EVOLUTIONARY THEORY AND TECHNOLOGY: THE FUTURE OF ANTHROPOLOGY

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In preparing my remarks for this forum, I happened to run across the essay by Ian Tattersall on theory and technique and the future of paleoanthropology that appeared in the most recent issue of *Ludus Vitalis*. I realized that without due credit to his excellent article I could easily be accused of plagiarism because of the commonalities in our sets of comments. With respect to evolution, the obvious theoretical backbone of paleoanthropology, Tattersall makes the case that his field has long been an importer rather than an exporter of evolutionary theory. His comment could easily be extended to the whole of anthropology, including archaeology. Whereas in paleoanthropology the kind of evolution being borrowed is at least broadly Darwinian, the same is not true in cultural anthropology and archaeology, which emphasize the unilinear evolutionary models of nineteenth-century social scientists such as Lewis Henry Morgan (1877) and their twentieth-century heirs.

It is surprising, however, that anthropologists early on did not seize on the idea that Darwinian evolution is entirely appropriate to the study of all humans, their behaviors, and their behavioral by-products. The notion that selection, the centerpiece of Darwinian evolution, operates on humans might have been profound back in 1859, but after Darwin published *On the Origin of Species,* it theoretically should have been a relatively uncomplicated matter to extrapolate "descent with modification" to humans and, by extension, to features that affect their fitness. This extrapolation, however, was rarely made. We cannot fault anthropologists solely because not even Darwin wanted to admit that humans were necessarily a product of natural selection.

A century later, anthropologists were still hammering away at the point that, at least in their minds, an unbridgeable gulf existed between Darwinian evolution and traditional cultural evolution. Sol Tax, in the third and final volume of the University of Chicago Centennial Discussions, which was published as *Evolution after Darwin*, stated authoritatively that

> *the term 'evolution' is applied to both socially transmitted culture and gene transmitted biology because neither can establish an exclusive claim.* However, there is no identity between the two usages. The cultural processes of continuity and

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> change are different, and it is only by analogy, if at all, that one can speak of 'natural selection,' for example, in the development of cultures (Tax 1960: 280; italics in the original).

That pretty well ended the discussion, but if it were not enough, Tax (1960: 280) attempted to finish it off once and for all: "Culture must be studied as a part of the evolution of man; but culture change and growth must be studied in their own terms. Therefore, anthropologists legitimately study culture apart from the organisms who carry it." Tax and others were quite willing to link humans with all other organisms until such time as "culture developed from something rudimentary in primitive australopithecines" (Tax 1960:281), at which point it became necessary to unlink humans from their animal kin and to send the former off on their separate trajectory.

The way in which evolution was viewed led directly to the great division that has long plagued anthropology in the United States: the separation of biological anthropology, including paleoanthropology, from the rest of the field. Since its inception, anthropology has been concerned with culture and its effects on human traits such as religion, tool manufacture, clothing, food customs, and kinship systems and residence patterns. It has also had an interest in the "hard parts" of the human phenotype—skeletons and teeth, for example—and, with the advancement of technology, genetic variation and phenotypic expression. However, anthropological tradition has tended to keep these interests on separate tracks—one dedicated to the study of culture and the other to the study of the organic aspects of humans.

Ever so slowly, however, some anthropologists and archaeologists have come to appreciate over the last two decades not only that evolution is a materialist strategy that has its roots in population thinking but that population thinking can lead to a previously unimagined vista on the human condition. This emerging view sees culture as a dynamic process that can dramatically affect the material world well beyond customs and tools. Further, it is becoming increasingly clear that the interactions of genes and culture—literally, their co-evolution—offer a faster and stronger mode of human evolution than either by itself (Richerson and Boyd 2005; Laland, et al. 2010).

There also is growing recognition that culturally derived selection pressures can be stronger than non-cultural ones. There are at least two reasons for this (Laland, et al. 2010). First, there is highly reliable transmission of cultural information between individuals, creating what anthropologists generally refer to as "traditions." Although reliability differs among kinds of traits, culturally modified selective environments can produce unusually strong natural selection that is directionally consistent over time. Second, cultural innovations typically spread more quickly than genetic mutations because social learning operates at a much faster rate than does biological evolution (Feldman and Laland 1996). If cultural practices modify selection on human genes, the more individuals who exhibit a trait, the greater the intensity of selection will be on a gene. The

rapid spread of a particular cultural practice quickly leads to maximum intensity of selection on the advantageous genetic variant or variants. Gene–culture co-evolutionary models repeatedly demonstrate more-rapid responses to selection than conventional population-genetic models, which help explain the argument that culture has accelerated human evolution (Hawks, et al. 2007).

This modern emphasis in anthropology has numerous parallels to paleobiology in that it is geared toward providing Darwinian explanations of the anthropological record, just as paleobiologists explain the paleontological record. This comprises, first, building cultural lineages—what Robert O'Hara (1988) refers to as historical chronicles—and, second, constructing explanations of those lineages—what O'Hara refers to as evolutionary narratives. Evolutionary anthropology comprises writing a description of the historical patterns of differential trait representation and constructing arguments as to how evolutionary processes acted to create those patterns (Jones, et al. 1995). Both steps employ concepts embedded within Darwinian evolutionary theory. Relevant concepts include *lineage* (a temporal line of change owing its existence to descent), *natural selection* (a mechanism of change), *transmission mechanisms* (e.g., social learning), *innovation* (a source of novelties similar to genetic mutation), *diffusion* (a source of novelties similar to genetic recombination), and *heritability* (denoting continuity, such that similarity is homologous). Heritability ensures that we are looking at change within a lineage rather than merely a temporal sequence or a case of convergence (O'Brien and Lyman 2002).

Tattersall points out in his essay that there has been a penetration of quantitative cladistic methods into paleoanthropology, and I note the same for anthropology in general (e.g., Gray and Jordan 2000; Buchanan and Collard 2007). These methods are revolutionizing the way we look at the anthropological record in that they provide an objective, replicable means of investigating cultural lineages. The logical basis for extending cladistics into anthropology and archaeology is the same as it is in biology: Artifacts, customs, languages and the like are all complex systems, comprising any number of replicators. The kinds of changes that occur over generations of, say, tool production are constrained, meaning that new structures and functions almost always arise through modification of existing structures and functions as opposed to arising de novo. This means that recombination is more common than genetic mutation. The history of these changes—additions, losses, and transformations—is recorded in the similarities and differences in the complex characteristics of related objects—that is, in objects that have common ancestors (O'Brien and Lyman 2003).

With respect to the technical side of gene–culture evolution, we are seeing an explosion not only in genome-mapping technology but also in the uses of genomic data. The rapidly falling costs of genomic sequencing is providing important new tools that allow us to understand more about demographic movements of past peoples and also where selection has occurred in the human genome (Richerson, et al. 2010). Even a decade ago

it would have been difficult to predict where our level of knowledge would be with respect to such things as genes that have been subject to recent rapid selection and their inferred cultural selection pressures (Laland, et al. 2010).

In summary, the next decade will witness an exponential increase in detailed knowledge of the human condition. No longer can we train anthropology students using the splintered tradition of separate subfields. An archaeologist who does not understand haplotype mapping will be at the same disadvantage as a biological anthropologist who has no understanding of the spread of Indo-European language and dairying across Europe during the Neolithic period. Moreover, both will need some training in mathematical modeling and cladistic methods. Otherwise, they cannot and will not be significant contributors to the really exciting advances that will continue to be made in understanding evolution in humans past and present.

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