Ethiopian fossils reveal a new branch on the hominid family tree: a small-brained hominid that is a candidate for the ancestor of our lineage

A New Human Ancestor?

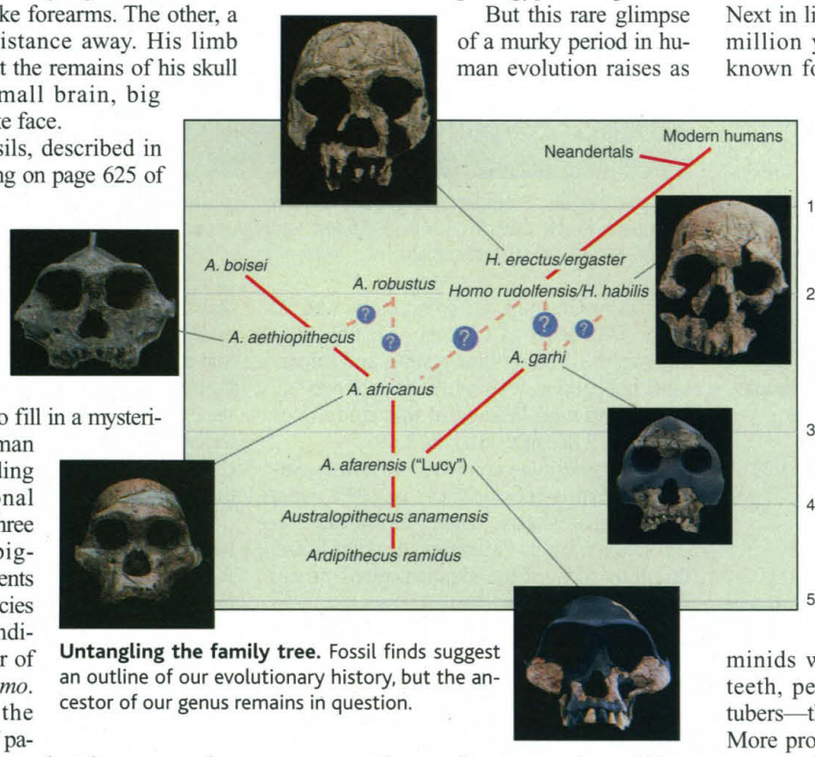
About two and half million years ago, on a grassy plain bordering a shallow lake in what is now eastern Ethiopia, a humanlike creature began dismembering an antelope carcass. Nothing remains of the hominid, but the antelope bones show that it wrenched a leg off the carcass, then used a stone tool to slice off the meat and smash the bone. After several tries, it managed to break off both ends of the bone and scrape out the juicy marrow inside.

At just about the same time, two other hominids died near the lake. One, perhaps 1.4 meters tall, had long legs and a human gait but long, apelike forearms. The other, a male, lay some distance away. His limb bones are gone, but the remains of his skull show he had a small brain, big teeth, and an apelike face.

These new fossils, described in two papers beginning on page 625 of this issue, give different glimpses of each hominid, and no one can be sure all three belonged to the same species. But even if not, their details are starting to fill in a mysterious chapter of human prehistory. According to the international team that made all three discoveries, the big-toothed skull represents an unusual new species that is the best candidate for the ancestor of our own genus, *Homo*. Not everyone in the contentious field of paleoanthropology agrees, but the new species, which Ethiopian anthropologist Berhane Asfaw and his colleagues have named *Australopithecus garhi* (*garhi* means "surprise" in the language spoken by the local Afar people), is certain to shake up views of the transition from the apelike australopithecines to humankind. And the scored bones from the first hominid's feast are the earliest recorded evidence of hominids butchering animals, bolstering the notion that meat eating was important in human evolution.

"They've put together a whole package here, so that you can say a fair amount about a time we don't know much about," says anthropologist F. Clark Howell of the University of California (UC), Berkeley. With its surprising mix of traits—primitive face and unusually big teeth—the new australopithecine doesn't match the profile many researchers expected for a human ancestor at this stage. "It's very exciting," says paleoanthropologist Alan Walker of Pennsylvania State University in University Park. "Until now it's all been just scraps of teeth and bits of mandible from this time. And this [morphology] is a surprise."

But this rare glimpse of a murky period in human evolution raises as many questions as it answers. *A. garhi* has few traits that definitively link it to *Homo*, and like other hominids from the same period, it may simply be an evolutionary dead end that brings us only slightly closer to understanding our own ancestors, says paleoanthropologist Bernard Wood of George Washington University in Washington, D.C. The debate is complicated by the fact that paleoanthropologists are deeply divided over who the first humans, or members of *Homo*, were, and indeed what makes a human. "These are magnificent fossils," says Wood, but he's not ready to admit *A. garhi* into the gallery of our ancestors. "At this point it's impossible to tell what's ancestral to what," he says. "This won't be the last 'surprise.'"



Untangling the family tree. Fossil finds suggest an outline of our evolutionary history, but the ancestor of our genus remains in question.

Anthropologists have long been itching to know just what East African hominids were doing between 2 million and 3 million years ago, says one of the team's leaders, paleoanthropologist Tim White of UC Berkeley. Decades of fieldwork and analysis have allowed researchers to identify many characters in the human evolutionary story (see diagram), starting with apelike species such as the 4.2-million-year-old *A. anamensis*. Next in line, known from 3.7 million to 3.0 million years ago, is *A. afarensis*, best known for the famed "Lucy" skeleton: a meter-tall, small-brained, upright hominid that retained apelike limb proportions and a protruding lower face.

More than a million years separate Lucy from the first specimens usually considered to be part of our own genus, which appear in East Africa around 2 million years ago and tend to have larger brains and a more human face, although they are highly variable. In the interim, the South African fossil record is diverse and confusing, and the East African record has been sparse. The period includes three species that fall into the "robust" australopithecine group—heavy-jawed hominids with skull crests and large back teeth, perhaps for eating hard roots and tubers—that are not part of our own lineage. More promising for those seeking a human ancestor is *A. africanus*, known from South Africa starting at around 2.8 million years ago, which has a more humanlike face than the Lucy species.

But the *A. africanus* fossils were found half a continent away from the East African cradle of *Homo*, and some anthropologists have been hoping for a stronger candidate for the root of our lineage. "After the split with the robust lineage, we have very little evidence," says Walker. That's why White and his team zeroed in on sediments in the desert of Ethiopia's Afar depression. They struck gold with three separate discoveries,

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all dated securely to 2.5 million years ago by radiometric techniques on an underlying volcanic rock layer.

One dramatic find came in 1997, when El Niño–driven rains washed away stones and dirt on steep slopes near the village of Bouri. Berkeley graduate student Yohannes Haile-Selassie spotted fragments of the skull—the color and thickness of a coconut shell—on the surface. A closer look revealed teeth poking out of the ground. Much of the rest of the skull had washed down the hill, so the team, which includes 40 members from 13 countries, took the slope apart. They dug tons of material from the hill, then sieved it and picked through it for bone—twice. "It was probably the most difficult fossil recovery we've ever done," says White. "We spent 7 weeks on that slope." Although the delicate bones of the middle face were gone for good, the team found many more skull fragments.

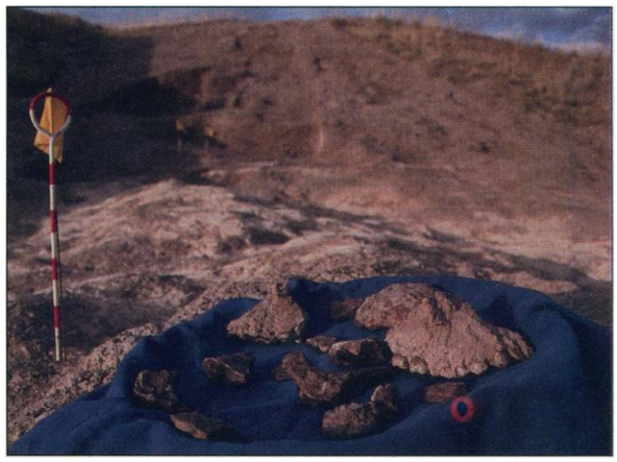
After reconstructing the skull, the researchers were confronted with a face that is apelike in the lower part, with a protruding jaw resembling that of *A. afarensis*. The large size of the palate and teeth suggests that it is a male, with a small braincase of about 450 cubic centimeters. (A modern human brain is about 1400 cubic centimeters.) It is like no other hominid species and is clearly not a robust form. And in a few dental traits, such as the shape of the premolar and the size ratio of the canine teeth to the molars, *A. garhi* resembles specimens of early *Homo*. But its molars are huge—the second molar is 17.7 millimeters across, even larger than the *A. robustus* average. "Selection was driving bigger teeth in both lineages—that's a big surprise," says Walker.

The other dramatic skeletal find had come a year earlier: leg and arm bones of a single ancient hominid individual, found together. The new hominid femur or upper leg bone is relatively long, like that of modern humans. But the forearm is long too, a condition found in apes and other australopithecines but not in humans. The fossils show that human proportions evolved in steps, with the legs lengthening before the forearms shortened, says co-author Owen Lovejoy of Kent State University in Ohio.

The third major find, at the same stratigraphic level and only a meter away from the skeletal bones, preserves dramatic evidence of hominid behavior: bones of antelopes, horses, and other animals bearing cut marks, suggesting that butchery may be the oldest human profession. One antelope bone, described by a team including archaeologist J. Desmond Clark of UC Berkeley and White, records a failed hammerstone blow, which scratched the bone slightly and caused a bone flake to fly off; a second blow was struck from exactly the same angle. Both ends of the bone were broken off, presumably to get at the marrow.

Similarly, an antelope jawbone bears three successive curved marks, apparently made as a hominid sliced out the tongue. In cross section under the microscope, these marks show a parallel series of ragged V-shaped striations with rough inner walls—the telltale signature of a stone tool rather than a predator's teeth, says White. Marks on the leg bone of a three-toed horse show that hominids dismembered the animal and filleted the meat from the bone.

The Bouri sites yielded few of the stone tools the hominids must have used, perhaps because there is no local source of stone. The hominids "must have brought flakes and cobbles in from some distance, so that obviously shows quite a bit of forethought," says Clark. Tool use by this point is no surprise: At other sites, anthropologists have found tools dated to 2.6 million years ago. But there had been little hard evidence of what the oldest tools were used for. The new find shows that tools enabled hominids to get at "a whole new world of food"—bone marrow, says White.



Treasure site. *A. garhi*'s skull was found on this Ethiopian desert slope.

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Marrow is rich in fat, and few animals other than humans and hyenas can get at it. Anthropologists have theorized that just such a dietary breakthrough allowed the dramatic increase in brain size (*Science*, 29 May 1998, p. 1345), to perhaps 650 cc or larger, that took place in the *Homo* lineage by 2 million years ago. Two researchers recently proposed that cooked tubers were the crucial new food source (*Science*, 26 March, p. 2004), but most others have assumed it was meat. The cut marks present convincing evidence that they were right, says Yale University anthropologist Andrew Hill.

Whether or not the three finds can be connected, *A. garhi*, as based on the new skull, is now a prime candidate as an ancestor of our genus. The species is in the right place—East Africa—and the right time—between the time of *A. afarensis* and that of early *Homo*—says White. But making the link to the human lineage isn't easy, in part because the nature of "early *Homo*" is itself something of a mystery. White notes that some of the early *Homo* specimens have large teeth, and that in the teeth "there's not much change at all from *A. garhi* to those specimens of early *Homo*."

The link between *A. garhi* and *Homo* would be strengthened, of course, if researchers could show that the humanlike long bones come from *A. garhi* rather than from some other humanlike hominid. For now White is willing only to "make up a hypothesis to be tested": *A. garhi*, a small-brained, big-toothed hominid with humanlike leg proportions, began butchering animals by 2.5 million years ago. Thanks in part to the better diet, brain size rapidly increased to that seen in early *Homo*, and the trend toward large back teeth reversed—changes that quickly transformed other parts of the skull as well, such as flattening the protruding jaw.

But some other researchers don't buy that as a likely scenario. There's no reason to expect that every new branch on the hominid tree is our ancestor, says George Washington's Wood. He adds that he is not surprised by *A. garhi*'s mix of humanlike and robust features, because, given that climate was changing, "we should expect a variety of creatures with mixtures of adaptations at this time." Other researchers note that the dental data linking the species to *Homo* are weak. "Nothing here aligns *garhi* closely with *Homo*," says paleoanthropologist Fred Grine of the State University of New York, Stony Brook. "It's a possible candidate [for *Homo* ancestry], but no better than *africanus*."

Some anthropologists also say that there may not have been enough time for evolution to have transformed *A. garhi* into *Homo*. The oldest known specimen assigned to *Homo*, a 2.33-million-year-old palate from Hadar, Ethiopia, is more humanlike than *A. garhi*, with smaller teeth. That requires either a burst of evolution or some other explanation, such as sexual dimorphism, if *A. garhi* is to be considered part of our lineage, notes paleoanthropologist Juan Luis Arsuaga of the Universidad Complutense de Madrid in Spain. White says that only further discoveries and analysis will show just where the hominids of that long-vanished plain stand in relation to our own species: "*A. garhi* isn't the end; it's the first step."

–ELIZABETH CULOTTA