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ONE

The Evolution of Mind

Origin of man now proved.—Metaphysic must flourish.—He who understands baboon would do more towards metaphysics than Locke.

CHARLES DARWIN, 1838: *NOTEBOOK M*

What goes through a baboon's mind when she contemplates the 80 or so other individuals that make up her group? Does she understand their social relations? Does she search for rules that would allow her to classify them more easily? Does she impute motives and beliefs to them in order to better predict their behavior? Does she impute motives and beliefs to *herself* when planning a course of action? In what ways are her thoughts and behavior like ours, and in what ways—other than the obvious lack of language and tools—are they different? These are questions that also vexed Charles Darwin.

We have taken our title from one of Darwin's most memorable remarks. He wrote it on August 16, 1838, almost two years after returning from his voyage on the *Beagle* and 21 years before the publication of *The Origin of Species*. It was a time of vigorous intellectual activity, when Darwin read voraciously on many subjects, both within and beyond the sciences, and met and talked with many different people, from family friends to prominent literary and political figures (Hodge 2003). Despite this active intellectual life, however, it seems unlikely that he or anyone else had ever combined the words "baboon" and "metaphysics" in the same sentence. What was Darwin thinking?

CHAPTER ONE

Mind and behavior in Darwin's time

The Cambridge English Dictionary defines metaphysics as "the part of philosophy that is about understanding existence and knowledge." Writing in the *Westminster Review* in 1840, John Stuart Mill offered a summary of views on the origin of knowledge that were being discussed by Darwin and his contemporaries. "Every consistent scheme of philosophy requires, as its starting point, a theory representing the sources of human knowledge, and the objects which the human faculties are capable of [understanding]. The prevailing theory in the eighteenth century ... was that proclaimed by Locke, and attributed to Aristotle—that all our knowledge consists of generalizations from experience" (Mill 1840). According to this theory, Mill continued, we know "nothing, except the facts which present themselves to our senses, and such other facts as may, by analogy, be inferred from these. There is no knowledge *a priori;* no truths cognizable by the mind's inward light and grounded on intuitive evidence." Locke believed that the mind acts simply to associate events that have been joined together through proximity and repetition. From these associations it generates behavior. Anything we think or do can ultimately be traced to our experience.

Mill continued: "From this doctrine Coleridge with ... Kant ... strongly dissents. ... He distinguishes in the human intellect two faculties ... Understanding and Reason. The former faculty judges of phenomena, or the appearance of things, and forms generalizations from these: to the latter it belongs, by direct intuition, to perceive things, and recognize truths, not cognizable by our senses." In Kant's scheme, these perceptions exist a priori but are not completely innate because they require experience for their expression. For Kant, the mind was not a blank slate on which any sort of experience can write any kind of instructions. It is, instead, biased in the way it responds to features of the world—actively organizing experiences and generating behavior on the basis of preexisting schemes. To understand our thoughts, beliefs, and behavior, therefore, we must consider not only our own individual experiences but also the preexisting nature of the mind itself.

Empiricism and rationalism were hotly debated at the time. Mill reported that "between the partisans of these two opposite doctrines there reigns a *bellum internecinum* [in which] even sober men on both sides take no charitable view of each others' opinions." Darwin followed the debate, but with a more open mind and a much more zoological perspective than many of his contemporaries. While others debated the

nature of the human mind, he also puzzled over the minds of bees, dogs, and baboons.

Darwin's interest in metaphysics was motivated by more than just idle curiosity—it was also fueled by excitement and personal ambition. By the late 1830s and 1840s, the theory of evolution by natural selection was beginning to take shape in his mind, and his notebooks are filled with many speculations about how his work might shed an entirely new light on the study of human knowledge.

Darwin had observed that every animal species engages in repeated, "habitual" behavior. Birds build nests, squirrels hoard seeds, and dogs raise the fur on their back when they feel threatened. He believed that these behaviors recurred because they were beneficial to the individuals involved and that, over generations, habitual behavior became "instinctive," or innate. Under the right conditions, instinctive behavior would appear automatically, even if the animal had never before had the appropriate experience. When they act by instinct, then, animals are not behaving according to Lockean reason, carefully weighing the information acquired from experience. Instead, they are governed by "hereditary tendencies" acquired over generations (Darwin 1838a; for Darwin's views on habitual and instinctive behavior, see his other notebooks in P.H. Barrett et al. 1987).

This is not to say that Darwin believed animals were slaves to their instincts, wholly devoid of learning or reason. Some of his contemporaries did hold such views, and used them to draw a sharp distinction between humans and other animals. The naturalist Edward Blyth (1837), for example, wrote that "whereas the human race is compelled to derive the whole of its information through the medium of its senses, the brute is, on the contrary, supplied with an innate knowledge of whatever properties belong to all the natural objects around." Darwin disagreed—both with the conclusion that animals' thoughts and behavior are entirely based on instinct and with the view that human thought and behavior are governed entirely by reason. "[It is] hard to say what is instinct in animals & what [is] reason, in precisely the same way [it is] not possible to say what [is] habitual in men and what reasonable. ... as man has hereditary tendencies, therefore man's mind is not so different from that of brutes" (Darwin 1838a). Like many of his contemporaries, Darwin was searching for an explanation of mind and behavior that would combine innate, inherited tendencies (a bit of rationalism from Kant) with reasoning based on experience (a bit of empiricism from Locke) (Richards 1987). In this as in so much else, Darwin was a man ahead of his time.

Darwin also realized that, whatever the exact balance between innate behavior and reason in any particular instance, his theory of evolution had important implications for the study of metaphysics. After all, thoughts and instincts came from the mind, and the mind could be studied like any other biological trait. It was different in different species, reflecting the particular adaptations of each, and it could change gradually over time, being transmitted from one generation to the next. In his notebook M (M for metaphysics), Darwin wrote: "We can thus trace causation of thought ... [it] obeys [the] same laws as other parts of structure" (Darwin 1838b).

With growing excitement, Darwin began to see that his theory might allow him to reconstruct the evolution of the human mind and thereby resolve the great debate between rationalism and empiricism. The modern human mind must acquire information, organize it, and generate behavior in ways that have been shaped by our evolutionary past. Our metaphysics must be the product of evolution. And just as the key to reconstructing the evolution of a whale's fin or a bird's beak comes from comparative research on similar traits in closely related species, the key to reconstructing the evolution of the human mind must come from comparative research on the minds of our closest animal relatives. "He who understands baboon would do more towards metaphysics than Locke."

Twentieth-century views: behaviorists and their critics

In the first half of the 20th century, research on the mind and behavior was dominated by modern-day empiricists like E. L. Thorndike, J. B. Watson, and B. F. Skinner, who together developed the doctrine of behaviorism. Like Locke, they believed that organisms come into the world with little a priori knowledge: behavior is the product entirely of experience. As an animal moves through its world, it encounters stimuli and responds to them. If its response is followed by something pleasant, like food, the response will be repeated whenever the animal encounters the same stimulus again. In this way, the animal quickly develops an array of behaviors that are well suited to its needs.

As the intellectual descendants of Locke, behaviorists believed that the mind is concerned primarily with the formation of associations: mechanical principles of attachment that develop as a result of experience. They saw the mind not as an active "thinking" organ, predisposed to organize incoming stimuli in certain ways, but instead as a rather

passive arena in which stimuli from the environment are combined according to simple rules, thereby producing behavior. The behaviorists concluded that a few simple but powerful laws, like Pavlov's Law of Association and Thorndike's Law of Effect, could account for all behavior, in every species and every circumstance. They believed in the principle of *equipotentiality*. As Skinner famously remarked, "Pigeon, rat, monkey, which is which? It doesn't matter ... once you have allowed for differences in the ways they make contact with the environment, what remains of their behavior shows astonishingly similar properties" (Skinner 1956:230–231).

The behaviorists saw little point in considering mental activities like thoughts, feelings, goals, or consciousness, for reasons that were both methodological and deeply philosophical. On the practical side, mental states like thoughts or emotions are private. They cannot be observed or measured, nor can one predict how they might be changed by experience. Under these circumstances, the mental activities of animals can hardly play a role in any scientific discipline. Even in humans, where introspection prompted some behaviorists to admit—grudgingly—that mental states might exist, the exact nature of these states are unknowable because they can never be verified by more than one person. Once again, this makes mental states unsuitable for scientific study. Some behaviorists went even further. In his 1974 book *About Behaviorism,* Skinner distinguished between "methodological behaviorists" who accepted the existence of mental states but avoided them because they could not be studied scientifically, and "radical behaviorists" like himself, who believed that "so-called mental activities" were an illusion—an "explanatory fiction." For Skinner, thoughts, feelings, goals, and intentions played no role in the study of behavior because they did not, in fact, exist.

Although behaviorism dominated 20th-century psychology, it was not without its critics. Perhaps the best way to understand them is to consider some classic observations and experiments that challenged the behaviorists' worldview.

Song sparrows (*Melospiza melodia*) and swamp sparrows (*Melospiza georgiana*) are two closely related North American birds with very different songs. Males in both species learn their songs as fledglings, by listening to the songs of other males. But this does not mean that the mind of a nestling sparrow is a blank slate, ready to learn virtually anything that is written upon it by experience. In fact, as classic research by Peter Marler and his colleagues has shown, quite the opposite is true. If a nestling male song sparrow and a nestling male swamp sparrow are

raised side-by-side in a laboratory where they hear tape-recordings of both species' songs, each bird will grow up to sing only the song of its own species (Marler and Peters 1989).

The constraints that channel singing in one direction rather than another cannot be explained by differences in experience, because each bird has heard both songs. Nor can the results be due to differences in singing ability, because both species are perfectly capable of producing each other's notes. Instead, differences in song learning must be the result of differences in the birds' brains: something in the brain of a nestling sparrow prompts it to learn its own species' song rather than another's. The brains of different species are therefore not alike. And the mind of a nestling sparrow does not come into the world a tabula rasa—it arrives, instead, with genetically determined, inborn biases that actively organize how it perceives the world, giving much greater weight to some stimuli than to others. One can persuade a song sparrow to sing swamp sparrow notes, but only by embedding these notes into a song sparrow's song (Marler and Peters 1988). It is almost impossible to persuade a swamp sparrow to sing any notes other than its own (Marler and Peters 1989). Philosophically speaking, sparrows are Kantian rationalists, actively organizing their behavior on the basis of innate, preexisting schemes.

In much the same way, human infants have their own sensory and cognitive biases. From the first days of life, they attend more readily to faces than to other visual stimuli and more readily to speech than to other auditory stimuli. This latter bias can apparently be traced to a preference for the intonation contours in spoken language: two-day-old babies show distinctive cerebral blood flow when they hear a normal sentence but not when the same sentence is played backward (Dehaene-Lambertz et al. 2002; Peña et al. 2003). Humans and sparrows are not alone in preferring their own species' sounds: when a rhesus macaque monkey (*Macaca mulatta*) hears a call given by a member of its own species, its brain exhibits activity that is markedly different from that shown in response to other sounds. Indeed, rhesus calls activate in the rhesus brain the same areas activated by human speech in the human brain (Gil da Costa et al. 2004).

Some of the most striking evidence for an innate predisposition to learn one's own species' communication comes from children who are born blind or deaf. Although they cannot see the objects in the world to which spoken words refer, blind children develop language at roughly the same age and in the same manner as children who can see (Landau and Gleitman 1985). Data from children born deaf are even more strik-

ing. Lila Gleitman, Susan Goldin-Meadow, and their colleagues studied several deaf children born to hearing parents who did not themselves know ASL, the American Sign Language for the deaf. Although raised in loving, supportive environments, these children were deprived of any exposure to language. Nonetheless, they spontaneously invented a sign language of their own, beginning with single signs at roughly the same age that single words would ordinarily have appeared. And during the following months and years, as they developed more complex sentences, the children produced signs in a serial order according to their semantic role as subject, verb, and object (see Goldin-Meadow 2003 for review).

The songs of sparrows, the calls of monkeys, and the language of human children could hardly be more different, yet they all lead to the same conclusion: each species has a mind of its own that, like its limbs, heart, and other body parts, has evolved innate predispositions that cause it to organize incoming sensations in particular ways. The mind arrives in the world with constraints and biases, "prepared" by evolution to view the world, organize experiences, and generate behavior in its own particular way (Pinker 2002). And because each species is different, the behavior of different species is unlikely to be explained by a few general laws based entirely on experience. Although there may well be some general features of learning that are shared by many species, the behaviorists' principle of equipotentiality ("pigeon, rat, monkey...") is understandable but incorrect.

But what of the behaviorists' second major premise, that the "mind" and "mental states"—if they exist at all—are private and unmeasurable, and cannot be studied scientifically? This view was also challenged, most prominently by the psychologist Edward C. Tolman (1932), who argued that learning is not just a mindless link between stimulus and response. Instead, animals acquire *knowledge* as a result of their experiences.

In 1928, Otto L. Tinklepaugh, a graduate student of Tolman's, began a study of learning in monkeys. His subjects were several macaques who were tested in a room in the psychology department at the University of California at Berkeley (sometimes the tests were held outdoors, on the building's roof, which the monkeys much preferred). In one of Tinklepaugh's most famous experiments, a monkey sat in a chair and watched as a piece of food—either lettuce or banana—was hidden under one of two cups that had been placed on the floor, six feet apart and several feet away. The other cup remained empty. Once the food had been placed under the cup, the monkey was removed from the room for several minutes. Upon his return, he was released from the chair and

allowed to choose one of the cups. All of Tinklepaugh's subjects chose the cup hiding the food, though they performed the task with much more enthusiasm when the cup concealed banana.

To illustrate the difference between behaviorist and cognitive theories of learning, pause for a moment to consider the monkey as he waits outside the experimental room after seeing, for example, lettuce placed under the left-hand cup. What has he learned? Most of us would be inclined to say that he has learned that there is lettuce under the left-hand cup. But this was not the behaviorists' explanation. For behaviorists, the reward was not part of the content of learning. Instead, it served simply to reinforce or strengthen the link between a stimulus (the sight of the cup) and a response (looking under). The monkey, behaviorists would say, has learned nothing *about* the hidden food—whether it is lettuce or banana. His knowledge has no content. Instead, the monkey has learned only the stimulus-response associations, "When you're in the room, approach the cup you last looked at" and "When you see the cup, lift it up." Most biologists and laypeople, by contrast, would adopt a more cognitive interpretation: the monkey has learned that the right-hand cup is empty but there is lettuce under the left-hand cup.

To test between these explanations, Tinklepaugh first conducted trials in which the monkey saw lettuce hidden and found lettuce on his return. Here is his summary of the monkey's behavior:

> Subject rushes to proper cup and picks it up. Seizes lettuce. Rushes away with lettuce in mouth, paying no attention to other cup or to setting. Time, 3–4 seconds.

Tinklepaugh next conducted trials in which the monkey saw banana hidden under the cup. Now, however, Tinklepaugh replaced the banana with lettuce while the monkey was out of the room. His observations:

> Subject rushes to proper cup and picks it up. Extends hand toward lettuce. Stops. Looks around on floor. Looks in, under, around cup. Glances at other cup. Looks back at screen. Looks under and around self. Looks and shrieks at any observer present. Walks away, leaving lettuce untouched on floor. Time, 10–33 seconds.

It is impossible to escape the impression that the duped monkey had acquired *knowledge,* and that as he reached for the cup he had an expectation or belief about what he would find underneath. His shriek reflected his outrage at this egregious betrayal of expectation.

Many years later, Ruth Colwill and Robert Rescorla (1985) carried out a more controlled version of the same experiment. They began by train-

ing rats to make two responses, pressing a lever and pulling a chain. When the rats pressed the lever they received a small food pellet; when they pulled the chain they received liquid sucrose. By the behaviorist view, the rats had learned only to press the lever or pull the chain whenever they saw them. By the cognitive view, the rats had formed some kind of mental representation of the relation between a particular act and a specific type of food. To test between these hypotheses, Colwill and Rescorla made either the food pellet or the water unpalatable by adding lithium chloride, a substance that makes rats sick. If the rats had learned which food type was associated with which behavioral act, then those for whom the food pellet had been devalued would avoid the lever but continue to pull the chain, whereas those for whom the water had been devalued would do the opposite. This is exactly what happened.

The results of these experiments challenge the more extreme behaviorists' view that mental states like knowledge, beliefs, or expectations cannot be studied scientifically and may even be an illusion. Instead, they support Tolman's view that learning allows an animal to form a mental representation of its environment. Through learning, animals acquire information about objects, events, and the relation between them. Their knowledge has content, and this content can be studied scientifically.

This conclusion from the laboratory is important, because it encourages us to believe that Darwin was right: we can trace the causation of thought in different species, study its structure, and reconstruct its evolution. But while the scientific study of mind is an exciting prospect, a large dose of humility is in order. For all of their failings, the behaviorists did understand that, whereas behavior can be unambiguously observed and measured, knowledge and the content of mental states are abstract, hard to measure, and difficult even to define. Once you accept the existence of mental states and ascribe causal power to them, you have opened Pandora's box, releasing a host of fundamental questions that are difficult if not impossible to answer.

When we say that a song sparrow's brain "predisposes" it to attend to song sparrow song in a way that it attends to no other, what precisely do we mean? When we claim that a rat has formed an association between bar pressing and a particular type of food, what exactly is the nature of its knowledge? Does the rat think that the bar somehow *stands for* that food? Does it believe that pressing the bar *causes* the food to appear? Can rats distinguish between the relations A *represents* B and A *causes* B? When Pavlov's dog salivated at the sound of a metronome, was this an automatic, unthinking reflex, or did it occur because the metronome

brought to mind an image of meat? None of these questions is easy to answer.

Why baboons?

On first—and perhaps even further—inspection, baboons might seem less than ideal subjects for a study of the mind. Among other failings, they are not as closely related to humans as some other nonhuman primates. Baboons are members of the genus *Papio,* Old World monkeys that shared a common ancestor with humans roughly 30 million years ago (Steiper et al. 2004). Baboons are more closely related to humans than monkeys of the New World, but they are much less closely related than the African apes—especially chimpanzees (*Pan troglodytes*)—which diverged from our own ancestors roughly five to seven million years ago. Moreover, the conservation status of baboons confers neither glamour nor prestige on those who study them. Far from being endangered, baboons are one of Africa's most successful species. They flourish throughout the continent, occupying every ecological niche except the Sahara and tropical rain forests. They are quick to exploit campsites and farms and are widely regarded as aggressive, destructive, crop-raiding hooligans. Finally, baboons are not particularly good-looking—many other monkeys are far more photogenic. Indeed, through the ages baboons have evoked as much (if not more) repulsion than admiration.

Baboons are interesting, however, from a social perspective. Their groups number up to 100 individuals and are therefore considerably larger than most chimpanzee communities. Each animal maintains a complex network of social relationships with relatives and nonrelatives—relationships that are simultaneously cooperative and competitive. Navigating through this network would seem to require sophisticated social knowledge and skills. Moreover, the challenges that baboons confront are not just social but also ecological. Food must be found and defended, predators evaded and sometimes attacked. Studies of baboons in the wild, therefore, allow us to examine how an individual's behavior affects her survival and reproduction. They also allow us to study social cognition in the absence of human training, in the social and ecological contexts in which it evolved.

In Darwin's theory of evolution by natural selection, necessity is the mother of invention. Traits arise or are maintained because they help the individuals who possess them to solve a problem, thereby giving those individuals an advantage over others in survival and reproduction. A

blunt, heavy beak allows a finch to crush hard, dry seeds and survive a withering dry season; antlers enable a stag to defeat his rivals and mate with more females. The finch's beak and the stag's antlers did not arise at random; they evolved and spread because of their adaptive value. To understand the evolution of a trait, therefore, we need to understand how it works, and what it allows an individual to do that might otherwise be impossible.

And brains, Darwin realized, were biological traits like any other. To understand how they evolved, we must understand the problems they were designed to solve. In recent years, studies of the brain, intelligence, and evolution in animals have produced two general conclusions that will guide our study of baboon metaphysics.

First, natural selection often creates brains that are highly specialized. Arctic terns (*Sterna paradisaea*) migrate each year from one end of the earth to another, *Cataglyphis* ants navigate across the featureless Sahara, bees dance to signal the location of food, and Clark's nutcrackers (*Nucifraga columbiana,* a member of the crow, or corvid, family) store and recover tens of thousands of seeds during the fall and winter. Yet despite these specialized skills, there is no evidence that terns, ants, bees, or nutcrackers are generally more intelligent than other species. Instead, they are more like nature's idiots savants: brilliant when it comes to solving a specific, narrowly defined problem, but pretty much average in other domains.

Specialized intelligence may be widespread in animals because brain tissue is costly to develop and maintain. The human brain uses energy at a rate comparable to that used by the leg muscles of a marathon runner when running (Attwell and Laughlin 2001). If brain tissue is energetically expensive, the cheapest way to evolve a specialized skill may be through a small number of especially dedicated brain cells rather than a larger, general-purpose brain. For arctic terns, the ability to fly from pole to pole in the spring and fall is adaptive because it allows the birds to live in perpetual summer. As a result, selection has favored individuals with the neural tissue needed to navigate great distances using the sun, the stars, and the earth's magnetic field. But it has done so in the cheapest, most energy-efficient way possible—by selecting specifically for navigational skills.

The second general conclusion to emerge from recent research is that the domain of expertise for baboons—and indeed for all monkeys and apes—is social life. Most baboons live in multimale, multifemale groups that typically include eight or nine matrilineal families, a linear dominance hierarchy of males that changes often, and a linear hierarchy

of females and their offspring that can be stable for generations. Daily life in a baboon group includes small-scale alliances that may involve only three individuals and occasional large-scale, familial battles that involve all of the members of three or four matrilines. Males and females can form short-term bonds that lead to reproduction, or longer-term friendships that lead to cooperative child rearing. The result of all this social intrigue is a kind of Jane Austen melodrama, in which each individual must predict the behavior of others and form those relationships that return the greatest benefit. These are the problems that the baboon mind must solve, and this is the environment in which it has evolved.

Social problems, of course, are not the only challenges. Baboons also need to solve ecological problems, like finding food and avoiding predators. But these problems are also overwhelmingly social. One of the most difficult aspects of finding food arises from the fact that as many as 100 other individuals in your group also want the food for themselves. And the best way to avoid being taken by lions, leopards, crocodiles, or pythons is to live in a group, with all of the opportunities and compromises that group life entails. Any way you look at it, most of the problems facing baboons can be expressed in two words: other baboons.

The study group and data collection

The focus of our research is a group of chacma baboons (*Papio hamadryas ursinus*) living in the Moremi Game Reserve in the Okavango Delta of Botswana. We began our study in 1992, but before our arrival the group had been observed more or less continuously for 14 years by W. J. Hamilton III and his students at the University of California at Davis. Because the baboons have endured interlopers for three decades, they are completely habituated to humans walking among them and tolerate our presence with diffident aplomb, if not affection. Even the oldest female in the group, the curmudgeonly and mean-spirited Sylvia, has had to put up with human observers since her birth in 1982. Between 1992 and 2006, group size averaged 80 individuals, with fluctuations depending on rates of infanticide, predation, and male immigration. The number of adult females has varied from 18 to 28 and the number of adult males from 3 to 12.

When following the baboons, we and our colleagues collect three sorts of data. First, each day we note all demographic changes in the group, including births, deaths, immigrations, emigrations, and sexual consortships. Second, we conduct 10 minute-long "focal animal sam-

ples" (Altmann 1974) on each individual following a systematic rotation. These samples supply us with a continuous record of the baboons' interactions and social partners and provide the data to document the continuous soap opera that constitutes baboon life. We also note specific other events—like fights, alliances, interactions between groups, and encounters with predators—on an ad libitum basis, whenever they occur. Third, we make audio recordings of the baboons' vocalizations, for both acoustical analysis and "playback" experiments. We describe these experiments in detail in Chapters 5 and 6. Finally, between 2002 and 2005 we have collected weekly fecal samples from all adult males and females for the extraction of testosterone (from males) and glucocorticoids (from males and females). Glucocorticoids are a class of steroid hormone associated with stress.

The beauty of a fecal sample—if that is the appropriate term—is that it allows us to measure a biological response that cannot be observed. It can also be collected without itself inducing stress, as would certainly happen if we tried to extract blood. The data from fecal samples allow us to look beneath the surface of baboon society and ask, "Who is under stress? Why? And how it is alleviated?" Like humans, baboons have families, seek mates, form friendships, and suffer fear and anxiety from events both social and environmental. Unlike humans, though, baboons cannot explain the causes of their anxiety to us; indeed, as we will see, they may not even be explicitly aware of feeling anxious or depressed. Like their behavior and vocalizations, the baboons' hormonal profiles allow us to ask them, indirectly, what they think and how they feel.

How this book is organized

In writing this book, we had to decide whether to include material from our earlier book on vervet monkeys (*Cercopithecus aethiops*), *How Monkeys See the World* (Cheney and Seyfarth 1990). We knew that we could not operate under the conceit that our readers would remember anything from that volume, but at the same time we wanted to avoid *The Bride of How Monkeys See the World*. We also had to resolve how exhaustively we would review the vast literature on animal cognition. In the end, we decided that we would focus primarily on research that was directly relevant to our work on baboons. We therefore discuss vervet monkeys only sparingly and make no attempt to consider, for instance, whether animals have "cognitive maps" of their environment, can represent numerical quantities, or make optimal foraging decisions. This is not due

to laziness, nor is it because we believe that baboons simply stumble about their habitat with no inkling about where they are, where they are going, or what they are eating. Instead, we avoid these and many other important questions because we were unable to investigate them directly (two good reviews of animal cognition are Shettleworth 1998 and Tomasello and Call 1997).

The link between primates' intelligence and the complexity of their social behavior may seem obvious, but this has not always been the case. In Chapter 2, we take a historical perspective and examine a curious fact about our ancestors' knowledge of their closest animal relatives. For centuries people have known that, of all the creatures in the world, monkeys and apes are most like us. Ironically, however, scholars reached this conclusion without knowing anything at all about the characteristics of primates that make them most human: their social life. Because Western scientists learned about primates by examining corpses or observing single animals brought home as pets, few if any ever learned what can be discovered only through long, patient observation: that the most human features of monkeys and apes lie not their physical appearance but in their social relationships.

In Chapter 3 we describe the ecological setting in which our work takes place and the predators that so affect baboons' lives. In Chapters 4 and 5 we introduce the protagonists with a discussion of social behavior and life histories among males (Chapter 4) and females (Chapter 5), in all of their familial complexity, friendships, alliances, stress, and Machiavellian intrigue. As part of this description we introduce, in Chapter 5, the method of field "playback" experiments that we use to explore what baboons know about the relations that exist among others. In doing so, we present one of our central arguments—that even though baboons lack language, their vocal communication is rich enough in meaning to tell us a great deal about how they think. Primate vocalizations, in fact, provide the key that unlocks the primate mind.

Whereas Chapters 1 through 5 are introductory, historical, and descriptive—designed to introduce readers unfamiliar with baboons to the monkeys' habitat, behavior, and social structure—Chapters 6 through 11 delve more deeply into the scientific questions that guide our research. In Chapter 6 we describe experiments designed to test baboons' knowledge of their social companions. The results show that baboons are good psychologists: they recognize their companions as individuals, observe their behavior, and create, in their minds, a hierarchical representation of society based on matrilineal kinship and dominance rank. The social knowledge of baboons is too varied and complex to

be explained by simple learning mechanisms. Instead, we propose that natural selection has led to the evolution of a mind innately predisposed to search for the patterns and rules that underlie other baboons' behavior.

In Chapter 7 we examine baboons' knowledge of their companions in light of the "social intelligence" hypothesis, which argues that the demands of living in large social groups have placed strong selective pressure on the evolution of the primate mind. The average value for relative brain size in primates exceeds the average value for other mammals, and primate brains contain many areas specialized for dealing with social stimuli. Baboons and other monkeys recognize each other's ranks and kin relations, and their reproductive success and ability to overcome stress depend on their skill in forming social relations. Similar social skills, however, are also found in nonprimate species that live in large social groups, including dolphins, hyenas, and pinyon jays. Furthermore, even relatively asocial species appear to monitor other individuals' social interactions. It therefore remains unclear whether social intelligence in animals depends on taxonomic affiliation, group size, or some other combination of factors.

In *How Monkeys See the World,* we concluded that, for all their intriguing similarities, the societies of nonhuman primates were fundamentally different from our own because monkeys and apes lack a "theory of mind"—the ability to attribute mental states like knowledge and belief to others. In Chapter 8 we reconsider this conclusion in light of experiments conducted over the past 15 years by ourselves and many others. In Chapter 9 we consider the related question of whether baboons or any other primates are aware of their own mental state—that is, whether they have anything like our concept of self.

We take it for granted that human words express thoughts and that language provides a window onto the mind. Surprisingly, however, few people have ever applied this idea to animals. In Chapter 10 we review what is known about the vocal communication of baboons and confront directly one of the questions that behaviorists—perhaps wisely—avoided: What does one baboon's vocalization "mean" to another? We also consider the complex relation between language and thought, but from a perspective not usually found among those who work exclusively on humans: we ask what thought is like in a creature without language. In Chapter 11 we consider what our work has to say about the evolution of language. Finally, in Chapter 12 we return to the challenge posed by Darwin's famous quotation—that an understanding of baboon metaphysics can shed light on the evolution of human mind and behavior.

TWO

The Primate Mind in Myth and Legend

Our descent, then, is in the origin of our evil passions!! The Devil under form of Baboon is our grandfather! CHARLES DARWIN, 1838: *NOTEBOOK M*

[Ahla, the baboon] is not only eager but really a maniac when it comes to putting back the lambs with the mothers. She can't wait until the door between the two enclosures is opened.
WALTER HOESCH, 1961: *ON GOAT-HERDING BABOONS*

The baboon in Egypt: god, scribe, and policeman

Baboons range widely throughout the African continent, so it is perhaps not surprising that they appear often in ancient Egyptian mythology and art. Beginning in at least the fourth millennium B.C., baboons were associated with the underworld and considered to be embodiments of the dead, no doubt in part because they resembled humans so closely. The word "baboon" may derive from the baboon god Baba, or Babi, a supernaturally aggressive deity who was revered during the Predynastic Period. Perhaps because the ancient Egyptians could not help but notice male baboons' sexual zeal and prominent genitalia, the baboon god ensured that the dead would not suffer from impotence in the afterlife. Indeed, baboon feces were used as an ingredient in aphrodisiacs.

By the time of the Old Kingdom, around 2400 B.C., baboons had become associated with Thoth, the god of wisdom, science, writing, and measurement. In tomb paintings

and sculptures, baboons instructed scribes in their tasks and weighed the hearts of the deceased. Baboons also came to be identified with the sun god Re, probably because the loud dawn choruses of male baboons' *wahoo* calls were taken as a sign that they were worshiping the sun. In addition to associating with Thoth, baboons were believed to stand by Re in his boat as he traveled across the sky. Even into the late Ptolemaic periods, baboons were still regarded as sufficiently sacred to be mummified and kept in colonies at temples (Budge 1969; David 1998; Redford 2002).

But the ancient Egyptians did not just depict baboons as deities. They also portrayed them in many other guises, not only as scribes but also as musicians, sailors, shipwrights, fishermen, and even vintners. Most, if not all, of these depictions were doubtless fanciful—it seems unlikely that baboons ever tended grapes or built ships. More credibly, baboons were depicted as captives brought from the south, as pets on leashes, or as dancers or jesters. Some paintings show them climbing trees to collect figs and dates for their master, and—even more plausibly—pilfering fruit from baskets (Wilkinson 1879; Janssen and Janssen 1989). Hieroglyphics from tombs of the New Kingdom accompany some of these pictures with remarks like "A monkey carries a stick (for dancing), though its mother did not carry it," suggesting the artist's appreciation for the baboon's ability to learn. Other hieroglyphics comment on baboons' capacity to understand words (Janssen and Janssen 1989). Baboons even appear in the role of police assistants. One illustration from the Old Kingdom mastaba of Tepemankh at Saqarra shows two baboons on leashes—one a female carrying an infant and the other an adult male—grabbing thieves in the market place (Fig. 1). The accompanying

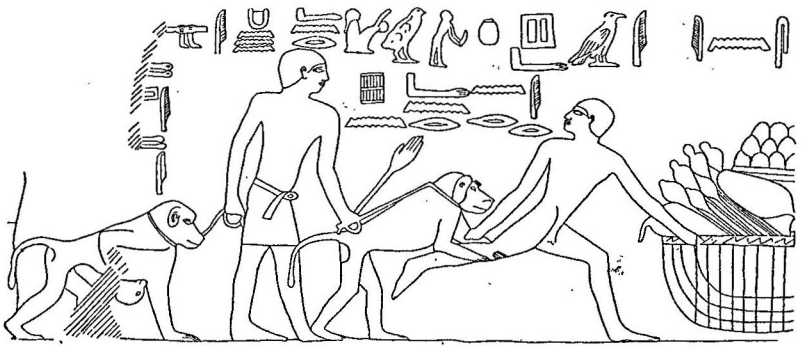

Figure 1. An Egyptian tomb painting from the Old Kingdom depicts two baboons acting as police assistants, attacking a thief in the marketplace.

hieroglyphic reads, "Fear for this baboon" (Smith 1946; Janssen and Janssen 1989).

The Egyptians probably derived much of their knowledge about baboons from pets, temple colonies, and stories emanating from Nubia or other remote areas. Although most of these portrayals probably served a religious or humorous function, they also show that the Egyptians were not entirely ignorant of baboons' natural social behavior: male baboons do, for example, participate in loud *wahoo* contests in the early morning. If any early Egyptian ever did take the time to observe the baboons' natural social interactions, however, he left no record of his observations.

European and Japanese attitudes

No clear record exists of the first contact between a European scientist and a nonhuman primate (Janson 1952). As far as we can tell from Aristotle's *Historia Animalium* and other Classical texts, the first primatological subjects to be studied by western scientists were baboons and the Barbary macaques (*Macaca sylvanus*) that inhabited the southern shores of the Mediterranean (Spencer 1995). These animals came to scientists either as corpses to be dissected or as single animals to be held in cages and observed.

Classical speculation about the mind and behavior of primates was part of a more general curiosity about all animals, and about the fundamental differences between animals and human beings. Aristotle believed that, when it came to emotions, the difference between animals and humans was only a matter of degree. In both humans and animals, tameness graded into wildness, docility into stubbornness, boldness into cowardice or fear, and confidence into anger (Sorabji 1993). By contrast, in matters of intellect Aristotle drew a sharp distinction between humans and all other creatures, including the nonhuman primates. Unlike humans, he argued, animals were completely lacking in reason, intellect, thought, belief, and, as a consequence, language. How, then, did they manage to deal with the world? To make up for their lack of intellect, Aristotle argued, animals have an elaborate, expanded, but intellectually limited, form of perception (Sorabji 1993). Dogs (*Canis familiaris*) are extremely skilled at identifying and tracking scents, but they know only how to detect and react to an olfactory stimulus. They have no true knowledge or beliefs about scents, nor about the causal

relations that link a particular scent with its owner. Dogs, in Aristotle's view, just react; humans understand.

Scapegoat and trickster

Were monkeys and apes any different? The Greeks and Romans recognized clearly that, among all animals, nonhuman primates were the creatures most similar to human beings. But their anatomy did not elevate their status; instead, quite the reverse occurred. Convinced, like Aristotle, that all animals were fundamentally different from humans on intellectual grounds, Classical scholars ignored both the anatomical evidence and Aristotle's argument for continuity in emotions. Instead, they adopted a kind of "reverse Darwinism" in which the more an animal resembled a human, the more it was shunned, made into an object of ridicule, and declared to be fundamentally different. The general view is summarized by the dictum of the Roman poet Quintus Ennius: *"Simia quam similis turpissima bestia nobis"* ("How like us is that ugly brute, the ape").[1] As the art historian H. W. Janson points out, "the ape was *turpissima bestia* precisely because it was *quam similis nobis.* As an unworthy pretender to human status, a grotesque caricature of man, the ape became the prototype of the trickster, the sycophant, the hypocrite, [and] the coward," as well as the symbol of extreme physical ugliness. Or as Plato put it, "The most beautiful of apes is ugly compared to man and the wisest of men is an ape beside God" (Janson 1952:14–15; McDermott 1938; Corbey 2005).

In Japan, where humans have coexisted with Japanese macaques (*Macaca fuscata*) for thousands of years, monkeys played a similarly ambiguous role in everyday life and legend. In Japanese legends monkeys were often portrayed as foolish and vain creatures whose servitude to their master gods eventually earned them courage, generosity, wisdom, and loyalty. Many of these legends arrived with Buddhism from India, where the monkey god Hanuman is still revered as a loyal and intelligent servant to the mythical King Rama. The Japanese recognized that monkeys were obviously the most humanlike of all animals: even today, the monkey is the only creature referred to in the Japanese language by the term *san,* the address form used for humans. As a "special" animal, monkeys were regarded as mediators between humans and deities and were thought to have the power to maintain the health and

1. In early writings, no distinction was made between monkeys and apes.

cure the illnesses of horses. Monkey parts were used to cure human illnesses and bring good luck. On the other hand, the monkey's elevated position coexisted uneasily with its image as a false pretender to human status, a scapegoat, a charlatan, and a harbinger of bad luck. Before the 13th century, portraits of the monkey as a semi-god predominated; in the art of the next 600 years, however, its role as an unlucky trickster took over (Ohnuki-Tierney 1987). For the Japanese, as for the Greeks and Romans, the image of nonhuman primates as pretenders to human status seems to have been crucial. The animals' physical similarity to humans was both their salvation and their curse.

Ironically, there was in this reverse Darwinism the germ of an evolutionary theory linking humans with monkeys and apes. Because these animals looked so much like humans, the Greeks, Romans, and Japanese all knew that they were somehow involved in fundamental questions about the origin of human beings. The Greeks believed that humans had originally lived in caves, freely mingling with animals and in particular with apes, until with the aid of the gods they gradually acquired civilization (Boas 1948; Janson 1952). The Japanese had similar origin myths. But the revulsion that arose in each of these cultures whenever monkeys and apes were compared to humans apparently prevented scholars from recognizing that their own legends might be more than just mythical accounts.

The image of monkeys and apes as humans manqué is perhaps nowhere better expressed than in a Jewish legend about the fall of the Tower of Babel. The story of the tower is of course well known: according to the Old Testament, the people of the earth had at that time only one language. Jealous of God's power, they gathered together and resolved to build a tower that would allow them to ascend into heaven. God saw them doing this, and realized that if they succeeded nothing could ever again be denied to them and they would become all-powerful. So to divide and weaken the people, God not only destroyed their tower and scattered them throughout the earth but also confounded their language, making their speech mutually unintelligible so that they would never again be able to communicate with one another.

But in Jewish legend it was not the humans who received the worst of God's wrath. There were also at the time "apes and monkeys" at work on the tower, and these primates were involved in a project that outraged God even more than the construction of the tower itself: they had begun to build idols that would stand atop the tower and be worshipped, in place of God, by all of the creatures on Earth. God punished

the monkeys and apes by taking away their language altogether and banishing them into the forest (Janson 1952; Ginsberg 1968).

Emotions, impulses, and lust

Just as in 13th-century Japan the image of the monkey changed from healer and sacred messenger to scapegoat and trickster, so in the European Middle Ages the image of monkeys and apes took a decided turn for the worse. Their downfall coincided with the rise of Christianity (Janson 1952). Western theologians now used monkeys and apes as living examples of what man would become if he turned away from God and gave way to his baser instincts. Monkeys and apes were no longer just devious sycophants—they now became creatures completely at the mercy of emotions, sadistic impulses, and lust. In the most extreme characterizations, they were depicted as the devil himself (or at least the devil's agents), sent from out of the land of darkness (usually Egypt) to perform Satan's work and lead people—particularly women—into sin.

Baboons were the object of particular revulsion and scorn, in large part because of their supposed deviant sexual appetites. Writing about a captive baboon in Paris in 1775, Buffon remarked that "the baboon was insolently lascivious, and satisfied its strong desire in public. It seemed also to make a parade of its nakedness, presenting its posteriors oftener to the spectators than its head; but it was particularly impudent in the presence of women, and plainly showed its immoderate desires before them by an inexpressible lascivity."

In 1699 the English anatomist Edward Tyson published a monograph on the anatomy of a juvenile ape that had died shortly after its arrival in London from Angola (Spencer 1995). The monograph was important for two reasons. First, it was the first scientific text to draw a clear distinction between the groups we now know as monkeys (particularly Old World monkeys) and apes. Although Tyson identified his primary specimen incorrectly (he called it an "orang-outang," *Pongo pygmaeus,* but coming from Angola it must have been either a chimpanzee, *Pan troglodytes,* or a gorilla, *Gorilla gorilla*), he nonetheless recognized that it was much more humanlike than many other "apes" (i.e., monkeys) that had been formerly described, and he concluded that the primates of the Old World must fall into two groups, one more closely related to humans than the other.

Second, Tyson's monograph spurred a new wave of popular speculation about the exact differences between humans and their closest animal relatives. The speculation was born of uncertainty about what his

creature actually was. According to Tyson's anatomical work, the supposed orangutan was clearly not human. But reading between the lines it was equally clear that Tyson believed the difference was very slight: he even called his specimen *Homo sylvestris.* What should be made of this chimera? Doubt, wonderment, and outrage expressed themselves in satire.

The satirical accounts came in two forms. In the most common genre, an ape was introduced into polite society, where his social and intellectual successes—along with his curious failures—served to show just how far education and proper training could subdue his animal nature and elevate him to full human status. In 1732, Alexander Pope, John Arbuthnot, and other prominent authors published the *Essay of the Learned Martinus Scriblerus, Concerning the Origin of the Sciences,* a collaborative work of the Scriblerus Club, designed to satirize the excesses of erudition (Ashley Montagu 1941; Janson 1952). In it they locate the beginnings of art and science in the work of monkeys and apes. Among their most advanced culture heroes is "Orang Outang the great, whose unhappy chance it was to fall into the hands of the Europeans [and] whose value was not [formerly] known to us, for he was a mute philosopher." Like the authors of the biblical legends concerning apes and the Tower of Babel, the members of the Scriblerus Club concluded that Orang the Great could think, write, and reason philosophically, but not speak. Thus it was language—or at least the ability to engage in speech—that separated *Homo sapiens* from *Homo sylvestris.*

Nearly a century later, in 1817, Thomas Love Peacock echoed this theme in *Melincourt,* the tale of a young orangutan from Africa who distinguishes himself in English society as Sir Oran Haut-ton. Sir Oran is regarded by his human companions as superior to most of their compatriots in gallantry and nobility of feeling, largely because he rescues a maiden in distress without taking advantage of her. Most of the time he is able to control his animal impulses, but on one occasion, after drinking wine, he leaps out of a window and "goes dancing along the woods like a harlequin." Although he cannot speak, Sir Oran is nonetheless elected to Parliament, where his lack of speech is an asset rather than a hindrance because it gives him the reputation of a powerful but cautious thinker (Henkin 1940).

The second genre of satirical account imagined a traveler in some remote corner of the world who discovers an animal society and then returns to describe what he has seen among these bizarre creatures. Jonathan Swift's Gulliver is, of course, the most well known of these philosophical explorers, the forerunners of modern ethologists. When

Gulliver encounters the Yahoos, he is shocked to find that they resemble humans in every detail of their bodies yet they behave like animals. They have no language, but can only bellow loudly and repeatedly. By contrast, the Yahoos' masters, the noble and generous Houyhnhnms, have both the ability to reason and the gift of language even though their bodies are those of horses. At first the Houyhnhnms assume that Gulliver is himself a Yahoo, but once he demonstrates his good manners, cleanliness, and linguistic ability they treat him more like an equal (Swift 1726).

The satirical accounts of the 18th and 19th centuries mocked not only the apes themselves but also the scientists and philosophers who were so undecided about the animals' classification. And the satirists had a point: at a time when zoological taxonomy was undergoing a revolution, no one knew exactly what to do about these creatures that were so much like us and yet so obviously different. In the first edition of his *Systema Naturae* (1735), Carolus Linnaeus, the father of modern taxonomy, based his classification of mammals exclusively on anatomical characteristics and lumped the apes as they were then known together with humans in the group Anthropomorpha. This provoked an outraged response from—among many others—the French naturalist Georges-Louis Leclerc, comte de Buffon, who strongly objected to Linnaeus' exclusive reliance on anatomical features. Like his countryman Rene Descartes, Buffon believed that the possession of reason and language distinguished humans from all other animals, and that to ignore the dualistic nature of the human condition was to ignore the noblest feature of our species (Spencer 1995; Corbey 2005). Twenty-three years later, in the 1758 edition of the *Systema,* Linnaeus responded to his critics by separating the various members of the genus Homo from all other animals and basing his classification not only on anatomical features but also on temperament, character, type of garments worn (if any), and forms of government.

Looking back, three characteristics about peoples' views of monkeys and apes from Classical times to the present are striking. First, reverse Darwinism appears in every age and every culture. Throughout time and around the world, people have readily accepted the idea that two animal species with similar morphology must bear some close genealogical relationship to one another, but they have balked and indeed reversed this rule when the species in question are human and nonhuman primates. Even today, the Mende hunters of the Ivory Coast believe that chimpanzees possess near-human levels of society and culture but argue that it is morally and physically dangerous for humans and

chimpanzees to live in the same environment because the chimpanzees "set low standards of behavior to which humans may be tempted to descend" (Richards 1995). Similarly, in the United States, "microevolution" is now widely, if reluctantly, accepted because of irrefutable facts like the emergence of bacterial strains that are resistant to antibiotics. However, the majority of Americans continue to deny that humans and apes share a recent common ancestry.

Second, in order to defend a strict, dichotomous division between themselves and their closest animal relatives, humans have needed to come up with a crucial, defining criterion: something important that we clearly have and nonhuman primates lack. For most of the past 2000 years, language has remained the preferred choice. This may seem obvious today, when debates about the humanness of apes (or the animal nature of humans) inevitably come down to language, but it has not always been the case. At various times in the past, the sine qua non of humanity has been our ability to overcome our baser instincts, our hairlessness, our upright posture, our large brain size, or our ability to make tools. As recently as 1986, the country music singer Dolly Parton suggested that "what separates us from the beasts is our ability to accessorize." Language, then, has not always been viewed as the defining feature that sets us apart from apes; it is, however, the feature that has stood the test of time.

Finally, as we look back on earlier views of human and nonhuman primates, we are struck not just by the attitudes themselves but even more forcefully by the biased samples on which these attitudes were based. For centuries, scientists and philosophers formulated their views of monkeys and apes entirely on the basis of either dissections of dead specimens, observations of lone, captive individuals, or (as in the case of Richard Jobson [1623]) glimpses of an entire group seen from a distance. Their judgments, as a result, were made without any awareness of the very traits—like systems of kinship and dominance, or complex social alliances—that today make monkeys and apes seem most like human beings.

Modern studies of monkeys and apes

The historical bias against studying nonhuman primates in natural, social settings seems all the more odd because people have always known that monkeys and apes are fundamentally social creatures. In Japan, hunters believed so strongly that the macaque is a group-living animal

that they held a taboo against killing any monkey found on its own (Ohnuki-Tierney 1987). Despite this enlightened view, Japanese opinions about the minds and behavior of nonhuman primates were derived almost exclusively from what they knew about monkeys' performances with humans (Asquith 1995). Although monkeys range freely on many of Japan's islands, Japanese artists, like those of India and Western Europe, have usually depicted them amidst humans, far from their natural habitats and social groups (Janson 1952; Ohnuki-Tierney 1987; Asquith 1995). As a result, it was not until the 1950s that Japanese scientists—and through them the rest of the world—learned that the society of Japanese macaques is organized around a ranked group of matrilineal families (Kawai 1958; Kawamura 1958).

Similarly, the Mende hunters of the Ivory Coast claim to have a sophisticated knowledge of chimpanzee behavior, and in fact do know a great deal about the chimpanzees in their area, including their use of tools to crack open nuts and plants for self-medication (Richards 1995). But the Mende's knowledge does not extend to the details of chimpanzee society. They are unaware, for example, that the core of a chimpanzee community is a group of long-term resident males, some of whom may be related to one another, and unrelated immigrant females, or that within each community individuals come and go in fluid, transient subgroups (Goodall 1968).

In Western Europe and America, where there are no indigenous nonhuman primates, the inclination to study monkeys and apes within the context of human society has been even more apparent. In the early 20th century, for instance, French scientists recommended the establishment of a model village in French Guinea that would serve as a training ground for the civilization of wild apes. Native women would act as nurses and guides. British scientists planned a monkey college to make chimpanzees human, and German scientists established a colony in North Africa to study how chimpanzees solve problems (Harraway 1989). In each case, Western scientists made the effort to travel to the apes' native habitat in Africa, but once there put all notion of naturalistic research aside. Later in the 20th century, the American psychologists Robert Yerkes and Harry Harlow embarked on major studies of chimpanzee and rhesus macaque behavior, but again focused their efforts exclusively on captive individuals, typically housed alone in highly restricted environments.

The twin beliefs that language constitutes the crucial difference between humans and nonhuman primates and that these animals are best studied in captivity are most evident in the "ape language" projects,

which began haltingly in the 1930s, flourished through the 1960s and '70s, and continue to this day. Like Classical and medieval scholars, the scientists who conducted these studies have been fascinated by the idea that language is what makes us different from all other creatures, and they have accepted, either explicitly or implicitly, the view that language and thought in apes cannot be studied in the apes' own societies but must instead be explored by bringing them into ours and teaching them to communicate like us.

But the artificial settings of the ape-language projects have made their results difficult to interpret. When an ape has failed to achieve some linguistic milestone—for example, when the chimpanzee Nim Chimpsky learned words but was unable to combine them into sentences—critics have charged that the animal's failure did not reflect his true ability. Instead, Nim failed because he had an abnormal upbringing, his training was nothing more than mind-numbing repetition, and he was tested under circumstances that were artificial, contrived, and entirely too rigid. Nim and other captive apes would have done better, the critics have argued, if their experience as youngsters, like the experience of human children, had been more conducive to learning language (Terrace 1979; Seidenberg and Pettito 1979). Conversely, when captive apes have apparently succeeded in acquiring a linguistic skill—for example, when the bonobo Kanzi learned to respond correctly to complex sentences like "Put the ball in the basket"—critics have argued that such achievements are anecdotal, and in any case do not reflect a genuine understanding of grammatical rules. Kanzi, the critics have argued, may simply have recognized "put," "ball," and "basket" as separate signs and put the ball in the basket because the basket could not be put in the ball (Savage-Rumbaugh 1986; Wallman 1992). Small wonder that the scientists involved in these studies have often felt trapped in a game of "heads you win, tails I lose."

There is no doubt that the best laboratory experiments achieve a level of precision and control that field research on natural groups of monkeys and apes cannot begin to match. Many captive studies are also highly creative and have succeeded in documenting abilities that can only be hinted at by field observations. We discuss some of these experiments in Chapters 7 through 10. At the same time, however, laboratory experiments can illuminate a species' abilities only if their results can be placed within the context of an animal's natural social behavior. In the absence of such grounding, they remain difficult, if not impossible, to interpret.

Studies of captive apes may be particularly difficult to interpret because human "enculturation" may affect the apes' cognitive abilities and performance on tests. To date, most of the evidence that chimpanzees' cognitive abilities are superior to those of monkeys comes from chimpanzees that have had prolonged contact and/or training with humans. But there may be as many differences between the performance of "enculturated" and "natural" chimpanzees as there are between apes and monkeys generally. In one experiment specifically designed to test the effect of human enculturation, Tomasello and colleagues (1993) compared the imitative abilities of chimpanzees raised by humans (but not language-trained), chimpanzees raised by their own mothers, and two year-old children. Each subject was shown a number of novel actions and scored according to whether the subject imitated the action of the demonstrator. Mother-reared chimpanzees did not, whereas human-reared chimpanzees and children did. In another experiment (Carpenter et al. 1995), investigators examined the use of joint attention by chimpanzees and children when learning to imitate a task involving novel objects. Again, children and enculturated chimpanzees looked back and forth from the object to the demonstrator and used gestures to direct the demonstrator's attention, whereas mother-raised chimpanzees did not.

Does exposure to humans somehow enhance chimpanzees' cognitive capacities? Human trainers actively engage their chimpanzee subjects' attention when interacting with them or instructing them in the use of signs. As a result, these apes may come to view humans as intentional agents who have goals and motives (Tomasello and Call 1997). Alternatively, through exposure to humans chimpanzees may become familiar with human artifacts and training regimes, which in turn facilitates learning. Whatever the explanation, evidence that exposure to humans affects chimpanzees' cognition complicates any comparisons between the apes' performance in captivity and their behavior in the wild.

Baboons in southern Africa

Farmers in southern Africa will tell you that they hate baboons. Baboons raid their orchards, decimate their cornfields, destroy their irrigation pipes, pollute their water tanks, and kill their sheep and goats. In response, the farmers shoot baboons whenever they get the chance.

But the farmer-baboon relationship is not as simple as it seems. Long before any Western scientist had begun to study monkeys in the wild, southern African farmers had gained a grudging appreciation not just of baboons' intelligence but also of their society.

The farmers' knowledge may have arisen from the peculiar ecology of their farms. In much of southern Africa, baboons sleep at night and rest during the day on steep, rocky cliffs, where they are safe from leopards and can find comfortable, baboon-sized sitting-places to groom and play in the shade. The farms lie in the valleys below. The result is a pastoral landscape in which farmers toil in the fields while groups of baboons sit like vultures on the cliffs, grooming, playing, watching, and waiting for just the right moment to raid a cornfield or steal a baby goat. And if a farmer looks up, he sees—albeit at a distance—what few European or American scientists ever observed: an entire baboon group, going about its daily activities. He sees infants and juveniles gathered around their mothers, females grooming one another, and males giving loud alarm barks if a human begins to approach. Observing these behaviors, a curious farmer might be prompted to ask, "Do they have families? Do males protect their offspring?"

Eugene Marais (1872–1936) was raised on a farm near Pretoria, South Africa, "as completely cut off from the rest of the civilized world as the loneliest isle in the Pacific" (cited in Ardrey 1969). But despite its remote location, the farm undoubtedly contained baboons. After receiving his education, Marais began work as a journalist, eventually becoming the editor of a small, rural, Afrikaner paper. He wrote well in both English and Afrikaans, but confined his writing to the latter language for patriotic reasons. A few years later, when his wife died in childbirth, Marais went to London, where he was admitted to the bar. When the Boer War began, he returned to South Africa to support his people in their fight against the English.

The Afrikaners' defeat plunged Marais into deep depression, and sometime around 1903 or 1904 he retreated to a small farm in the Waterburg district to recover. Farmers had abandoned this area during the war, leaving baboons free to forage wherever they wished. Even though the farmers were now beginning to return, they had no guns to drive the simian raiders away. The baboons were bold, unafraid of humans, and Marais was able to watch them at close range. In a letter written in 1935 he stated:

> In other countries you are lucky if you catch a glimpse of the same troop twice in a day. I lived among a troop of wild baboons for three years; I followed them on

their daily excursions; slept among them; fed them night and morning on mealies; learned to know each one individually; ... . I have an entirely new explanation of the so-called subconscious mind and the reason for its survival in man. I think I can prove that Freud's entire conception is based on a fabric of fallacy. No man can ever attain to anywhere near a true conception of the subconscious in man who does not know the primates under natural conditions. (cited in Ardrey 1969:20)

Today, Marais' books on baboons, *The Soul of the Ape* (1922) and a series of articles published as *My Friends the Baboons* (1939), seem rambling, idiosyncratic, and anthropomorphic in the extreme. But Marais was a scientific pioneer because he realized that the essence of baboon life was their society. His insights resulted from a lucky confluence of events: his background in rural South Africa, where he encountered baboons in groups; his luck in the Waterburg, where he could observe them at close range; and his need to escape the world and recover from deep depression. This last bit of fortune—if you can call it that—gave him the time to study animals in depth, the motivation to recognize them as individuals, and a deep, thoughtful curiosity about the subconscious and the relation between individuals and society.

Oxcart drivers, signalmen, and shepherds

One consequence of the war between farmers and baboons was that, inevitably, some infant baboons were orphaned. And for perhaps the first time since the ancient civilizations of Egypt, some of these orphans were adopted by local people and put to work, in a few celebrated cases as oxcart drivers, railway laborers, and goatherds on farms. Particularly in their role as "herdsmen," these baboons displayed the kind of sophisticated social knowledge that we know today is the hallmark of baboon metaphysics. In all of their assigned roles, baboons served their masters through their intelligence. The story of Jack the Signalman provides one such example.

During the latter part of the 1800s, the Cape Government Railways opened the first line from Cape Town to Port Elizabeth. In the inland town of Uitenhage, a railway guard named James Wide earned the nickname "Jumper" because of his skill in leaping from one moving train to another. Alas, the inevitable happened; one day Jumper fell. The train ran over him and both legs had to be amputated at the knees. In a desperate attempt to keep his job, Jumper made himself a pair of pegged legs by strapping pieces of wood to his lower body. He also built a hand

trolley that made him more mobile. The company agreed to hire Jumper as a signalman, but his work remained a struggle.

One Saturday morning in the Uitenhage marketplace, Jumper noticed an ox wagon being driven into town by a young baboon, who acted as "voorloper" (oxen leader). Convinced that such an intelligent creature might be useful to him, Jumper persuaded the owner to give up his favorite pet. The baboon was called Jack. In parting, the owner warned Jumper that every evening Jack should be given "a tot of good Cape brandy"; otherwise he would spend the next day sulking and refuse to work.

Jack soon learned to drive Jumper to work each morning. He pushed the trolley on the uphill grades, then leapt aboard in great excitement to get a free ride as the trolley glided downhill. Next, Jack learned to perform Jumper's job as signalman by waiting patiently with Jumper in the signalman's hut and listening for the number of blasts from the approaching locomotive drivers. Each track was assigned a different number. If the driver gave one, two, or three blasts, Jack switched the signals in the appropriate manner, altering the direction of travel so that oncoming trains would not collide. If the driver gave four blasts, Jack collected the key to the coal shed and carried it out to the driver. His performance was so unerringly correct that he earned the name "Jack the Signalman" (Fig. 2).

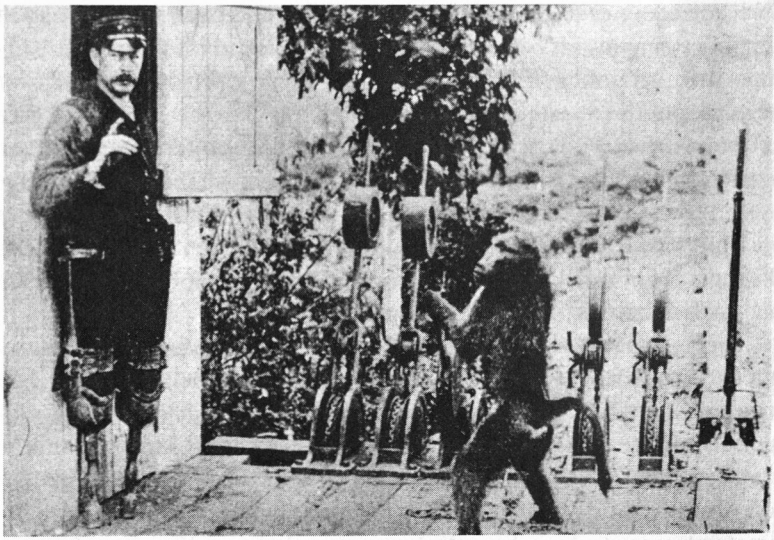

Figure 2. Jack the Signalman with his coworker, Jumper Wide. Photo courtesy of Paul Screeton.

On one occasion, a prominent lady traveling from Cape Town to Port Elizabeth saw to her horror that the signals in the train yard were being changed by a baboon. When executives in Cape Town received her indignant report, their first reaction was disbelief. When she insisted that her account was true, they sent a delegation of inspectors to Uitenhage. Jumper and Jack were dismissed from duty. But once again Jumper persuaded the inspectors that he (and Jack) could do the job. He challenged the inspectors to give Jack a rigorous test of his skills, and Jack passed with flying colors. He even looked in both directions each time a signal was changed, apparently checking to make sure that trains passing in the yard would be on different tracks. From that day on, Jack the Signalman received daily rations and was given an official employment number. After a long and successful career, he died of tuberculosis in 1890 (du Plessis, n.d.).

Accounts of Jack the Signalman and other working baboons spread widely and helped to convince 19th-century South African farmers that baboons were intelligent creatures. But stories like Jack's revealed little about baboons' social skills. Other anecdotes were more illuminating.

Traveling through what is now Namibia in 1836, the British explorer James Alexander (1838) reported that the Namaqua people sometimes kept baboons as goatherds. These baboons reliably followed the herd of goats during the day, keeping the animals together and giving alarm calls if a predator was spotted. At dusk, they guided the flock back to the compound, sometimes riding on the back of the largest goat.

The Namaquas' domestication of baboons as goatherds was apparently passed on to the local European farmers, because it persisted until very recently. In 1961, the German naturalist Walter Hoesch described the behavior of an adult female, Ahla, who served as a faithful tender of livestock on a Namibian farm for over seven years (Hoesch 1961). She was the third baboon that the owners had employed as a goatherd. As part of her work, Ahla groomed the goats and led them back and forth to the fields every day, again often riding on one of the larger goats (Fig. 3). Like the baboons who served as shepherds for the Namaqua, Ahla gave alarm calls when predators were spotted. She also recognized immediately when a goat or kid was missing from the herd and searched anxiously for it, giving what Hoesch describes as "ho ho" calls until she found the missing animal.

Most intriguing for our purposes was Ahla's ability to recognize the kinship relations that existed among individual goats. In the evenings, the kids were often separated from their mothers in a different barn.

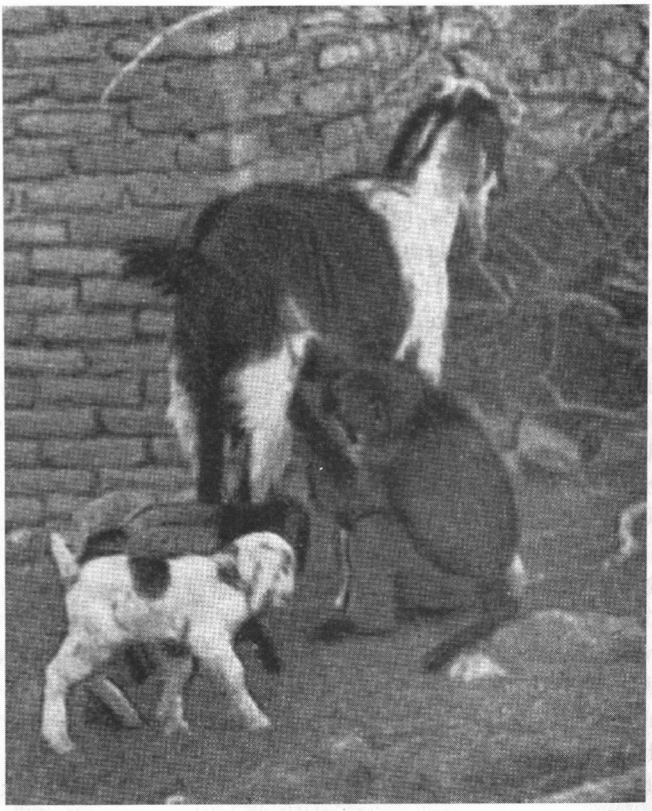

Figure 3. Ahla the goat-herding baboon grooms one of her charges.

Figure 4. Ahla carries a kid to its mother.

When this happened, Ahla became "not only eager but really a maniac" in her efforts to reunite kids with their mothers (Fig. 4). Hoesch reported:

> When Ahla comes home in the evening after feeding, she will first go to the enclosure and from there through a door to the lambs' enclosure. From here, she can only hear the adult animals but not see them. Once she hears from inside the voice of a lamb that is calling for its mother, she will retrieve the correct lamb and jump through the opening between the two enclosures and put it underneath the mother so it can drink. She does this flawlessly even when several other mothers are calling and several lambs are responding at the same time. It seems impossible that she does this solely on the smell of the animals. She also retrieves lambs and brings them back even before mother and infant have begun calling. Apparently, she knows every animal in the herd but it seems unclear how she effectively recognizes them. Mrs. Aston [the farm's owner] noted that "No local personnel and also no white person would be able to assign correctly the 20 or more identically looking lambs to the mothers. However Ahla is never wrong." (Hoesch 1961:299)

Ahla's determination to ensure that each kid remained with its mother sometimes interfered with her work as the farmer's assistant. When a ewe gave birth to twins, the farmer often tried to foster one of the kids onto a ewe that had lost her own offspring. Ahla would have none of this. She *knew* which kid belonged with which mother, and at every opportunity she doggedly returned the fostered twin to its real parent. Hoesch noted that Ahla was never trained to recognize the kinship relations between mother goats and their kids: "she does things that she has never observed and that she has never been told." Occasionally, though, "she was punished with a belt when for instance she took a lamb up into the top of the trees where she slept."

Intrigued by Ahla's tale—but at the risk of losing what remained of our scientific dignity—we traveled to Namibia in 2006 in search of a goat-herding baboon. Unfortunately, the practice appears to have fallen away, although through our colleague Conrad Brain we did speak with several people who had owned, or knew someone who had owned, a herding baboon. One farmer, Walter Utz, reported that he had employed a female baboon, Bobejaan (the Afrikaans word for baboon), as a goatherd well into the 1980s at his farm near Otjiwarango. Bobejaan led the goats to and from their pastures each day, watched for predators, groomed the goats, and kept them free of ticks. She also groomed Mr. Utz's two Simmentaler bulls, which would wait every evening by the gate for Bobejaan to return from the fields with the goats. Mr. Utz

remarked that Bobejaan could also recognize each goat's offspring by both voice and sight, and that she had learned to do so without any training. Bobejaan became so effective at guarding her herd that she was eventually trapped and killed by local rustlers who wanted to steal the goats. Mr. Utz concluded the conversation by stating that he would certainly employ another baboon if he ever again decided to keep goats.

As we will discuss later in this book, baboons and other monkeys may be unique among animals in recognizing the close bonds that exist among other members of their group. The accounts of goat-herding baboons, though anecdotal, suggest that this ability also allows baboons to recognize the relationships that exist among members of another species. They suggest, too, that the first people to recognize baboons' unusual social skills were not European or American scientists in the late 20th century, but the Namaqua people who kept baboons as goatherds many hundreds of years ago.