# A Long-Lost Relative

## The oldest hominid skeleton ever discovered offers unexpected clues to what our even more ancient ancestors might have looked like

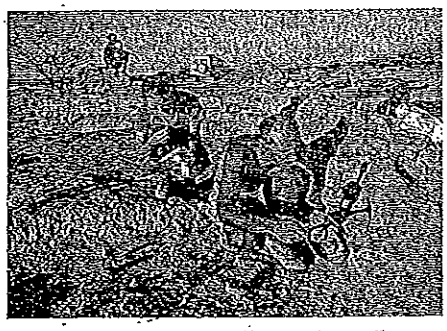
BY MICHAEL D. LEMONICK AND ANDREA DORFMAN

FIGURING OUT THE STORY OF HUman origins is like assembling a huge, complicated jigsaw puzzle that has lost most of its pieces. Many will never be found, and those that do turn up are sometimes hard to place. Every so often, though, fossil hunters stumble upon a discovery that fills in a big chunk of the puzzle all at once—and simultaneously reshapes the very picture they thought they were building.

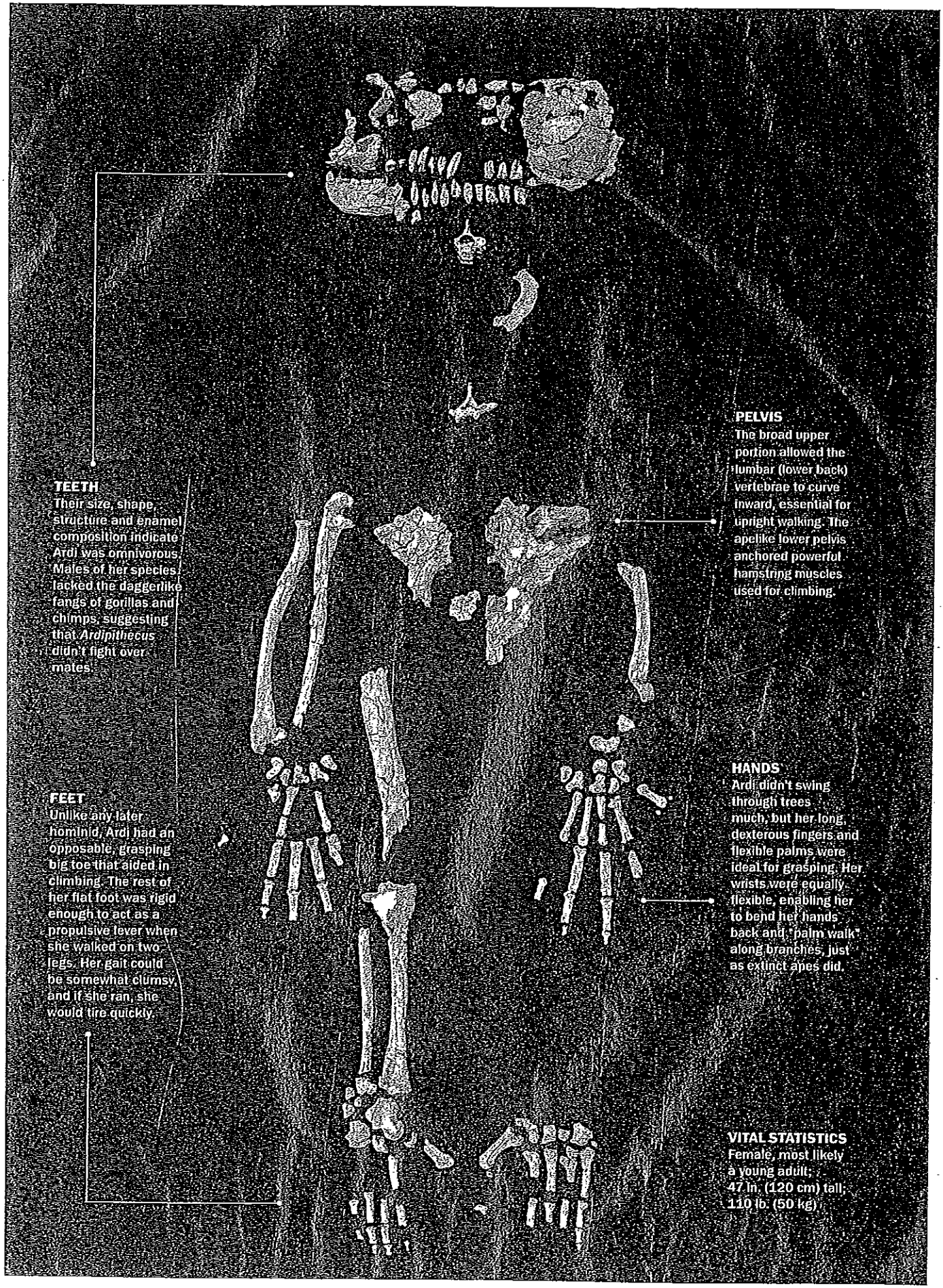
The path of just such a discovery began in November 1994 with the unearthing of two pieces of bone from the palm of a hominid hand in the dusty Middle Awash region of Ethiopia. Within weeks, more than 100 additional bone fragments were found during an intensive search-and-reconstruction effort that would go on for the next 15 years and culminate in a key piece of evolutionary evidence revealed this week: the 4.4 million–year–old skeleton of a likely human ancestor known as *Ardipithecus ramidus* (abbreviated *Ar. ramidus*).

In a series of studies published in the Oct. 2 special issue of *Science*—11 papers by a total of 47 authors from 10 countries—researchers unveiled Ardi, a 125-piece hominid skeleton that is 1.2 million years older than the celebrated Lucy *(Australopithecus afarensis)* and by far the oldest one ever found. Tim White of the University of California, Berkeley, a co-leader of the Middle Awash research team that discovered and studied the new fossils, says, "To understand the biology, the parts you really want are the skull and teeth, the pelvis, the limbs and the hands and the feet. And we have all of them."

That is the beauty of Ardi—good bones. The completeness of Ardi's remains, as well as the more than 150,000 plant and animal fossils collected from surrounding sediments of the same time period, has generated an unprecedented amount of intelligence about one of our earliest potential forebears. The skeleton allows scientists to compare *Ardipithecus* directly with Lucy's genus, *Australopithecus*, its probable descendant. Perhaps most important, Ardi



**Surveying** *Researchers collect ancient soil samples near the site where Ardi was found*



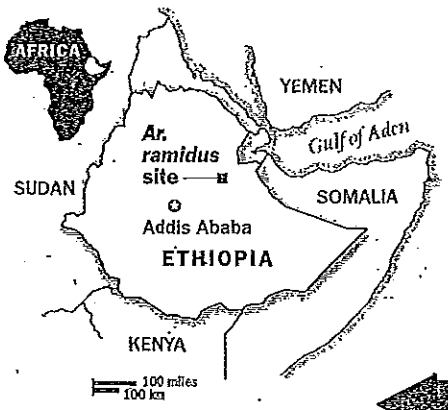
**TEETH**
Their size, shape, structure and enamel composition indicate Ardi was omnivorous. Males of her species lacked the daggerlike fangs of gorillas and chimps, suggesting that *Ardipithecus* didn't fight over mates.

**FEET**
Unlike any later hominid, Ardi had an opposable, grasping big toe that aided in climbing. The rest of her flat foot was rigid enough to act as a propulsive lever when she walked on two legs. Her gait could be somewhat clumsy, and if she ran, she would tire quickly.

**PELVIS**
The broad upper portion allowed the lumbar (lower back) vertebrae to curve inward, essential for upright walking. The apelike lower pelvis anchored powerful hamstring muscles used for climbing.

**HANDS**
Ardi didn't swing through trees much, but her long, dexterous fingers and flexible palms were ideal for grasping. Her wrists were equally flexible, enabling her to bend her hands back and "palm walk" along branches, just as extinct apes did.

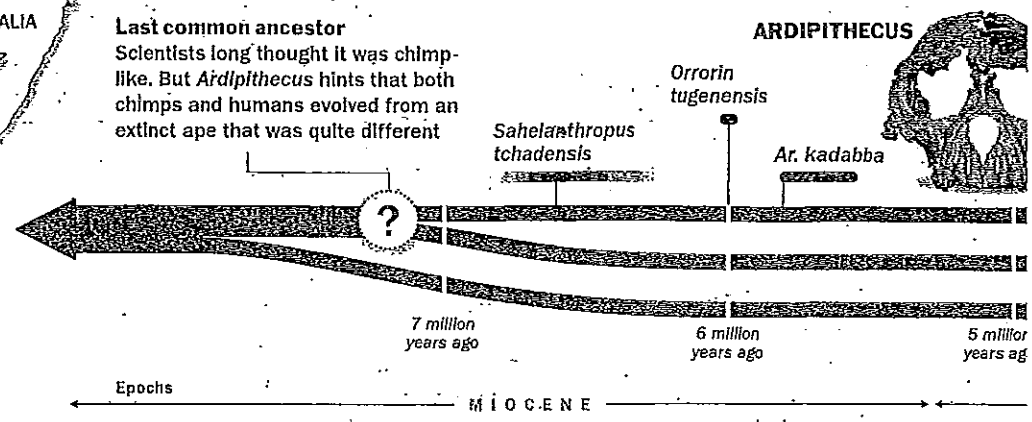
**VITAL STATISTICS**
Female, most likely a young adult; 47 in. (120 cm) tall; 110 lb. (50 kg)




Sources: Science; T.D. White, Cold Spring Harbor Symposia on Quantitative Biology, published online Sept. 23, 2009

## Filling In the Family Tree

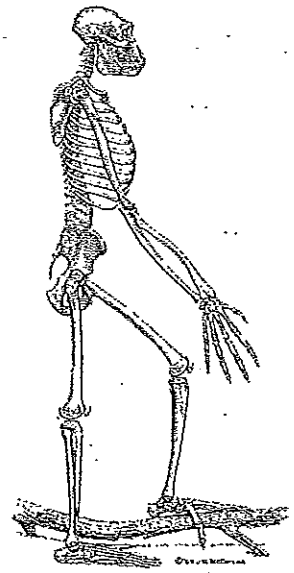
Anatomy and genetics point to a human-chimp split about 7 million years ago, long after other apes, like gorillas, had gone down their own evolutionary road. The human line spawned side branches, but only ours survived




provides clues to what the last common ancestor shared by humans and chimps might have looked like before their lineages diverged about 7 million years ago.

Ardi is the earliest and best-documented descendant of that common ancestor. But despite being "so close to the split," says White, the surprising thing is that she bears little resemblance to chimpanzees, our closest living primate relatives. The elusive common ancestor's bones have never been found, but scientists, working from the evidence available—especially analyses of *Australopithecus* and modern African apes—envisioned Great-Great-Grandpa to have looked most nearly like a knuckle-walking, tree-swinging ape. But "[Ardi is] not chimplike," according to White, which means that the last common ancestor probably wasn't either. "This skeleton flips our understanding of human evolution," says Kent State University anthropologist C. Owen Lovejoy, a member of the Middle Awash team. "It's clear that humans are not merely a slight modification of chimps, despite their genomic similarity."

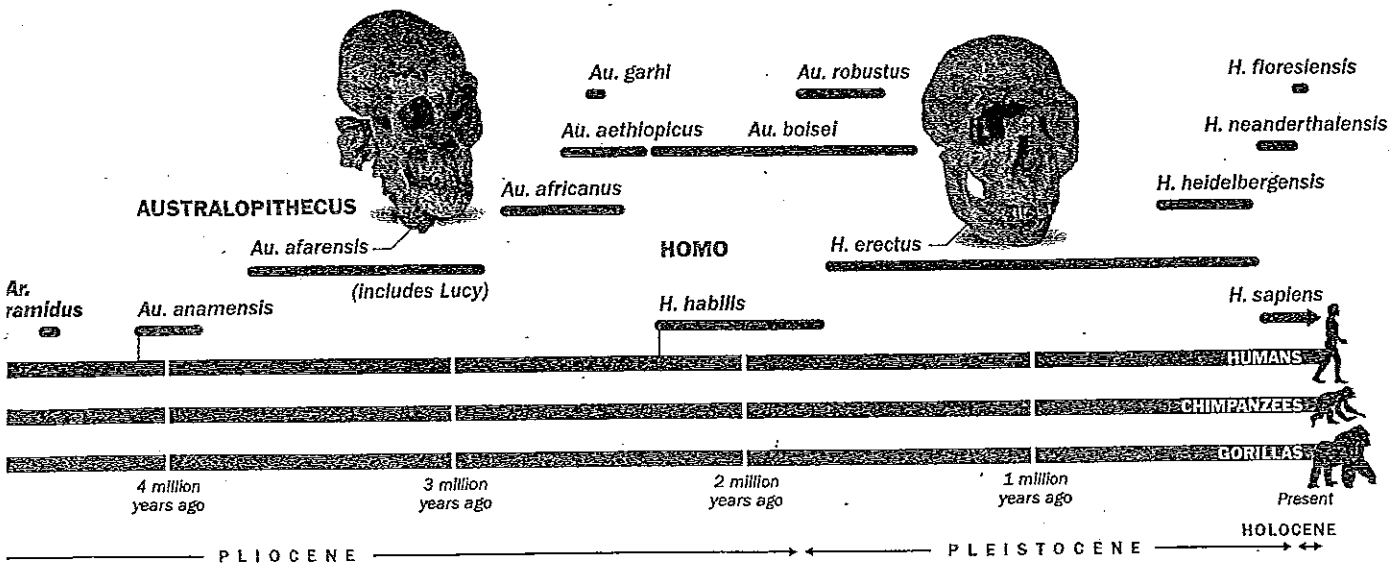
So what does that mean? Based on Ardi's anatomy, it appears that chimpanzees may actually have evolved *more* than humans—in the scientific sense of having changed more over the past 7 million years or so. That's not to say Ardi was more human-like than chimplike. White describes her as an "interesting mosaic" with certain uniquely human characteristics: bipedalism, for one. Ardi stood 47 in. (120 cm) tall and weighed about 110 lb. (50 kg), making her roughly twice as heavy as Lucy. The structure of Ardi's upper pelvis, leg bones and feet indicates she walked upright on the ground, while still retaining the ability to climb. Her foot had an opposable big toe for grasping tree limbs but lacked the flexibility that apes use to grab and scale tree trunks and vines ("Gorilla and chimp feet are almost like hands," says Lovejoy), nor did it have the arch that allowed *Australopithecus* and *Homo* to walk without lurching side to side. Ardi had a dexterous hand, more maneuverable than a chimp's, that made her better at catching things on the ground and carrying things while walking on two legs. Her wrist, hand and shoulder bones show that she wasn't a knuckle walker and didn't spend much time hanging or swinging ape-style in trees. Rather, she moved along branches using a primitive method of palm-walking typical of extinct apes. "[Ardi is] a lovely Darwinian creature," says Penn State paleoanthropologist Alan Walker, who was not involved in the discovery. "It has features that are intermediate between the last common ancestor and australopithecines."



**'The parts you want are the skull and teeth, the pelvis, the limbs and the hands and feet. And we have all of them.'**

—TIM WHITE, CO-LEADER OF THE MIDDLE AWASH TEAM

Scientists know this because they've studied not only Ardi's fossils but also 110 other remnants they uncovered, which belonged to at least 35 *Ar. ramidus* individuals. Combine those bones with the thousands of plant and animal fossils from the site and they get a remarkably clear picture of the habitat Ardi roamed some 200,000 generations ago. It was a grassy woodland with patches of denser forest and freshwater springs. Colobus monkeys chattered in the trees, while baboons, elephants, spiral-horned antelopes and hyenas roamed the terrain. Shrews, hares, porcupines and small carnivores scuttled in the underbrush. There were an assortment of bats and at least 29 species of birds, including peacocks, doves, lovebirds, swifts and owls. Buried in the Ethiopian sediments were hackberry seeds, fossilized palm wood and traces of pollen from fig trees, whose fruit the omnivorous *Ar. ramidus* undoubtedly ate.



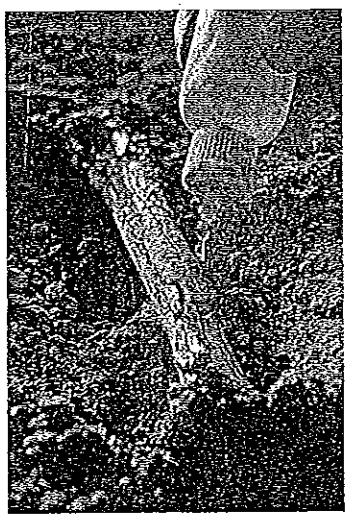

This tableau demolishes one aspect of what had been conventional evolutionary wisdom. Paleoanthropologists once thought that what got our ancestors walking on two legs in the first place was a change in climate that transformed African forest into savanna. In such an environment, goes the reasoning, upright-standing primates would have had the advantage over knuckle walkers because they could see over tall grasses to find food and avoid predators. The fact that Lucy's species sometimes lived in a more wooded environment began to undermine that theory. The fact that Ardi walked upright in a similar environment many hundreds of thousands of years earlier makes it clear that there must have been another reason.

No one knows what that reason was, but a theory about Ardi's social behavior may hold a clue. Lovejoy thinks *Ar. ramidus* had a social system found in no other primates except humans. Among gorillas and chimps, males viciously fight other males for the attention of females. But among *Ardipithecus*, says Lovejoy, males may have abandoned such competition, opting instead to pair-bond with females and stay together in order to rear their offspring (though not necessarily monogamously or for life). The evidence of this harmonious existence comes from, of all things, *Ardipithecus*' teeth: its canine teeth are relatively stubby compared with the sharp, dagger-like upper fangs that male chimps and gorillas use to do battle. "The male canine tooth," says Lovejoy, "is no longer projecting or sharp. It's no longer weaponry."

That suggests that females mated preferentially with smaller-fanged males. In order for females to have had so much power, Lovejoy argues, *Ar. ramidus* must have developed a social system in which males were cooperative. Males probably helped females, and their own offspring, by foraging for and sharing food, for example—a change in behavior that could help explain why bipedality arose. Carrying food is difficult in the woods, after all, if you can't free up your forelimbs by walking erect.

Deducing such details of social behavior is, admittedly, speculative—and several researchers are quick to note that some of the authors' other major conclusions need further discussion as well. One problem is that some portions of Ardi's skeleton were found crushed nearly to smithereens and needed extensive digital reconstruction. "Tim [White] showed me pictures of the pelvis in the ground, and it looked like an Irish stew," says Walker. Indeed, looking at the evidence, different paleoanthropologists may have different interpretations of how Ardi moved or what she reveals about the last common ancestor of humans and chimps.

But *Science* doesn't put out special issues very often, and the extraordinary number and variety of fossils described in these new papers mean that scientists are arguing over real evidence, not the usual single tooth here or bit of foot bone there. "When we started our work [in the Middle Awash]," says White, "the human fossil record went back to about 3.7 million years." Now scientists have a trove of information from an era some 700,000 years closer to the dawn of the human lineage. "This isn't just a skeleton," he says. "We've been able to put together a fantastic, high-resolution snapshot of a period that was a blank." The search for more pieces continues, but the outlines of the puzzle, at least, are coming into focus. ■



**Preservation** *Liquid adhesive helps keep fossils from crumbling*

**'It's clear that humans are not merely a slight modification of chimps, despite their genomic similarity.'**
—C. OWEN LOVEJOY, ANTHROPOLOGIST

CLOCKWISE FROM LEFT: J.H. MATTERNES; SCIENCE/AAAS; VILMI BISCHOF—AFP/GETTY; KIKE CALVO—AP; TIM D. WHITE