TOWARD AN EVOLUTION OF MIND: IMPLICATIONS FOR THE FAITHFUL?

by Jeffrey A. Kurland

Abstract. Ever since its inception, Charles Darwin's theory of evolution by natural selection has challenged assumptions about the nature of humankind and human institutions. It did not escape the notice of Darwin, sympathetic allies, or hostile contemporaries that his theory had profound implications for ethics and theology. In this paper I review some current sociobiological hypotheses about the mind that are based on the theory that the human mind is primarily a social tool. Many researchers now believe that both complex human within-group cooperation and between-group competition are the anvils that may have shaped the modules of the mind. Given this evolutionary theory of the mind, the Darwinian challenge to theism, ethics, and faith is now being relaunched with a vengeance. However, I suggest that modern physics, evolutionary biology, and cognitive science all seem to fit nicely into the atheistic and phenomenological niche defined by Buddhism.

Keywords: Buddhism; Darwinism; evolution; group conflict; mind; modularity; religion; sociality.

Der menschliche Körper ist das beste Bilder der menschlichen Seele.
The human body is the best picture of the human soul.
—Ludwig Wittgenstein, *Philosophical Investigations*

Ever since Thomas Huxley's ([1894] 1989) essay on "Evolution and Ethics," it has been clear to many scholars that the Darwinian perspective on evolution has profound implications for one's perspective on human existence, religious institutions, and humankind's place in nature. Certainly

Jeffrey A. Kurland is Associate Professor of Anthropology at The Pennsylvania State University, where his mailing address is 416 Carpenter Building, The Pennsylvania State University, University Park, PA 16802. His e-mail address is jak@psu.edu.

[*Zygon*, vol. 34, no. 1 (March 1999).]
 ISSN 0591-2385

the initial, and continuing, raucous reception of Darwin's theory of evolution would seem to confirm this. Most recently, Lee Smolin's (1997) audacious but convincing extension of the natural selection mechanism to physics in order to explain the formation of the universe makes further inroads into theology. In contrast, there are those like Stephen Gould (1997) who are more agnostic and less confrontational in their reading of evolutionary biology and its implications for human affairs. The purpose of this paper is to foment discussion for the readers and contributors to this journal of religion and science. I intend to review, in as nontechnical a manner as possible, some recent work in behavioral and cognitive biology that can inform our view of the mind and hence our place in nature. Increasingly, natural and social scientists have set aside the rank behaviorism of previous generations that declared the mind off-limits to science and instead have begun to outline a set of theories that can generate hypotheses about the natural history of the mind. I also address some areas where religion, ethics, and evolutionary theory overlap. It is not my intent to avoid such contentious issues.

Even before Darwin had apparently solved the problem of his times, the origin of new species, he had already filled up the M Notebook with musings about the continuity between the emotion and thought of animals and humans. In one of the more overquoted entries, he reflects, "Origin of man now proved.—Metaphysics must flourish.—He who understand baboon would do more toward metaphysics than Locke" (entry 84, Gruber and Barrett 1974).

Thus, Darwin succinctly makes the point taken up by latter-day evolutionary psychologists that the human mind is a contingent organ of natural history and hence its operation must reflect that history. The very foundation of our awareness of the world must be a result of evolution. Locke's metaphysics attempts to explain our understanding of the world as a result of the acquired associations between sense impressions, but for Darwin such psychology is itself the historically contingent property of a modified African ape. Similarly, Immanuel Kant's synthetic a priori concepts are the contingent properties of the evolved human brain.

Darwin's theory of evolution by natural selection challenged most, if not all, the preconceived assumptions of proper Victorian society. As one Victorian lady commented, "Descended from apes? Let us hope not. But if it is true, let us pray that it does not become widely known!" (Moorehead 1969). Not only is the form of the human body a result of historical mechanism but so too are all our loftiest aspirations and achievements; so much for accepting a "natural," God-given order to society with royalty on top and the working poor on the bottom. Religion, politics, and aesthetics are all the outcome of natural processes rather than divine intervention. The rather conventional Charles Darwin himself was well aware of these implications and feared the consequences if the political radicals of his time grasped his view of the world for their revolutionary attempts to destroy the Church of England, Parliament, and the Monarchy (Desmond and Moore 1991). In a letter to his close friend, the botanist Hooker, he commented of his theory that "It is like confessing a murder," a ripping apart of the very fabric of English society and culture. Indeed, the humanities and social sciences remain outside the purview of the Darwinian perspective because of the revulsion that most academics have felt toward mere vulgar evolution (e.g., Sahlins 1976). Surely we humans have transcended the evolutionary process? However, scholars in these fields are often ignorant of the potentially beneficial application of Darwinian thinking to their studies. Given an unsavory history of biological rationalizations for racism and sexism, many scholars, sometimes rightly, reject out of hand any biologizing of the human experience. On the other hand, such resistance to a broad synthesis of the natural sciences and the humanities or social sciences, such ignorance of the evolutionary roots of human behavior, can only widen the gap between the "two cultures" to the detriment of both (Snow 1964; Wilson 1998).

It is the claim of a number of researchers in anthropology, psychology, political science, and economics that failure to recognize that the human brain and its mental activities are themselves the product of evolution will create an incomplete social science as well as an incoherent humanities. The human mind has been "designed," not in the teleological sense of religion but rather in the sense of "teleonomy" (Pittendrigh 1958). The mind is the result of generations of differential reproduction, that is, some properties of the mind allowed better survival and ultimately reproduction in some environments (Williams 1966). Such mental "design features" must to varying degrees determine human behavior, thought, and culture. I review here some of the arguments in favor of this view.

The Darwinian Machine

On first exposure, the concept of evolution by natural selection is so obvious that it seems tautological in its import. Natural selection is the differential reproductive success of particular traits in a particular environment. The natural selection mechanism requires (1) variation, (2) heredity, and (3) differential reproduction, and these properties together are sufficient to account for the evolution of adaptation. Darwin, like his fellow countryman and codiscoverer of natural selection Wallace, found the ultimate source of natural selection in the "struggle for existence" that occurs between organisms. Aware of the writings of Adam Smith and Thomas Malthus, both Darwin and Wallace realized that the economics of production and the demography of humans can lead to competition for limited resources. This occurs with even more force in nature, where there are no controls on fecundity and no artificial modification of resources.

Reproduction in nature always outstrips resource availability, and hence only successful competitors survive to reproduce. It is the accumulation of small changes in the traits of successful reproducers that underlies all of evolution, be it the coat color of the snow hare or speciation in lagomorphs.

As Darwin was well aware, the challenges to his mechanism for evolutionary change were complex organs of seeming perfection, like the eye. After all, it was the eye to which William Paley (1802) pointed in his treatise on the argument from design as proof of the existence of God. To assume that the eye could have arisen by blind chance is as absurd as to assume that a pocket watch found on the forest floor could have come into existence by random forces. Where there is design, there must be a designer. And God is the ultimate designer of his artifice, the natural world. Of course, this leaves considerable semantic confusion: if nature is also artifice, then both words have lost their meaning. While studying at Cambridge to prepare for life as a country vicar, Darwin found Paley's logic inescapable (Desmond and Moore 1991). Yet a few decades later, his own theory of evolution took up the challenge of the origin of complex organs by showing that intermediate steps could connect the various stages of their evolution.

In the case of the eye, an appropriate "organ of perfection" for a discussion of the evolution of mind, we can turn to contemporary mollusks for examples of possible stages in the evolution of the eye (Slavini-Plawen and Mayr 1977). Some mollusks have merely a layer of pigmented cells that are photon-sensitive, others add an invagination that better focuses the light, others a primitive lens, and so on. The point is that there is no great leap from eyelessness to eyeness. Each one of these creatures is apparently well adapted to its photon environment for the tasks it faces (see Dawkins 1997 for a detailed and beautiful overview of the evolution of the eye). A recent computer simulation clearly illustrates the creative powers of Darwinian selection (Nilsson and Pelger 1994). In this case, the researchers generalized the stages of eye anatomy in terms of a layer of light-sensitive pigmented cells and eye shape. Next they isolated a single perceptual function of ocular anatomy, namely, visual acuity, as the criterion of optical design. This facilitated mathematical representation in a computer and hence an estimate of the speed at which random variation and selective retention of better anatomical designs could proceed. The result is remarkable. In spite of rather pessimistic assumptions, a complex eye can evolve in only a few hundred thousand generations. If the average generation length of most organisms is about a year, then complex eyes can evolve in as little as a million years, which is geologically instantaneous. Again, as Darwin was keen to point out, all this may be hard for the human mind to imagine, but that says more about what our mind evolved to do and the scale on which it operates than the truth of Darwin's theory of the evolution of complex adaptations.

To paraphrase William Blake, we can now ask who authored the eye's fearful symmetry. The answer is not found in either Blake or Paley. The structure and function of a mollusk eye or a human eye is the result of many generations of culling by the things in the organism's environment that light detectors can detect for better or worse: predator, prey, aggressive conspecific, mate, or cliff. Eyes, at any stage of complexity, perform as they do because of how successfully they have contributed to an organism's survival and reproduction, that is, finding food or avoiding being food for another. It is important to appreciate how opportunistic and peculiarly engineered complex organs are. The human eye is rather good at photon-detection visual perception, along with the relevant area of the neocortex of the brain. But it is not the sort of design that an intelligent electrical engineer in robotics would choose. Images are laid out upside down on the retina requiring considerable central nervous system (CNS) processing to make them all right side up so that the body and its functions can operate in four-dimensional space-time. There is a blind spot with no light sensitivity. Because of this our eyes constantly twitch in saccadic movements so that the CNS can fill in the missing part of the visual field. Photons first pass through the cell bodies of the retina, then bounce back before striking neuronal receptors (Dawkins 1997). It's a real Rube Goldberg machine, jerry-built by means of a clumsy process of differential reproduction over thousands of generations. By the way, the octopus's eye is remarkably convergent to the vertebrate eye, yet it reveals a better design feature in that retinal neurons have receptors on the first layer so that photons strike them directly without first having to pass through cell bodies. If one wanted to play a theological game, one might declare the octopus god a better designer than the human God.

But that kind of theology misses the point. The challenge of Darwinism is that there is no explanatory role for God or gods in the creation of the natural world and, by implication, in the evolution of humans. Natural selection is the immediate reproductive advantage that accrues to one trait over another. As demonstrated in the case of the eye, evolution is *mosaic* in that what appears to be a complex organ of perfection is actually a complex organ of imperfection whose constituent parts can change at different rates over time without completely compromising immediate function. This has always been a sore point for fundamentalist creationists. Every part of any organism can be decomposed into components that evolve independently. The latest research in evolutionary developmental genetics, on homeobox genes and their variants, is finally providing the way to connect molecular biology and embryology to paleontology in order to explicate the evolution of complex traits (e.g., Erwin, Valentine, and Jablonski 1997; Gilbert, Opitz, and Raff 1996; Shubin, Tabin, and Carroll 1997). All adaptations are historical compromises between the genetic variants that were available during evolution, the developmental processes that generate the traits during ontogeny, and the alternative demands of the organism's life-history schedule of somatic maintenance and reproductive effort. There is no goal, purpose, or end to the Darwinian process. How could the accumulation of relatively better variants in particular environments from generation to generation, through all the vagaries of an ever-changing world, produce direction or progress? The answer, of course, is that it cannot. And one greatly misreads evolution in seeing the medieval *scala naturae* in the randomly branching tree of life (Dawkins 1986).

Brain and Mind

Even my intellectual hubris is humbled before what we all rightly consider the most complex organ in the known universe: the human brain. Yet if we look at a series of nonhuman primate brains, we see an analogue to the variation found among mollusk eyes. The path of mosaic evolution can be discerned even in this organ of great complexity. Anatomical substructures of the brain have evolved at different rates even among this group of closely related mammals. Like the eye, the brain suffers imperfections, such as we all have experienced in the form of optical or auditory illusions, and for some, mental delusions. The problem, of course, is that we have known for centuries, since Harvey's insight, that hearts, veins, and arteries are designed to pump life-sustaining blood through the body, but what the brain is designed to do just isn't obvious. We could say that brains are for secreting thoughts, feelings, and other such mental stuff, but in the end, although that may be true, it doesn't seem very helpful.

However, there are experiments from rat psychology that do shed some light on what sorts of environmental features might be expected to select for a particular brain structure and hence mental activity. In the 1960s, John Garcia and his co-researchers began to discern the inadequacy of classical (Pavlovian) and operant (Skinnerian) conditioning paradigms to explain the stimulus-response behavior of experimental subjects (e.g., Garcia and Koelling 1966; Garcia, Hankins, and Rusiniak 1974; Palmerino, Rusiniak, and Garcia 1980; and Trivers 1985 for an excellent review). The basic assumptions underlying the psychology of learning were that (1) any stimulus can elicit any response (2) so long as the association is rewarded immediately. Both assumptions were falsified. For example, a rat will avoid sweet-tasting water in one or several trials if it is irradiated with X-rays that induce nausea (vomiting) five to seven hours later. It will also avoid a particular area of its cage in response to an audible click if immediately given a mild electric shock to its paws. But it will *not* avoid sweet water even after a very large number of shocks to its feet or avoid an area of its cage even if it is made very nauseous. Similarly, rats associate the smell of tainted water more rapidly than its taste with nausea. Such flavor-illness aversion training experiments inform us about the learning biases of rats.

If we consider the natural ecology of the ancestors of these laboratory rats, their highly biased responses make good Darwinian sense. Rats are omnivores, eating a wide variety of plants and animals, some of which may be tainted with putrefying microbes. Taste and smell can be good indicators of poisonous food. Similarly, pain to the feet and body are probably associated with the high-pitched sounds that colony nestmates make during fights. To smell the toxicity of dangerous foods is obviously a better response than sampling by taste. Thus, despite the fact that experimental psychologists have used rats to investigate the plasticity of behavior under different environmental ("reward") regimes, these animals still exhibit a very biased set of intransigent responses. Moreover, these biased responses can be interpreted as the result of generations of selection. Indeed, without some kind of biased, stimulus-response pattern, a rat in its species-typical environment might never survive long enough to learn the correct behavior. Nausea hours later is a good sign that ingested material is to be avoided from now on.

Rats therefore come into the world with a set of biases, rules of thumb, or preparedness to acquire those responses that have been reproductively successful in the past. This preparedness sets up the organism to rapidly acquire the appropriate behavioral repertoire during its lifetime for the recurrent problems presented by its species-typical environment. A rat's learning is therefore highly constrained by its evolutionary history.

The mind, too, can be operationalized as the brain's theory of the world. It prepares the organism to attend to some stimuli, to ignore others, and to respond rapidly to some stimuli on first exposure. The mind prepares the organism for what will count in the world as stimulus, response, or reinforcement. A real Lockean, tabula rasa mind would allow no learning. For example, if one postulates that mother-infant bonding is critically established by eye contact, then one assumes that the neonate already "knows" that eye contact is reinforcement but that mother's random lip-smacking sounds are not. Otherwise how could the bond be reinforced? The Skinnerian conditioning paradigm is a remarkably vacuous perspective on animal learning, let alone human behavior. Until recently, psychological models of learning overlooked the evolutionary background to behavioral responses. This may be because psychologists are often more interested in the proximate causes of behavior. But it is increasingly clear now that the ultimate causes of behavior in the evolutionary process also shape what organisms do. The preceding examples should make that clear. More to the point, there is no reason why this should not apply to humans. Or, as Nobel laureate François Jacob (1977) would have it, "Our brain has therefore evolved at our gonad's services." This brings us to some speculations on the natural history of the human mind.

Modules of the Mind

Humanists, social scientists, and our own common sense subscribe to the tenet that the nature of humans is they have no nature. Except for a few primitive physiological instincts, we start with blank minds that are then filled in by whatever culture we are born into (Tooby and Cosmides 1992; or Geary 1998 for a brief recent review). Tooby and Cosmides have dubbed this dogma "The Standard Social Science Model" (SSSM). According to the SSSM, our minds and behavior result from induction and generalization, which are themselves grounded on what the early British empiricists would call "associations of habit," or what was discussed above as the conditioning paradigm. This "empiricist doctrine," grounded in the British philosophy of Bacon, Locke, and Hume and traceable further back in Western philosophy, dominates Western contemporary culture. From the perspective of empiricism, the human mind is in effect an all-purpose computer that acquires its understanding of the world by means of general laws of learning (association) and the powerful mental faculty of intelligence. Such a machine is pretty much open to any kind of culturally constructed "software." On the surface there is apparently much to recommend this philosophy; after all, we humans are highly flexible organisms who by means of culture modify the world and our behavior in vastly varied ways. Everything that we are is a result of learning. However, over the last several decades, research in psychology, linguistics, and philosophy suggests that such naive empiricism requires serious revision (see Tooby and Cosmides 1992; Pinker 1997 for a detailed critique).

The real explanatory inadequacy, indeed bankruptcy, of the conditioning paradigm in particular and of the SSSM in general is apparent when they are faced with the challenge of human language. As Noam Chomsky first pointed out, a fundamental problem in psychology is how to explain how a human child develops the extremely rich system of knowledge that is a natural language, despite marked variation in other cognitive abilities and despite a limited exposure to examples of its native language (Chomsky 1957, 1977; but see Saffran, Aslin, and Newport 1996). All humans can speak and understand an effectively infinite number of well-formed utterances from a natural language. Most of the speech we encounter and understand every day is novel. This cannot be explained by a conditioning paradigm (Chomsky 1959, 1977). The only prediction that one can make from Skinnerian conditioning is that what the organism was reinforced to do, it will repeat when exposed to the same stimulus. But human language is characterized by its infinite productivity and creativity. By age four to six, all human children are effectively fluent in their local, native language, that is, they can carry out meaningful conversations, recognize well-formed and nonsensical utterances, and understand puns and jokes that they have never heard. Calculus is formally a much simpler system of knowledge, so much so that my hand calculator can do it. Yet most humans so motivated never become fluent in calculus despite many years of exposure and explicit teaching. No hand calculator, no machine so far invented, can handle translation between natural languages with anything like the human facility. This seems a miracle.

Using this "miracle," Chomsky has argued most persuasively for a rationalist, Cartesian, as opposed to empiricist, perspective on human psychology (Chomsky 1977). When we find knowledge acquired in such a uniform and rapid manner, it is reasonable to assume that humans have a set of initial constraints that guide the maturation process, much like our acquisition of walking or color vision. No one learns to walk by Pavlovian or Skinnerian conditioning. A child does not have to be rewarded or punished to organize such complex tasks. Similarly, almost all utterances we encounter in everyday life are novel combinations of words. The ability to decode and encode such utterances is best explained as a result of a mental set of recursively applied rules that define the grammar of the language. The remarkable fact about human children is that they acquire the grammar of their local language not by formal instruction but by mere exposure to a greatly impoverished corpus of its output. Without innate guidelines it would be impossible for an immature human to develop the grammar. Unconstrained learning of language is impossible. The acquisition of language must therefore be based on the unique biology of humans. It follows that language is an evolved property of the human mind, although for what environments it is designed it is not at all obvious (Pinker 1994). For linguists of the Chomsky school, what guides language acquisition is a *universal grammar* in the mind that is able to take a small, incomplete sample of the language heard and from that re-create the grammar of the local language. The universal grammar is a language-acquisition device that is apparently stimulated by utterances so that in a short time the range of possible human languages (the phonology, grammar, semantics, etc.) can be sufficiently narrowed down to the actual language heard by the child. It is indeed hard to imagine how anyone could learn a language without this language-acquisition device. The SSSM cannot be valid with regard to natural languages.

From this Chomskyan perspective, the mind can be conceived of as a collection of task-specific faculties, "complex mental organs" that are designed to solve certain cognitive problems like perception, social interaction, and reasoning. If language is a universal property of the human species that develops in the organism because of its genetic constitution and a surprisingly brief exposure to the language environment, then why should other mental faculties not also develop in a similar fashion? The answer, of course, is that there is good reason to expect the same of other mental faculties. Indeed, this general theory of "the modularity of the mind" has gained considerable currency in contemporary psychology and anthropology, despite rather disparate interpretations of exactly what "mental modularity" refers to (Fodor 1985; Pinker 1994, 1997; Tooby and Cosmides 1992). The problem, of course, becomes one of accurately specifying how many modules there are and what problems in the human world they address. Each module can itself be characterized by a different set of rules, a grammar, that defines the mental organ. Adherents of this philosophy reasonably argue that negotiating language requires a different grammar than identifying potential social allies. That is, there is a priori no reason to expect there to be general laws of learning that can be applied to all or most domains of human cognition and behavior, but much reason to expect human psychology to be compartmentalized into domain-specific modules. Human flexibility is predicated on the large number of task-specialized modules rather than on an all-purpose computer in our head. These modules, like the flavor-aversion behavior of the laboratory rats, presumably reflect a history of differential reproduction in response to particular and regularly occurring problems that humans have faced over the millennia. The nonevolutionary, nonbiological SSSM is inadequate to the task of explaining the human mind.

Sociality and the Mind

Humans are group-living primates. Although the evidence is indirect, comparative primatology and paleoanthropology suggest that we and our immediate ancestors may have lived in social groups larger than a monogamous pair for hundreds of thousands if not millions of years (e.g., Walker and Shipman 1996). More to the point, our very existence and, of course, reproductive success depend on how well we balance social interactions that entail competition and cooperation, altruism and selfishness. We seem to live in a virtual social world of intentions, emotions, and motives of self and other, and this may have been the case for an evolutionarily significant length of time. If this is true, then we may expect that the human mind is importantly characterized by modules that specify adaptive social behavior and cognition in our species-specific social environment (Minsky 1986).

Since Darwin, biologists have had to confront the paradox of altruism, namely, that organisms sometimes exhibit reproductively self-sacrificing behavior, for example, kamikaze bees or avian helpers at the nest (reviewed in Trivers 1985 and Krebs and Davies 1993). The most extreme form of such altruism is the sterility found in eusocial insect colonies. The revolution in evolutionary biology over the last several decades, conducted primarily by William D. Hamilton and Robert L. Trivers, has greatly clarified the conditions under which altruism can evolve. There are five major selective processes for the evolution of altruism: kinship, reciprocity, parental manipulation, parasitism, and group selection (see, e.g., Kurland

1996). What is characteristic of, if not unique to, humans is the degree to which reciprocity defines our social life (e.g., Mauss [1925] 1967; Sahlins 1972).

A useful formalism from game theory for modeling reciprocity is the Prisoner's Dilemma (PD; Axelrod 1984; Bonhage-Freund and Kurland 1994). In this model, two individuals have been accused of cooperating in a crime. The police separate the suspects from each other to prevent collusion and then work them over and try to get one to implicate the other. If they cooperate by not implicating each other, they are both set free. If both confess, they are each imprisoned. However, as inducement to get one suspect to defect on his or her partner, the police offer a reduced sentence to the defector and a longer sentence to the partner who keeps his or her mouth shut. This array of payoffs is known to each prisoner. If they both act rationally by attempting to reduce their sentence, each will defect on the other. But each would have done better if they had trusted each other not to turn state's evidence. Each chooses defection, but each would do better in cooperation. Hence, the dilemma.

Both mathematical analysis and computer simulations of alternative strategies that might resolve the PD into cooperation rather than defection demonstrate that in any finite number of such encounters defection is always favored. However, whenever there is a high probability of repeatedly entering into a PD with the same individual, a new and remarkably simple strategy emerges: tit for tat (TFT). TFT initiates its PD interactions with cooperation and then does whatever the other actor does: Do unto others as they would do unto you. However, with a memory of one move, TFT can be reset so that it now does unto others as they did unto you. So TFT can defect if it receives defection. In simulations of the evolution of strategies involved in the PD, TFT manages to hang on and win. But defection also is always present in this social environment.

Elsewhere I have explored the conditions necessary for TFT to operate in the real-world political situation of the Iroquois League (Bonhage-Freund and Kurland 1994). Similarly, Cosmides and Tooby (1992) argue that we might well expect human psychology to reveal design features for evaluating the details of social exchange, because human sociality must have evolved under conditions of reciprocity. Cosmides and Tooby describe in great detail the cognitive implications of this game-theoretic model. To the extent that this rather simplistic and abstract game-theoretic model epitomizes the essential logic of iterated cooperation, that is, reciprocity, it predicts that humans should be sensitive to the existence of cheaters (the defectors of the PD) or conditions that would allow cheating in social exchanges based on TFT.

Cosmides and Tooby reason that much reciprocity, hence, social exchange, has the property of being like a social contract that is rule-governed. In this case, the rule has the form of the conditional, *if P then Q*.

The cognitive psychology of reciprocity is therefore reduced to the rules of inference of the first-order predicate calculus, the sort of formalisms that one is exposed to in introductory logic and philosophy courses. Now the interesting property of logic is that it is so robust that standard inferences may well fail to detect violations of a social contract. No matter what the content of *P* and *Q* are, *if P then Q* is false if and only if *P* is true and *Q* is false.

Cosmides and Tooby review and greatly extend the investigation of what in psychology is known as the Wason Selection Task. In this experiment, a subject must determine if a conditional rule has been falsified by any of four examples on cards. For examples, *if a person has an A rating, then she must have code 1 on her documents* or *if someone is drinking alcohol, she must be over 21*. In each case a violation of the rule consists of the antecedent clause and the negative of the consequent clause. Yet the common finding is that only about 25 percent of the subjects evaluate the first conditional rule correctly, whereas a significant majority evaluate the second conditional correctly. Cosmides and Tooby have recreated the Wason Selection Task for social exchange contexts and discovered that their test subjects are rather sensitive to cheating. For example, if they set up a contract of the form *if you take a benefit, then you pay the cost*, then most subjects correctly identify a violation as *taking a benefit but not paying the cost*. On the other hand, if the contract is of the form *if you pay the cost, then you take the benefit*, then most subjects *still* identify a violation as the cheater action, even though logically a violator is an altruist who pays for a benefit but receives nothing in compensation.

Cosmides and Tooby, of course, do not use social contract rules in such naked, unmasked form but rather embed them in culturally realistic stories that subjects must evaluate. In no way have I conveyed the richness of their Wason Selection Tasks. But the upshot seems to be that their study subjects are rather good at reasoning about and detecting cheaters but not very good at reasoning about and detecting altruists. The major weakness of these experiments is that the subjects are all undergraduates at Western universities. Until the results can be generalized to people in non-European cultures, we should be wary of attributing these results to "humans." Given that caveat, evolutionary hindsight suggests that there should be no indiscriminate altruists in the human social world. Consequently, Cosmides and Tooby interpret their results as indicating that there has been selective pressure in the human mind for cheater detection but not altruist detection. These results also reveal another case of imperfection in complex traits. Humans clearly can evaluate social contracts, and they can evaluate logical propositions, but they cannot always harmonize them. The context, hence the social meaning, of propositions has overwhelming importance such that humans may reason adaptively but not logically. The human mind may be no more an organ of perfection than the eye.

There is a marked convergence between the biology and the psychology outlined here. Where the one emphasizes the mosaic, piecemeal aspects of the evolutionary process, the other emphasizes the modular, domain-specific structures of the mind. Each reinforces the other in offering a testable theory of the human mind. For example, clinical neurologists have described a rather specific perceptual and memory deficit, known as *prosopagnosia*, in which individuals cannot identify familiar faces, including their own (Geshwind 1979; Tranel and Damasio 1985; Damasio 1995). It is tempting to interpret this as the physical basis for part of the discrimination module's need to keep track of defectors and cooperators. Moreover, as Trivers (1971) first pointed out in his seminal paper on the evolution of reciprocity, there is a whole panoply of emotions associated with reciprocal altruism, including shame, guilt, gratitude, and sympathy. Sometimes it may be possible to cheat, but if caught one risks losing the critical social relationships that humans depend on. In this situation, the cheater may have to give convincing evidence that such cheating will not be repeated. Shame, guilt, and the associated reparation may have evolved as an internal governor that punishes the cheater and motivates her to compensate for past transgressions so as to reinstate reciprocity. Trivers (1985) describes in much more detail the evolutionary logic of these and other emotions. But the important point is that it does not make much sense to imagine that such emotions arise by chance and then allow systems of reciprocity to evolve. Rather these emotions make functional sense only if there is reciprocity. It is the evolution of mind in this social world of reciprocity that selects for the concomitant emotional and cognitive systems that underlie adaptive social exchange.

All of us who have thought about the evolution of mind have come to realize that deception must be a common feature of human and nonhuman communication (e.g., Trivers 1976; Krebs and Dawkins 1984; Johnstone 1997). For example, you might more likely gain a resource from another if you can convince her that it has a greater value to you than to her or that the cost to her is much less than she may think. Of course, deception can gain a foothold only once honest communication has evolved. But like the PD, honesty is often open to deception. Once deception evolves, self-deception, at least for language- and symbol-using humans, can't be far behind. If successful deception depends on minimizing the signs of the deception, whatever they may be, then the best deception is that that is believed by the actor. He lies best who lies best to himself!

If any of this Darwinian theorizing about the mind is accurate, we can begin to see how systems of social communication, relationships, contracts, and other aspects of our sociality begin to favor a complex of cheating, cooperation, deception, and ultimately self-deception. Such social machinations will be built up over evolutionary time, hidden from the actors themselves. Layer upon layer of manipulation accumulates like the components of the eye in mosaic evolution. Our best artists call this *the human condition*. Freud and Marx, the other Victorian theoreticians of the mind, made strikingly parallel arguments about the difficulty of self-knowledge and the price we pay for false consciousness. The Darwinian view is perhaps the strangest of the three, given that we continually resist its implications. Perhaps this is because, as Alexander (1987) suggests, we have made the existence of genes and evolution explicitly part of our consciousness in just the last fifty years. Or perhaps it's because an organism that hides its ultimate motives from itself will be reproductively most successful. From this perspective, as Trivers (1976) points out, the mind is not a mechanism for gaining ever more accurate pictures of the world; it is a tool for gaining ever more effective advantage over the world. And a key part of that world is the presence of other humans who are up to the same thing. Evolution might be expected to favor a mind that warps and weaves the appearance of the world to the (unconscious) self-serving interests of its bearer.

Prime Movers of Mental Evolution

Wilson (1975, 32) uses the term "prime mover" to refer to the ultimate determinants that constrain social evolution. Prime movers are specified by the population genetics and ecology of a species. For our purposes in this brief survey of human evolutionary cognitive science, prime movers are the ultimate causes of the human mind. In other words, we can ask what properties of apes, hominids, or humans would have favored the emergence of the kind of modular human mind outlined above. There are some obvious candidates.

Tools, manual dexterity, and bipedalism are hallmarks of humans. Marx and others have argued for a labor theory of human origins. And Darwin himself argued that bipedalism may have evolved in the context of specialized forelimbs for tool manipulation. But Egyptian vultures, California sea otters, and the Galapagos cactus finch, as well as chimpanzees, use tools, yet most are remarkably nonhuman in their behavior and cognition (Kurland and Beckerman 1985). Indeed, bipedalism appears in the hominid lineage at upwards of four million years ago, but indisputable evidence of the human mind, for example, the symbolic and iconic representations found in European Upper Paleolithic caves and Australian rock shelters, is not apparent until about 40,000 years ago (Schick and Toth 1993).

It was Nicholas Humphrey (1978) who first made explicit the idea that the peculiar complexity of human sociality may have favored our intelligence and brand of mental life. What has become apparent to a number of researchers since then is that the environment that has selected for a human form of sociality and mind is one dominated by humans themselves. For Humphrey, then, the human mind is primarily a social tool. Certainly reasoning about the inanimate world in order to make tools would select for an increasingly toolmaking mind, so long as these tools increase the reproductive success of the actor. And reasoning about animate objects such as prey and predators may also produce significant selective pressure on the mind: having to search for, capture, process, or avoid other animals would seem to be more demanding than feeding on grass. But as Humphrey argues, reasoning about the social world should put the most demands on the mind. This is because social interactions have a gamelike quality in that one's best action depends on what the other actor does, and because the other actor is following the interaction in a similar manner, the winning move becomes an ever-changing, elusive target. (Pinker 1997 offers a cogent critique of this hypothesis.)

Simple models of such interactions have been developed in that branch of game theory known as "evolutionarily stable strategies" (ESS; Maynard Smith 1982). In some ESS analyses there may be no winning strategy, no maximization of fitness, but rather cycles or chaos (Nowak and May 1992). Evolution can be indeterminate. However, assuming that these social interactions have a heritable basis and that they have an effect on evolutionary fitness, each approximate solution for negotiating the social community will spread over time, raising the level of social complexity for the next round. As Humphrey points out, this would seem to lead to a feedback process and an evolutionary ratchet that raises intellectual ability until such time as some other factor comes into play to halt the process, for example, when too much time is devoted to solving a social problem, thereby jeopardizing other aspects of the actor's life-history budget.

The remaining question now becomes, what could keep driving this feedback process? Richard D. Alexander (1987), among many since Darwin, argues that humans themselves drive the process. After all, what species has the most similar reproductive and survival needs, the most effective competitiveness, the greatest unpredictability, and the most deadly effects? In summary, what species potentially has the most dramatic effects on our evolutionary fitness? The answer obviously is other humans, because humans have the most dramatic effects on their own ecology. Alexander provides the most detailed—though unfortunately turgid and often convoluted—discussion of the balance-of-power hypothesis: humans have evolved to cooperate within groups in order better to compete against other groups (see also my review and brief summary, Kurland 1991).

Within human groups and in comparison to other species, murder and mayhem are infrequent, despite media hysteria. This is true even though we can maintain groups of thousands and millions on a daily basis, whether at a sporting event or in a city square. For example, a reasonable estimate is that in about every thousand hours of observations, a lion, heron, or monkey kills a conspecific (Wilson 1975). Yet how many thousands of hours of observation have we all logged "watching" humans without having seen or heard such murder and mayhem? Compared to life in a chimpanzee community or a lion pride, life even in some of our urban centers may be safer by orders of magnitude.

However, *between* groups, human violence is another story altogether. Humans have practiced and still practice mass slaughter on a scale unparalleled in the rest of the animal kingdom. Not merely combatants but women and children are killed. Jared Diamond (1992) has summarized much of the unsavory history of human genocide and mass slaughters from 1492 to 1990. Torture and terrorism also are human inventions. Tens of thousands to tens of millions have been raped, mutilated, and murdered in episodes of unfathomable bloodletting. From the perspective of the vanquished, these episodes of conflict are typically total, planned, unprovoked, and preemptive, in short, the final solution. Diamond does not mention the Mongol hordes who killed how many we do not know, or the Chinese pogroms against the Buddhists in the eighth and twelfth centuries, or the Japanese annihilation of the indigenous Ainu, or the Bantu-speaking cattle herders of sub-Sudan Africa who killed an unknown number of Khoisan aborigines.

Although modern state-organized societies are particularly good at such programs of total extermination, it has become apparent that mass slaughter is much more cross-culturally and historically widespread than previously assumed (Keeley 1996). Indeed, Keeley shows that among low-technology societies, the consequences of intergroup conflict have a greater effect on local populations than in the European conflicts of this century. Pre-Columbian Native Americans were not immune from conflicts that wiped out whole villages (e.g., Crow Creek: Zimmerman and Whitten 1980; Norris Farm: Milner, Anderson, and Smith 1991). In some cases the skeletal evidence implies that only men and children were killed, whereas women were take captive, much as with the contemporary Yanamamo (Chagnon 1988). The Old Testament offers similar examples of total destruction millennia ago (e.g., Deuteronomy, Numbers, 1 and 2 Samuel, and Joshua). There is a rock painting of indisputable intergroup conflict with bows and arrows from about 9,000 years ago in Spain. Keeley's review finds scattered evidence of scalping and skeletal trauma from stone and wood projectiles from 18,000 to 30,000 years ago in Egypt, Central Europe, the Mediterranean, and Africa. The Middle Pleistocene Archaic human Bodo skull exhibits butchering cut marks implying violence or cannibalism or both at half a million years ago (White 1986). But how far back does intergroup conflict go? We can only speculate. It seems exceedingly unlikely that the Upper Paleolithic hunters and gatherers of 50,000 B.C., with their sophisticated tool kits, ambush tactics, and highly coordinated group hunting of mammoths and other Ice Age megafauna, would never have used similar tactics to find, stalk, and kill members of other competing groups, especially when the other group was most vulnerable.

Or perhaps they were rather different kinds of humans.

The balance-of-power hypothesis implies that there is a "first cause" of human mental and social evolution. However, tool production could amplify the consequences of intergroup conflict. Toolmaking in the hands of a socially manipulative creature might be expected to crank up the ratchet of social competitiveness and cognitive competence to higher and higher levels, with devastating results: foraging tools evolve into weapons, group hunting tactics become premeditated gambits for warfare. In the context of group conflict, the interaction between these aspects of human cognition becomes mutually reinforcing.

In such an unpredictably competitive environment, cooperation within the group is the key to personal survival and reproduction. Competition between groups could occur at any time, and a win or a loss might well be swift and final. The Alexander-Humphrey balance-of-power hypothesis implies that there would be an evolutionary feedback loop such that individuals evolve better to play out the internal social dynamics necessary to create stable coalitions that allow effective competition against other groups of humans who are, of course, up to the same thing. Once the process begins, it keeps raising the level of cooperation within and competition between human groups. There seems to be nothing else in the human world that can account for our peculiar mix of cooperation and competition.

Implications for the Faithful

The import of evolution for ethics and religion is a vast subject. I would not even pretend to be able to cover it adequately here. Perhaps much of what I state below merely repeats what others have already said (Stent 1980; Singer 1981; Williams 1989). However, I wish to emphasize some points that follow from the Darwinian perspective.

At the beginning of this paper I used a well-known entry from Wittgenstein's (1953) *Philosophical Investigations* as an epigraph. Wittgenstein was merciless in his social honesty, his hatred of hypocrisy, and his desire to strip away self-deception in order to find what certainty and spirituality is left in the wake of such an unrelenting and often tormented search for self-knowledge (Monk 1990). His comment that "the human body is the best picture of the human soul" does not imply of course that Marilyn Monroe was more spiritual than, say, Olive Oyl. It is found in a section where Wittgenstein discusses the ordinary-language logic of how we ascribe personhood to another. In that sense, the human body and its expressions are indexical of the inner person, as a weather vane is indexical of wind direction. But for our purposes the aphorism can be translated into a query: What Darwinian picture of the human soul is portrayed here?

I believe that the metaphorical picture from evolutionary biology is rather clear: humans are two-faced, like the Roman god Janus who guarded the portal to Roman cities and the entry to the atrium, the heart of the patrician's home and hearth, and from whom we get the month name January (Landau 1989). The inner face is the relaxed expression reserved for kith and kin, whereas the outer face manifests the incipient features of the scowl and snarl reserved for outsiders. This dual nature maps into group member and stranger, friend and foe, self and other, good and bad selves, cooperation and competition, and past and future. Humans are not innately good or bad. Our propensity for helping and hindering others in their pursuit of life's good is itself context-dependent and conditioned by our evolution.

For some researchers, like Alexander (1987), morality and hence religion are reducible to a history of reproductive striving among individuals within and between human groups. Social exchange and reciprocity evolve into formalized rules that codify the costs of cheating. These moral sanctions benefit the rule makers and rule enforcers by decreasing the chance that they will be cheated but can also benefit other group members by making an increasingly complex social world more predictable. The consequences of group deviance (immorality) are known before acts are carried out. In such circumstances, individuals may well evolve tendencies to display altruism in order to better announce that they are trustworthy candidates for cooperation. Increasingly devious and indirect karmic chains of beneficence and cheating evolve. But society also increasingly progresses to levels of wider and wider beneficence, because all actors have to periodically display their altruistic tendencies by means of indiscriminate aid or suffer group sanctions (see Alexander 1987 for details).

Religion, then, becomes a complex and layered set of institutions that controls within-group sociality, often, and maybe primarily, to the advantage of the leaders of the institutional hierarchy. When group membership and religious affiliation become intertwined, group conflict easily escalates into genocidal "holy wars." Moreover, supernatural entities like witches, ghosts, angels, and devils guarantee to the credulous and group-dependent that their obligation to maintain fair reciprocity will be checked and punished even after death; if the actors themselves are not punished, then their heirs will be. Everlasting life, no matter what the detailed landscape is, would also seem to guarantee that actors must keep close account of their social exchanges during life in order to be rewarded or damned forever. In similar fashion, Pinker (1997) speculates about the origins of ancestor worship.

Toward the close of the nineteenth century, it was Thomas Huxley ([1894] 1989) who first explicitly confronted the moral implications of Darwinism. Huxley perceived an inescapable moral indifference of nature, and hence came to see the world as the cosmic enemy. Although later commentators, such as George Williams (1989), are sometimes ambiguous about an evolutionary perspective on ethics, it is clear that nature is not *im*moral, as they claim, for this implies an entity that is violating morality and thus could be moral. The cosmos is *a*moral, for the world is neither good nor evil. The world can in no sense be construed as designed to foil or nurture the lives of humans any more than for lilies or tapeworms. It simply is. And the interaction of reproductively prolific living entities with the conditions of life results in the diversity that we see about us.

In addition to this rather stark evolutionary reductionism, Huxley and others since (most notably, Humphrey 1978; Alexander 1987; Williams 1989) note the short-term evolutionary advantages of the human mind in playing the social game. But in addition, as these and other scholars emphasize, there is an epiphenomenon of this mental evolution, namely, our ability sometimes to realize that the long-term consequences of our behavior and thought may be detrimental to our well-being. We can sometimes see through the sheer oafish blindness of the evolutionary machine. We can therefore see clearly the indifference of an amoral universe that mechanically culls its exquisitely crafted creatures by the most crude and brute force: natural selection. With the realization that most species go extinct, that we will return to the void from which we came, and that in no sense is nature designed, we confront the root of all existential fear: How does an individual define himself in the here and now? How *ought* one to be? That question, of course, is strictly speaking outside the domain of evolution, indeed outside of the sciences, even though the one creature who can ask it is itself a product of evolution. Huxley, too, was keenly aware of this paradox. But it was he who first made it clear that we need to *resist* the selfish push of evolution.

Recent evolutionary biology emphasizes that the origins of altruism and cooperation in nonhuman animals are typically based on kinship or reciprocity. However, the roots of this view can be clearly found in Huxley's essay. The Alexander-Humphrey model particularly emphasizes reciprocity as expanding among members of human groups under the threat of perpetual siege by other groups. In taking up this theme, Singer (1981) argues for "an expanding circle" of beneficence as the domain of human interactions expands. Of course, this puts us into more and more conflict with evolved selfish tendencies. However, as Williams (1989), Singer (1981), Stent (1980), and others point out, our self-conscious reasoning may have some purchase over the blind process of evolution by recognizing that evolution by reciprocity and kin-based altruism might be subverted to wider ethical demands. For Huxley this meant that ethics *is* the self-conscious mechanism by which we humans actively combat the cosmic enemy. It means that we need all the understanding of the processes and outcomes of evolution that we can garner, unencumbered by the prejudices and fantasies of human venality and religious dogma.

For most humans, the evolutionary biases and unquestioned cultural traditions that are part of the human condition seem sufficient to quell existential angst. What is "good"? What ought I to do in this circumstance?

What is life's meaning? These and other such questions are answered by most of us without thought. Rather we turn to the dictates of religious texts, dogma, community standards, and tradition. That is, the metaphysical queries are answered by the contingent evolutionary and cultural history of the one modified African ape who can ask them. But the questions and answers are all part of a closed system of evolved mental properties and concomitant cultural institutions. In other words, there is no God or gods outside the ethical system. These gods are mere further rationalizations of ethical behavior. Many humans clearly do have faith in their God, the afterlife, and the inherent goodness of the world. But this faith too is an evolved trait of human psychology and culture. In principle, faith, religion, ethics, and morals can all be naturalized; all can be "biologized."

In no way can I declare that we know the route of human mental evolution. But the outline of that evolutionary journey has been clear since Darwin's and Huxley's time. By providing us with a satisfactory and convincing explanation of the appearance of complex traits in evolution, Darwin has eliminated the need for a God who created us. God did not fashion living entities by the will of God and humanity in the image of God. A Creator is logically unnecessary, because the Darwinian mechanism leaves nothing for such a God to do. *In pacem requies,* William of Ockham.

Conclusion with a Sectarian Twist

We have covered, in a somewhat cursory manner, a fair amount of material relevant to the evolution of mind. The mosaic process of evolution has produced organisms, including humans, that are apparently a collection of integrated modules that serve specific fitness-enhancing functions. Among these are modules specialized for particular sensory perception, foraging cues, and, if contemporary evolutionary psychology is correct, cheater detection in complex societies of reciprocators; and at a higher scale of organization, cultural institutions like religion.

No doubt many of the ideas and hypotheses explored above will not pass the rigors of scientific testing. But the epistemological implications will not change: the very core of human life, our mental activity, consciousness itself, is open to investigation by science, though not without some profound epistemological reorientation (Chalmers 1996). The humanities and much of the social sciences will increasingly be called into question and perhaps put under siege by biologists who anticipate that all human activity and institutions are rooted in the process of evolution (e.g., Wilson 1998).

Understanding the world that made and makes us is surely the way to understand ourselves. It will force us to see our evolved Janus nature. For we are the product of a balance between cooperative and competitive propensities. If the ideas presented here are correct, we cannot have one without the other. That is the legacy bequeathed by blind evolution, and that is our present dilemma. Even ethical and religious systems subserve the self-interest of particular groups and subgroups. Our ability to self-deceive in order to advance our self-interest easily leads to religious justification for group conflict, wars, and ultimately genocide. Such massive self-deception about our own group's natural superiority can build to such an extent that with complete sincerity we bless the troop train and then proceed to cleanse the earth of the godless others. After all, it is divine right, the will of Allah, and Bushido; and after all, the others are non-human, infidels, and barbarians.

Following Huxley's original meditation on evolution and ethics, we can only hope that our ability to see the cosmic enemy for what it is will allow us to combat the struggle for existence. But this cannot be an easy task given our evolutionary past and given what we know of recent human history. It requires constant vigilance. But most of all it requires seeing ourselves for what we are and not expecting the gods to bail us out. In that sense, all knowledge of the world is self-knowledge; studying the world and the struggle for existence is a struggle to understand the self.

Despite the pessimistic view of the human condition that Darwinian evolution offers, Huxley ([1894] 1989) seems to have found in Buddhism an ethical system remarkably consistent with the Western science he espoused. Here is a major religion that is atheistic, denies an immortal soul, holds no belief in sin, accepts no allegiance to authority, exhibits unconditional tolerance, and most important, emphasizes that each person can, and must, find his or her own way to peace of mind and understanding. The historical founder or founders of this world religion claimed a set of practices of The Middle Way between hedonism and asceticism that can free (enlighten) humans from the fear, greed, and ignorance characteristic of self-interest, what in the Zen Buddhist canon is tellingly referred to as our "monkey mind." Indeed, Buddhist meditative and everyday practice (The Eightfold Noble Path) may be seen as one means to carry out Huxley's combat with the cosmic enemy and to accept the reality of amoral nature. Of course, in Buddhist metaphysics, there is ultimately no enemy and no self, only the phenomena (*dharma*) of the world. From the perspective of mental modularity also, the self is without concreteness. It is rather perhaps an experiential illusion resulting from the integration of mental processes. And it is the enemy who evolved this illusion. But it is one thing to *think* this and quite another to *experience* it as Siddhārtha Gautama and his followers have.

The primary claim of contemporary science is that physics, natural selection, and the psychophysical rules that connect consciousness to insensate matter are sufficient to explain the world (Chalmers 1996; Smolin 1997). Smolin makes it quite clear that the theories of general relativity and quantum mechanics have utterly destroyed the last traces of the Newtonian absolutism that we all took to be common sense. For Newton, space and time were absolutes, and matter moved absolutely with reference to them. God was the source of absolute space-time. God was the ground of the world while residing outside the world. God was the Intelligence that made the world. At worst, God was for Deists the original Watchmaker. Nineteenth- and twentieth-century physicists, like Einstein, succumbed to the seduction of the search for absolute truths. Hence, they sought the fundamental and irreducible particles of matter and the concomitant sets of equations that would completely describe their behavior. In this sense, as Smolin (1997) argues, God is replaced by mathematics in the Platonic search for an absolute, noumenal world. What has yet to filter through to most of us is that relativity and quantum mechanics have demonstrated *empirically* that the universe cannot be understood in terms of such absolutes. Rather, what the world presents to us are totally interconnected, contingent, observable phenomena, period. Mind, life, galaxies, and the universe itself are improbable objects. Smolin argues that such entities are self-organizing, nonequilibrial systems. That is, these systems are thermodynamically open in either space or time: they take energy, use it, and then radiate the remainder to a sink. In effect, these systems evolve their complexity. The so-called fundamental particles and forces that we now observe are therefore the result of a historical process and are no more eternal and invariant than are the myriad forms of life on the earth. The current magnitude of the gravitational force, the weak force, hadron size, proton mass, and Planck's constant are all contingent on the evolution of the cosmos. There is no epistemological or rational role for anything outside the universe, whether God, noumena, or intelligence, to explain the universe. There is nothing to seek beyond what is right in front of us.

If this is true, then we arrive at a set of startling conclusions. Relativity and quantum theory have demolished the essentialism of Newton's absolute space and time. Darwin has forever destroyed essentialism in biology. Species are not invariant, unchangeable entities; they are instead highly variable populations of individuals undergoing constant change. Without such variance there would be no evolution. The modular approach of cognitive science outlined above would seem to put to rest the essentialism of the mind. Where can the ego or self be if "I" am in fact a collection of occasions? Buddhism, too, denies the independent concrete reality of an essential ego. Buddhism's uniqueness among world religions is perhaps its denial of a noumenal world. For example, in one famous parable attributed to the historical Buddha, he is asked by a follower about the reality of the soul, that is, the Hindu *atman*. Siddhārtha Gautama replies: Look at that chariot. Where is the essence of the chariot? What is left over after one takes it apart piece by piece? Indeed, Buddhist psychology and epistemology emphasize the emptiness (*sunyata*) of all aspects of the world, but especially our sense that there is an independent corporeal self underlying our mental gyrations.

Perhaps in the end all the preceding musings about the evolution of mind are for naught. They may merely retrace the devious route of Western intellectuality that ends up stating the obvious, what we all knew already about the human condition: that life is short, wretched, unfair, and often meaningless. On the other hand, Western science may be the one way we can recognize the causes of the struggle for existence and our personal struggle for existence. Perhaps we can transcend both struggles by studying the world and ourselves in the most unencumbered manner, unafraid of what we may discover about this modified African ape who so dominates the planet and its inhabitants. In that sense, the Western scientific tradition seems most congruent with the doctrines of Buddhism. And increasingly to many Westerners exposed to the power and limitations of modern science, Buddhism, particularly its Zen variant, seems most relevant to our times and predicaments (Kapleau 1966; Merzel 1991; Radcliff and Radcliff 1993). The overlap between the materialism of science and the phenomenology of Buddhism reinforces my claim that self-knowledge can be gained through knowledge of the world. It is perhaps by means of science that we can begin to understand the call for personal and social liberation that Eihei Dogen, the great thirteenth-century Japanese philosopher and founder of the Soto Zen sect, left us:

> *To study the way to enlightenment is to study the self.*
> *To study the self is to forget the self.*
> *To forget the self is to be enlightened by myriad phenomena.*
> *To be enlightened by myriad phenomena is to free one's mind and body and those of others.*
> *No trace of enlightenment remains and this traceless enlightenment continues forever.*
>
> (*Genjo Koan*, Section 4 [modified from Dogen 1985])

Note

This paper is based in part on a public lecture that I presented on 1 March 1997 at The Pennsylvania State University as part of the "Frontiers in Science Lectures: 'Becoming Human.'" In that spirit, I have tried to keep technical details to a minimum. Wherever possible I have chosen references that are readily available and comprehensible to novices interested in evolutionary biology. I have also eliminated figures and lecture slide prompts. I have added material on the ethical and religious import of evolution that was only briefly touched on during my public presentation but which came up repeatedly in after-lecture discussion.

It gives me great pleasure to thank Alan Walker for inviting me to participate in what was a very exciting series of talks. Richard Sherwood and Victoria Emch greatly helped me with the audiovisual presentation. Both of them, along with Michael DuPree, the Reverend Charles Peterson, and Alan Walker, also made very constructive criticisms of my often half-baked ideas. The *Zygon* staff did a first-rate job of copyediting an earlier draft. I especially thank Roberta F. Jalet Kurland for editorial assistance and for critically reading my perhaps idiosyncratic interpretation of a Buddhist perspective on evolutionary biological theory. As academics are often fond of saying, the remaining errors remain those of the author. Indeed.

References

Alexander, Richard D. 1987. *The Biology of Moral Systems*. New York: Aldine de Gruyter.

Axelrod, Robert. 1984. *The Evolution of Cooperation*. New York: Basic Books.

Bonhage-Freund, Mary Theresa, and Jeffrey A. Kurland. 1994. "Tit-for-Tat among the Iroquois: A Game Theoretic Perspective on Inter-tribal Political Organization." *Journal of Anthropological Archaeology* 13:278–305.

Chagnon, Napoleon A. 1988. "Life Histories, Blood Revenge, and Warfare in a Tribal Population." *Science* 239:985–92.

Chalmers, David. 1996. *The Conscious Mind: In Search of a Fundamental Theory*. Oxford: Oxford Univ. Press.

Chomsky, Noam. 1957. *Syntactic Structures*. The Hague: Mouton.

———. 1959. Review of B. F. Skinner's *Verbal Behavior*. *Language* 35:26–58.

———. 1972. "Psychology and Ideology." *Cognition* 1:1–32.

———. 1977. "Rationalism and Empiricism." In *Language and Responsibility*. New York: Pantheon Books.

Cosmides, Leda, and John Tooby. 1992. "Cognitive Adaptations for Social Exchange." In *The Adapted Mind*, ed. Jerome H. Barkow, Leda Cosmides, and John Tooby, 163–228. Oxford: Oxford Univ. Press.

Dogen, Eihei. 1985. *Moon in a Dewdrop: Writings of Zen Master Dogen*, ed. Kazuaki Tanahashi. San Francisco: North Point Press.

Damasio, Antonio R. 1995. *Descartes' Error: Emotion, Rationality, and the Human Brain*. New York: Putnam, Grosset Books.

Dawkins, Richard. 1986. *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe without Design*. New York: W. W. Norton.

———. 1997. *Climbing Mount Improbable*. New York: W. W. Norton.

Desmond, Adrian, and James Moore. 1991. *Darwin: The Life of a Tormented Evolutionist*. New York: Warner Books.

Diamond, Jared. 1992. *The Third Chimpanzee: Evolution and the Future of the Human Animal*. New York: HarperCollins.

Erwin, Douglas, James Valentine, and David Jablonski. 1997. "The Origin of Animal Body Plans." *American Scientist* 85:126–37.

Fodor, J. A. 1985. "Précis of *The Modularity of the Mind*." *The Behavioral and Brain Sciences* 8:1–42.

Garcia, John, Walter G. Hankins, and Kenneth W. Rusiniak. 1974. "Behavioral Regulation of the Milieu Interne in Man and Rat. *Science* 185:824–31.

Garcia, John, and Robert A. Koelling. 1966. "Relation of Cue to Consequence in Avoidance Learning." *Psychonomic Science* 4:123–24.

Geary, David C. 1998. "Functional Organization of the Human Mind: Implications for Behavioral Genetics Research." *Human Biology* 70:185–98.

Geshwind, Norman. 1979. "Specializations of the Human Brain." *Scientific American* 241 (3):180–99.

Gilbert, Scott F., John M. Opitz, and Rudolf A. Raff. 1996. "Review: Resynthesizing Evolutionary and Developmental Biology. *Developmental Biology* 173:357–72.
Gould, Stephen J. 1997. "Nonoverlapping Magesteria." *Natural History* 106 (3):16–24.
Gruber, Howard E., and Paul H. Barrett. 1974. *Darwin on Man: A Psychological Study of Scientific Creativity Together with Darwin's Early and Unpublished Notebooks*. New York: E. P. Dutton.
Humphrey, Nicholas K. 1978. "The Social Function of Intellect." In *Growing Points in Ethology*, ed. P. P. G. Bateson and Robert A. Hinde, 303–17. Cambridge: Cambridge Univ. Press.
Huxley, Thomas H. [1894] 1989. *Evolution and Ethics.* In *T. H. Huxley's Evolution and Ethics: With New Essays on its Victorian and Sociobiological Context*, ed. James Paradis and George C. Williams. Princeton: Princeton Univ. Press.
Jacob, François. 1977. "Evolution as Tinkering." *Science* 196:1161–66.
Johnstone, Rufus A. 1997. "The Evolution of Animal Signals." In *Behavioural Ecology: An Evolutionary Approach*, ed. John R. Krebs and N. B. Davies, 155–78. Oxford: Blackwell Science.
Kapleau, Philip. 1966. *The Three Pillars of Zen: Teaching, Practice, and Enlightenment*. New York: Harper and Row.
Keeley, Lawrence H. 1996. *War before Civilization: The Myth of the Peaceful Savage*. Oxford: Oxford Univ. Press.
Krebs, John R., and N. B. Davies. 1993. *An Introduction to Behavioural Ecology*, 3d ed. Oxford: Blackwell Science.
Krebs, John R., and Richard Dawkins. 1984. "Animal Signals: Mind-reading and Manipulation." In *Behavioural Ecology: An Evolutionary Approach*, ed. John R. Krebs and N. B. Davies, 380–402. Oxford: Blackwell Science.
Kurland, Jeffrey A. 1991. "The Good, the Bad, and the Ugly: Moral Lessons from Social Anthropology and Evolutionary Biology." *Reviews in Anthropology* 20:125–37.
———. 1996. "Altruism." In *Encyclopedia of Cultural Anthropology*, ed. David Levinson and Melvin Ember, vol. 1, 50–52. New York: Henry Holt.
Kurland Jeffrey A., and S. Beckerman. 1985. "Optimal Foraging and Hominid Evolution: Labor and Reciprocity." *American Anthropologist* 87:73–93. Errata. *American Anthropologist* 87:262.
Landau, Terry. 1989. *About Faces: The Evolution of the Human Face*. New York: Doubleday, Anchor Books.
Mauss, Marcel. [1925] 1967. *The Gift: Forms and Functions of Exchange in Archaic Societies*. New York: W. W. Norton. Originally published as *Essai sur le don, forme archaïque de l'échange*.
Maynard Smith, John. 1982. *Evolution and the Theory of Games*. Cambridge: Cambridge Univ. Press.
Merzel, Dennis Genpo. 1991. *The Eye Never Sleeps: Striking to the Heart of Zen.* Boston: Shambhala Publications.
Milner, George E., Eve Anderson, and V. Smith. 1991. "Warfare in Late Prehistoric West Central Illinois." *American Antiquity* 56:581–603.
Minsky, Marvin. 1986. *The Society of Mind.* New York: Simon and Schuster.
Monk, Ray. 1990. *Ludwig Wittgenstein: The Duty of Genius*. New York: Free Press.
Moorehead, Alan. 1969. *Darwin and the Beagle*. New York: Harper and Row.
Nilsson, D. E., and S. Pelger. 1994. "A Pessimistic Estimate of the Time Required for an Eye to Evolve." *Proceeding of the Royal Society of London*, B, 256:53–58.
Nowak, Martin A., and Robert M. May. 1992. "Evolutionary Games and Spatial Chaos. *Nature* 359:826–29.
Paley, William. 1802. *Natural Theology: Or Evidences of the Existence and Attributes of the Deity, Collected from the Appearances of Nature*. London: R. Faulder.
Palmerino, Claire C., Kenneth W. Rusiniak, and John Garcia. 1980. "Flavor-Illness Aversions: The Peculiar Roles of Odor and Taste Memory for Poison." *Science* 208: 753–55.
Pinker, Steven. 1994. *The Language Instinct: How the Mind Creates Language*. New York: William Morrow.
———. 1997. *How the Mind Works*. New York: W. W. Norton.

Pittendrigh, Colin S. 1958. "Adaptation, Natural Selection, and Behavior." In *Behavior and Evolution*, ed. Ann Roe and George Gaylord Simpson, 557–75. New Haven: Yale Univ. Press.
Radcliff, Benjamin, and Amy Radcliff. 1993. *Understanding Zen*. Boston: Charles E. Tuttle.
Saffran, Jenny R., Richard N. Aslin, and Elissa L. Newport. 1996. "Statistical Learning by Eight-Month-Old Infants." *Science* 274:1926–28.
Sahlins, Marshall. 1972. *Stone Age Economics*. Chicago: Aldine.
———. 1976. *The Use and Abuse of Biology*. Ann Arbor: Univ. of Michigan Press.
Schick, Kathy D., and Nicholas Toth. 1993. *Making Silent Stones Speak*. New York: Simon and Schuster.
Shubin, Neil, Cliff Tabin, and Sean Carroll. 1997. "Fossils, Genes, and the Evolution of Animal Limbs." *Nature* 388:639–48.
Singer, Peter. 1981. *The Expanding Circle: Ethics and Sociobiology*. New York: Farrar, Straus, and Giroux.
Slavini-Plawen, L. von, and Ernest Mayr. 1977. "On the Evolution of Photoreceptors and Eyes." In *Evolutionary Biology*, ed. M. K. Hecht, W. C. Steere, and B. Wallace, vol. 10:207–63. New York: Plenum Press.
Smolin, Lee. 1997. *The Life of the Cosmos*. Oxford: Oxford Univ. Press.
Snow, C. P. 1964. *The Two Cultures and a Second Look*. Cambridge: Cambridge Univ. Press.
Stent, Gunther S., ed. 1980. *Morality as a Biological Phenomenon: The Presuppositions of Sociobiological Research*. Berkeley: Univ. of California Press.
Tooby, John, and Leda Cosmides. 1992. "The Psychological Foundations of Culture." In *The Adapted Mind*, ed. Jerome H. Barkow, Leda Cosmides, and John Tooby, 19–136. Oxford: Oxford Univ. Press.
Tranel, Daniel, and Antonio R. Damasio. 1985. "Knowledge without Awareness: An Autonomic Index of Facial Recognition by Prosopagnosics." *Science* 228:1453–54.
Trivers, Robert L. 1971. "The Evolution of Reciprocal Altruism." *Quarterly Review of Biology* 46:35–57.
———. 1976. Foreward to Richard Dawkins, *The Selfish Gene*. Oxford: Oxford Univ. Press.
———. 1985. *Social Evolution*. Menlo Park, Calif.: Benjamin/Cummings.
Walker, Alan, and Pat Shipman. 1996. *The Wisdom of the Bones*. New York: Alfred A. Knopf.
White, Tim D. 1986. "Cut Marks on the Bodo Cranium: A Case of Prehistoric Defleshing." *American Journal of Physical Anthropology* 69:503–9.
Williams, George C. 1966. *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought*. Princeton: Princeton Univ. Press.
———. 1989. "A Sociobiological Expansion of Evolution and Ethics." In *Evolution and Ethics*, ed. James Paradis and George C. Williams, 179–214. Princeton: Princeton Univ. Press.
Wilson, Edward O. 1975. *Sociobiology: The New Synthesis*. Cambridge: Belknap Press of Harvard Univ. Press.
———. 1998. *Consilience: The Unity of Knowledge*. New York: Alfred A. Knopf.
Wittgenstein, Ludwig. 1953. *Philosophical Investigations*. New York: Macmillan.
Zimmerman, L., and R. Whitten. 1980. "Prehistoric Bones Tell a Grim Tale of Indian vs. Indian." *Smithsonian Magazine* 11:100–7.