

## WHAT'S NEW IN HUMAN EXPLORATION

The last few years have witnessed dramatic shifts in the reconstruction of our family history. Just when the basic outline of the story seemed well established, new data appear to contradict some of the well-known scenarios. The new data derive not only from new fossils, but also from new ways of looking at already known fossils and sites, as well as from new analytical techniques from the physical and biological sciences. The latter range from ways of dating fossil sites too old for radiocarbon but too young for potassium-argon determinations, to reconstruction of ancestry through similarity in DNA, to a better understanding of the hyena's contribution to the fossil record. As a result, we must reconsider the definition of "humanness" and adopt a more objective, and distant view of our ancestors.

### New Members of the Human Family

Some of the newest members of the human family (Hominidae) have been in the literature longer than any African fossils and, in fact, are not fossils at all. In several recent publications, as well as in a forthcoming Encyclopedia of Human Evolution and Prehistory, Delson and Tattersall have placed the chimpanzee (Pan), gorilla (Gorilla) and orangutan (Pongo) within the human family, rather than in a family of great apes (Pongidae). Other authors (e.g. P. Andrews in Delson, ed., 1985, Ancestors: The Hard Evidence: 14-22) would group humans in a sub-family (Homininae) with African apes but not with the Asian orang. In the most extreme rearrangements of the primate kinship chart, supported by recent DNA studies (Science, 10/16/87, 238: 273-275), chimpanzees are more closely linked to humans than they are to gorillas.

Although those who were troubled by the ape in our ancestry will not welcome the modern African apes to the family reunion, the reclassifications



make sense for several reasons. First, a re-examination of comparative skeletal morphology shows that in such features as eyebrows, shape of sinus cavities, orientation of canine teeth, size differences in upper incisor teeth, and the relationship of bones in the roof of the mouth, humans (living and fossil) and the African apes share common features not shared by orang. Second, studies of similarities in DNA group African apes with humans rather than with orang, and suggest that the latter may have branched off the family tree up to 10 million years before the split between African apes and humans. Third, the Miocene fossil evidence of Asian and African apes, 18 to 8 million years ago, suggests that Asian apes, similar in some respects to orang, formed a distinct and diversified lineage in Asia and southeast Europe by 14 million years ago (e.g. Sivapithecus, Ramapithecus). Evidence of a distinct lineage of bipedal humans, however, is not found before 5 million years ago, and then only in Africa.

Those who argue for a closer relationship between humans and African apes have been further stimulated by discoveries of several groups of west African chimpanzees who use stone tools and other implements to crack nuts. Not only do the chimpanzees select stones or wooden clubs of differing hardness, depending on the kinds of nuts they intend to crack that day, but they appear to have a mental map of all the discarded tools in their terrain, so that they can swing by and pick up the nearest tool of the appropriate material on their way to a nut tree (Journal of Human Evolution 13: 415-440 and 15: 77-132).

### New Fossils Negate Old Theories

New fossil discoveries from Kenya and Tanzania have also upset previous reconstructions of the human family tree. In 1985 (Nature 316: 788-792), Brown, Harris, Leakey and Walker published a description of the most complete early hominid skeleton ever found: that of a ca. 12 year-old Homo erectus boy, who, although not fully-grown, was already almost 5'6" tall at the very beginning of Homo erectus times, ca. 1.6 million years ago! Since we had imagined that members of this species were short as well as primitive in appearance, the implication that Homo erectus individuals may have attained an adult height of 6 feet is revolutionary. What new food source did Homo erectus exploit in order to sustain this rate of growth for the first time in hominid history? In addition, the pelvis of the boy from Nariokotome on the west side of Lake Turkana is considerably narrower than the male pelvis of today, implying that erectus infants were as underdeveloped or 'altricial' at birth as ours are, since an infant with a full-grown erectus brain would not have fit through the birth canal.

The erectus boy differs dramatically from another new, but more fragmentary adult skeleton from Olduvai Gorge, announced in May, 1987 by Johanson and colleagues (Nature 327:

205-209). Although dated only about 200,000 years earlier than the erectus boy, the Olduvai skeleton, provisionally attributed to a previous human species, Homo habilis, was as short as the "Lucy" fossil (Australopithecus afarensis) of more than a million years earlier (3.0 million years ago) and had comparably long arms. The new fossil seems to confirm the "punctuated equilibrium" model of human evolution: long periods with little change in morphology followed by rapid bursts of dramatic change in size, shape, and lifestyle. Like the erectus boy, however, the Olduvai skeleton raises more questions than it answers. If the first assemblages of chipped stone tools now dated to 2.5 to 2.0 million years represent a new way of making a living in savanna environments, why are the hominids like Lucy who date from before this event so similar to the ones who lived in east Africa at 1.8 million years ago? Have we grouped fossils into "Homo habilis" that don't belong together? Are the fossils we are calling Homo, because of expanded brain cases and a presumed dependence on tools and cultural behavior, in fact not responsible for the tools after all?

Curiously, the most dramatic shifts in the hominid lineage at the time when stone tools first appeared concern not the presumed ancestors of Homo erectus, but their cousins, the robust australopithecus group. Until the publication of the "black skull" from the west side of Lake Turkana by Walker and colleagues in 1986 (Nature 322:517-522, Discover, September 1986: 87-93, Science 233: 720-21), robust australopithecus individuals, with their "nutcracker" jaws, large grinding molars, gorilla-like crests, and flat faces, were thought to represent a specialized dead-end in human evolution that evolved only after 2 million years ago in response to competition from more "advanced" early humans (Homo habilis) wielding stone tools. The extremely robust "black [manganese-stained] skull", however, is 2.5 million years

old! While not as flat-faced or as large-brained as later forms, the "black skull" had molar teeth and a bony skull crest as large or larger than any of the hyper-robust Australopithecus boisei forms from east Africa, such as Zinjanthropus from Olduvai. The new skull shares some primitive features with the earlier form, Australopithecus afarensis (Lucy and the "first family"), but relatively few with its presumed contemporary, A. africanus ("Mrs. Ples.") from south Africa, or with later representatives of the genus Homo. How are all these fossil forms related to one another? Many scholars agree (see Science News 7/4/87 p.7) that the robust australopithecines must now be derived directly from afarensis. But is Homo, who only appears after 2 million years ago, also derived from afarensis, and if so, is africanus a side-branch or an intermediate ancestor? And finally, who made the first stone tools at 2.5 to 2.1 million years ago, at Kada Gona (Ethiopia), Omo (Ethiopia) and Senga (Zaire)? (No stone tools are known from this time range in South Africa or in association with africanus). Was it a robust australopithecus or an undiscovered human ancestor?

The new fossils concur with several re-analyses of the behavioral and physical evidence for early human adaptations. Early humans were not simpler versions of ourselves but a group of animal forms with no living analogue. To live on the east African savannas, they probably had to be able to exploit underground tubers, and small animal prey, but the simple stone tools they made did not change for a million years. While Homo erectus may have had a long period of childhood dependency and learning, considerable controversy exists as to whether Homo habilis and Australopithecus matured in an "ape" or "human" growth pattern (Nature 317:525-527, 323:327-330). Rather than representing "home bases" and a modern pattern of food-sharing and division of labor, the evidence of the earliest archaeological sites is now seen to reflect processing of

animal bones by hominids at localities where large carnivores were also active and where no clear evidence of human campsite activities is found (Potts 1984, American Scientist 72: 338-347; Bunn and Kroll 1986, Current Anthropology 27(5): 431-452; Binford 1987, Current Anthropology 28(1):102-105).

#### The Origin of Modern Humans

About 1 million years ago or slightly earlier, the first humans spread out of Africa via the Middle East into southern and eastern Asia, and, finally, Europe, the northernmost continent. To do so, they had to learn to cope with colder winters and shorter growing seasons in which increased reliance on the meat and fat of large animals would have been essential. Yet many sites that were once thought to demonstrate this reliance, along with the hunting competence of later Homo erectus, have recently been questioned. In a series of 1985-6 articles in Current Anthropology, (26(4):413-442; 27(5):453-475) Binford and colleagues argue that the Chinese site of Zhoukoudian (Choukoutien), "the cave home of Beijing [Peking] man" was also the cave home of two species of hyena, wolf, tiger and bear. While humans also left their stone tools in the cave, the food habits of these carnivores were probably responsible for much of the bone accumulation in the cave, as well as for the damage to the human skulls, formerly interpreted as evidence of cannibalism. In addition, the "ash layers" cited as evidence for human control of fire are probably the remains of huge guano accumulations, some spontaneously ignited and burning over long periods, so that "the 'cave home of Beijing man' may well have been one of the first 'homes' in the temperate zone to have had 'central heating'" (1985: 429). As Binford's conclusions are strongly contested by other scholars, both in the US and abroad, a definitive reconstruction of life in China in Homo erectus times must await further data from Zhoukoudian and other sites.

In Europe, the site of Torralba is interpreted in the Time-Life book on Early Man, as well as in the Smithsonian's Hall of Ice Age Mammals and the Emergence of Man as a place where Homo erectus was thought to have used fire to drive elephants into a bog and slaughter them. Although stone tools indicate some human activity at the site, recent restudy of the evidence for fire, hunting, and butchering of the elephants and other animals suggests that the large mammals could well have died a natural death, since hearths were absent, and previous identifications of stone tool "cutmarks" are now in doubt.

Even the European Neandertals, whose large brains qualify them for inclusion in our own species, have been "dehumanized," their ability to speak clearly and plan ahead called into question. In a review article in the 1986 Annual Review of Anthropology (15:193-218), Trinkaus demonstrates that Neandertals were more cold-adapted and much more robustly built than Homo sapiens sapiens, indicating that their ability to find cultural rather than biological solutions to environmental stress was considerably less than that of early modern human (Homo sapiens sapiens). The "early moderns", on the other hand, were more "advanced" in their cultural behavior than we had previously imagined. Not only did they carve images of their world and decorate themselves with beads and pendants, but they also built boats and sailed them to Australia, New Guinea, and New Ireland, where sites, some with painted images, are known from 32,000 years ago (Nature, 8/20/87, 328:666).

Surprisingly, in view of its relatively recent date, the origin of modern humans is one of the most debated topics in palaeoanthropology (Science, 9/11/87, Vol. 237:1292-1295). Where is the birthplace of "Cro-magnon" and other peoples who appear in Europe beginning around 35,000 years ago and whose achievements culminate in the great painted caves of Lascaux and Altamira? Two new lines of

evidence lead us back to the place where the human story began. Studies of mitochondrial DNA in modern human groups suggest that all modern humans are descended within the last 200,000 years from an African ancestor. Since mitochondria are present in eggs but not in sperm, only female ancestry is reflected in the pattern. If this ancestral modern woman bred with Neandertal or other males, whose mitochondria are not heritable, this intermixture would not show up in the mitochondrial DNA, although it would be reflected in the more slowly-evolving nuclear DNA. Many scholars, however, including Trinkaus, see the contribution of Neandertals to modern humans as minimal. The physical differences are too great, and the replacement time too short, to envision a slow transformation from one form to the other.

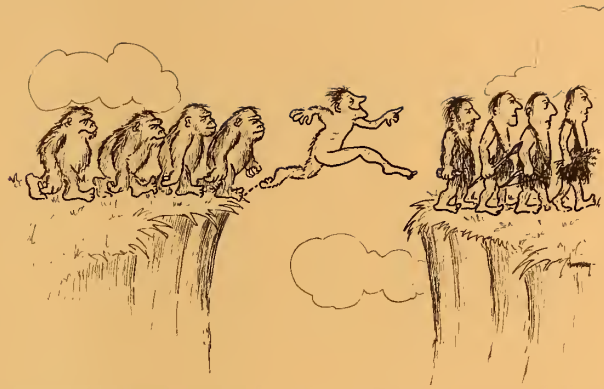
Some anthropologists argue that the molecular clock does not keep good time, or that alternative explanations for why African populations are more diverse genetically than the entire rest of the human species can be developed (Science 10/2/87: 238:24-26). Yet the mitochondrial evidence may well be in agreement with a second source of evidence: that of the fossil record itself. At two sites in South Africa, Border cave and Klasies River Mouth, fossils with chins and small modern teeth have been dated to the end of the last interglacial, about 75,000 years before the first appearance of modern humans in Europe. Skeptics (e.g. Binford, 1984, Faunal Remains from Klasies River Mouth) have questioned the dates or argued that younger, more modern skeletons may have been buried or mixed into older deposits. Recent stratigraphic work at Klasies, however, shows that the modern human fossils there are contemporary with the earliest archaeological levels at the site, levels whose soils and associated molluscs are linked to the warmer climate of the last interglacial. More "archaic" but still large-brained Homo sapiens fossils are known from even earlier deposits at Omo (Ethiopia),

Ndutu, Laetoli, and Eyasi (Tanzania), Florisbad (South Africa) and several other sites. A few scholars point to the existence of transitional populations between archaic and modern humans at several sites in eastern Europe and southeast Asia, but these can also be seen as evidence for the intrusion and interbreeding of new populations. As a result of several converging lines of evidence, an African ancestry for all modern humans appears likely.

### General Considerations

All of these new discoveries and interpretations, whether due to new fossils, new analytical techniques, or new ways of looking at old data, reflect changing views of evolution in general, and human evolution in particular. If new evolutionary advances are rare events, followed by long periods of stasis, then dramatic differences between early human groups only 200,000 years apart make sense, as do long periods when both the biology and behavioral adaptations of hominid species were stable. The rapid replacement of Neandertals by modern humans also fits this model.

A second trend in these new scenarios is the progressive refusal to recognize modern human behaviors in our ancestors. Like scholars in the early twentieth century, modern anthropologists are struck by the great gulf that separates us from the primitive past rather than by the few traits which unite everything grouped in the human family (including possibly, the living African apes). Where to draw the line between "human" and "non-human"? The answer may not lie entirely in the fossil record, but in the ways scientists and philosophers think about themselves, their evolutionary past, and the world around them.



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