New Fossil Upsets Human Family

The discovery of a 2.5-million-year-old cranium from northern Kenya means that the currently accepted two-pronged-fork model of the human family tree has to be replaced by a three-way split; many new interpretations are now possible

VERY occasionally a new hominid fossil is discovered that simply was not predictable on the basis of current theory and therefore really does force a major restructuring of the human family tree. The remarkably complete cranium from northern Kenya reported this week by Richard Leakey and his colleagues is just such a fossil. "It turns a lot of our ideas upside down, about the sequence of evolutionary changes in the skull and about who is related to whom," comments Henry McHenry, of the University of California at Davis.

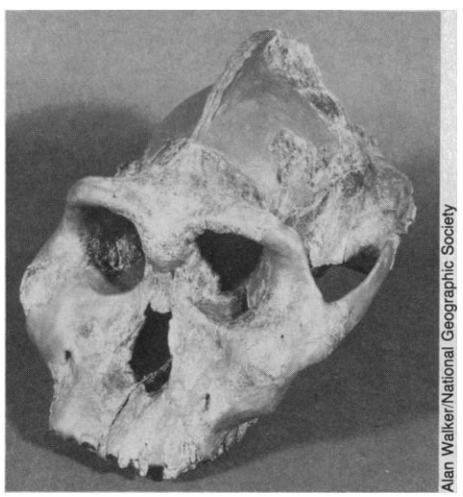
"There's absolutely no doubt that this cranium is the most significant fossil to come out of Africa since the *afarensis* material," comments William Kimbel, of the Institute of Human Origins (IHO), Berkeley. *Afarensis* is the species to which the famous skeleton "Lucy" belongs, which was discovered by Donald Johanson and his colleagues just over 10 years ago in Ethiopia and was the cause of a major rethinking of human origins. Kimbel's remarks are echoed by virtually all paleoanthropologists who have seen the new cranium from Kenya.

At the very least the new fossil means that the the simple two-pronged-fork picture of the human family that is most generally accepted by the paleoanthropological community has to be replaced by a three-pronged fork. "Whichever way you look at it, it's back to the drawing board," observes Frederick Grine of the State University of New York at Stony Brook.

The new cranium, which was discovered last summer by Alan Walker of Johns Hopkins University, comes from the fossil-rich deposits on the west side of Lake Turkana, deposits that Leakey and his colleagues have only recently begun to explore in earnest. This latest find, which is designated by its museum number, KNM-WT 17000, was found just 32 kilometers south of the spot from which the much-celebrated skeleton of the *Homo erectus* boy was recovered in 1984. However, the new fossil had been buried in deeper deposits in the sequence and is therefore about a million years older: specifically it is 2.5 million years old. The geological mapping and dating of the deposits on the west side of the lake have been worked out in detail by Francis Brown, of the University of Utah, and Ian McDougal, of the Australian National University, Canberra.

One of the great surprises about WT 17000 is that it shows a suite of characters in its face that previously were thought to have evolved much later in time, perhaps as much as a million years later. The second surprise is that this "advanced" face is combined with a very primitive cranium. "No one could have predicted this kind of combination," says McHenry.

Although there are differences of interpretation about the shape of the human family tree that covers the past 4 million years, the most popular idea is a rather simple and appealing two-pronged fork.



Alan Walker/National Geographic Society

New hominid skull, *found on the west side of Lake Turkana in northern Kenya. The face shows the typical massive structure, dished shape, and flared cheek bones of* Australopithecus boisei *but has a very primitive cranium.*

The main stem of the fork is represented by the species known as *Australopithecus afarensis*, which is therefore the common ancestor for the two later prongs. One of these is a continuation of the *Australopithecus* line, which goes successively through three species, namely, *africanus*, *robustus*, and *boisei*, which marked the extinction of the genus. The second prong is the line leading to modern humans, which passed through *Homo habilis*, *H. erectus*, and *H. sapiens*.

This was the scheme proposed in 1979 by Donald Johanson, of the IHO, and Timothy White, of the University of California at Berkeley, shortly after the announcement of the name *A. afarensis* for Lucy and her fellow fossils from Ethiopia and a collection of slightly older jaws and teeth from Laetoli in Tanzania, which are dated at 3.75 million years. The main differences of opinion center on the origin of the *Homo* lineage.

Some authorities, including Kimbel and McHenry, believe that the line leading to modern man arose not from *A. afarensis* but from the slightly later species *A. africanus*. If correct, this would still produce a two-branched tree, with the split occurring a little later than generally supposed. Others, most notably Leakey, suggest that *Homo* arose much earlier than the 2 million years or so implied by the above schemes, and that some of the Hadar fossils are in fact a primitive *Homo* that Johanson, White, and others failed to recognize as such. Nevertheless, once again the overall picture is a two-pronged fork.

The appearance of WT 17000 now means that simple Y-shapes are out and must be replaced by a three-way split.

The reason is that the new cranium is clearly related to *A. boisei*. Therefore *boisei*, which was thought to have been the end point of the australopithecine lineage, apparently arose much earlier than generally believed. It must therefore be a separate line evolving in parallel with the *A. africanus* and *A. robustus*, not as its final product. Hence, the three-pronged fork is formed: *africanus-robustus* going in one direction, *boisei* in another, and the *Homo* line in a third.

The interesting thing about this picture is the extent of parallel evolution that appears to have been going on. Although there are differences among the three lines, each is undergoing a dramatic shortening of the face, so that instead of protruding like an ape's it becomes more vertical, as in modern humans. In addition, the base of the cranium in each line is becoming more flexed, which is probably related to the tucking under of the face.

Accompanying the facial shortening in the *africanus-robustus* and *boisei* lines is an

expansion of the size of the cheek teeth and a diminution of the front teeth. If these developments are indeed evolutionarily independent they are, in Grine's words, "the most incredible functional convergence I have ever seen." By contrast the facial shortening in *Homo* is accompanied by a reduction in the size of the cheek teeth.

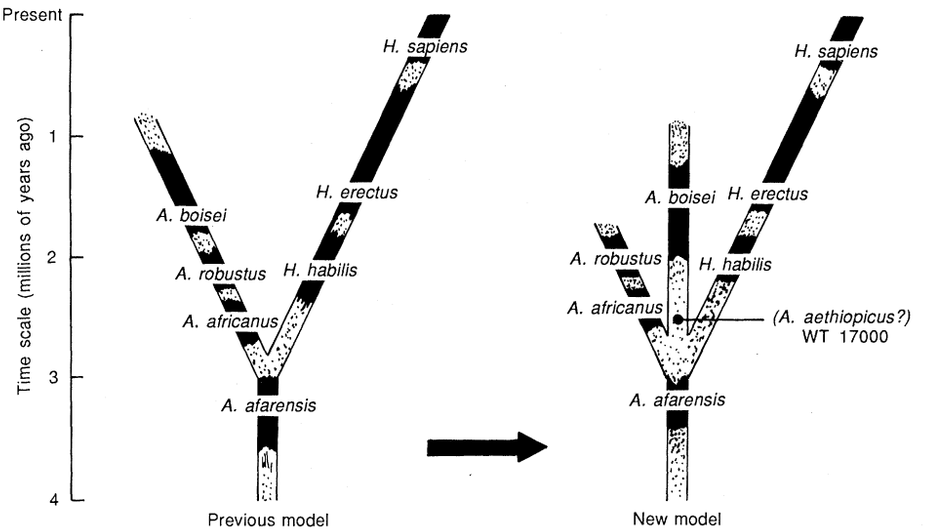
It is possible that the tucking under of the face in the three lines is directly related in different ways to the different changing functions and structures of the dental arches, but this is considered to be unlikely. "We just don't know what is driving these changes," says Walker.

The shift from a two-pronged- to a three-pronged-fork model necessarily implies parallel evolution in other areas of the cranial anatomy too. In all, three separate suites of characters have each apparently evolved independently in different lineages at least twice and sometimes three times, which, says Kimbel, "may be a lot for some people to swallow." For McHenry this simply means that there might be even more parallelism than is implied by this new picture. "It is certainly going to affect the way we think about such processes," he comments.

The idea of an evolutionary progression from *A. africanus* through *A. robustus* and finishing with *A. boisei* had been extremely appealing. For one thing, the tucking under of the face gets more pronounced through this series. But more particularly there is clear increase in robusticity: the cheek teeth steadily get more massive, as does the overall facial architecture. The "end product" of the series was seen as *A. boisei*, which sports a characterically dish-shaped face with enormous, flared cheek bones.

Australopithecus boisei and *A. robustus* are clearly the same kind of animal; it is simply that *boisei* has taken the dental and facial specializations to an extreme. Some paleoanthropologists suggest that the anatomical differences between the two groups may in fact be related to geographical variation: *robustus* has to date been found only in South Africa and *boisei* in East Africa.

In an elegant piece of research, Yoel Rak, of Tel-Aviv University, had recently shown how the steady rise in bulkiness of the face through the three species in the australopithecine line could be explained as graded architectural reinforcement required by increased chewing forces. However, the discovery that WT 17000 already had the characteristically huge, dished *boisei* face at 2.5 million years ago and in association with a distinctly primitive cranium means that Rak's scheme is almost certainly untenable. *Boisei* cannot be the end product of the *africanus-robustus* line if it is present at the beginnings of the lineage.



Human family trees. *The version on the left shows the two-proned-fork model proposed by Johanson and White in 1979. On the right is the minimum restructuring implied by the new fossil. Other interpretations are possible.*

The primitive features of WT 17000 include a jutting out face, a characteristically ape-like joint between the jawbone and the skull, a bony crest running down the midline of the skull and reaching far back, and an unflexed cranial base. In this suite of characters WT 17000 is identical with *A. afarensis*, which is the most primitive hominid known so far. It is therefore reasonable to assume that the species to which WT 17000 belongs derived directly from *afarensis*, as Kimbel notes: "Its primitive features make it a nice link with *afarensis*."

However, this particular suite of primitive characters does not uniquely tie WT 17000 to *afarensis*, because it is also shared with the African great apes, the gorilla and chimpanzee. Strictly speaking, it is conceivable therefore that the WT 17000 species could have evolved independently from an ape-like ancestor and not from the hominid *afarensis*, such is the uncertainty of employing primitive characters in trying to draw family trees. However, the possibility is not considered very likely by most paleoanthropologists.

The new skull bears only indirectly on the origins of the genus *Homo*. For instance, those authorities who see an ancestor/descendant relationship between *A. africanus* and *Homo habilis* as a result of series of advanced features being shared between the two species might now be more tempted to view these as parallelisms. In which case, *A. afarensis* becomes an appropriate ancestor, as Johanson and White originally proposed.

But there is one researcher, Todd Olson, of the City University of New York, who sees the new cranium as supporting his view that Johanson's sample of fossils from Ethiopia contains a robust australopithecine species. "Yes, everyone has got to go back to the drawing board because of this new cranium," he says. "But the difference is that I go back smiling." Olson's scheme also implies that the fossils that Johanson calls *A. afarensis* are in fact two species, not one.

The current picture of these early stages of the human family tree was most clearly stated by White, Johanson, and Kimbel in a review article at the end of 1981. "We said that our hypotheses would be tested by finds in East African from between 2.0 and 3.0 million years ago," says Kimbel. "Well, we've been shown that we didn't get it quite right, and that's just fine."

One last issue remains, and that is a name. What species does WT 17000 represent? Although it is clearly related to *A. boisei*, the extent of primitive features seems to rule out the possibility of calling the new fossil *boisei*. Leakey and his colleagues decline to offer a new species name, and suggest that, if it indeed is not *boisei*, then it should be called *A. aethiopicus*, which is derived from a name given to a toothless lower jaw found half a dozen years ago in Ethiopia. Most authorities contacted by *Science* believe this is unwise, not least because the specimen to which the name is attached is in such poor condition and is not a part of the skull represented in WT 17000. Therefore, no direct comparison can be made.

Several of Walker's fellow paleoanthropologists warned him at the American Association for Physical Anthropology meetings earlier this year that "If you don't give this thing a new name when you publish it, someone else will." ■ **ROGER LEWIN**

ADDITIONAL READING

A. Walker *et al.*, "2.5 Myr *Australopithecus boisei* from west of Lake Turkana, Kenya," *Nature (London)* **322**, 517 (1986).

T. D. White *et al.*, "*Australopithecus africanus*: its phyletic position reconsidered," *S. Afr. J. Sci.* **77**, 445 (1981).