stuff of metaphor and ritual. Although the evidence is far from all in, the brain appears to have kept its old capacities, its channeled quickness. We stay alert and alive in the vanished forests of the world. ❧

Edward O. Wilson *is Pellegrino University Professor and curator of entomology at the Museum of Comparative Zoology at Harvard University. His many books include* Naturalist *(1994),* Consilience *(1998), and* The Future of Life *(2002).* On Human Nature *(1978) and* The Ants *(1990, co-authored with Bert Holldobler) won the Pulitzer Prize.*

Snakes in the Balance

David Suzuki, host of the television series *The Sacred Balance,* is on a quest to understand humanity's place in Nature. No wonder, then, that Dr. Suzuki asked his old friend, E.O. Wilson, to share with viewers his philosophy on "biophilia" and his deep connection to many of the least understood creatures on the planet—including snakes. Dr. Wilson is featured in the final episode of *The Sacred Balance;* this 4-part television series will air on many PBS stations starting September 3.

David Suzuki and E.O. Wilson share a serpent.

The Wildlands Project is a proud partner in *The Sacred Balance* outreach campaign bringing informal science activities to museums, classrooms, and public libraries. Meet David Suzuki on a Sacred Balance tour starting September 2 in Washington DC, and traveling to New York City, September 4; St. Louis, September 5; San Francisco/Berkeley, September 7; Dallas, September 9; and Atlanta, September 10. Science and technology museums will partner with local PBS stations to screen series segments—it's an opportunity to hear a presentation from Dr. Suzuki and connect with local conservation efforts. For more information visit www.sacredbalance.com/outreach.