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.

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.

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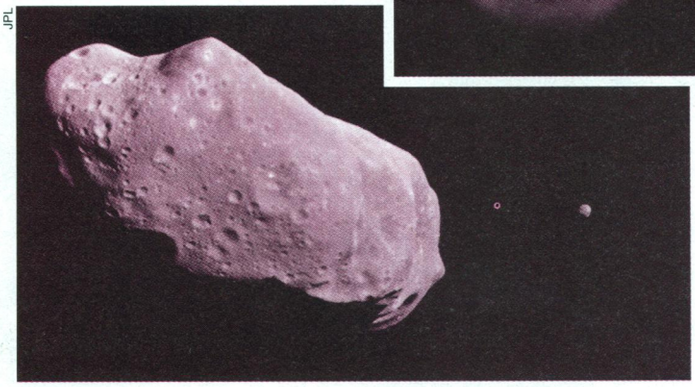

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New moon. Ida and its 1.5 kilometer companion *(enlarged at top)*, as seen by Galileo from a distance of 10,000 kilometers.

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).