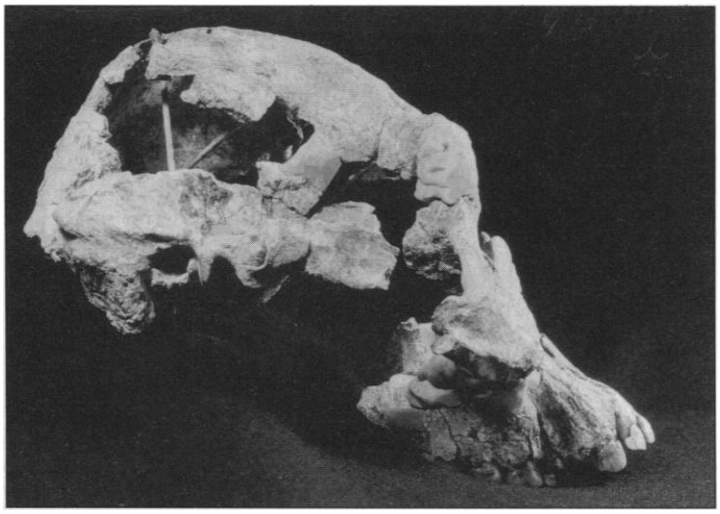
PALEOANTHROPOLOGY

'Lucy,' Crucial Early Human Ancestor, Finally Gets a Head

To a paleoanthropologist, few experiences are as heady as finding a good skull. From "Peking Man"—a human forerunner also known as *Homo erectus*—to the Neandertals, most species in the protohuman gallery are personified by cranial fossils, each bearing distinctive variations on the familiar themes of human face, brain, tooth, and jaw. A glaring exception has been *Australopithecus afarensis*, arguably the oldest human ancestor of them all; paleoanthropologists have been persistently frustrated by the lack of afarensis skulls. Even "Lucy," the famous *afarensis* skeleton found in Ethiopia in 1974, is little more than an enormous question mark above the neck.



INSTITUTE FOR HUMAN ORIGINS

Toothsome find. This skull, the first from *A. afarensis*, the "Lucy" species, may settle a controversy by showing that the bones found with Lucy represent one species—not two.

Now, at last, Lucy's species has a head. The first adult skull attributed to *afarensis* was announced yesterday in *Nature* by William H. Kimbel and Donald C. Johanson of the Institute of Human Origins (IHO) in Berkeley, along with Yoel Rak of the Sackler School of Medicine at Tel Aviv University. Dated to around 3 million years ago, the find from the Hadar region in Ethiopia is approximately 200,000 years younger than Lucy herself.

Lucy's move to the head of the class, anthropologists think, will provide important information about human origins. "Once we know more about the anatomy of this skull," says Bernard Wood of the University of Liverpool, "it will throw some light on the relationship between *afarensis* and later hominids, including the beginnings of the genus *Homo*."

But while some anthropologists think this is a capital discovery, others demur. Its arrival, in fact, may soon inflame a smoldering controversy pitting its discoverers, who think *afarensis* is a single species at the base of the hominid family tree (the primate lineage leading to humans), against those who contend that *afarensis* is really two species that IHO researchers have jumbled together, hopelessly tangling the tree's roots.

The IHO team argues that the new skull, along with other fossils described in the paper, show traits that unite a diverse collection of earlier *afarensis* fossils behind the single-species banner. "A lot of the controversy over taxonomic diversity might have been avoided if we had found a complete skull early on," Johanson says. Furthermore, Kimbel states, the skull's links to some 3.9-million-year-old fossil fragments previously known from Ethiopia suggest that *afarensis* endured for nearly 1 million years.

A number of anthropologists think the anatomy of the fossils indeed supports the single-species contention. "I don't think you can put this argument to bed yet," says Wood, who has largely stayed above this fray. "But the balance on the two scale pans is increasingly coming down in favor of there being a single species." F. Clark Howell of the University of California at Berkeley, already an advocate of the single-species view, concurs. But several critics, such as Todd Olson of the Albert Einstein College of Medicine, argue that the skull, though impressive, doesn't disprove the two-species theory. "You can never prove something right. You can only prove something wrong. And they haven't done that," he says.

The tale of the missing head began in the late 1970s, when Johanson and his colleagues shocked the anthropological community by announcing the discovery of a new, very primitive species of hominid that lived around 3.5 million years ago. As evidence, they had in hand Lucy and numerous other fossils from Hadar, as well as others from Laetoli in Tanzania (found by Mary Leakey's team). To Johanson and Tim White of UC Berkeley, aspects of the jaws and teeth and skull bones appeared more primitive than such features did on all later hominids. As a result, the scientists placed the new species, *afarensis*, at the root of a family tree that later branched, with one limb leading to the genus *Homo* about 2.5 million years ago, and another to creatures known as robust australopithecines, which eventually went extinct. Though there was considerable variation in size among the specimens, Johanson's team attributed the difference to sexual dimorphism: the bigger specimens were male, the smaller, female.

That argument didn't head off criticism from skeptics such as Olson, who claimed there was far too much variation among the fossils to be explained solely by sexual dimorphism. He and others argued that the fossils represented at least two separate species. Some small, slender bones, he said, were remnants of a hominid ancestral to *Homo;* the larger, bulkier bones were remains of a group that ultimately led to the robusts. This scenario left open the possibility that the *Homo* lineage extended deeper in the past than the 2.5 million year cut-off suggested by Johanson and White. The two-species view was favored by Richard and Mary Leakey, among others, and a bitter debate developed.

In 1984 the controversy flared again, but on slightly different grounds. To better understand the functional relationships between the *afarensis* jaw, face and cranium, Kimbel and White made a composite skull based on cranial and facial fragments from several individuals. But skeptics objected. Pat Shipman of the Johns Hopkins School of Medicine and others saw in this skull another form of lumping two species into one: They claimed Kimbel and White had force-fit the face of a slender *Homo*-like species onto the brain case of a robust one.

That argument, however, runs head-on into the newly announced skull. Massive, with a projecting face and large canines, it has the same features as the reconstruction. "People were saying they had muddled up two sorts of early hominid," says Wood. "But judging from the photographs of the new skull, it's pretty clear that they haven't done that."

Yet even this skull doesn't account for everything, Olson and Shipman point out: there are still the original small fossils from Hadar, which the IHO researchers claimed were female *afarensis* specimens but could yet be a small hominid in another lineage. The new *afarensis* skull seems far too large to be grouped with them, says Olson. To pull the smaller fossils into the *afarensis* taxon, Kimbel needs a smaller skull.

He doesn't have one, but he does have a rejoinder, in the form of a small, relatively intact *afarensis* face from Hadar that's also described in the *Nature* paper. It has smaller canines and less facial projection than the larger skull, indicating it is a female, but in all other respects it strongly resembles the larger skull's face. These size variations, as well as those in some limb bones recently found at Hadar, fall within the range expected for sex differences among primates, Kimbel says. "There is absolutely no doubt in our minds that the variation in these specimens is consistent with what you see between male and female apes," he says. "It is completely harmonious with the hypothesis of sexual dimorphism."

Although such harmony does not extend to all the critics, one of them does hold out the possibility that it eventually might. Richard Leakey, who has not seen the new specimens and declined to evaluate them, does note the discovery is a sign of progress. "As I've said all along, we really need more evidence to settle these questions and if they are finding them and getting good material, then, what a good thing that is," he told *Science*. "All we've wanted is the truth, not victory."

–James Shreeve

James Shreeve is a science writer living in Kensington, Maryland.

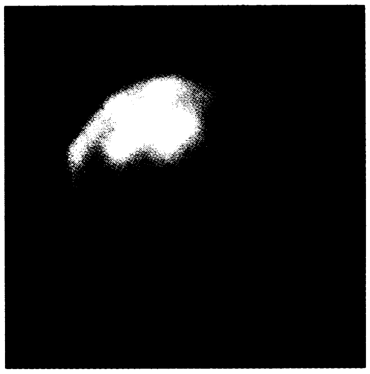
PLANETARY SCIENCE

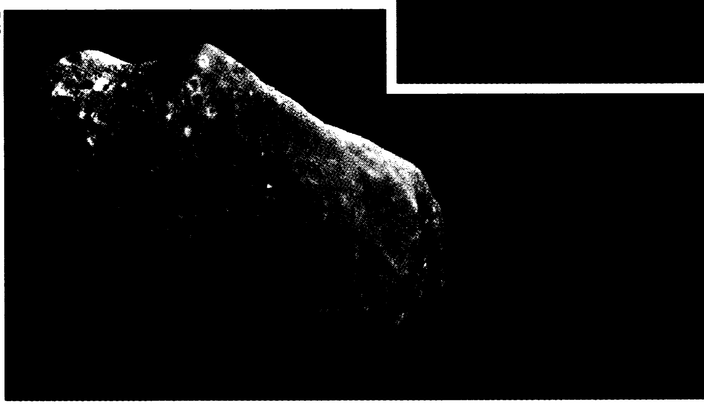
An Asteroidal Family Adds a Little One

In Greek mythology, Ida was one of the nymphs who protected the infant Zeus from his violent father Cronus. Thanks to the Galileo spacecraft, astronomers now know that the 56-kilometer-long asteroid named Ida is also guarding a baby, albeit a somewhat aged one: a tiny, as yet unnamed, moon that seems to have been Ida's companion for 100 million years or more. But instead of being a refugee from violence, Ida's companion may be a product of it—the offspring of one of the collisions that punctuate the life of an asteroid.

At least that's what astronomers are guessing 2 weeks after the announcement of the discovery, which was made by Galileo on its second rendezvous with an asteroid (*Science*, 18 March, p. 1566). In search of clues about how the moon formed and how many other asteroids might be guarding similar secrets, theorists have dusted off old calculations and observers have studied the first image of the satellite, released by Galileo team members last week. And if they're right about the moon's origin, Ida may not be unique in having a companion.

The object of all the speculation, as last week's image showed, is a chunk of rock at least 1.5 kilometers in diameter orbiting roughly 100 kilometers from Ida—too small and too close to Ida to have been detected by ground-based telescopic searches. But it's at about the distance where theorists figured satellites of an Ida-sized asteroid, if there were any, would likely be found, notes Stuart Weidenschilling of the Planetary Science Institute (PSI) in Tucson. Too far out, and the sun's gravitational pull would snatch any satellite away (or the asteroid's feeble gravity would not be likely to capture it in the first place). Too close in, and tidal interactions—like those between Earth and its moon—would drag a satellite down to the surface of the asteroid.





New moon. Ida and its 1.5 kilometer companion *(enlarged at top)*, as seen by Galileo from a distance of 10,000 kilometers.

Just how Ida's satellite—unofficially dubbed Ida 2 by Galileo team members—got into its stable orbit is less obvious. Asteroid specialist Clark Chapman of PSI, a Galileo team member, rules out the capture of another asteroid that happened by. Unlike a spacecraft, which can slip into orbit around a planet by firing its rocket engine to slow down, one asteroid approaching another has only two options: collision or a flyby. Nor does Chapman think the pair formed together along with the rest of the solar system, 4.5 billion years ago. For one thing, random collisions with passing asteroids would destroy any body as small as Ida 2 in just 100 million years or so.

Instead, Galileo data on Ida 2's color, reflectivity, and surface texture suggest a connection to Ida itself. The moon could be a chunk of Ida blasted into orbit by the impact of a smaller asteroid, says Chapman, but he adds that it's unlikely that a fragment from a collision would reach a stable orbit. More likely, he says, the moon is a relic of the same event that produced Ida: a collision that shattered an ancestral asteroid a couple of hundred kilometers in diameter to produce Ida and the "family" of other large fragments known to travel in much the same orbit about the sun. The two newly created family members might have shot away from the collision in a single jet of debris, making them similar enough in speed and direction for the larger one to capture the smaller one, Chapman says.

Since about 10% to 20% of all asteroids belong to families like Ida's, its situation may not be unique. Indeed, in the late 1970s and early 1980s, observers waiting to measure the size of asteroids by watching them pass in front of stars often reported that the stars appeared to wink out briefly just before or after the passage of the asteroid, presumably because a satellite had intervened (*Science*, 17 July 1987, p. 250). Most astronomers found these observations unconvincing. But other researchers saw evidence for asteroid companions closer to home: the three large impact craters on Earth that are paired with smaller craters, formed at the same time tens of kilometers away.

In 1991, Jay Melosh and John Stansberry of the University of Arizona argued that asteroids with moons were "the only rational explanation" for the craters. Their calculations demonstrated that even if Earth's gravity tore an approaching body in two, the pieces couldn't spread far enough apart to explain such crater pairs. Melosh and Stansberry concluded that from 10% to 20% of the kilometer-sized asteroids crossing Earth's orbit have well-separated satellites. Add the fact that it took only two tries to find a moon around an asteroid, and Galileo's discovery could well be the start of a baby boom.

–Richard A. Kerr

Additional Reading

H. J. Melosh and J. A. Stansberry, "Doublet Craters and the Tidal Disruption of Binary Asteroids," *Icarus* **94**, 171 (1991).