Out of the ages. *Australopithecus sediba* makes its debut.

CREDIT: L. BERGER ET AL., *SCIENCE*

PALEOANTHROPOLOGY

Candidate Human Ancestor From South Africa Sparks Praise and Debate

"Dad, I found a fossil!"

Lee Berger glanced over at the rock his 9-year-old son, Matthew, was holding and figured the bone sticking out of it was probably that of an antelope, a common find in ancient South African rocks. But when Berger, a paleoanthropologist at the University of the Witwatersrand, Johannesburg, took a closer look, he recognized it as something vastly more important: the collar bone of an ancient hominin. Then he turned the block around and spotted a hominin lower jaw jutting out. "I couldn't believe it," he says.

Now on pages 195 and 205 of this issue of *Science*, Berger and his co-workers claim that these specimens, along with numerous other fossils found since 2008 in Malapa cave north of Johannesburg and dated as early as 2 million years ago, are those of a new species dubbed *Australopithecus sediba*. *Sediba* means "wellspring" in the Sesotho language, and Berger's team argues that the fossils have a mix of primitive features typical of australopithecines and more advanced characteristics typical of later humans. Thus, the team says, the new species may be the best candidate yet for the immediate ancestor of our genus, *Homo*.

That last claim is a big one, and few scientists are ready to believe it themselves just yet. But whether the new hominins are *Homo* ancestors or a side branch of late-surviving australopithecines, researchers agree that because of their completeness—including a skull and many postcranial bones—the fossils offer vital new clues to a murky area in human evolution. "This is a really remarkable find," says paleontologist Meave Leakey of the National Museums of Kenya in Nairobi, who thinks it's an australopithecine. "Very lovely specimens," says biological anthropologist William Kimbel of Arizona State University (ASU), Tempe, who thinks they are *Homo*.

Such different views of how to classify these fossils reflect a still-emerging debate over whether they are part of our own lineage or belong to a southern African side branch. The oldest *Homo* specimens are scrappy and enigmatic, leaving researchers unsure about the evolutionary steps between the australopithecines and *Homo*. Some think that the earliest fossils assigned to that genus, called *H. habilis* and *H. rudolfensis* and dated to as early as 2.3 million years ago, are really australopithecines. "The transition to *Homo* continues to be almost totally confusing," says paleoanthropologist Donald Johanson of ASU Tempe, who has seen the new fossils. So it is perhaps no surprise that the experts disagree over whether the new bones represent australopithecines or early *Homo*. And for now, at least, they don't seem to mind the uncertainty. "All new discoveries make things more confusing" at first, says anthropologist Susan Antón of New York University.

The finds stem from a project Berger embarked on in early 2008 with geologist Paul Dirks, now at James Cook University in Townsville, Australia, to identify new caves likely to hold hominin fossils. Malapa, just 15 kilometers northeast of famous hominin sites such as Sterkfontein, had been explored by lime miners in the early 20th century; they apparently threw the block that Matthew Berger found out of the cave. (Matthew was originally included as a co-author on one of the papers, but *Science*'s reviewers nixed that idea, Berger says.)

When Berger's team excavated inside the cave, it found more of that first individual, a nearly complete skull and a partial skeleton of a boy estimated to be 11 or 12 years old, plus an adult female skeleton, embedded in cave sediments. These fossils are reported in *Science*. The researchers also found bones of at least two other individuals, including an infant and another adult female, that are yet to be published.

Dirks enlisted several experts to help date the fossils. Labs in Bern, Switzerland, and Melbourne, Australia, independently performed uranium-lead radiometric dating, taken from cave deposits immediately below the fossils. They yielded dates of 2.024 million and 2.026 million years respectively, with maximum error margins of ±62,000 years. Paleomagnetic studies suggest that layers holding the fossils were deposited between 1.95 million and 1.78 million years ago, and animal bones found with the hominins were consistent with these dates.

The uranium-lead dating is "credible" and indicates that the fossils are no more than 2 million years old, says geochronologist Paul Renne of the Berkeley Geochronology Center in California, citing the strong reputations of the Bern and Melbourne groups. But Renne regards the paleomagnetic work, which relies on correctly identifying ancient polarity reversals in Earth's magnetic field, as less convincing. The cave's stratigraphy might not be complete enough to formally rule out a much younger paleomagnetic signal for the fossils, he says. Geochemist Henry Schwarcz of McMaster University in Hamilton, Canada, notes that the team suggests that the hominin bodies might have been moved by river flows after they fell into the cave from holes in the earth above. If so, the fossils may not be tightly associated with the dated deposits below and above them, Schwarcz says. But Dirks rejects that suggestion, pointing out that the bones were partly articulated with each other, implying that they were buried soon after death.

For now, many researchers are accepting the dates and moving on to consider the team's hypothesis that *A. sediba* represents a new species transitional between australopithecines and early *Homo*. That idea fits with Berger's long-held—and controversial—view that *A. africanus*, rather than the earlier species to which

"Lucy" belongs, *A. afarensis*, was the true ancestor of *Homo*. (Some of Berger's other past claims have sparked strong criticism, including a highly publicized 2008 report of small-bodied humans on Palau, which Berger thought might shed light on the tiny hobbits of Indonesia. But other researchers say the Palau bones belong to a normal-sized modern human population.)

The team's claims for *A. sediba* are based on its contention that the fossils have features found in both genera. On the australopithecine side, the hominin boy's brain, which the team thinks had reached at least 95% of adult size, is only about 420 cubic centimeters in volume, less than the smallest known *Homo* brain of about 510 cc. The small body size of both skeletons, a maximum of about 1.3 meters, is typical of australopithecines, as are the relatively long arms. The team says *A. sediba* most resembles *A. africanus*, which lived in South Africa between about 3.0 million and 2.4 million years ago and is the most likely ancestor for the new species.

Fossil finder. Nine-year-old Matthew Berger at the moment of discovery at Malapa cave.

CREDIT: LEE BERGER

But *A. sediba* differs from *A. africanus* in traits that also link it to *Homo*. Compared with other australopithecines, *A. sediba* has smaller teeth, less pronounced cheekbones, and a more prominent nose, as well as longer legs and changes in the pelvis similar to those seen in later *H. erectus*. This species, also known in Africa as *H. ergaster* and considered an ancestor of *H. sapiens*, first appears in Africa about 1.9 million years ago. Some features of *A. sediba*'s pelvis, such as the ischium (bottom portion), which is shorter than in australopithecines, "do look like they are tending more in a *Homo* direction," says Christopher Ruff, a biological anthropologist at Johns Hopkins Medical School in Baltimore, Maryland.

The claimed *Homo*-like features suggest to some people that the fossils belong in that genus rather than *Australopithecus*. "I would have been happier with a *Homo* designation," based on the small size of the teeth and also their detailed structure, such as the shape of their cusps, says Antón. "It's *Homo*," agrees Johanson, citing features such as the relative thinness of the hominin's lower jaw.

But others are unconvinced by the *Homo* argument. The characteristics shared by *A. sediba* and *Homo* are few and could be due to normal variation among australopithecines or because of the boy's juvenile status, argues Tim White, a paleoanthropologist at the University of California, Berkeley. These characters change as a hominin grows, and the features of a young australopithecine could mimic those of ancient adult humans. He and others, such as Ron Clarke of Witwatersrand, think the new fossils might represent a late-surviving version of *A. africanus* or a closely related sister species to it, and so will be chiefly informative about that lineage. "Given its late age and *Australopithecus*-grade anatomy, it contributes little to the understanding of the origin of genus *Homo*," says White.

Putting *A. sediba* into *Homo* would require "a major redefinition" of that genus, adds paleoanthropologist Chris Stringer of the Natural History Museum in London. At no earlier than 2 million years old, *A. sediba* is younger than *Homo*-looking fossils elsewhere in Africa, such as an upper jaw from Ethiopia and a lower jaw from Malawi, both dated to about 2.3 million years ago. Berger and his co-workers agree that the Malapa fossils themselves cannot be *Homo* ancestors but suggest that *A. sediba* could have arisen somewhat earlier, with the Malapa hominins being late-surviving members of the species.

The team thought long and hard about putting the fossils into *Homo* but decided that given the small brain and other features, the hominin was "australopithecine-grade," says team member Steven Churchill of Duke University in Durham, North Carolina. However they are classified, the Malapa finds "are important specimens in the conversation" about the origins of our genus, says Antón, and "will have to be considered in the solution."

–MICHAEL BALTER

ScienceNOW

From *Science*'s Online Daily News Site

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Using supercomputers and mind-bogglingly complex simulations, researchers have calculated the masses of particles called "up quarks" and "down quarks" that make up protons and neutrons with 20 times greater precision than the previous standard. The new numbers could be a boon to theorists trying to decipher particle collisions at atom smashers like Europe's Large Hadron Collider or trying to develop deeper theories of the structure of matter.
http://bit.ly/commonquark

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