New fossils support a multiple-species view of early human evolution

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Newly reported fossils from East Africa support the view, which has been gaining support in the scientific community, that there were multiple species early in the evolution of the genus *Homo*, at about two million years ago.

Dubbed the "bushy" view of early human evolution, this conception of many different branches is in line with the generally observed pattern of evolutionary development in other groups of animals, which tends to show multiple branches, each reflecting adaptations to particular environments and food sources. This stands in contrast with the "unilineal" interpretation of human evolution, which sees development proceeding along a single line, generally summarized as progressing from *Homo habilis*, to *H. erectus*, to *H. sapiens*.

The newly reported fossils, which date to between 1.78 million and 1.95 million years ago, add more data to the still scant assemblage of specimens from the earliest beginnings of our genus. Three specimens are reported in the scientific journal *Nature* by Meave Leakey, of the Turkana Basin Institute in Nairobi, and a member of the famous Leakey family of paleontologists and archaeologists, Fred Spoor of the Max Planck Institute for Evolutionary Anthropology in Leipzig, and five others.

The fossils were discovered at the Koobi Fora locality in the Lake Turkana region of Kenya, an area which has yielded other important human fossils. These new specimens include the skull of a late juvenile individual, an almost complete mandible, and a portion of another mandible. The skull is especially notable because of its resemblance to another skull which was discovered at a nearby location in 1972.

This earlier find, designated KNM-ER (Kenya National Museum—East Rudolf) 1470, was initially recognized as belonging to the genus *Homo*, but differed from the already known species, *Homo habilis*. At the time, *H. habilis* was thought to be the earliest member of the genus and the first known maker of stone tools. The presence of another, roughly contemporaneous human species in East Africa, with a larger skull and a longer, flatter face (i.e., more advanced physical characteristics) suggested a greater complexity to the early history of *Homo*. It was assigned by some researchers to a separate species—*H. rudolfensis*.

Over the years, several additional large skull fragments have been discovered and tentatively attributed to *H. rudolfensis*, but none included either a face or a lower jaw. With so few, incomplete specimens assigned to this taxonomic group, its status remained uncertain. Now, however, with the announcement of these new discoveries, the existence of a species separate from *H. habilis* seems more likely. The picture is rendered even more complicated by the contemporary appearance of the earliest evidence of a third species, *Homo erectus*, thought to have evolved from *H. habilis* and to be the progenitor of a variety of later humans, including our own species, *H. sapiens*.

The possible existence of at least three species belonging to the genus *Homo* at roughly two million years ago in East Africa raises a number of questions. First of all, since members of a single genus must have evolved from a common ancestor, the evolutionary separation between these species would have had to occur at some earlier time. Therefore, the common ancestor, the first member of the genus *Homo*, perhaps the earliest *H. habilis*, dating to at least 2.5 million years ago, gave rise to multiple "daughter" species within a half million years of its first appearance, implying a rapid evolutionary differentiation, known as an adaptive radiation.

The second question is—since the existence of separate, but closely related species implies distinct adaptations, as, for example, between chimpanzees and gorillas, how did these various forms of *Homo* differ in their habitat preferences, dietary choices, and, perhaps, cultural capabilities? If, as seems likely, one of these species gave rise to the lineage that ultimately led to later human forms, is it possible to discern, at this early date, the distinctive attributes which gave it an evolutionary advantage? Did, for example, all of these species make Oldowan tools, the earliest known stone tool industry?

One distinction between the species may be in their

respective diets. The longer, flatter face of the new species (there is some disagreement over whether it should be called *H. rudolfensis*) suggest the consumption of foods requiring chewing with the back teeth. This trend in reduced prognathisim, or forward projection of the mouth, had already begun in *H. habilis*, but appears more pronounced in the new species and became even more extreme in later species.

The question of how many species of early Homo existed at roughly two million years ago is far from settled. Other researchers believe it is premature to make specific attributions of the evolutionary affiliations of the various early hominin specimens, given that the overall number of fossils is still quite small and it is therefore difficult to gauge the likely range of variation within species. Some suggest that the "rudolfensis" specimens are actually a variant of *H. erectus*. The relatively broad time range provided by available dating techniques, generally accurate only to the scale of a hundred thousand years, increases the difficulty in judging which fossil specimens represent individuals who were effectively contemporary and thus potentially members of the same population.

One example of the increasingly complex picture is provided by the early *Homo erectus* specimens from the Dmanisi locality in Georgia, tightly dated to about 1.76 million years ago (nearly overlapping with the date of the new East Africa finds), which show a great deal of morphological variation in what appears to be a single population. The Dmanisi fossils bear similarities to the new East African fossils, according to A.P. Van Arsdale, who has studied the Georgia materials.

The question of how straight or branching ("bushy") the evolution of the genus *Homo* has been depends, in part at least, on the degree to which cultural as opposed to purely biological adaptation played the central role in how humans interacted with their environments.

The straight or unilineal view holds that despite the fact that early members of the genus *Homo* soon spread over vast distances encompassing Africa and Eurasia there was, nevertheless, sufficient genetic flow between widely dispersed populations to prevent separation into distinct species, as generally happens in most groups of plants and animals.

One argument advanced in support of the unilineal interpretation of human evolution is that the development of culture (i.e., complex, learned behavior including the manufacture and use of sophisticated tools, social division of labor, etc.) meant that humans were buffered from the full impact of natural selection driven by the environment. In other words, humans, to increasing degrees through time, created their own environment, adapting to nature by cultural rather than biological means.

Cultural evolution is much more rapid and flexible than biological evolution, since the latter depends on changes in genetic frequencies which require many generations to become established in a population. As culture became the predominant mode of adaptation, humans could occupy many different environments by the use of new technology and social organization without the need to develop anatomical and physiological modifications to permit survival in these diverse settings, or at least with such adaptations significantly reduced.

While the predominance of cultural over biological adaptation is certainly true of modern humans (though biological evolution has not ended), the balance between cultural and biological forms of adaptation at various times and places in the past and how that determined the patterns of human development over the last two million years are still very much subject to debate.

As long as the paleontological, archaeological, and genetic records were relatively sparse, there was only a limited basis on which to judge between the unilineal and branching views of human evolution. That paucity of data is slowly beginning to change. In recent years, the discoveries of the so-called hobbits, *Homo floresiensis*, on the island of Flores in Indonesia and of the Denisovans of southern Siberia have further expanded our appreciation of the many forms that human evolution has taken.

The new genetic evidence which suggests that Neanderthals and modern humans interbred and were, therefore, not separate species, may indicate that over the last 200,000 years at least, despite the development of certain anatomical differences, the reliance on cultural adaptation may have dampened biological differentiation. This is not a settled matter, however.

The emerging picture of a high level of diversity in early human evolution, not only in physical form, but in rapid expansion out of Africa into a variety of new environments reflects a complex, dialectical interaction between biological and cultural evolution. Many evolutionary "experiments" in balancing the two forms of adaptation are likely to have occurred, but only one ultimately succeeded.