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Biological Anthropology: An Evolutionary Perspective Part II

Acknowledgement:

Footage of a rhesus monkey on Cayo Santiago provided by Christy Hoffman.

Biological Anthropology: An Evolutionary Perspective

Scope:

These twenty-four lectures present detailed, up-to-date material about all aspects of the evolution of humanity. Aimed at those who are curious about our origins as a species, this course covers the wide range of topics in the discipline of biological anthropology. Biological anthropology takes as its goal a comprehensive exploration of the forces of both biology and culture that shaped human prehistory and continue to shape our lives today.

Following an introductory explanation of the various scientific approaches that together make up the field of biological anthropology, the initial lectures focus on evolution and its mechanisms. Important concepts, such as Darwin's principle of natural selection, are defined clearly, with real-life examples, and their significance is explained. What emerges from this section of the course is an understanding of why evolution and religious faith never need be opposed, whereas evolution and the theory of creationism are in direct conflict (with creationism rejected by scientists).

Applying these concepts to evolutionary history, Lectures Four through Eight explore the origins and behavior of the nonhuman primates. As primates ourselves, we humans share a 65-million-year evolutionary history with prosimians, monkeys, and apes. These lectures concentrate on primate behavior, showing how our own cognition, language, and kinship bonds developed out of the abilities present in these primate relatives. Particular emphasis is put on the great apes, such as chimpanzees, those animals closer to us genetically and behaviorally than any other.

The hominids, our extinct ancestors that walked upright, evolved from a common ancestor with the great apes nearly 7 million years ago. The anatomy and behavior of these species, ranging from the famous "Lucy," to the less well-known but equally important "Nariokotome Boy," to the cave-dwelling Neandertals, are profiled in Lectures Nine through Fifteen. These lectures highlight ways in which biology and culture intersect to allow for milestones to be reached in human prehistory.

Examples include the enlarged brain that allowed stone tools to be manufactured for the first time by hominids at 2.5 million years ago and the increasing cognitive skills and emotional ties that together led to deliberate burial of the dead by Neandertals at about 60,000 years ago. Two lectures deal with issues related to gender in prehistory, asking what we can know about the relative roles of females and males in hominid societies.

Lectures Sixteen through Eighteen are devoted to the origins of modern human anatomy, behavior, and language. Biological anthropologists have identified

what they believe to be the oldest modern-human remains at about 125,000 years ago. For reasons made clear, it is unlikely that these earliest *Homo sapiens* could have evolved from Neandertals. From which hominids, then, did they arise? Was Africa the center of modern human origins, as it had been the center for early hominid evolution? We consider two competing models in evaluating these questions. One model points to Africa as the sole home of our species, whereas the other posits simultaneous evolution in Africa, Asia, and Europe.

Even more debated are the origins of modern human behavior and language. New evidence points to significant shifts in biological anthropologists' understanding of each of these topics. Sites in Africa tell us that symbolism, art, and finely crafted tools may not have first appeared at 35,000 years ago in Europe as long thought; evidence for a long evolutionary history for language is mounting as well.

The final five lectures consider modern human life in evolutionary perspective. A near-consensus conclusion in biological anthropology, that the practice of grouping humans into "races" based on supposedly genetic traits is invalid scientifically, forms the heart of Lecture Nineteen. Subsequent lectures explore ways in which evolution has tailored human anatomy and behavior, even today, to specific environmental pressures.

Also considered at length are fascinating new suggestions that modern health problems and aspects of modern health psychology have arisen as a direct result of conditions in human prehistory—conditions to which we were once adapted but no longer are. Pregnancy sickness and human mate choice are two case studies in this section.

The course concludes with a look at twenty-first century "gene discourse," in which undue power is given to genes and genetic research as panaceas for the future. An evolutionary perspective yields an understanding that the kinship we humans feel with other primate species (both living and extinct), as well as the tools we collectively have at our disposal for solving conflicts and other problems, are based not on genetics. Rather, they stem from a dynamic interplay of biological and cultural factors at work in our long evolutionary history.

Lecture Thirteen

Who Were the Neandertals?

Scope: No hominids pique greater interest, or are more shrouded in mystery, than the Neandertals. Did the Neandertals resemble the shambling cavedwellers so beloved by fiction writers, B-movie makers, and cartoonists? Or were they, in fact, relatively advanced, well-adapted primates, more like humans in many ways than like early hominids?

Biological anthropologists favor the second view. Neandertals were large-brained, bipedal walkers. Neandertals were significantly more stocky and muscled than are modern humans, however, with a very differently shaped skull.

Neandertal behavior is by no means primitive. These hominids made significant technological advances, hunted big game successfully, and even buried their dead—an act not associated with *Homo erectus*. The latest anthropological interpretations emphasize these advances while noting that bands of Neandertals were likely not as efficient in survival skills as were groups of modern humans.

As we will see, no consensus exists about the precise nature of the relatedness either between Neandertals and modern humans or among the other hominid species at this general time period. The interval between the latter *Homo erectus* time period and the disappearance of the Neandertals at approximately 30,000 years ago is currently a challenging one in paleoanthropology.

Outline

I. The Neandertals have been known to science since 1856 and, in that century and a half, have become a kind of cultural icon.

- **A.** Say "Neandertal," and the image that pops into many people's minds is that of an ancient, stooped, and not-so-clever "caveman" wearing animal skins. Asserting that someone today "thinks like a Neandertal" is far from a compliment.
- **B.** Historically, we can explain the source of this image. In 1911, a French anatomist reconstructed a Neandertal skeleton to represent just such a shambling, unintelligent creature.
  1. The anatomist, like most others of his day, had a preconceived notion of what "ancient man" should look and act like.
  2. He chose for reconstruction a skeleton whose bones were affected by arthritis, thus strengthening his conclusion that this hominid was far from modern in appearance.

II. Biological anthropologists now reject the "stooped caveman" reconstruction of Neandertals. Like other hominids, Neandertals were bipedal and show a mix of both more and less humanlike traits.

A. Neandertals were large-brained hominids and walked bipedally with a modern gait.

B. Neandertals were short, stocky, and extremely strong. This is one way in which they were markedly different in appearance from modern humans.

C. From the neck up, Neandertals, despite their large brains, had a more primitive look than do modern humans. The Neandertal skull, with its low forehead, large brow ridges, and enlarged nasal area, is distinctive.

III. The best way to think of the Neandertals is as an archaic species closely related to modern humans but different enough to be classified in its own species, *Homo neandertalensis.*

A. Precursors to Neandertal features can be traced in fossils as far back as 300,000 years ago.

B. Most biological anthropologists refer to Neandertals as living between 130,000 to 30,000 years ago, with emphasis on the period of the last glaciation, starting at 75,000 years ago. Neandertals lived in Europe and Asia.

C. Neandertals are different enough from *Homo sapiens* to warrant their own species. As we will see later, the two species did overlap in time and space.

IV. Behavior and culture of the Neandertals give intriguing hints that Neandertals were, in fact, complex thinkers. Biological anthropologists, however, disagree on how like modern humans they were in this regard.

A. The trend toward improved hominid technology over time continues with the Neandertals. Neandertal tools are based on flake manufacture.

B. Neandertals did sometimes live in caves and were successful hunters, proving that even oversimplified stereotypes do contain some truth! Some biological anthropologists suggest that their foraging patterns were more restricted and simplified than those of modern humans.

C. The area of interpretation about Neandertals that is subject to the most contention involves their cultural behavior.

1. Deliberate burial of the dead by Neandertals is accepted by most scholars. Burials at a cave in Shanidar, Iraq, offer a good case study. Do these and other Neandertal burials involve some kind of symbolism? Here, little agreement exists.
2. Can we find glimmers of early art among Neandertals? Biological anthropologists are skeptical.

V. The precise relationship of Neandertals to modern humans, and to other hominids of the same general time period, is unclear.

A. In these lectures, Neandertals are considered to belong to a separate species than modern humans. The Jurmain textbook recommended for this course, however, concludes that Neandertals are an archaic variant of our own species.

B. Analysis of ancient DNA may eventually reconcile this issue. At present, DNA analysis tends to support the view that Neandertals were a distinct species, but uncertainties surround this technique.

C. The time period directly before Neandertals appeared, that is, between 400,000 and 130,000 years ago, is best thought of as a transitional one. Several types of hominids may be present. Scientists are at work attempting to clarify the relationship of these species to both the earlier *Homo erectus* and the latter *Homo sapiens.*

D. In sum, Neandertal anatomy has come clearly into focus in recent decades, and we learn more about Neandertal behavior by the year. Yet the ancestral relationships among Neandertals, modern humans, and other hominids in this general time period remain fuzzy.

Essential Reading:

Jurmain et al., *Introduction to Physical Anthropology*, chapter 12.

Tattersall, *The Last Neanderthal.*

Questions to Consider:

1. State some significant ways in which Neandertals differ from *Homo erectus.* Consider both anatomy and behavior.
2. What are three possible interpretations for why Neandertals deliberately buried their dead? Are some of these interpretations more cognitively impressive than others?

Lecture Fourteen

Did Hunting Make Us Human?

Scope: In several previous lectures, we have noted that early *Homo* ate meat, obtaining it by processing animal carcasses with stone tools. But when did hominids turn from scavenging and opportunistic capture of small game to organized big-game hunting? Was hunting a "prime mover" of increased hominid brain size, as envisioned in classic early anthropological models?

In the late 1960s, two male anthropologists published a paper that was to remain influential for many years. This "Man the Hunter" paper claimed that hominid hunting, specifically the male-male cooperation seen as the heart of hunting, brought about great leaps in hominid problem solving and intelligence. The story of human evolution, in this view, was equated with the story of hunting.

Before long, some female anthropologists objected. What about the role of women in hominid food procurement, they asked? Female gathering of plant and vegetable material was likely far more crucial than hunting, they wrote, in bringing about increased intelligence and promoting the cohesion of social groups.

More recently, some anthropologists have challenged the hunting scenario from another quarter. They argue that hunting, as opposed to scavenging, developed too late in human evolution to have acted as a prime mover. A key question here is whether *Homo erectus* was primarily a scavenger or a hunter.

Although the "Man the Hunter" scenario in its starkest form has been rejected, echoes of the debate surrounding it may still be heard today. The biological anthropologist Craig Stanford has recently resurrected the role of meat-eating and meat-exchange as a prime mover in the story of human evolution. Taking a look at these various arguments, we will assess the degree to which hunting is a fundamental human adaptation.

Outline

I. We have seen that *Homo habilis* processed animal carcasses with Oldowan tools, and *Homo erectus* ate even more meat. We have remained agnostic, however, on the question of how this meat was procured, other than to suggest a role for scavenging. Several classic anthropological models have debated directly whether hunting was a prime mover in human evolution.

A. In the 1960s, Sherwood Washburn co-authored a seminal article with fellow anthropologist Chet Lancaster, claiming in no uncertain terms that hunting made humans human.

1. Males are naturally drawn to hunting, these authors wrote. The skills of intelligence and cooperation required to bring off a successful hunt shaped the evolution of our species.
2. In this scenario, females were painted as passive creatures who evolved on the "coattails" of the hunting males.
3. Modern hunter-gatherer peoples were a referent for this type of model, but selectively so; the role of modern male hunters was emphasized.

B. Response to Washburn and Lancaster came from anthropologists writing in the 1970s, including Tanner and Zihlman, who believed that the female role in hominid evolution had been keenly undervalued.

1. Tanner and Zihlman, among others, suggested that the gathering activity of females—collecting plants, tubers, and nuts—would have been more reliable and important than male hunting in hominid evolution.
2. Using chimpanzees as referents, these female anthropologists argued that female hominids may have invented new tools to aid foraging in early human evolution. Thus, women would have been active, perhaps primary, contributors to the evolution of hominid intelligence and social cohesion.
3. Ironically, Washburn and Lancaster's male-hunting model coincided with the publication of anthropological data showing that it is women's gathering activity that makes the major contribution to foraging in many hunter-gatherer peoples. These data supported Tanner and Zihlman.

II. In the next decades, the 1980s and 1990s, paleoanthropologists avidly sought hard evidence to shed light on the origins of human hunting. Early paleoanthropologists had been quick to equate any indicator of meat-eating with hunting. Paleoanthropologists were now more cautious.

A. Scavenging is an obvious alternative method for obtaining meat. Because hominid scavenging leaves marks on bones that look distinct from hunting marks, scientists can sometimes distinguish the two foraging strategies.

B. No hard evidence supports hunting in any australopithecine or in *Homo habilis*, though scavenging is indicated for *Homo habilis.*

C. Debate still surrounds the role of hunting versus scavenging in later hominids, such as *Homo erectus* and the transitional forms between *Homo erectus* and *Homo sapiens.* The clearest case for hunting can be made at the site of La Cotte de Saint-Brelade on the Channel Island of Jersey, which is associated with a transitional form appearing after *Homo erectus.*

D. The relatively late appearance of organized big-game hunting, coupled with the existence of cooperative small-game hunting in wild

chimpanzees, leads many biological anthropologists to exclude hunting as a prime mover factor in human evolution.

III. Very recently, the biological anthropologist Craig Stanford has reinvigorated the debate about the significance of hunting in human evolution. He once again suggests that hunting has been of critical importance in early hominid evolution, but he does so in a new way.

- **A.** For many years, Stanford studied chimpanzees at Gombe, Tanzania, becoming impressed by their skills in hunting red colobus monkeys.
- **B.** Stanford suggests that chimpanzees make an excellent referential model for the origins of meat-eating and hunting in human evolution.
- **C.** He stresses, however, not so much the act of hunting itself as the food-sharing that results when male hominids get meat. The strategic use by males of meat as currency when interacting with females is the key factor.
- **D.** Response to Stanford's model varies. Whereas he insists that his model avoids the passive female stereotyping so pervasive in Washburn and Lancaster's, other anthropologists are not so sure.

IV. Looking back at the history of hunting models, we see shifts over time; the importance accorded to male hunting waxed and waned over the decades. Certainly, some of these shifts were brought about by new paleoanthropological and primatological evidence. However, less concrete factors also play a role, as we will examine in the next lecture.

Essential Reading:

De Waal, *Tree of Origin,* chapter by Stanford.

Questions to Consider:

1. In what ways does the recent Stanford scenario differ from Washburn and Lancaster's original formulation about hunting? Are any similarities evident between the two?
2. Why do you think hunting has been far more popular as a prime mover in evolutionary theories than has scavenging?

Lecture Fifteen

The Prehistory of Gender

Scope: Biological anthropologists have hotly contested the relative roles of men and women in human prehistory, as the previous lecture on hunting versus gathering attests. From our current vantage point, it becomes clear that some important models of the evolution of human behavior were constrained by assumptions particular to American culture in the 1960s and 1970s. The nuclear family was, for instance, assumed to be the typical family structure in hominid evolution by some anthropologists; the male "producer" (food provider) was depicted as giving food and other aid to the female "reproducer" (breeder).

Such a simplistic scenario, we now see, does not fit with the cross-cultural data on human families. Neither does this scenario square with the evidence from primate studies showing that female monkeys and apes are capable of producing food for themselves and caring for their offspring without assistance from males. And if hominid females needed aid because their reproductive profiles differ from those of monkeys and apes, were males really the sole available source for that aid?

As assailable as male-dominated models, however, are scenarios of human evolution that depict females in control. No evolutionary validity is gained by transforming male-centered into female-centered models. The most credible schemes are those that emphasize flexibility in gender roles according to local resources and local environmental circumstances.

Outline

I. Paleoanthropological models by necessity involve interpretation (see Lecture Eight); the relatively sparse bones and artifacts of human evolution must be fleshed out. In turn, scientists' interpretations are shaped by the time and place in which they think and write. This may be especially true when it comes to interpretations of gender.

- **A.** Anatomical differences based on sex, that is, sexual dimorphism in male and female skeletons, may fossilize. It is often possible to distinguish skeletons by sex and to make inferences about different levels of strength, or variation in diet, between males and females.
- **B.** Behavioral differences based on sex do not fossilize. Few other clues exist as to which sex hunted, or cooked, or made tools—or whether both sexes may have carried out these activities. In the absence of hard

evidence, paleoanthropologists turn to ethnographic evidence from living modern peoples.

C. In selecting the data to use, and in combining different sources of data, subjectivity inevitably plays a role. An individual scientist's preconceptions about gender may creep into his or her model, perhaps unconsciously. As a quick example, we will analyze the museum diorama depicting two bipedal australopithecines leaving footprints in African ash more than 3.5 million years ago.

II. We will analyze in-depth three prominent paleoanthropological models, one already encountered and two new ones, that touch on gender roles. Our focus in each will involve the roles accorded to the hominid male and the nuclear family.

A. As we have seen, Washburn and Lancaster's hunting model from 1968 gives to the hominid male the primary evolutionary role, deemphasizing the female's role. Significantly, it also projects the nuclear family millions of years back into the past.

B. Thirteen years later, in 1981, Owen Lovejoy published a much-touted scenario in which the role of hunting was minimized. Males were still the evolutionary prime movers, though; mobile males were naturally selected to provision sedentary females and offspring. The nuclear family is as prominently placed in this model as in Washburn and Lancaster's.

C. In 2001, Richard Wrangham and colleagues suggested that cooking food over a controlled fire outweighs hunting as a prime mover in human evolution. Females are active in this model because they are the ones who cook. Males, however, must protect females from potential theft of cooked resources by other "scrounger" males. Once again, the nuclear family reappears.

D. All three models imply that hominid females would have pair-bonded with males because they require male protection to ensure their survival and reproductive success. How valid is this perspective?

1. Primate studies tell us that female primates are capable of both reproduction (of offspring) and production (of food for themselves); males do not provision females in monkeys and apes.
2. As life spans lengthened, however, hominid females would have become responsible for feeding their juveniles, as well as their infants. Hominid females may well have needed aid, then, to cope with an increased reproductive burden. Yet equating aid with male protection may be unnecessarily constraining.
3. Anthropologists have long known that the nuclear family is a minority pattern across the globe; it is now the minority pattern even in American society.

4. Gender patterns in American society may have influenced the models' authors in their willingness to draw conclusions about males and females in our distant past.

III. When anthropologists turn the tables on these male-dominant models and prioritize hominid females instead, rejecting the nuclear family in the process, no scientific validity is gained.

A. The models put forth by Tanner and Zihlman simply reverse the prevailing assumptions about gender. Females become more important evolutionarily than males, and female-centered networks are favored over the nuclear family.

B. Little support exists for models that privilege strict "behavioral sorting" by gender. Ethnographic data show that a variety of roles may be played by men and women and that a variety of social units may provide a society's base.

C. The best solution may be to offer alternative behavioral scenarios that all recognize the inherent variation within genders. Referential, phylogenetic, or conceptual models from primates; paleoanthropological evidence from skeletons and behavioral artifacts; and ethnographic analogies may all be used.

Essential Reading:

De Waal, *Tree of Origin,* chapter by Wrangham.

Supplementary Reading:

Jolly, *Lucy's Legacy.*

Questions to Consider:

1. What data support a shift in focus on hunting as prime mover to cooking as prime mover in human evolution?
2. What part can studies of monkeys and apes play in fashioning solid models of hominid gender roles?

Lecture Sixteen

Modern Human Anatomy and Behavior

Scope: A single question forms the core of this lecture: When and where did modern human anatomy and behavior appear? The fossil record points to development of modern human anatomy by about 125,000 years ago. Modern humanity, defined anatomically, is thus quite young in evolutionary terms.

The timing of modern human *behavior* is more contentious. An earlier view converged on a radical shift in behavior at about 35,000 years ago in Europe, with the appearance of new forms of technology; symbolic representations, including art; and advances in foraging and trading. Support for this view came from the famous "cave art" sites. The beautifully rendered animal representations on the walls at Lascaux Cave, France, have long been known. Newer data from the exciting 1994 discovery of Chauvet Cave, also in France, yield an even more complete picture of the art of early *Homo sapiens*.

Based largely on two exciting archaeological African sites, scholars are reassessing the idea that a revolution in behavior can be neatly pinpointed in time at one specific region. Sophisticated tools and art predating 35,000 years ago, and found in Africa rather than Europe, indicate that scientists need to take a more global view of the origins of modern human behavior.

Outline

I. Fully modern *Homo sapiens* differ in appearance from Neandertals and the so-called transitional forms that show a mix of *erectus-sapiens* traits.

- **A.** The most dramatic changes appear in the shape of the skull. Compared to Neandertals and transitional hominids, modern humans have a high forehead, smaller brow ridges, smaller teeth, and a definite chin.
- **B.** Variation can be still seen today in the modern human skull; a few populations show a more pronounced brow ridge than is the norm, for example.
- **C.** Post-cranially, modern humans have lighter, more slender bones than Neandertals and other hominids.

II. Modern human anatomy most likely first evolved in Africa at approximately 125,00 years ago.

- **A.** Three sites in Africa provide the most concrete evidence: Klasies River Mouth and Border Cave in South Africa, and Omo Kibish in Ethiopia. Dating of these sites, however, is not foolproof.

- **B.** Rival sites in the quest to identify the first modern human anatomy are found in the Middle East. Two cave sites in Israel, Qafzeh and Skuhl, are the most important but probably post-date slightly the African sites.
- **C.** Whether the African or Israeli sites turn out to be older, we can conclude that *Homo sapiens* is evolutionarily quite recent.

III. Identifying modern human behavior, and when and where it might first be found, is an order of magnitude more difficult than the search for the first modern anatomy.

- **A.** Typically, by the term *modern behavior*, biological anthropologists refer to a cluster of innovations relating to technology, art and other symbolic representation, and advances in foraging and trading.
- **B.** Biological anthropologists initially traced these behavioral innovations to Western Europe, suggesting that they appeared there at about 35,000 years ago. In this view, there was a great leap forward in human behavior in a single time and place.
  1. So-called Upper Paleolithic tools in Europe at this time show fine workmanship in wood, bone, and antler.
  2. Breathtaking examples of art, only seen after 30,000 years ago, have long been known from such caves as Lascaux in France. In 1994, Chauvet Cave was discovered, also in France, yielding amazing new clues to hominid art. Portable art is also associated with the Upper Paleolithic in Europe.
  3. These advances and others in hunting and long-distance exchange of objects look wholly different from anything produced by Neandertals, or other hominids, according to many scholars.
- **C.** Recently, evidence suggests that instead of a sudden behavioral revolution in Europe, modern human behavior may have appeared more gradually and in a more distributed way around the globe.
  1. Although it seems clear that *Homo sapiens* is set apart from other hominids behaviorally, the early focus on a specific behavioral revolution may be, in part, the result of a Eurocentric bias. Africa may once again be implicated in some "firsts" in human evolution, as it has been so often.
  2. New excavations at two African modern-human sites, Katanda in Zaire and Blombos Cave in South Africa, are forcing reevaluations of the appearance of sophisticated modern technology. Bone, for example, appears to be very finely worked at these sites. These sites significantly predate the supposed European behavioral revolution.
  3. Rock art in Namibia and other places in Africa date to approximately the same time periods as the French caves.

IV. In sum, it appears that modern human anatomy evolved before the cluster of traits that we refer to as modern human behavior. However, the timing for

appearance of modern human behavior has shifted appreciably in just the last few decades. The old idea that Africa was the home of early human evolution but that modern human behavior evolved in Europe is now suspect.

Essential Reading:

Jurmain et al., *Introduction to Physical Anthropology*, chapter 13, second half.

Questions to Consider:

1. What questions would arise for paleoanthropology if the Israeli *Homo sapiens* sites are found to predate the sites in Africa?
2. Two sites excavated in the 1990s are significantly altering our understanding of the origins of modern human behavior. What are the main new findings at Chauvet Cave in France and Blombos Cave in South Africa?

Lecture Seventeen

On the Origins of *Homo sapiens*

Scope: We know that *Homo sapiens* is a young species, in evolutionary terms; we humans are no older than 125,000 years anatomically, with modern behavior appearing even more recently than that. But from which hominid populations did *Homo sapiens* evolve? And at what point did modern humans become the sole hominid on Earth?

Homo sapiens likely evolved from transitional hominid populations living between 400,000 and 200,000 years ago; by about 30,000 years ago, our species was the only hominid alive on Earth. Two major models try to explain modern human origins. Scientists who support the *Out-of-Africa replacement* model suggest that *Homo sapiens* developed first in Africa, then migrated out across the world, replacing all other hominid populations as they went. Those who support the rival *multiregional* model insist that *Homo sapiens* evolved locally on three continents, each regional population responding to local selection pressures.

Each model produces different predictions. To evaluate these differentially, three sources of information can be used. Hominid sites and specific fossils can be compared across regions of the world. Evolutionary theory allows assessment of more likely and less likely scenarios of evolutionary change. Finally, DNA can be analyzed to identify pathways of genetic changes over time.

At this point in the course, it is likely no surprise to learn that biological anthropologists can reach no consensus on which model to support. It is even possible that an intermediate sort of model, combining elements of both the Out-of-Africa and multiregional models, might be the best candidate for explaining modern human origins.

Outline

I. Modern humans originated no earlier than about 125,000 years ago. Between that time and 30,000 years ago, *Homo sapiens* shared the Earth with Neandertals. Could our species have evolved from Neandertals?
   A. Given that Neandertals and modern humans evolved at about the same time, it is unlikely that Neandertals gave rise to modern humans. Rather, we can think of the two species as co-inhabiting certain areas at certain times.
      1. Neandertals and modern humans occupied the same general region of the Middle East between about 90,000 and 60,000 years ago.

Biological anthropologists have no sense of whether the two species directly met.

2. Neandertals and modern humans not only occupied the same regions of Western Europe at about 40,000 years ago, but biological anthropologists are fairly sure that the two species met and competed for resources.

B. Neandertals and modern humans may have both arisen from the same or similar earlier hominid populations, then adapted in different directions to different selection pressures.

1. A plausible hypothesis is that *Homo erectus* evolved into transitional hominids marked by a mix of *erectus-sapiens* characteristics. Populations lived in Africa, Asia, and Europe between 400,000 and 130,000 years ago.
2. Some populations evolved in the direction of modern *Homo sapiens*, whereas others did not.

II. The *Out-of-Africa replacement* hypothesis posits that all the evolutionary "action" in modern human origins occurred in Africa. Modern forms then spread out through the Old World, replacing all other hominid populations.

A. Modern humans first evolved in Africa, as evidenced by the sites of Klasies River Mouth, Border Cave, and Omo.

B. As hominids migrated north out of Africa, they encountered other hominid populations and replaced them but without interbreeding.

III. The *multiregional* hypothesis posits that evolution of modern humans occurred on three continents.

A. Gradual evolution in Africa, Asia, and Europe accounts for the origins of modern humans in this perspective.

B. Gene flow among populations on these three continents prevented speciation from occurring.

C. Replacement of one hominid population by another did not occur; rather, *Homo erectus* and other hominids evolved locally and gradually into *Homo sapiens.*

IV. Multiple sources of evidence can be brought to bear in testing these two models.

A. Precise dating of archaeological sites is crucial; if the African *Homo sapiens* sites are not, in fact, the earliest, then the Out-of-Africa position is weakened.

B. Comparison of fossil anatomy from different regions produces a mixed picture.

1. In some regions, for example, in Asia, there seems to be clear evidence of local continuity. That is, certain features can be traced across long periods of time within a certain region (but not across regions). This fact supports the multiregional model.
2. On the other hand, a corollary of the multiregional model is that in Europe, Neandertals evolved into modern humans. As we have seen, this situation seems unlikely.

C. At least one reading of evolutionary theory appears to support the Out-of-Africa model. Stephen Jay Gould says that the multiregional model is very unlikely because it requires disparate populations to evolve in the same direction, despite variant local selection pressures.

D. Out-of-Africa theorists have claimed that DNA analysis supports their case. A variety of methods have been attempted, most famously the one involving "mitochondrial Eve."

1. Mitochondrial DNA (mtDNA) is a subtype of DNA inherited only through the maternal line. Changes in mtDNA come about only through mutation and, thus, can be used to trace ancestry.
2. A study of modern variation in women's mtDNA showed that the greatest variation exists in Africa, implying that African people evolved first. It was even deduced that the first African, the so-called mitochondrial Eve, lived in Africa at about 200,000 years ago.
3. Subsequent genetic tests cast doubts on the precise methods used to reach the conclusion about mitochondrial Eve. In any case, skeptics, especially those who espouse the multiregional model, say it is misleading to imply that one specific modern human female was the mother of us all.

V. A possible solution in the stalemate between the two models of modern human origins is to embrace an intermediate model, which is called the *partial replacement model.*

A. In this third model, *Homo sapiens* did migrate north from Africa, where they first originated.

B. Along the way, these individuals hybridized to some degree with local hominid populations. Replacement, thus, occurred gradually.

VI. Returning to a familiar refrain, we can sum up by saying that biological anthropology has produced good, solid, testable models about the nature of modern human origins; we now await more data to differentiate among them.

Essential Reading:

Jurmain et al., *Introduction to Physical Anthropology*, chapter 13, first half.

Sykes, *The Seven Daughters of Eve.*

Questions to Consider:

1. What evidence do you believe would be most helpful in nailing down either the Out-of-Africa or multiregional model?
2. Why is mtDNA more useful in tracing ancient ancestries than is regular (nuclear) DNA?

Lecture Eighteen

Language

Scope: We humans can hardly imagine our daily lives without being able to express our ideas verbally (or through signed languages). Language underpins our most human experiences, from watching the performance of a Shakespearean play to exchanging news of our experiences at work, home, or school with loved ones at the end of a day. Language is the keystone of human culture. Biological anthropologists are, thus, keenly interested in finding out whether it is a trait unique to modern humans or has a longer evolutionary history.

The dominant view in linguistics, philosophy, cultural anthropology, and related disciplines tends to be that language is indeed confined entirely to our own species. In this view, production and comprehension of syntax or complex grammatical patterns must be evident before any sort of communication can be defined as language.

Another view posits that language developed gradually within the hominid lineage. Hominid anatomy, hominid behavior, and evolutionary reconstructions may all be marshaled in favor of this gradualist viewpoint. Some biological anthropologists extend this continuity perspective even farther, pointing out that monkey and ape communication includes elements of language.

Inarguably, some aspects of human language are unprecedented in the primate world. Humans have vast vocabularies with which to discuss not only the present, but also the past and future, sometimes using complex narratives. We will explore, using one reasonable (if speculative) model, how such abilities might have evolved.

Outline

I. Language involves far more than just conveying information; we humans experience and even construct our lives through language.
   - **A.** Language is the basis for human sociality. Whether vocal or signed, language shapes our world.
   - **B.** Language is such a fundamental part of the human adaptation that we routinely engage in "conversation" with infants, pets, and computers.
   - **C.** Children learn immensely complicated languages with little apparent effort. How this process is accomplished is fiercely debated; for our purposes, we should note that even the youngest infants live in a linguistic world.

II. Three distinct possibilities can be envisioned in biological anthropology for how this fundamental human adaptation might have come about. Each is tied to a different understanding of the definition of language.

A. Language is unique to modern humans and of recent evolutionary origin.
   1. The complex grammatical patterns of syntax are the key element of language; without them, language cannot exist.
   2. Only the modern human brain is capable of generating and comprehending syntactical utterances. Thus, only modern humans can possibly have language.
   3. Significant discontinuity exists between human language and all other forms of hominid, as well as animal, communication.

B. Language is unique to the hominid lineage but not unique to modern humans; early *Homo* might have had, and certainly Neandertals and later transitional forms did have, language.
   1. Language should not be equated with syntax. We cannot know when syntax evolved, but a broader view of language is more compatible with an evolutionary perspective.
   2. Both anatomical and behavioral clues point to hominids as capable of language. These clues range from the position of various organs in the hominid vocal tract, to details of hominid brain anatomy, to known hominid behaviors that would have required some linguistic capability to perform.
   3. Significant continuity exists across hominids, and between early and later forms of *Homo*, but significant discontinuity exists between hominid language and all other forms of animal communication.

C. Language, or significant elements of language, can be found in primates even before the evolutionary split between hominids and great apes.
   1. An evolutionary perspective compels us to understand that language emerged gradually, with no major Rubicon crossed at the starting point of the hominid lineage. We may view language either as composed of various critical components or as complex communication that results in cohesive social groupings.
   2. Either of these definitions of language allows us to find language in monkeys and apes today. Some wild monkey populations, together with the enculturated apes, offer the best illustrations.
   3. Complex nonhuman primate communication is related to human language by homology; the relationship between the two is unlike that between communication of primates and of all other animals, even, for instance, dolphins.

III. The human species-specific form of language is without a doubt different, even if only by degree and not by kind, from all other communication systems. Viable step-by-step evolutionary scenarios exist for a gradual development of this human adaptation.

A. Only human language relies on large vocabularies comprised of words with specific, widely understood meanings. These words are used in ways that not only convey information in the present, but reflect on the past and plan for the future.

B. The emergence of these special abilities need not be thought of as mysterious or wholly disconnected from evolutionarily prior systems of communication. A scenario proposed by the anthropologist Robbins Burling includes key steps that might explain the necessary evolutionary shifts.
   1. The evolutionary base is provided by the iconic gesturing of great apes (see Lecture Seven).
   2. With increased brain size and an increased ability over that of the great apes to imitate actions of others, hominids would have been better able to adopt utterances made by social companions and use them in a socially conventional way. The need for reliance on iconic signs would have decreased.
   3. Over time, linguistic signs would become more and more arbitrary—breaking the link between a sign and its referent. Words could begin to refer to specific objects, events, or actions.
   4. Eventually, using words in orderly combinations would have become more and more beneficial, leading to the development of syntax.
   5. Burling clearly admits this scenario is speculative, but it does dovetail nicely with data from primate studies, as well as with evolutionary logic.
   6. As with all other hypothetical scenarios that we have reviewed, this one both requires more data and stimulates more research. The creation of plausible scenarios is an important part of the ongoing work in biological anthropology today.

Essential Reading:

King, *The Origins of Language,* especially chapter by Burling (second half) and King's chapter 2.

Questions to Consider:

1. Which of the three views of language do you find most convincing? Why?
2. What specific type of hominid discovery do you think would most help clarify the origins of language?

Lecture Nineteen

Do Human Races Exist?

Scope: In the final lectures, we shift gears again to consider ways in which biological anthropology explicitly interacts with issues in today's modern world. We start with a question that may be a surprising one: Do human races exist?

Contemporary biological anthropologists have achieved a near-consensus in answering this question: No matter how sociologically useful the concept of race may be, there is no biological validity to the idea that human races exist. Whichever way one tries to carve up the human species into discrete races—based on skin color and other genetic attributes—it turns out that there is too much variability *within* each race for the idea to have any biological meaning. The human species is too recent in origin, and too characterized by gene flow and mating between groups, for meaningful biological differences to evolve.

Yet a few prominent scholars refuse to accept the view that race is a biologically invalid concept. They ask us to open our eyes. Races, they say, are immediately distinguishable by the person on the street; why, then, can't biological anthropologists accept reality? Don't race-specific anatomies, behaviors, and diseases exist? Confronting this type of query head on, we will work to understand why it is based on scientifically inadequate thinking about race.

Outline

I. The final section of the course explores topics in biological anthropology that relate to contemporary human populations. We begin with a vexing one: Can the human species be understood as made up of biologically distinct races?

- **A.** The term *race* is so ingrained in American society that the very question we are asking may take people aback.
  1. As the biological anthropologist Michael Blakey has said, the idea that people can be grouped into races may seem as obvious to us as the sun rising in the east every morning.
  2. Since at least the time of Linnaeus, the eighteenth century Swedish biologist, we have been presented with taxonomies of the human races, and the concept has become second nature.
  3. Yet we know that science pushes us to investigate phenomena that are seemingly obvious and to insist on questioning their validity. (After all, the sun doesn't really rise in the sky; this was Blakey's point.)
- **B.** We wish to explore race only from the perspective of biological anthropology.
  1. Biologically speaking, a race would represent a group of people sharing genetically determined traits, such as skin color, hair color, eye shape, and nose shape, among others.
  2. A race, then, would be an intermediate-level grouping of humans, in between that of the population and that of the species.
  3. The sociological and historical validity of race, unlike the biological validity, are not at issue here.

II. Most biological anthropologists today reject the idea that the concept of human race has any biological validity. Race is a socially constructed concept.

- **A.** No agreement exists on how many races can be identified in the world. The possibilities range from 3 to more than 200, based on which traits one deems significant.
- **B.** No such entity as a pure human race exists in the world today; the world's populations constantly intermarry and interbreed.
- **C.** Further, to the best of anthropological knowledge, no such entity as a pure human race ever existed. Gene flow, migration, and interbreeding across populations are all processes with very long histories in the development of our species.
- **D.** Today, more variation exists within so-called races than between them. The best estimate suggests that only 15% of all human genetic variation can be traced to differences between races.
- **E.** History shows us that race is used in socially constructed ways that are divorced from biological reality. The definition of what kind of person "counts" as a member of a certain race changes with historical context.

III. A few scientists today insist that the majority view is wrong. These scientists can be grouped into two camps, one from biological anthropology generally and another from forensic anthropology. They say that racial differences are both obvious and real.

- **A.** According to a few biological anthropologists, obvious evidence exists for the fact of human races.
  1. Compare a man native to Stockholm, Sweden, with one from Dar es Salaam, Tanzania. The obvious differences one sees reflect human biology and race.
  2. *Cluster diseases*, such as sickle cell anemia, much more prevalent in some races than others, cannot be ignored.
  3. Occasionally, these notions extend to claims that different levels of intelligence can be found among different human races.
- **B.** The problem with these views is not that they are politically incorrect. Rather, they reflect poor (and outdated) evolutionary thinking.

1. The "Stockholm versus Dar es Salaam" test is flawed, in part because it ignores the gradual shifts in populations between these two geographic extremes.
2. When measuring such factors as disease or intelligence between groups, we must not forget that the groups are not now, and have never been, distinct from each other in the first place. So-called biological differences diminish or disappear when this fact is realized and when overlap between groups is recognized.

C. In the area of applied biological anthropology, forensic anthropologists routinely classify individuals (from their skeletal remains) using the variable of race.
1. Forensic anthropologists, in analyzing bones, attempt to discern not only an individual's sex and age but also his or her race.
2. These scientists insist that using such categories as Caucasian-American, African-American, Asian-American, Hispanic, and native American is reliable and beneficial.
3. Most biological anthropologists reply that such classification has limited use. Providing information about race may help in legal matters but tells us little that is valid or genuinely interesting about the individual in question.

D. The New York African Burial Ground Project shows how biological anthropologists can work with skeletal remains to go well beyond a focus on racial traits.
1. Project scientists have analyzed more than 400 skeletons from enslaved individuals who died and were buried in Manhattan during the seventeenth and eighteenth centuries.
2. The project's focus has been to explore the culture and history of an important human population.

IV. Human variation is a fascinating topic, one deserving of study by biological anthropologists. Trying to approach it by way of racial variation is inaccurate, but other avenues are available, and we turn to these in the next lecture.

Essential Reading:

Jurmain et al., *Introduction to Physical Anthropology*, chapter 15, pp. 410–20 and 437–38.

Marks, *What It Means to Be 98% Chimpanzee,* chapters 4–7.

Supplementary Reading:

Blakey, "Bioarchaeology of the African Diaspora in the Americas."

Questions to Consider:

1. Of what significance to the discussion of race is the long human history of gene flow, migration, and intergroup mating?
2. From the perspective of biological anthropology, what is wrong with a statement such as "Asian-Americans are more intelligent than European-Americans?"

Lecture Twenty

Modern Human Variation

Scope: Though they reject the idea of human races, biological anthropologists remain very interested in how human populations vary in the modern world. As we saw in the last lecture, it is possible to glean much useful information about human variation by shifting the focus from individual or "racial" traits to analysis of whole populations.

We will consider two types of case studies of human variation. In the first, variation is studied in basic human features according to environmental variables. For instance, evidence suggests that individuals of the early hominid lineage originated in Africa with darkly pigmented skin. Lightening of skin color likely occurred only with the first Out-of-Africa hominid migrations north to areas of less intense sunlight. Variation in body shape has also been naturally selected in predictable and interesting ways.

Second, in working out how humans have adapted to extreme environments—to high altitude, for instance—biological anthropologists weigh the relative contributions of genetic adaptation, acclimatization, and cultural adaptation. We will differentiate and discuss these processes.

Research areas such as these allow biological anthropologists to study modern human variation in vital ways that reflect the human evolutionary past and free this field of study from its past obsession with human races.

Outline

I. Biological anthropologists embrace the study of human variation through study at the population level. We have come full circle back to Lecture Two, in which the population concept was introduced; now we can relate that concept to contemporary human life.

II. Skin color, when linked to the issue of race, is overemphasized in the study of human variation. Yet when approached populationally, skin color provides an excellent example of natural selection at work.

- **A.** One's skin color comes about through the interplay of several biological substances, including the pigment melanin. Melanin acts to absorb ultraviolet (UV) light.
- **B.** Using melanin as a key, we can understand the origins of variation in skin color.
  1. Originating in Africa, the earliest hominids likely had dark skin, to block dangerous levels of UV light. We can see UV light as a selection pressure on early hominid populations.
  2. When *Homo erectus* migrated north out of tropical Africa, this selection pressure for dark skin would have relaxed.
  3. A different selection pressure would have emerged in these northern hominid populations, the need for enough vitamin D, which is synthesized by sunlight striking the skin. A combination of dark skin and little light would have been costly to northern hominids.
- **C.** The maintenance of variation in human skin color is a biocultural phenomenon. Social patterns (of marriage, for example) are as important as biological selection pressures in the present day.

III. Just as human populations differ in predictable ways by skin color, so do they differ by body and limb shape.

- **A.** Populations that inhabit tropical areas tend toward having long, slender bodies and limbs. This body configuration is optimal for heat dissipation.
- **B.** Populations that inhabit colder areas tend toward having short, stocky bodies and limbs. This body configuration is optimal for heat retention.
- **C.** The words "tend toward" in A and B above are chosen with care; not all human populations conform to these expectations.

IV. Some humans live in areas where they must adapt to extreme climates. Study of high altitude, for example, allows biological anthropologists to distinguish separate but closely intertwined processes of human adaptation.

- **A.** Anyone who has traveled to high altitude is likely to recall the biological stresses of this extreme climate. Reduction in available oxygen may cause the new arrival to experience shortness of breath, dizziness, and other symptoms.
- **B.** Anthropologically, high altitude is defined as above 10,000 feet. Human populations that reside at high altitude face significant stressors, including higher rates of miscarriage and infant mortality than at lower elevations.
- **C.** Biological anthropologists have identified several different processes that allow humans to adapt to extreme altitude, in both the long term and short term.
  1. Some populations with thousands of years of cultural history at high altitude appear to have genetic advantages, because their reproductive success seems undiminished by their residence in such extreme climate.
  2. Individuals native to high altitude are born with larger hearts and greater lung capacity than those native to lower elevations. They

undergo a type of acclimatization process during maturation, in which they become very efficient at using oxygen in the body.

3. Immigrants or visitors to high altitude undergo a short-term variant of acclimatization, in which they gradually adapt to altitude stressors, and the unpleasant symptoms felt upon arrival diminish.
4. Cultural adaptations, such as clothing, shelter, and traditions related to birth practices, may all aid the process of adaptation to high altitude.

V. Human adaptation to extreme heat appears to come somewhat more naturally to our species than does adaptation to extreme altitude.

- **A.** As we have seen, some human populations are characterized by skin color, body shape, and limb shape designed by natural selection for maximal adaptation to the heat of the tropics.
- **B.** All human populations, however, have evolved significant capacity to cope with heat relatively rapidly and efficiently by sweating.
- **C.** Heat adaptations in contemporary *Homo sapiens* reflect our long history as tropical primates.

Essential Reading:
Jurmain et al., *Introduction to Physical Anthropology*, chapter 15, pp. 420–36.

Questions to Consider:

1. How does the fact of our African origins help us understand the phenomenon of human skin color variation?
2. In what ways does individual acclimatization to high altitude differ from the genetic adaptation characteristic of some native populations?

Lecture Twenty-One
Body Fat, Diet, and Obesity

Scope: Another avenue biological anthropologists may use in studying modern human variation involves comparing and contrasting the adaptations of males and females. Many people would guess that the greatest difference between the sexes is to be found in height or weight. In fact, the single most pronounced feature of sexual dimorphism relates to the distribution of fat on the body.

Sexual dimorphism in fat deposition makes good evolutionary sense. Female fat is typically located in specific areas where it can buffer the body against periodic food shortages. We can understand the evolution of this link between fat and reproductive success by thinking about the conditions of our evolutionary past.

Yet what we see in many countries is not just a predictable pattern of sexually dimorphic fat deposition. We find also a virtual epidemic of obesity among men, women, and children. What has happened here? Examining the evolutionary history of human diet yields some clues. For many people in the world, access to foods that were previously in quite short supply is now rather easy. The human body cannot always cope in a healthy manner with such abundance.

Considering body fat, diet, and obesity in evolutionary perspective illustrates the interplay between biology and culture in modern society. Practical solutions for healthier living may emerge from this consideration.

Outline

I. Modern human variation occurs within as well as between populations. One significant source of such variation is sex; male and female humans show aspects of sexual dimorphism.

- **A.** *Sexual dimorphism* is defined as differences in physical traits between males and females of the same species.
- **B.** In humans, compared to many other primates, males and females show minimal sexual dimorphism in height and weight.
- **C.** The way in which sexual dimorphism is most pronounced in humans involves the distribution of body fat.
  1. Body fat tends to cluster around the hips, buttocks, and breasts in females. These are the so-called "reproductive areas" of the female body.
  2. Body fat for males, by contrast, tends to cluster around the stomach.

II. Reasons for the sexually dimorphic nature of fat deposition may be found in the link between fat and reproductive success in human evolutionary history.

A. Fat acts as a buffer in the human body against reduced caloric intake. Should food become scarce, the body begins to metabolize its fat to prevent malnutrition or starvation.

B. Food shortages, whether seasonal or periodic, are a likely fact of ancestral hominid life. All humans, until 10,000 years ago, lived off the land (gathering, scavenging, and/or hunting); animal domestication and agriculture developed later in human history.

C. Hominid females with "fat buffers" in so-called reproductive areas of the body were likely able to withstand caloric reduction during food shortages better than females without such buffers. Fat reserves would have been selected for in this context.

III. The increasing rate of obesity in the United States can be seen as stemming from an ancestral adaptation that has gone seriously awry in our modern environment.

A. According to figures released by the Centers for Disease Control in 2002, 27% of adults and 15% of children in the United States are obese.

B. This obesity is evolutionarily recent. In the hominid past, food shortages would have combined with a perennial scarcity of salt, sugar, and fat. It was virtually impossible for anyone to ingest too much of these three substances.

C. In many parts of the world, access to salt, sugar, and fat is now immediate and easy. Humans may tend to "crave" these substances and find themselves unwilling or unable to limit intake of them.

D. The abundance and easy availability of unhealthy and processed foods is exacerbated by a modern shift from active to sedentary lifestyles.

E. Recent research suggests that the decreases in dietary quality and in activity levels now reach into far corners of the globe. Populations in the South Pacific and Africa provide good examples.

IV. Some anthropologists suggest that a partial return to an ancestral diet may have ameliorative benefits for some modern populations.

A. Practitioners of a new cottage industry based on *paleonutrition* suggest that modern humans could improve their health by adopting some of the dietary and lifestyle habits of our hominid ancestors.

B. Some anthropologists embrace (and contribute to) this movement. Others point out that there was too much variation in the hominid past to forge any kind of self-help plan based on a homogeneous conception of how hominids lived.

C. Whether or not specific pieces of advice are adopted, the field of biological anthropology can increase one's awareness of how modern habits have departed significantly from those that shaped our species.

Essential Reading:

Jurmain et al., *Introduction to Physical Anthropology*, chapter 16.

Somer, *The Origin Diet: How Eating Like Our Stone Age Ancestors Will Maximize Your Health.*

Supplementary Reading:

Consult www.PaleoDiet.com.

Questions to Consider:

1. Why have fat buffers been particularly important for women, more so than for men, throughout human evolution?
2. Do you think that that the notion of an evolutionary predisposition for sugar, fat, and salt could be helpful in selecting a healthy lifestyle in today's world?

Lecture Twenty-Two

The Body and Mind Evolving

Scope: We have just explored the idea that the human diet may now be "out of whack" with our evolutionary history. This analysis leads to a larger question: Can twenty-first century human wellness, both physical and emotional, really be so heavily influenced by events that occurred thousands, and maybe even millions, of years ago?

In some ways, the answer is a crystal-clear "yes." The underlying claim of this course is, after all, that we can better understand ourselves by looking to our past. To the case we have been building all along, we can add three new data points.

First, we consider the phenomenon of morning sickness found among pregnant women. Now treated as pathology by most physicians, the perspective of evolution suggests that it may, in fact, be a quite adaptive response.

Next, we shift time periods to the more recent history of *Homo sapiens.* Surprising new explanations have been published for why the rate of high blood pressure differs between different populations in the United States.

Finally, we investigate the burgeoning field of evolutionary psychology, which extends evolutionary analysis into the area of human emotions and preferences. A "hot topic" in evolutionary psychology is human mate choice.

Dangers exist, however, in the idea that the selection pressures of our hominid past somehow determine our physical or emotional health. We conclude this lecture by affirming that the human species has evolved with a premium on behavioral plasticity.

Outline

I. In earlier lectures, we proposed that certain aspects of modern human life can be explained by examining not only culture but also biological pressures from our past. Does this evolutionary influence apply only to skin color, human heat tolerance, and dietary preferences, or might it extend to many more areas of physical and emotional health?

A. Our first step is to see how radically new is this question. As we have seen, acceptance of human biological evolution came slowly (and is still not complete). Using an evolutionary perspective to illuminate human health (of body and mind) is still in its infancy.

B. The term *Darwinian medicine* has been coined to acknowledge the fact that some co-called diseases, syndromes, or symptoms might, in fact, have evolved for adaptive reasons. Fever presents us with a quick introductory example.

II. The phenomenon of morning sickness during human pregnancy affords a good opportunity to consider the pros and cons of applying the evolutionary perspective to modern health.

A. As defined by Margie Profet, morning sickness includes feelings of nausea and food aversions, most often during the first trimester.

B. Virtually all women in all cultures experience some degree of morning sickness.

C. Women and their doctors often treat morning sickness as an unpleasant and unnecessary side effect of pregnancy; it sometimes causes concern and alarm among women.

D. Profet points out that the concentration of morning sickness during the first trimester coincides with the period of organ formation in the developing human fetus. Morning sickness may be an adaptive response that has evolved to protect the vulnerable fetus from maternal ingestion of toxins.

E. In our evolutionary past, the foods most available to hominids would likely have included those containing high levels of toxins dangerous to the fetus.

F. Women today who experience a moderate (rather than only slight or very severe) level of morning sickness may be feeling exactly what evolution has designed them to feel to best protect their babies.

III. Health issues may also be studied by focusing on more recent population histories, as is illustrated by new reports on hypertension in the United States.

A. Hypertension, or high blood pressure, exists at higher rates in African-Americans than it does in white Americans in this country.

B. Researchers expected to find that African-Americans ate more salt than their white counterparts, thus accounting, at least in part, for the raised blood pressure. This dietary difference turned out to be absent.

C. Scientists who are tuned in to the evolutionary perspective note some key factors that together might explain the elevated blood pressure.

1. Many Africans were brought forcibly to this country from West Africa. Their areas of origin are thought to have had unusually little salt available. Peoples' kidneys would, in the distant past, have been selected to be efficient at processing what little salt was available.

2. Enslaved individuals were forced to endure torturous journeys en route to the Americas. In addition to other stresses, these people

endured severe and prolonged thirst. Their kidneys would, thus, have undergone a type of intense "super-selection" for even more efficient uptake and processing of salt.

3. Under conditions of slavery, this bodily response would have been adaptive. Under current conditions, however, ingesting even typical levels of salt is dangerous because of the "hyperefficient" kidneys that are no longer adaptive.
4. As with the morning-sickness example, increased awareness of why certain individuals may experience medical problems (here, hypertension) may help patients and physicians alike agree on an effective course of treatment.

IV. The emerging field of evolutionary psychology borrows the principles we have been discussing and applies them to human emotions and choices. The underlying idea is that the evolution of the human mind has been as influenced by our ancestral past as the body, as can be seen through an analysis of human mate choice.

A. Cross-cultural data point to a strong pattern in which human males choose their mates based on different criteria than do human females.

B. Human males tend to select as mates women who are youthful and physically attractive; females tend to use criteria related to status and ability to acquire resources.

C. Some anthropologists suggest that we can use the hominid past to understand this sex difference.

1. Because women are the ones who bear and nurse offspring, their youth and health are critically important. These qualities are signaled to males by their appearance.
2. By contrast, the male's critical contribution to reproductive success (after conception) may involve acquisition of resources. Status and power, sometimes correlated with older rather than younger age, may signal to females the male's reproductive ability.
3. Greater male than female sexual jealousy is predicted from this evolutionary model and appears borne out by the data.

V. Skeptics, both biological anthropologists and others, fear that Darwinian medicine and evolutionary psychology veer too close to biological determinism.

A. The reliance of both these fields on the so-called "environment of evolutionary adaptedness" may be spurious. Very little is known about the social groupings and social behaviors of hominids (at least until Neandertal times and beyond); surely, these varied widely according to local circumstances.

B. The social context, together with learned traditions, plays an enormous role in how symptoms of morning sickness or hypertension are actually experienced and how mate choice unfolds. To lay these patterns at the door of a single set of past selection pressures produces a simplistic picture.

C. We may conclude that the evolutionary perspective has merit when applied to the human body and mind. What we should not do is empower past selection pressures to the exclusion of social learning and flexibility, which are equally key facets of the human evolutionary past.

Essential Reading:

Profet, *Pregnancy Sickness: Using Your Body's Natural Defenses to Protect Your Baby-to-Be.*

Supplementary Reading:

Cosmides et al., *What Is Evolutionary Psychology: Explaining the New Science of the Mind* (forthcoming in spring 2003).

Questions to Consider:

1. What main points support the claim that morning sickness is an evolved mechanism for protection of the human fetus? Can you think of any evidence that detracts from this claim?
2. The concept of variation is central to any understanding, or application, of evolutionary theory. In what ways does evolutionary psychology neglect this critical concept?

Lecture Twenty-Three
Tyranny of the Gene?

Scope: We have just emphasized human social learning and flexibility as twin pillars of the human evolutionary legacy. Yet, in academic and popular science, many of the latest "hot topics" revolve not around the interplay of biology and culture but around the role of genes in determining human behavior and health.

Americans are currently bombarded with news stories about discoveries related to sequencing the human genome, the potential for gene therapies in conquering various diseases, and the volatile issue of cloning. We are even invited to consider cloning our pets! Analysis of pet cloning serves to show how dangerously oversimplified "gene discourse" has become—and how this oversimplification may affect the way we think about our own lives.

Despite the promise of genetic "quick fixes," the truth is that genes are just one part of a complex interrelated system. Genes do not determine appearance or health, let alone behavior. Discourse implying that genes will unlock new secrets of human health and happiness in the next century deserves skeptical analysis.

Outline

I. In the words of the philosopher of science Evelyn Fox Keller, "never in the history of the gene has the term had more prominence."

- **A.** We live now in an era that looks to the gene not only as a major explanatory factor in aspects of present-day health and behavior but also as a vehicle to improve health and behavior in the future.
- **B.** The media find enormously "sexy" such topics as sequencing the human genome, genetic therapies for human diseases, and the ethics of cloning. The power of the gene is virtually taken for granted in these presentations: If genetic problems exist, modern science can fix them by understanding and working with the gene.
- **C.** An accurate scientific picture of the gene clarifies that only very rarely is there a 1:1 relationship between a gene and a specific outcome (whether physical or behavioral). Even a 1:1 relationship between a gene and the production of a specific protein is unusual.

II. A good place to start in exploring these topics is pet cloning.

- **A.** Among the animals that have now been successfully cloned is the domestic cat; this feat was front-page news in 2002.

- **B.** Biotechnology companies now advertise widely available cat cloning as a coming reality; they invite customers to freeze their pets' tissue samples for future genetic duplication.
- **C.** Although the fine print in these advertisements does refer to "slight differences," including those in appearance, between donor animal and resultant clone, the selling point is that people will be able to resume life with a beloved lost pet.
- **D.** In point of fact, the assumption that cloning produces a near-duplicate creature is seriously flawed. Just as with people, an animal's personality and even its appearance, including such major features as coat color, emerge from a dynamic and unpredictable relationship between genes and the environment.

III. How do the lessons of pet cloning apply to human concerns more directly?

- **A.** In 2000, the Human Genome Project succeeded in sequencing all the DNA and, thus, identifying all the genes in a "typical human cell." This "cracking of the human genome" was heralded as an enormous breakthrough for humankind.
  1. As the anthropologist Jon Marks has pointed out, "*the* human genome" is a misleading term. Owing to genetic diversity, there is more than one human genome.
  2. Although identifying the DNA sequence in a human cell is indeed impressive, it is not the prize in itself, because it tells us nothing about the function of genes. Genes act not singly but in complex combinations and unpredictable ways.
- **B.** Genetics research may hold out real hope for medical progress in certain areas, but this hope is routinely inflated in the media.
  1. The effect of some diseases may be ameliorated because we understand the genes' role in them. Cystic fibrosis and Tay-Sachs are examples of diseases in which single genes have been implicated.
  2. The vast majority of diseases responsible for human suffering or mortality are not the result of single genes; heart disease, stroke, diabetes, and depression come about for complicated biological and social reasons.
  3. The persistent tendency to think in 1:1 terms may lead to suggested correlations between genes and personality traits ("You may have a gene for shyness; does your spouse have a gene for risk-taking?"). These have no basis in scientific fact.
  4. Just as with pet cloning, the public's expectations in the area of gene therapy have been raised in inaccurate and unrealistic ways.

IV. We return to the words of Evelyn Fox Keller in noting "how large [is] the gap between genetic 'information' and biological meaning…"

- **A.** Genes should be thought of in two fundamentally different ways.

1. Genes are structural entities that get passed along from generation to generation and that can be isolated and studied as single elements in the research laboratory.
2. Genes are functional entities in a very different sense. They have no straightforward functional identity of their own but play a role in dynamic interaction within a larger system.

B. Improving human life and health does not depend primarily on genetics research. Rather, it requires a solid understanding that the quality of human existence depends on the interaction of many processes, some biological and some social. Biological anthropology provides a window into this complex understanding.

Essential Reading:

Keller, *The Century of the Gene*.

Marks, *What It Means to Be 98% Chimpanzee*, chapter 9.

Questions to Consider:

1. Why do you think the media, and some factions of the public, are so quick to embrace "gene discourse"?
2. What does it mean to say that genes have no functional identity of their own?

Lecture Twenty-Four

Evolution and Our Future

Scope: Is there any truth to the joke that humans are gradually evolving a new physical form, perhaps best termed *Homo sedentarius obesus*? Can we, in fact, predict how human bodies and minds might change and adapt in the future? Might some future speciation event result in the coexistence of multiple hominids on Earth, as once was common?

These questions can be approached with information about our evolutionary past, as can similar ones about how increases in human population may affect the other creatures with which we share this planet. The knowledge gained from biological anthropology, however, can lead us to reflect with deeper understanding on two issues of even greater overarching importance to humanity.

The first issue can be summarized by the term *continuity*. Taking "the long view" of human history allows us to recognize and appreciate our close kinship with other primates, whether living or extinct. We are not just related to these other species in some distant, technical way, as can be represented by comparisons of DNA or on evolutionary timelines. Rather, our continuity with monkeys, apes, and hominids plays out vitally in our everyday lives, in the way we parent and educate our children, in our reliance on problem-solving technology, in the comfort we take in our symbolic rituals and ceremonies, and in our mobile lifestyle.

The second issue can be summarized by the term *dynamic interaction*. We humans live today in dynamic interaction with every other creature on Earth: every animal, plant, and ecosystem; every human across the room, across the street, across the country, and across the planet. What each of us does affects, in contingent and unpredictable ways, what happens elsewhere. That we live in our world dynamically reflects how we have evolved; we are the result of millions of years of dynamic interplay between biology and culture, between genes and social learning.

Outline

I. Science fiction writers love to imagine the evolutionary future of *Homo sapiens*. Will we evolve larger heads to cope with the Information Age? Will our bodies dwindle even as our heads enlarge, because we have become so sedentary?

A. As a step toward considering our future, let us remember how very young a species we are. We have been a species for perhaps 125,000 years, and the sole hominid for only 30,000 years.

B. Biological anthropology teaches us that we cannot predict the precise ways in which we will change as our species moves beyond its infancy. Any traits that are naturally selected are those that will allow differential reproductive success in the surrounding environment, yet shifts in that environment are not foreseeable.
   1. The robust australopithecines, now considered "failed" species, nonetheless lived about a million years. This is nearly ten times as long as we have existed so far. Their apparent dietary "overspecialization" becomes clear only in hindsight.
   2. As the biological anthropologist Chris Stringer points out, the trend in hominid evolution for millions of years was to get heavier-boned and stronger. Only recently did that trend reverse, with selection acting to choose lighter-boned, more gracile creatures. This change was not predictable.

II. Evolutionary scenarios featuring large heads and small bodies, or increasing obesity, are fanciful. More worthy of our effort is recognizing that selection pressures are not a one-way street.

A. Courses on human evolution place our species squarely at their center. They depict *Homo sapiens* as having evolved because we met certain challenges and adapted to various selection pressures. Less prominent is the idea that we generate selection pressures, as well as cope with them.

B. Hominids always existed as part of a community of plants and animals, with reciprocal selection pressures at work.
   1. Evidence of this can be seen back in early hominid times when, for example, big cats were predators on human ancestors.
   2. Current predators—and selection pressures—on humans include the viruses that cause AIDS and ebola.

C. *Homo sapiens* now exists in unprecedented numbers; there are 6 billion of us. Our actions create selection pressures on an unprecedented scale for the animals and plants with which we share the Earth.
   1. The disappearance now underway of animal life differs in kind from earlier mass extinctions.
   2. Logging by humans in the Amazon and Congo basins allows us to see the processes at work that may lead to more species extinctions in the future.
   3. Social learning and collective activism can still turn around the bleak picture that ecologists paint of future animal extinctions.

III. Humans are simultaneously influenced by their evolutionary past, in the process of adapting to current local conditions, and capable of rapid social learning and cultural change.

A. We are and will remain one species, divided only into populations that undergo a great deal of gene flow.
   1. All populations of *Homo sapiens* are fundamentally equal in the biological sense. Access to resources, including healthy food and good medical care, is not equal across populations of *Homo sapiens.*
   2. Differential stresses across populations will not result in biological speciation. Human mobility and mating between groups occurs at levels unparalleled in history. One estimate suggests that 1 million people cross national borders in an airplane every single day.

B. The simultaneous facts of our biological equality and our constructed social inequality constitute a challenge for humanity. We must not forget what it means that we are a *single species*, linked with each other across populations and living in a community with other species. This knowledge may help reassert priorities and perspective in today's world.

IV. In sum, biological anthropology can help us reflect on two specific issues of supreme importance to humanity.

A. Our relationship with other primates, whether the living monkeys and apes or the extinct hominids, is one of continuity. Please think back on some examples we have reviewed in this course and consider the links with human behavior:
   1. Monkey mothers, organized into matrilines, tend to treat their kin preferentially as compared with non-kin.
   2. Chimpanzee mothers respond with guidance and teaching when they realize that their offspring or close friends lack knowledge in certain situations.
   3. The archaeological record reflects that once early hominids figured out how to modify stone tools, they began to invent more types of tools, each made in more efficient ways. Sometimes progress was slow, but problem solving with technology increased over time.
   4. Neandertals no longer discarded or left to the elements the bodies of deceased relatives and friends; rather, they began to bury their dead. At times, the bodies were buried along with objects of apparent value, likely reflecting some degree of ritual and ceremony.
   5. From the time period of *Homo erectus* onward, hominids were not content to stay put, near to where they had been born; rather, they traveled and explored new worlds. The Exploration Age might well be considered to have started 2 million years ago!

B. This continuity means that our modern-day behavior is built on the evolutionary legacy of our past. But human evolution has been too dynamic for us to conclude that our current condition is the result of biology or genes.

1. Let's think about what the concept *dynamic* really implies. Change, yes, but what else? Key elements of dynamic interactions are contingency (things might have turned out another way) and unpredictability (the outcome cannot be known at the start).
2. Human evolution has been dynamic in the sense that our biology and our culture cannot be separated out from each other; their relationship is closely intertwined, contingent, and unpredictable. The same goes for the relationship between genes and social learning. Biological anthropology teaches us that we must understand this complexity to fully cope with the challenges of our future.

Questions to Consider:

1. What is meant by the term *reciprocal selection pressures*?
2. In what ways have we humans evolved dynamically? What lessons does this knowledge carry for us as we move into the twenty-first century?

Timeline

Prehistory

(**Note**: Biological anthropologists frequently revise these dates, updating them according to new information. Included here are the current best estimates. The abbreviation *mya* stands for "million years ago.")

70 mya	Age of Dinosaurs nears an end; no primates yet exist
65 mya	Age of Mammals begins; ancestral primates appear
55 mya	Earliest definite primate
55–6 mya	Numerous speciation events produce ancestors to today's prosimians, monkeys, and apes
8–7 mya	Common ancestor to African apes and hominids
approx. 7 mya	First hominid, perhaps *Sahelanthropus tchadensis*
4.2 mya	First australopithecines
3.2 mya	Time at which "Lucy" lived (*Australopithecus afarensis*)
2.5 mya	First hominid-modified stone tools
2.4 mya	First hominid in the *Homo* genus, *Homo habilis*
1.9 mya	First *Homo erectus*, in Africa
1.8 mya	Some populations of *Homo erectus* migrate out of Africa to Asia
130,000	First Neandertals
125,000	First *Homo sapiens*
30,000	Disappearance of Neandertals; *Homo sapiens* is the only surviving hominid

History

1856	First Neandertal discovery, in Germany
1859	Charles Darwin publishes *On the Origin of Species*

1891	First *Homo erectus* discovery, in Java
1924	Raymond Dart finds first australopithecine, in South Africa
1925	Scopes Monkey Trial in Tennessee
1951	Sherwood Washburn outlines the new physical anthropology
1960	Jane Goodall begins observations of wild chimpanzees
1968	Washburn and Lancaster publish "Man the Hunter" paper
1974	Don Johanson uncovers "Lucy" in Ethiopia
1978	Glyn Isaac publishes theory on *Homo habilis* behavior
1984-1985	Discovery of "Nariokotome Boy" (*Homo erectus*) in Kenya
1990s	Excavation of African sites showing that early modern behavior did not originate exclusively in Europe
2002	Announcement of the fossil discovery *Sahelanthropus tchadensis* from Chad, currently considered the oldest hominid known to science

Glossary

(**Note**: For names of specific primates, please refer to the Species Sketches section.)

Acclimatization: A physiological process of adaptation, as to extreme climate, in either the short or long term.

Adaptive radiation: Rapid expansion of new animal forms into new habitats.

Anthropoids: One of the two major groupings of primates; the anthropoids are diverse, including all the monkeys, apes, extinct human ancestors, and modern humans.

Apes: A subset of anthropoids that tends to be large-bodied and includes humans' closest living relatives.

Biological anthropology: The subfield of anthropology that takes as its subject matter the evolution, genetics, and anatomy of, and modern variation within, the human species.

Conceptual model: Model that focuses on evolutionary processes rather than specific organisms in trying to understand the behavior of extinct human ancestors.

Differential reproductive success: Refers to the fact that within a population, some individuals will produce more healthy offspring than others.

Evolution: Change in the genetic structure of a population.

Gene: A sequence of DNA that can be passed on to offspring.

Gene flow: One of the major mechanisms of evolution; refers to the exchange of genes between populations.

Gene pool: All the genes shared by members of a single population.

Genetic drift: One of the major mechanisms of evolution; occurs in small populations when random events shift the composition of the gene pool.

Gracile: Relatively light-boned and slender.

Hominids: Primates, including those that led to modern humans, characterized by bipedalism; evolved after the evolutionary split with the great apes.

Homology: A similarity based on shared descent (if two primates have homologous traits, the traits are alike owing to a common evolutionary heritage).

Iconic gesture: Gesture that indicates the specific action that the gesturer wishes another animal or person to take.

Intelligent design: A set of beliefs predicated on the idea that some organs and organisms, such as humans, are so complex that they could have arisen only by design (not by unguided evolutionary mechanisms).

Matriline: A group of related females.

Mitochondrial DNA (mtDNA): Inherited only through the maternal line and, thus, changed only via mutation, mtDNA is a possible tool for tracing descent lines in prehistory.

Monkeys: A diverse set of anthropoids that are relatively small-bodied, more distantly related to humans than are the apes.

Multiregional model: One of two major models for the origins of modern humans; this one suggests that *Homo sapiens* evolved from earlier hominids on three continents at about the same time in response to regional selection pressures.

Mutation: One of the major mechanisms of evolution; refers to a change in the structure of DNA within a gene.

Natural selection: The single most important mechanism of evolution; refers to the fact that some individuals within any population will be better adapted to their local environment than others, leading to greater reproductive success.

Out-of-Africa replacement model: One of two major models for the origins of modern humans; this one suggests that *Homo sapiens* evolved first in Africa, then spread out to other areas and replaced all other hominids.

Patriline: A group of related males.

Phylogenetic model: Model that proposes taking into account the behavior of all four great apes in trying to understand an extinct human ancestor.

Population: Members of a species that share a common gene pool and mate more with one another than with members of other populations.

Primates: Division of mammals that includes all prosimians, monkeys, apes, extinct human ancestors, and modern humans.

Prosimians: One of the two major groupings of primates; the prosimians evolved first and are relatively specialized.

Punctuated equilibrium: The idea that evolution may sometimes proceed in rapid leaps rather than always by small, gradual modifications.

Race: A term used to suggest that humans can be sorted into distinct groups based on genetic traits, such as skin color or nose shape. Almost all biological anthropologists agree that this term has no biological validity.

Referential model: Model that proposes a 1:1 relationship between the behavior of some living primate and an extinct human ancestor.

Robust: Heavy-boned and strong.

Scientific creationism: A set of beliefs predicated on the ideas that the Earth is young and humans were created by a supernatural force within the last 10,000 years.

Sexual dimorphism: Anatomical differences based on one's sex.

Speciation: The process by which new species are formed from existing ones.

Species: A grouping of organisms whose members can all interbreed with one another and produce fertile offspring. The species is a larger grouping than the population.

Theory: In science, a set of principles that has been supported by observation and testing.

Theory of mind: The ability to take into account the mental perspective of another.

Species Sketches

Australopithecus afarensis: A gracile hominid species that includes "Lucy" and lived in Africa from about 3.6 to 3 million years ago.

Australopithecus africanus: The first australopithecine to be discovered, this gracile African form lived from perhaps 3.6 to about 2 million years ago.

Australopithecus anamensis: An African hominid dating to about 4.2 million years ago.

Australopithecus robustus and ***Australopithecus boisei***: Two robust hominids that lived in Africa along with gracile forms but eventually went extinct, apparently due to dietary overspecialization.

Bonobo: One of the African great apes; lives in bisexual communities with greater emphasis on female-female bonds than is found in the chimpanzees.

Chimpanzee: One of the African great apes; lives in bisexual communities with greater emphasis on male dominance than is found in the bonobos.

Gelada baboon: An Old World monkey that lives in one-male units; females bond with one another to prevent domination by males.

Gorilla: One of the African great apes; lives in either one- or two-male groups.

Great apes: Humans' closest living relatives, these large-bodied and large-brained apes are the orangutan, gorilla, chimpanzee, and bonobo.

Hamadyras baboon: An Old World monkey that lives in one-male units; males dominate females, harassing and biting them.

Homo erectus: The first hominid to live in Asia as well as Africa, this species, which includes the "Nariokotome Boy," is thought of as a turning point in human evolution. Appearing at about 1.9 million years ago, its "endpoint" is hotly debated but may be about 400,000 years ago.

Homo habilis: The first hominid in our own genus, this species is famous for being the first (as far as we know!) to manufacture stone tools. It lived in Africa from about 2.4 to 1.9 million years ago.

Homo neandertalensis: See **Neandertal**, below.

Homo sapiens: Modern humans; us. Modern human anatomy developed at perhaps 125,000 to 100,000 years ago.

Kenyanthropus platyops: Flat-faced hominid of Kenya, discovered by Maeve Leakey, that existed at about 3.5 million years ago. This species thus overlapped in time with *Australopithecus afarensis*.

Lesser apes: Small-bodied apes of Asia, including gibbons, that usually live in monogamous pairs.

Marmoset: A small New World monkey that lives in extended family groups.

Muriqui: A relatively large New World monkey that lives in peaceable social groups largely devoid of relative ranking.

Neandertal: Hominid that is likely a separate species from modern humans but overlapped with them in time and place. The Neandertals lived in Asia and Europe from about 130,000 to 30,000 years ago.

Orangutan: The only Asian great ape and the least social of all apes.

Orrorin tugenensis: A very old African hominid, dated to about 5.8 million years ago; dethroned by *Sahelanthropus tchadensis* in 2002 as the "oldest known hominid."

Rhesus monkey: An Old World monkeys organized into matrilines with great emphasis on dominance hierarchies.

Ring-tailed lemur: A group-living African prosimian in which females are routinely dominant to males.

Sahelanthropus tchadensis: Best current candidate for the oldest hominid, at about 7 million years ago; announced in 2002 by scientists working in Chad, central Africa.

Savanna baboon: An Old World monkey organized into matrilines and heavily dependent on dominance hierarchies.

Slow loris: A nocturnal Asian prosimian that is far more social than expected for such a primate.

Transitional hominid species: The catchall term we use to refer to those hominids that lived after ***Homo erectus*** but before ***Homo sapiens***, with a mix of *erectus-sapiens* traits. These hominids are found in Africa, Asia, and Europe.

Bibliography

Essential Reading:

De Waal, Frans. *Tree of Origin: What Primate Behavior Can Tell Us About Human Social Evolution.* Cambridge, MA: Harvard University Press, 2001. This edited collection, with contributed chapters from leading scholars, demonstrates beautifully the ways in which specific studies of monkeys and apes can shed light on our hominid ancestry.

Gould, Stephen Jay. *The Structure of Evolutionary Theory.* Cambridge, MA: The Belknap Press of Harvard University Press, 2002. Published just before his death, this volume is Gould's *magnum opus.* It explains how newer concepts can be integrated with Darwin's insights to produce a comprehensive vision for understanding evolution. At well over 1,000 pages, the volume is formidable, but selected chapters are well worth the effort for the serious student.

Johanson, Don, and Maitland Edey. *Lucy: The Beginnings of Humankind.* New York: Simon and Schuster, 1981. A fact-filled, enjoyable account of Lucy's discovery specifically and theories of human evolution generally, this book gives an excellent feel for what it is like to be a fossil hunter in Ethiopia. It must be read in the context of the course, however; some of its conclusions about Lucy's place in the human family tree have been overturned by newer information.

Jurmain, Robert, Harry Nelson, Lynn Kilgore, and Wenda Trevathan. *Introduction to Physical Anthropology,* 8th edition. Belmont, CA: Wadsworth Publishing, 2000. The text of choice for many biological anthropologists, this book provides vital background information on the topics covered in this course. It includes superb visuals (photographs, charts, diagrams). The chapters cited as essential reading at the end of each lecture are keyed to the 8th edition, but newer editions, when available, would be even better.

Keller, Evelyn Fox. *The Century of the Gene.* Cambridge, MA: Harvard University Press, 2000. Written elegantly and aimed at non-experts, this book examines what genes are and what they are not (and how that understanding has changed as new knowledge accumulates). Keller shows that we cannot understand genes as isolated units, but must instead, study them at work as part of a larger biological system.

King, Barbara J. *The Origins of Language: What Nonhuman Primates Can Tell Us.* Santa Fe, NM: School of American Research Press, 1999. Lecture Eighteen relies heavily on this volume's contribution by Burling, who creates a plausible scenario of the evolution of language from ape gesture. Other chapters are useful for understanding the evolutionary transition from nonhuman primate communication to human language.

Marks, Jonathan. *What It Means to Be 98% Chimpanzee: Apes, People, and Their Genes.* Berkeley, CA: University of California Press, 2002. Marks's title refers to the oft-cited statistic that humans and chimpanzees share 98% of their genes. But what does this really mean? In his typically engaging style, Marks examines not only this question but others related to human "race" and variations that spring from it.

Natural History, April 2002 issue. Two features in this issue explain in clear terms issues of relevance to this course. First is a series of short opinion pieces that together constitute a written debate between evolutionary theorists and intelligent design advocates. Second is the column by science writer Carl Zimmer on evolution of the eye.

Profet, Margie. *Pregnancy Sickness: Using Your Body's Natural Defenses to Protect Your Baby-to-Be.* Cambridge, MA. Perseus, 1997. A readable account of Profet's fascinating theory that pregnancy sickness is a long-ago evolved adaptation to protect the developing fetus.

Scientific American, July 2002 issue. The no-holds-barred title of John Rennie's article says it all; "15 Answers to Creationist Nonsense" refutes myths and misunderstandings related to basic concepts in evolutionary theory.

Somer, Elizabeth. *The Origin Diet: How Eating Like Our Stone Age Ancestors Will Maximize Your Health.* New York: Owl Books, 2002. As a registered dietician, Somer does an intriguing job of suggesting ways in which knowledge of paleonutrition might improve our lives today.

Sykes, Bryan. *The Seven Daughters of Eve: The Science That Reveals Our Genetic Ancestry.* New York: W.W. Norton and Co., 2001. Genetics professor Sykes writes about the uses to which mitochondrial DNA may be put in clarifying issues in human evolution. He tackles controversies, such as how closely related Neandertals are to modern humans, and gives his perspective on the origins of modern *Homo sapiens.*

Tattersall, Ian. *The Last Neanderthal: The Rise, Success, and Mysterious Extinction of Our Closest Human Relatives*. Boulder, CO. Westview Press, 1999. A paleoanthropology curator at the American Museum of Natural History in New York, Tattersall has written a string of valuable books on human evolution. This one is particularly welcome for its illustrations that wonderfully bring to life the Neandertals.

Weiner, Jonathan. *The Beak of the Finch: A Story of Evolution in Our Time.* New York: Knopf, 1994. Reviewers have noted that this Pulitzer-Prize-winning account reads like a thriller! It details research done by the Grants, a husband-and-wife team of biologists that has carried out modern-day evolutionary studies on the finch populations in the Galapagos Islands—the descendant birds of those studied by Charles Darwin.

Supplementary Reading:

Behe, Michael. *Darwin's Black Box: The Biochemical Challenge to Evolution.* New York: Free Press, 1996. This book, billed by some as "a scientific argument for the existence of God," presents one case for an intelligent design perspective. It can be read as an alternative to the evolutionary thinking that is the foundation for this course.

Blakey, Michael. "Bioarchaeology of the African Diaspora in the Americas: Its Origins and Scope." *Annual Review of Anthropology* 30:387–422, 2001.

Cosmides, Lena, John Tooby, et al. *What Is Evolutionary Psychology: Explaining the New Science of the Mind.* New Haven, CT. Yale University Press (forthcoming in 2003). This book promises to be a lively and lucid account of the principles of the emerging field of evolutionary psychology.

Jolly, Alison. *Lucy's Legacy: Sex and Intelligence in Human Evolution.* Cambridge, MA: Harvard University Press, 1999. An always literate, sometimes amusing analysis of how issues of sex and gender figure into primate behavior and human evolution.

Potts, Richard. *Early Hominid Activities at Olduvai.* Aldine de Gruyter, 1988. The Smithsonian Institution's Potts lays out a fascinating behavioral framework for interpreting the hominid sites at Olduvai Gorge, Tanzania. Particularly enlightened is his alternative formulation to a long-accepted model of *Homo habilis* behavior.

Sapolsky, Robert. *A Primate's Memoir.* New York: Scribner, 2001. An informative and fun account by a distinguished primatologist, MacArthur "genius" award winner, and Teaching Company faculty member. He writes about his many years in Kenya studying wild baboon behavior.

Savage-Rumbaugh, E. S., and R. Lewin. *Kanzi: The Ape at the Brink of the Human Mind.* New York: Wiley, 1994. The accomplishments of the bonobo Kanzi, who can produce and comprehend symbolic utterances, are chronicled in this volume.