

Theological Implications of Human Evolutionary History

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What is man, that thou art mindful of him? ... For thou hast made him a little lower than the angels, and hast crowned him with glory and honour. – Psalm 8:4–5.

Der heutige Tag ist ein Resultat des gestrigen. Was dieser gewollt hat muessen wir erforschen, wenn wir zu wissen wuenschen, was jener will.
– Hermann Kant, Die Aula.

The basic distinction is between having an experience and being aware of having an experience.
– Gordon G. Gallup.

The interaction of science and theology occupies my work each year during the closing weeks of the spring semester. I have just finished teaching the genetics and evolution course required of all biology students at UST, and this issue comes up frequently over the semester. Even more dramatically, we close the semester with a discussion of human evolution. Throughout the term students ask about, or object to, the implications of evolutionary biology for their religious beliefs. While this occurs at the University of St. Thomas more often than at other schools where I have taught, perhaps due to the serious religious nature of the school and of many of the students' backgrounds, the issue arises every time I teach evolution.

I glibly tell my classes that I see no reason for conflict between belief in some sort of divine creation of the universe and acceptance that the universe, and life, has evolved. While I do feel that this is basically true, I also think that I am being a little dishonest with my students in at least two ways. The first is that if we are, indeed, descended from other species of hominids, which were in turn descended from other primate species, which were derived from some generalized ancestral mammalian stock, which had reptilian ancestors, and so on, how can we justify what we perceive as our unique position on earth, in the universe, and in the eyes of God? In other words, what does it mean when we say we are created in the image of God?

The second point is related to the first: how does our own eventual extinction and ultimate ecological replacement by other species influence our religious beliefs? Acceptance of our evolution places humans solidly amidst all other species, extinct and extant, and forces us to consider that we are subject to the same ecological and evolutionary patterns we observe for the rest. We are biological entities, and just as each of us will die individually, so shall the species *Homo sapiens* disappear from the planet. The ecological resources we use will not remain unutilized upon our extinction; some

other species (singular or plural) will take our place. We might be the ancestors of one or more species that replace us, or our replacements might branch from some other taxon. What does this say about our concept of the soul? Is the soul a characteristic of *Homo sapiens* alone? If we are an evolutionary dead end, becoming extinct without leaving any descendant species, will there be no living beings with souls? If the soul is a property of *Homo sapiens* as we currently exist, will members of a species derived from us also possess a soul? Did members of the species immediately ancestral to us have souls? If the soul, however we define it, is an emergent property of our species, will other, phylogenetically unrelated species develop (evolve?) “the soul” as (if) they come to occupy our ecological niche?

In the introduction to his *History of Western Philosophy*, Bertrand Russell describes three ways of acquiring knowledge (religion, philosophy, and science) and distinguishes them from one another by the basis of authority that underlies each. For religion, he uses revelation as the source of authority, logic for philosophy, and observation for science. While his definitions are easily blurred, they do correspond to general categories of experience that most of us can subscribe to. Even so, I suspect that they cannot be completely isolated from one another. Science in particular, with its empirical description of the physical world in which we live, is going to influence, or even provide, the context within which we interpret revelation. Religion may be an effort to define our relationship with the rest of creation and with a deity, but our conception of that relationship will be influenced by what we conceive our position within creation to be. In the rest of this essay I will take it as given that we, members of the species *Homo sapiens*, have evolved and were not independently created in our current physical state. I will summarize our current understanding of the pathway by which that evolution occurred, as well as the evidence supporting that pathway. Next I will present the currently most favored hypotheses for the process(es) behind that evolution. Finally I will pose some questions about the religious implications of the path and process of human evolution. Specifically, I want to ask whether the suite of characteristics by which we define ourselves, or at least those characteristics that affect our spiritual lives, arose simultaneously and in our species alone, or did they themselves evolve gradually over a series of ancestral species, and what might the theological consequences of these alternatives be?

The Path of Human Evolution

When I ask my students to list characteristics that distinguish humans from apes they suggest a number of differences that almost always include intelligence, speech, brain size, upright posture, tool use and manufacture, relative lack of body hair, social organization, bipedal locomotion, self-consciousness, and a moral sense. Other characteristics that are frequently mentioned include reduction of the snout (flattening of the face), lack of natural weapons, such as prominent canines or claws, and a carnivorous or omnivorous diet. If I also ask them to define humanity using these characteristics, they almost always focus on intelligence, brain size, self-consciousness, and morality. In what might be perceived as a devilish trick to see who has done the assigned reading before class, I then ask which of these characteristics, or suites of characteristics, appeared first in human history. That is, what characteristics allow us to recognize the oldest fossil

species that lived after our last common ancestor with apes, the species that began our divergence from our simian ancestry?

The answer is an upright posture and bipedal locomotion, and the suite of skeletal and muscular features associated with these traits. My students are always surprised by this fact, even those who have done the reading, because it differs so much from what one would expect, based upon our self-image. This change in the way our ancestors held their bodies and their shift to walking on two legs instead of four will largely define the conditions under which the rest of our differences from apes will evolve, and it is central to theories attempting to explain how we evolved to become what we are.

The suite of skeletal and muscular modifications necessary for upright posture and bipedalism appeared essentially complete in the first known hominid species. Since then there have been major changes in our skulls, but except for an alteration of the ratio of arm length to leg length our post-cranial (from the neck down) anatomy has changed very little from the first hominid species. The identity of this first species is currently a matter of debate. The traditional opinion has been *Australopithecus afarensis*, a species that lived in eastern Africa from about 3.9 MYBP (million years before present) to 2.9 MYBP (R. Leakey 1994). Recent discovery of two species of older fossil hominids (M. E. Leakey et al. 1996) has pushed the date back to 4.4 MYBP, but has not changed any interpretations about post-cranial anatomy.

The anatomical rearrangements needed for the changes in human posture and movement are numerous, and their occurrence in the fossil record provides solid evidence that these physical changes and associated behavioral changes did indeed take place. The angle at which the skull attaches to the spinal column changed from approximately 180° to less than 90°, as the foramen magnum (the opening in the skull for the spinal cord to pass through) migrated from the back of the skull to the bottom. The spine itself changed from a four-legged animal's single graceful curve resembling a suspension bridge to the s-shaped double curve we have that looks and functions more like a spring or shock absorber. Since the spine was bearing the weight of the torso and now needed to withstand gravity, this modification was a considerable improvement, but the lower back pain experienced by many of us demonstrates the imperfect design of our bodies for this new way of life. The bones of the pelvis shifted relative to one another such that the joints for our leg bones became oriented towards the sides of our bodies, allowing greater movement of our legs to the front and back but restricting movement to the sides, and the surfaces for attachment of muscles pulling the legs to the front and back increased. This change had the inadvertent result of producing the buttocks, a uniquely human characteristic. The joints of the hips, knees, ankles, and the arrangement of bones in the foot all changed in accordance with their new orientation and the need to bear all of the body's weight.

Whether one speaks of *A. afarensis* or of the newly published discoveries, this entire set of anatomical novelties was complete in the earliest known species of hominid. The arms were still long relative to the trunk and legs, indicating that the creatures spent a considerable amount of time in trees, but the rest of their anatomy indicates that they

spent a great deal of their lives on the ground, moving on two feet (Susman and Stern 1983). Except for the location of the foramen magnum, the skulls of the early hominid species had hardly changed from their simian ancestor: their faces protruded, they had a massive brow ridge, they had no real forehead, the back of the skull was rounded and sloping, and their brain was no larger than a chimpanzee's of the same body size.

At least three other species of *Australopithecus* succeeded *A. afarensis*. *A. afarensis* probably also gave rise to *Homo habilis*, the oldest species in our genus, about 2.5 MYBP (Johanson and White 1979), although some would argue that the genus *Homo* appeared earlier in some as-yet-undiscovered species (R. Leakey 1994). In any case, a number of novelties appear in *H. habilis*: the brain size doubles and the face begins to flatten. The reduction of the size of the frontal teeth and relative enlargement of the cheek teeth, begun in *Australopithecus*, continues. More interestingly, and most pertinent to this discussion, the brain begins to rearrange itself. Regions that are devoted to speech in our brains appear (especially Broca's region, Holloway 1983) and the asymmetry between the left and right hemispheres of the brain becomes well established (Holloway 1983). Some maintain that this asymmetry is also seen in *A. africanus* (Schepers 1950), but this conclusion is disputed (Corballis 1991, R. Leakey 1994). We are the only living species displaying such asymmetry (Corballis 1991) and its evolution at the very beginning of our genus is significant. The first manufactured stone tools, which date from 2.5 MYBP, were made by *H. habilis*. These tools display a marked tendency toward right-handedness (Toth 1985), itself an indication of asymmetrical hemispheres of the brain.

After *H. habilis* came a succession of taxonomic groups, some considered to be species by all paleoanthropologists, all considered species by some paleoanthropologists, some considered to be mere subspecies by some paleoanthropologists. For the most part, the changes that occurred during this portion of our lineage involved continuation of trends already seen earlier. In *H. erectus* (appearing 2 MYBP) the arms reached their current proportions, indicating that we had become fully terrestrial. Our faces continued to recede beneath our crania and our brains continued growing, reaching their current states with archaic *H. sapiens* about 200,000 – 300,000 years ago. Fine tuning led to "anatomically modern humans", *H. sapiens sapiens*, by 100,000 years ago. Tool manufacture and material culture got better with each evolutionary step along the lineage. This series of events began with the original hominids standing upright and walking on two feet. In spite of the many unique human characteristics that came later, this bipedality is what started us down the path that led to what we are now. This evolutionary innovation is what initially made us different from all other primates, indeed, all other mammals, and we need to explain this

A Model of Human Evolution

Numerous hypotheses have been proposed to explain the evolution of human beings from the common ancestor we share with the great apes, or at least with gorillas and chimpanzees, and they usually focus on one or another of the four most popular characteristics that distinguish us from the apes: our large brains, our bipedality, our reduced anterior teeth and enlarged cheek teeth, or our tool making. The models are built

around presumed hunting behavior, predator defense, dietary shifts, etc. All of these models have short-comings, as discussed in any general treatment of our evolutionary history (e. g., Johanson et al. 1994, R. Leakey 1994), and none of them address a fifth, less apparent, but biologically extremely important, distinction between humans and all other beings on this planet. We have a very odd life history, and Lovejoy (1981) has developed a very plausible hypothesis based directly upon the demographic differences separating human populations from non-human populations. It is also a model of human evolution that has some interesting implications for the theological issues I raised above.

Most chimpanzee and gorilla populations have essentially zero growth rates. Their population sizes are stable within environmentally stable habitats (Teleki et al. 1976). As long as their habitat does not deteriorate their populations are safe. However, this demographic stability is not due to some extremely fine tuned adjustment to their current habitat and niche. The stability is the result of these species reproducing as rapidly as they can and still only being able to hold their own. Their populations cannot grow at any significant rate in their current environment without changing their reproductive physiology and behavior. Any decrease in successful reproduction would threaten populations with extinction. This situation is the natural end of a trend seen throughout the Primate order: there is an obvious trend towards greater longevity, with correlated increases in gestation time, length of infant dependency, time to sexual maturity, and spacing between births. A chimpanzee female becomes sexually mature only when she is ten years old. Including gestation and infancy, she will be encumbered with a dependent for about 6 years with each pregnancy. This includes both nursing and physically carrying the young chimpanzee for the 5 to 6 years of dependency. Thus, simply in order to replace both herself and her mate (a requirement for and definition of a population with zero growth rates) she must live until she is 21 or 22 years old and begin her second pregnancy immediately after the first offspring enters adolescence. Most chimpanzees in the wild do not live beyond 21 years of age. Thus anything that reduces survivorship or increases the spacing between births will threaten the population.

At the time our ancestors diverged from the line leading to chimpanzees and gorillas, the tropical environment was deteriorating, at least from the point of view of arboreal, forest dwelling primates such as the common ancestor of apes and humans. This was 8–10 MYBP, and the world was becoming cooler and drier. Seasonality in the tropics was increasing. What was once an unbroken tropical forest was breaking into a mosaic of woodlands surrounded by savannas. Some populations of the “common ancestor” remained deep in the forest, continued to follow the primate demographic trajectory, maintained the ancestral arboreal behaviors and anatomy, and became gorillas and chimpanzees. Others, living at the edges of the forest, ventured into (or were forced into) the mosaic regions of woodland and grassland.

These others, who moved into the environmental mosaic, could have continued to travel on all fours. Quadrupedal locomotion is faster and lends greater agility than bipedal locomotion. Baboons, for example, manage to live in a woodland savanna very well, all the while moving on four feet. But they are monkeys, not apes, and are not so far along the demographic trajectory as apes. Many large monkeys would only need to live to be

nine years old in order to reproduce both themselves and their mates (Drickamer 1974). Rather than suggest that movement into the savannas required arboreal primates to abandon quadrupedal movement and adopt bipedal locomotion, let us say that life in the mosaic allowed such a shift in locomotion. This shift took place, according to Lovejoy, as part of a solution to the demographic bind the original hominids found themselves in when they left the forests.

When the tropical habitat deteriorated, any decrease in survivorship or increase in the spacing between births would have driven a population extinct. In most primates, a mother must forage for both herself and for her dependent offspring. This is the primary reason for long, enforced spacing between births. A mother primate is physiologically limited in the number of offspring she can care for. As difficult as this can be in a stable, favorable habitat, in a deteriorating habitat it would have become considerably more difficult. Lovejoy suggests that the development of “home–base foraging”, coupled with a division of labor between mothers with infants and everyone else in the social group, would have removed vulnerable individuals from exposure to predation while foraging (i.e., dependent young and individuals encumbered with them). This would have improved survivorship. It would also have reduced the need to spread consecutive births out over time, since more than one individual would provide food for dependents and thereby reduce the physiological load on the mothers. This would have increased the birth rate, increasing the population’s likelihood of persistence yet more.

Most importantly for our purposes, Lovejoy’s hypothesis provides a reason for early hominids to have walked upright: to free the hands to transport foodstuffs from a site of discovery to the site of consumption. Ultimately adopting a lifestyle of scavenging and gathering (Leutenegger 1987, McHenry 1986, Sinclair et al. 1986), these early hominids had embarked upon the trajectory that would lead to the increasing social and material culture that first left fossil traces in the recognizable campsites and stone tools of *H. habilis* by 2.5 MYBP. Lovejoy offers a great deal of theoretical and empirical support for his demographic hypothesis that I will not present here. The important thing to remember is that it did not need to happen. The apes remained in the forest successfully and did not face the rigors of life in woodland savannas. Other primates colonized the mosaic of woodland and grassland without abandoning their quadrupedal, arboreal anatomy and behavior. Because one group of proto–hominids did leave the forest and took up a wholly new way of life, eventually evolving a thoroughly modified bipedal phenotype, they were launched upon a pathway leading ultimately to our existence as self–conscious, introspective, intellectual, and spiritual beings. In the next, and last, section, I want to explore the possibility that all of this – our consciousness, our intellectual and spiritual natures – is an inadvertent result, a by–product, so to speak, of that locomotory solution to a pressing demographic problem.

Mind, Consciousness, and the Ability to Imagine

Our physical bodies clearly arose from an animal ancestry. Opinions are divided concerning whether the mind and other higher human faculties can be explained in materialistic terms or not (no: Eccles 1989, yes: Crick 1994, ambivalent: Cairns–Smith

1996, Corballis 1991), but that is not really the question at hand. For my purposes it is more important to ask whether a discontinuity exists between humans and other animals for such traits as consciousness.

In many ways, an answer to such questions depends upon one's point of view. As objective means have been developed to study mental or psychological processes associated with consciousness, it has become increasingly reasonable to suppose that at least some other animal species may possess consciousness (Griffin 1981). Defining consciousness in terms of "mental experience", i.e., experience or even stimulation generated within and by the mind of an individual and not arising from the outside, physical world, Griffin offers a large amount of evidence that other mammals share this experience with us. Eccles (1989) and Corballis (1991) would include some birds in this list, citing research such as that reported in Herrnstein and Loveland (1964).

Still, there is a discontinuity in degree, even if not in kind. Such a discontinuity in the extent of our mental experiences is actually only apparent when one considers extant species. If one looks at the entire evolutionary history of humanity, clear continuity is evident from an original simian ancestor, through *Australopithecus*, and through the various species of *Homo*. This continuity exists for both the materialistic physical evolution of our brains and the expressions of higher mental faculties

The increasing asymmetry between the hemispheres of the human brain from *Australopithecus* spp. onwards provides the strongest evidence for the gradual evolution of a human mind that can create images and experiences within itself and for itself. Corballis (1991) outlines psychological research into abilities of animals to recognize and classify external images and shapes of objects. He describes two forms of mental representation of the external world. One is a holistic form of representation that all animals, including humans, possess. The ability to mentally envision an object as an entire, complete form, such as a whole piece of fruit or a whole animal, is something all animals have. They can recognize and interpret objects that they are likely to encounter in their daily lives, even if an individual undergoing testing has not yet personally encountered that particular kind of fruit or that particular kind of animal. Animals seem to use this faculty to understand the natural world of integrated organic forms. We do this, too, and in humans this inherited, ancestral capacity is based in the right hemisphere of the brain.

The second form of representation developed in humans, beginning with the genus *Australopithecus*. This mental novelty is seated in the physical novelty of the left hemisphere of the brain. Much that distinguishes us from other animals is located in this hemisphere, such as the parts of the brain involved in the use and production of language. Corballis calls this novelty a "geon-based form of representation", by which he means that generalized forms and shapes can be combined as parts of some larger whole to create or assemble images of things that do not exist in the natural world. That is, this second form of representation is the ability to envision something unlike anything the individual has ever experienced, to invent a mental

Much as we assemble a finite number sounds into words and words into sentences, standardized shapes such as cylinders can be combined into an infinite number of represented objects, and thus generate an infinite number of imagined or hypothetical visions. In other words, this capacity which Corballis calls “the generative mind” gives us the ability to think abstractly. Corballis argues that the generative mind evolved as an adaptation to industry, to the new part of the human environment comprised by our material culture. His argument resembles that of Lumsden and Wilson (1981, 1983): genes influence the structure of the brain, which influences the functioning of the mind, which influences the culture in which we live, which influences our behavior, which exerts selection upon our genes.

As tool making, for example, became more important for human biological success, an ability to improve upon tools by consciously and intentionally envisioning a new design would have been strongly favored by natural selection. Remember that the oldest stone tools coincide with the first enlargement of the human brain in *Homo habilis*. Remember, too, that the evolution of the genus *Homo* follows upon the evolution of the genus *Australopithecus*. It was the behavioral, or cultural, innovation underlying social foraging and sharing of resources that caused the evolution of our dramatically different bodies that were then capable of being further molded by natural selection to develop material culture. Planned, intentional improvement of material culture was enabled by the evolution of Corballis’ combinatorial form of mental representation that allowed our ancestors to envision non-material objects and beings. This same form of representation allows us to invent artistic and intellectual culture, to contemplate morality and mortality, and even to conceive of a soul and a deity. These are the things that make us humans, as opposed to simply hominids, but they are the inadvertent result of the biological need of hominids to survive in a physical, material world.

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