# Sorting the Hominoid Bone Pile

**At a remarkable gathering at the American Museum of Natural History, a small group of anthropologists had a hands-on discussion of the ancestors of apes and human beings**

Less than 15 minutes after the start of an unusual workshop* at the American Museum of Natural History last weekend, anthropologist Meave Leakey sprang a surprise on the 21 paleontologists seated around a large conference table. She reached toward a metal tray and picked up a cast of a fossil jawbone with four teeth. The maxilla, she said, belonged to an extinct ape-like creature that lived in Kenya 27 million to 24 million years ago during the Oligocene epoch—making it the oldest example yet found of the Hominoids (the superfamily that includes humans, apes, and their many ancestors).

This fossil had been known for some time but had been associated with a more recent epoch. And that was the reason Leakey's announcement of a new date stunned her colleagues. "I'm speechless," exclaimed British Museum paleoanthropologist Peter Andrews, contradicting himself as he jumped up and reached across the table for the cast. "Leave it to a Leakey to spring a surprise." American Museum geologist John Van Couvering said enthusiastically: "That's really big news: There hasn't been an Oligocene hominoid found in Africa."

And that was just the beginning of a most unusual gathering. Paleoanthropologists meet as often as members of other disciplines, but when they do, it's usually to exchange opinions and conclusions rather than sit down together and examine the raw data of the field. But that's just what these anthropologists were doing. Stacked on the big table at which they were seated were trays of teeth, a few jaws, and one or two skulls. Their task was to sort through the bone pile in an attempt to puzzle out an evolutionary chronology for a key period in prehistory: the late Oligocene and the Miocene, stretching from 30 million to 5 million years ago. Somewhere in that pile of bones, they hoped to find clues to some key questions: What was the earliest hominoid? What ape-like creature was the last common ancestor of human beings, apes, and chimps? When did our own line diverge from the great apes?

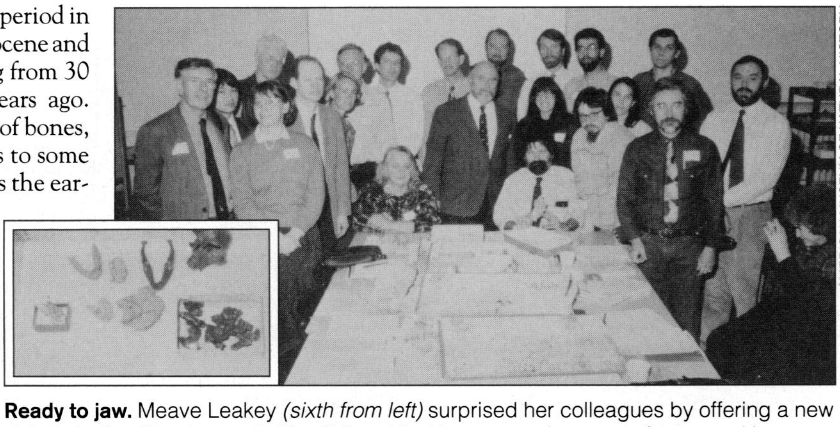
In an attempt to puzzle out those questions, the workshop brought together fossils from Africa, Asia, and Europe spanning almost 20 million years of evolutionary history. "Some of that material has been under lock and key since it was found," says Van Couvering. "One of the reasons for the workshop was that that was a way to get them out so people could get a look at them." Even after they looked, the 21 researchers (from as far away as Japan and Kenya) couldn't reach a consensus on those key questions. That's not surprising, given that they started with very different preconceptions and philosophies. But they did begin to sort out how their diverse fossils fit together.

**Monkey puzzle.** One key piece of the puzzle was Leakey's fossil, because the new date on that gives anthropologists the physical evidence they need to begin to solve the mystery of the first hominoid. That's partly because the jawbone falls right into a 10-million-year gap in the fossil record—from 32 million to 22 million years ago—that is of great interest because during this time the ancestors of apes and humans split off from the line leading to monkeys. The features of the jawbone are already beginning to help researchers get an idea of what that first hominoid looked like—probably more like an ape than a human, says Leakey.

The new dates come from the site where the specimen, which most closely resembles either *Xenopithecus* or *Proconsul*, was found: Losodok in Kenya. There, geologists Frank Brown and Brad Boschetto of the University of Utah and Ian McDougall of the Australian National University used potassium/argon dating on the basalts. The upshot, as Eric Delson, a paleoanthropologist at the City University of New York's Lehman College and the museum, puts it, was that the jaw can now be said to be "from the oldest hominoid found anywhere in the world." These dates provide the first physical evidence that the hominoids had already evolved in the late Oligocene, from 30 million to 23 million years ago.

While researchers have too few fossils from the Oligocene at this stage to draw a clear profile of the first hominoid, they have the opposite problem when they try to answer the second question posed at the workshop: Which of the many fossils from the Miocene period are ancestral to the modern great apes and humans? The hominoid whose jaw Leakey offered was followed in evolution by a spate of "middle-Miocene apes," which roamed Africa, Europe, and Asia between 16 million and 11 million years ago. Many were about the size of a 7-year-old child, with ape-like features such as pointy snouts and small brains. "These creatures are not like any living hominoid," says New Jersey Medical School anatomist Michael D. Rose. They are represented by dozens of specimens, including teeth, jaw fragments, and partial skulls found in eastern Africa (known as *Kenyapithecus* and *Afropithecus*); southwest and central Europe (known as *Dryopithecus*); Greece and East Asia (known as *Ouranopithecus* and *Graecopithecus*); the Middle East and Asia (known as *Sivapithecus*); and most recently in Namibia (where a newly discovered fossil is known as *Otavipithecus*—see *Science*, 20 March, p. 1506). "Only one of these things survived and went on to become African apes and humans," says Van Couvering.

But which one? When American Museum evolutionary biologist Ian Tattersall tried to pose an answer at the workshop, he met with tremendous resistance. Andrews of the British Museum had even drawn an ancestral tree of sorts, called a cladogram, to sort out relationships between



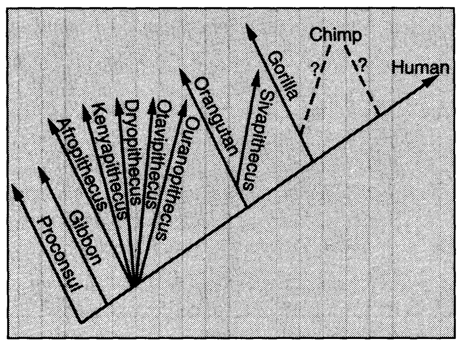
AMERICAN MUSEUM OF NATURAL HISTORY

**Ready to jaw.** Meave Leakey *(sixth from left)* surprised her colleagues by offering a new date for a fossil jawbone, making it the oldest known predecessor of apes and humans.

*"Apes or Ancestors?" 28 March in New York City, cosponsored by the American Museum of Natural History, the Leakey Foundation, and the Wenner-Gren Foundation.

these middle-Miocene species based on their common morphological features—but most participants at the workshop thought it was too early to pick the most promising candidate. And what's more, they wanted additional time to examine the fossils. "Putting cladograms up like this forces us to make decisions we can't make," complained Washington University Medical School paleoanthropologist Glenn C. Conroy.

Part of the problem that leads to Conroy's complaint is that there is another major gap in the fossil record in Africa just after the middle-Miocene apes lived: from 14 million to 4 million years ago. And that's just the time when one of these hominoids was diverging from the ancestors of African apes (including chimps and gorillas) to give rise to the group that includes humans and other extinct species of *Homo* and *Australopithecus*. Anthropologists covet fossils from this second major break in the fossil record—the so-called hominid gap—because they could provide the missing link between the hominoids and *Australopithecus afarensis*, which probably was ancestral to humans and extinct species.




**Early days?** Some researchers believe it's too soon for cladograms of hominoid descent, such as this one put forth at the workshop.

SOURCE: P. ANDREWS, E. DELSON A. HENRY

They may be missing from the fossil record in Africa, but late Miocene fossils are turning up in other parts of the world—such as northern Greece. That's where French paleontologist Louis de Bonis found a 10-million-year-old fossil face last year, one that he has named *Ouranopithecus macedoniensis*. At first, anthropologists thought that this species had traits that made it ancestral to orangutans. But now, an analysis of its small canines, thick tooth enamel, and other features prompts de Bonis to say it "would be possible" to consider it the sister group of hominids or their early forerunner. If he proves right, "it could be either the closest thing we know to a common ancestor to all living apes, including people, or it's already on the line leading to chimp, gorilla, and human," says Delson.

By the time the anthropologists were packing up their bones at the end of the day and planning to swap casts, it was clear they were reeling with the sense of the many ways it is possible to be a Miocene ape. While some professed to having a clearer understanding of the Miocene and a new glimpse of the late Oligocene, others said they had a new respect for the complexity of the period—and how difficult it would be to sort out the different species. Just one look at the fossils on the table made that apparent. As Johns Hopkins University anthropologist Pat Shipman says, "Boy, there are a million ways to be apes!"

**–Ann Gibbons**

CELL BIOLOGY

# How Cells Get Their Actin Together

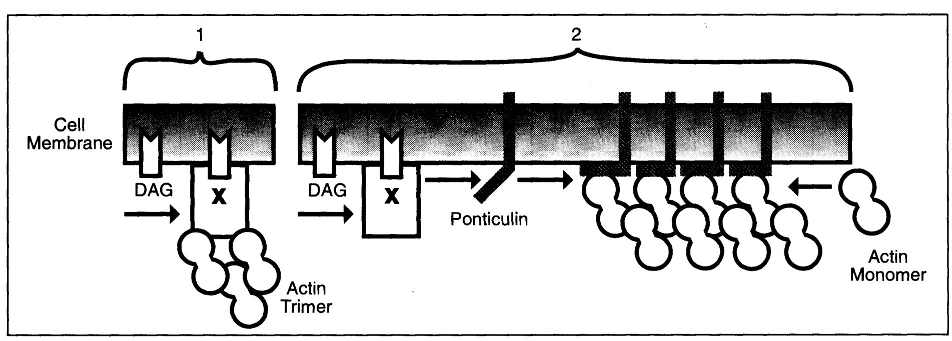
Cells are constantly on the move—white blood cells crawl at a snail's pace of millimeters per days; sperms cells can be virtual speed demons, whipping through their reproductive journey in under a day. But what makes these cells go? The closer scientists get to answering this "simple" question, the more they discover how exceedingly complex that answer will be—not to mention how important such an understanding would be to apparently mundane mysteries like how amoebas crawl and incredibly important ones like how cancer spreads and how healing cells rush to wounds.

For a privileged few cells, the answer to their mobility is easy of course. They have specialized parts like flagella or cilia to speed them about—sperm cells are an obvious example. The vast majority of mobile cells, however, simply crawl, thrusting out extensions called pseudopods, or "false feet," but no one knows precisely how. In recent years, cell biologists have determined that a protein called actin plays a crucial role in this cell movement. They've even figured out that the protein works by forming a skeleton of filaments inside each cell. But understanding how these actin assemblies form, much less what they can then do, has proved a Herculean task. By studying the cells of an organism more common to the forest floor than the lab bench, cell biologists Aneesa Shariff and Elizabeth Luna of the Worcester Foundation for Experimental Biology report, in this week's issue (p. 245), that they may have found important clues to the construction of these vital filaments.

Like other researchers seeking to understand the actin puzzle, Shariff and Luna have been trying to sort out the babble of chemical signals inside a cell that cause the individual protein molecules, called actin monomers, to arrange themselves into long filaments, a process known as polymerization. Scientists understand the physical processes by which actin comes together, but don't ask them how the cell directs the process. Says Sally Zigmond, a cell biologist at the University of Pennsylvania: "It's been extremely difficult to figure out anything about actin polymerization in cells."

That's ironic considering the abundance of actin in eukaryotic cells: Sometimes over 15% of a cell's total protein is made up of actin. But, at any given time, more than half of the actin inside a cell is not linked together in the polymerized form. Instead, it remains isolated as a monomer or forms small chains of monomers, in both cases "capped" by other proteins that bind to it. And as Thomas Pollard, a cell biologist at Johns Hopkins Medical School, explains: "To get from an actin monomer to an actin filament with hundreds of subunits is a complex, highly regulated process in the cell." Still, researchers are determined to map out that process, because the very act of assembling and disassembling these actin filaments may be how cells move. And that's where Shariff and Luna come in.

In their report, the two researchers suggest that a lipid molecule called diacylglycerol holds a key to polymerization. In a number of in vitro experiments with the cellular slime mold *Dictyostelium discoideum*, a slug-like or-




SOURCE: E. LUNA ILLUSTRATION: A. HENRY

**Forming filaments.** Two possible mechanisms for the diacylglycerol (DAG)-mediated regulation of actin assemble in *Dictyostelium* membranes. (1) Activation of an unknown peripheral protein (X) that directs the formation of trimeric actin nuclei. (2) Activation of X increases activity of ponticulin, a membrane protein that promotes actin nucleation.