

# Out of Africa, a Missing Link

**Science:** The fossil of our unknown ancestor is what researchers expected. Its lessons aren't.

BY SHARON BEGLEY

**S**CIENTISTS DREAM OF DISCOVERING something that no one predicted, but *anyone* can make a splash with that sort of find. Anthropologists who study the origin of humans face a tougher challenge: to draw dramatic implications from the expected. Ever since the 1974 discovery in Ethiopia of the fossil of a little protohuman christened Lucy, it was clear what sort of human ancestor must have walked the Horn of Africa just before her: one that was more apelike. Last week, in the British journal *Nature*, three anthropologists announced what Tim White of the University of California, Berkeley, called "the oldest known link in the evolutionary chain that connects us to our common ancestor with the [apes]." The fossils look almost exactly as everyone expected. But their implications for human evolution are completely unexpected. For the new species suggests that, at the dawn of humanity, what made us become different from the apes was a better way of raising a family.

It started with a tooth. On Dec. 17, 1992, as Gen Suwa of the University of Tokyo walked across the badlands of Ethiopia in Aramis, 45 miles south of Lucy's resting place, a glint from the ground caught his eye. "I knew immediately that it was a hominid"—a humanlike primate, he says. "And because we had found other ancient animals that morning, I knew it was one of the oldest hominid teeth ever found." Over that winter and the next, the 20-person team uncovered additional specimens locked in 4.4 million-year-old sediment, coming up with teeth, arm bones and parts of a skull and jaw that turned out to belong to 17 individuals. To the scientists, they clearly represented a new species. White (codiscoverer of Lucy), Suwa and Berhane Asfaw of the Paleoanthropology Laboratory in Addis Ababa named it *Australopithecus ramidus*. *Australopithecus* means "southern ape"; *ramidus* means "root."

The diminutive creatures—adults would have weighed 65 pounds and stood four

feet tall—are so perfectly positioned between humans and apes that Darwin must be smiling in his crypt. Members of the new species, write its discoverers, "share a wide array of traits with *A. afarensis*"—Lucy. But *ramidus* lacked some of 3.2 million-year-old Lucy's definingly human characteristics. It had canine teeth comparable to ancestral apes', for instance, and an unmistakably chimpanzee-like skull. As paleoanthropologist Bernard Wood of the University of Liverpool puts it in an accompanying commentary in *Nature*, *ramidus* "lies [extremely] close to the divergence between the lineages leading to the African apes and modern humans . . . The metaphor of a 'missing link' has often been misused, but it is a suitable epithet for [this] hominid." Not that there was much doubt, but *ramidus* shows unequivocally that, as White says, "Darwin was right: humans evolved from an African ape."

More surprising is how recently that happened. Ever since Darwin, anthropologists have believed that the lineage leading to *Homo sapiens* and that leading to today's African apes were rooted in a common ancestor. For decades they believed that our



last common ancestor lived 15 million to 20 million years ago. But then molecular biologists horned in. They compared blood proteins in today's apes to blood proteins in humans, found them strikingly similar and in 1973 pronounced humans a lot closer to their simian cousins: the two lineages could not have split more than 4 million to

6 million years ago 5 million 4 million

## Roots of the Family Tree

The fossils just discovered in Ethiopia come from the oldest direct human ancestor known. The new species, *Australopithecus ramidus*, has features midway between apes and humans. It promises to provide clues to still earlier evolutionary stages.

HYPOTHESIZED COMMON ANCESTOR

Latest discovery:  
**Australopithecus ramidus**, 4.4 million years old

A. AFARENSIS

Molecular biology suggests the last common ancestor of humans and African apes lived 4-6 million years ago



Brain size: 400-500 ml  
Discovery: 1974  
Site: Hadar, Ethiopia  
Features: "Lucy." Fully upright, lived in family groups throughout eastern Africa.

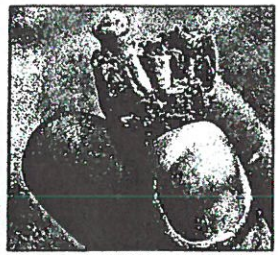


Brain size: 400-500 ml  
Discovery: 1924  
Site: Taung, South Africa  
Features: Long arms, light build; descendant of Lucy who lived in social groups.



DIXON ROHR - NEWSWEEK





**TIM WHITE - UC BERKELEY**  
**A glint on the ground:**  
*White and tribesman at Aramis, teeth and jawbone of ramidus child*

GEN SUWA - UNIVERSITY OF TOKYO  
 6 million years ago. (If they had, the proto-teins would have diverged more.) This became known as the "Eve" hypothesis, for the woman who would have been the first humanlike child of that common ancestor. Anthropologists told these interlopers to crawl back under the test tubes where they belonged. But virtually every recent fossil

find has put the naked ape and the hirsute one on ever-closer branches of the genealogy. Ramidus confirms once and for all that the common ancestor lived just a little more than 4.4 million years ago (chart). Humans are barely down from the trees.

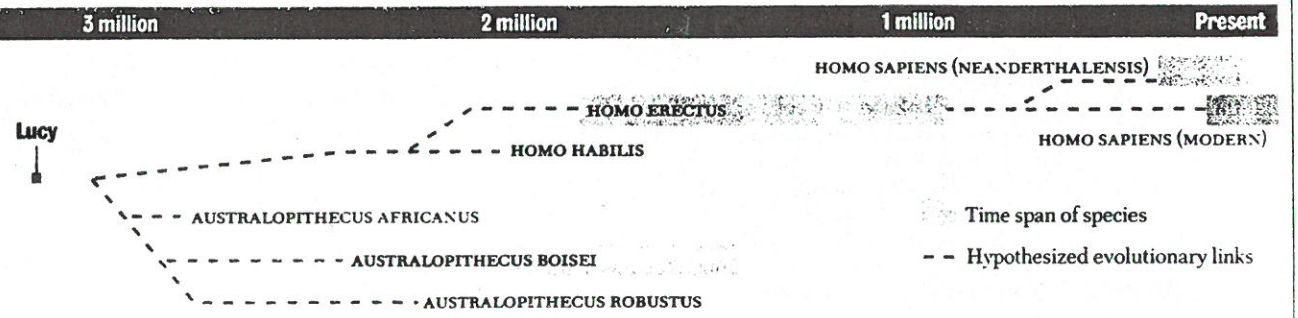
Now the question is, what brought them down? There is wide agreement that walking upright, on two feet, was the fateful change that spurred the evolution of humans. It made possible quintessentially human traits such as tool use (easier if you're not using knuckles to get around), a big brain (spurred by use of tools) and families (bipedalism allowed early humans to carry infants and food). Did ramidus walk upright? Although the fossil hunters have not yet found any hip or leg bones that would clinch the case, two other bones are suggestive. A forward opening for the spine at the base of the skull and canine teeth smaller than apes' are both typical of later creatures that walked on two feet. Moreover, ramidus's arm wasn't built for swinging through trees.

If it turns out that ramidus walked upright, then the implications for human evolution will be dramatic. Aramis was a thickly wooded flood plain 4.4 million years ago, filled with the chatter of colobine monkeys, prowling saber-toothed cats, browsing kudu, pigs and bears. (The habitat may explain why humanlike fossils older than 4 million years are so rare: in a woodland, acid from vegetation destroys bones before they fossilize.) But the conventional wisdom holds that our ancestors did not walk upright—and thus take the first steps toward becoming fully human—until climate

change turned forests into savannas. On these vast grasslands, say textbooks, natural selection favored creatures that could get around other than by swinging from vines. But there's a rogue view, too. "I have argued that bipedalism could only have evolved in a protected environment, like a woodland, not an exposed one," says anatomist Owen Lovejoy of Kent State University. "On a savanna, a creature just learning to walk, and therefore very slow, would have been exposed to predators."

**Sharp teeth:** Since learning to walk in a carnivore-filled forest is not exactly a prescription for longevity, ramidus must have derived a different advantage from the new posture. A clue to what that might be lies in its teeth. "In apes, the sharp projecting canine teeth are used as weapons of threat and display," explains White. But ramidus had low canines that wouldn't have frightened a kudu. So females must not have chosen mates based on how convincingly they bared their teeth at rivals, argues Lovejoy. Instead, females sought out mates who could help care for offspring; the best caregivers may well have been those who walked upright, using their hands to carry food and infants. According to natural selection, protohumans that became bipedal would have been more apt to mate, launching their genes for that trait into the next generation. "Lately, people have claimed some pretty bizarre reasons for walking upright, such as reducing exposure to solar radiation," says Lovejoy. "This discovery promises to wipe such claims off the slate."

The fossil hunters are returning to the field in November. If further finds confirm that our oldest direct ancestor learned to walk in the primeval forest, it will push to center stage a very '90s notion: the crucial spur toward becoming human was changing from a tooth-baring aggressive ape to one that carried home dinner and helped raise the kids.



**Brain size:** 530 ml  
**Discovery:** 1938  
**Site:** Kromdraai S. Africa  
**Features:** Brawnier cousin of africanus; left no descendants.



**Brain size:** 600-800 ml  
**Discovery:** 1960  
**Site:** Olduvai Gorge, Tanzania  
**Features:** First known species in the "Homo" family of humans; first tool user.



**Homo erectus**  
**Brain size:** 750-1,250 ml  
**Discovery:** 1891  
**Site:** Trinil, Java  
**Features:** First species to move out of Africa, colonizing the Middle East and to China.



**Homo sapiens (modern)**  
**Brain size:** 1,200-1,700 ml  
**Discovery:** 1868  
**Site:** Cro-Magnon, France  
**Features:** Ponders its origins and evolution.

SOURCE: UNIVERSITY OF CALIFORNIA, BERKELEY



# The 3 Million-Year-Old Man

**Science:** A skull of the human family's oldest known member answers some evolutionary questions

**S**AY WHAT THEY WILL ABOUT THE IMPORTANCE of brains in research, in anthropology there's no substitute for sharp eyes and an easily stubbed toe. One afternoon in 1992, while a team of scientists laboriously sieved soil in the harshly beautiful Ethiopian valley, their Afar-tribe assistants combed a nearby hill. Suddenly, one of the Afar appeared on the crest waving and shouting. The histrionics meant only one thing: he had stumbled upon the grayish-white jawbone of a hominid, an almost-human of whom we are the direct descendants. It took an additional 20 months to excavate and piece together what turned out to be more than 200 rock-frosted fragments, but the anthropologists are finally announcing what inspired the euphoria: the first skull of the oldest known member of the human family. The fossil, predicts paleontologist Leslie Aiello of University College, London, could help "settle some of the most heated controversies surrounding... the human lineage."

One of those debates has been just how many roots anchor our family tree. The new fossil belongs to the same species as 3.18 million-year-old Lucy, the slender little female discovered a mile away in 1974. Called *Australopithecus afarensis*, she was the first of what now amounts to more than 300 fossils from 75 individuals. But the skeletons seem so different—some as lithe as a ballerina and others as brawny as a fullback, some that seemed like simian tree climbers and others that walked fully erect—that some scientists argued they represent two species. The latest find—call him *Son of Lucy*—supports the notion that these fossils, 3 million to 3.9 million years old, are all *afarensis*, argue the anthropologists in the current issue of the journal *Nature*. It was the first species to evolve after the human and ape lineages split. By the evidence of their teeth, *afarensis* ate fruit, insects and small animals. They left no tools but may have used sticks as today's chimps do to scoop termites out of nests.

*Son of Lucy* should also resolve what *afarensis* looked like and how they got around. He has a protruding jaw, thick brow ridges and a braincase so small it leaves no doubt that our ancestors learned to walk long before they mastered complex thought. The women topped out at four feet and 75 pounds, but their consorts grew to five feet and 100 pounds. And the arm bones of the

new 3 million-year-old man suggest *afarensis* was as comfortable scrambling around trees as walking upright on the ground.

The new fossil is startlingly similar to the oldest *afarensis*. For almost 1 million years *afarensis* hardly changed, says Donald Johanson of the Institute of Human Origins, codiscoverer of Lucy as well as the new fossil. "Afarensis was a very flexible spe-

cies," adds IHO paleontologist William Kimbel. "Even as the local climate changed from humid to arid and back—a change that made other animals go extinct—this little hominid adapted by learning how to use the new flora." Yet in the blink of an evolutionary eye, 3 million years ago, *afarensis* gave rise to no fewer than five branches of the human family tree. Two led to brainy, tool-using *Homo*: three, to brawny australopithecines that went extinct (diagram). When the IHO scientists return to Ethiopia this year, they hope to stub a toe on a human fossil from 2.5 million to 3 million years old. Such a find could fill in the gap between *afarensis* and the first *Homo* species. Get ready for Lucy's grandchild.

SHARON BEGLIA



Homo neanderthalensis



Homo sapiens



Homo erectus



Homo habilis



Homo rudolfensis



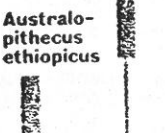
Australopithecus africanus



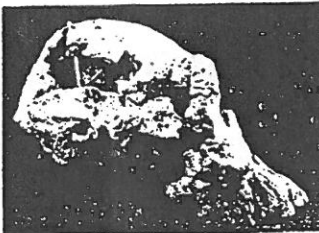
Australopithecus boisei



Australopithecus robustus



Australopithecus ethiopicus



New skull



Lucy

Earliest known Australopithecus afarensis



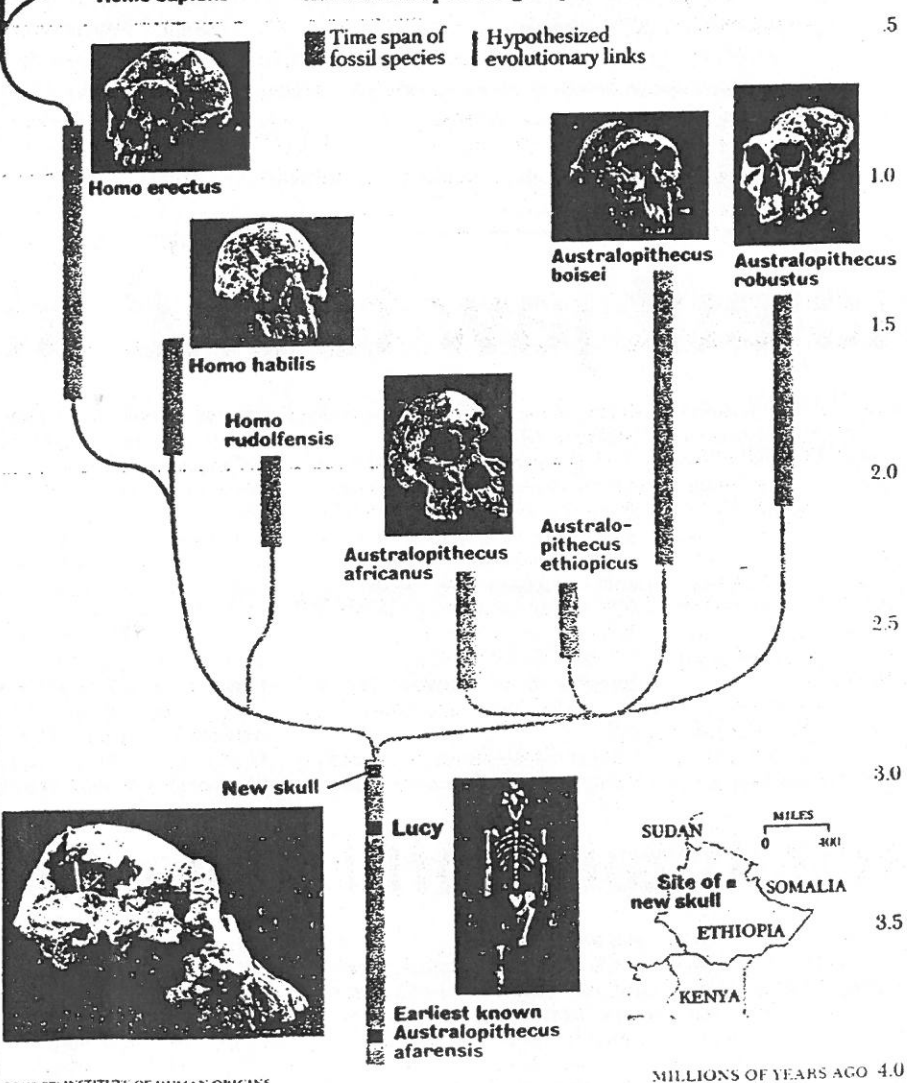
Site of a new skull

MILLIONS OF YEARS AGO 4.0

## Out of Africa

A new skull discovered in Ethiopia strongly suggests the human family tree has one root: the species *Australopithecus afarensis*, which lived just after the human and ape lineages split.

Time span of fossil species | Hypothesized evolutionary links



SOURCE: INSTITUTE OF HUMAN ORIGINS ROHR—NEWSEK

PHOTOS FROM TOP TO BOTTOM: DAVIDE BRILL / INSTITUTE OF HUMAN ORIGINS



# THE 444 SKULL

Every time an early human fossil is discovered on a Johanson expedition, Tel Aviv University paleontologist Yoel Rak turns up his portable stereo and blasts the camp with a recording of Beethoven's Ninth Symphony. And that is just how Johanson first learned that Rak himself had made an important new find: a nearly complete skull of *Australopithecus afarensis*, humanity's earliest ancestor.

It took weeks of arduous work to clean, identify, and glue all the hundreds of skull pieces that Rak had found, the barest slivers of bone proving sometimes crucial to the reconstruction. The result was the 444 skull (named for the number of the Hadar fossil site where it was found) from a large male who died in his thirties some 3 million years ago. That makes 444 about 200,000 years younger than his older "sister," Lucy, the most famous member of this species.

Scientists have had fragments of *afarensis* skulls before, but this specimen is 75 to 80 percent complete, with upper and lower jaws, a number of teeth, much of the face, and the top, back, and bottom of the skull all remaining. "It has very pronounced markings for substantial



chewing muscles that we had no evidence of before," says Johanson, "and a number of teeth are worn down so heavily—right down to the dentine—that it suggests he was eating very tough, fibrous foods—that *afarensis* was mostly a plant eater."

On first appearance, 444 is a massive skull, but it still has the small, ape-like brain characteristic of *afarensis*. Johanson fears, however, that its special combination of features may once again generate intense debate as to the real position of this species on the family tree. "Some people may pick up on the enormous face, the large flaring cheekbones, and the bone shelf that

reflects the massive size of the chewing muscles," he says, "and view these traits in isolation. They may suggest they are typical of only the robust branch of the human family [that died out] and not the one that led to man." But Johanson points to the fact that a number of later skulls on the *Homo* side of the family—the one that did evolve into human beings—also have massive faces and considerable muscle markings. "We still feel comfortable," he says, "seeing *afarensis* as the trunk of the human tree."—Sharon McAuliffe

## Ancient jaw found at new site

NEW YORK (AP) — Scientists have found a 2.4-million-year-old jaw from a close cousin of modern humans outside of the well-known fossil sites of Africa, revealing a new place to seek remains of early human ancestors.

The jaw is one of only two known specimens thought to be as old from the evolutionary group called *Homo*, which includes modern people, *homo sapiens*.

The fossil was found near the western shore of Lake Malawi in Malawi. The area lies between the well-known sites for fossils of early

human predecessors in eastern and southern Africa.

The bone belonged to *Homo rudolfensis*, researchers from Germany, Malawi and Hunter College in New York write in the journal *Nature*.

Study co-author Tim Bromage of Hunter College said *Homo rudolfensis* may have arisen in Africa's Rift Valley, which stretches from Ethiopia to Mozambique, partly in response to an unusually cool and dry period some 2.5 million years ago.

Other predecessors of the human lineage also may have originated in

that area, he said. But while *Homo rudolfensis* stayed put, the others migrated to southern Africa only during warmer periods, he suggested.

The other fossil dated at 2.4 million years and attributed to early *Homo* is eight-centimetre scrap of skull bone found in Kenya.

*Homo rudolfensis* had a brain about half the size of that of modern humans, as well as more powerful jaws and bigger teeth than modern humans have, Bromage said. Its existence as a distinct species has been proposed only recently, and

the new finding gives added weight to that classification, Bromage said.

Scientists have not yet addressed whether *Homo rudolfensis* made stone tools, he said. *Homo habilis*, which is known from about two million years ago, is generally considered the first tool-maker, he said.

Eric Delson, an anthropologist at Lehman College of City University of New York, said the report is important because it revealed a new area to look for remains of early *Homo*, and because it and the Kenyan fossil support each other's claim to be remains of early *Homo*.

## Pluto's bizarre orbit linked to past events

NEW YORK (AP) — What made Pluto's orbit so bizarre? A U.S. scientist is proposing it was a gravitational dance with Neptune back when the solar system was still forming.

Neptune could have pulled Pluto out of a fairly circular orbit and put it into the more egg-shaped path it follows today, the scientist says in

her study.

Pluto's orbit is unusual because the other known planets follow almost circular paths. Pluto's path is so distorted that although it is the outermost planet for most of its 248-year journey around the sun, it periodically cuts inside of Neptune's orbit before going back out again.

Collisions are avoided because the

two planets orbit in a lockstep that keeps them away from each other.

Pluto's orbit is also unusual in that it is markedly tilted compared with the orbits of the other planets.

The reason for Pluto's orbit has long been a mystery. Some have suggested Pluto is an escaped moon of Neptune, or that it alone survived while many similar objects were de-

stroyed or hurled away by Neptune's gravity.

The latest proposal is presented in the journal *Nature* by Renu Malhotra of the Lunar and Planetary Institute in Houston.

"I'd say it looks pretty good," commented Scott Tremaine, a professor of physics and astronomy at the University of Toronto.



BACKGROUND INFORMATION: In 1959, Mary and Louis Leakey found a hominoid skull in the Olduvai Gorge in Tanzania, East Africa. They named their discovery Zinjanthropus man, claiming that he was over 600,000 years old and was a bridge between homo sapiens and ancient premen types previously discovered in South Africa. Their find was a remarkable one, but their immediate observations concerning it were not quite correct. Zinjanthropus man proved to be far older than the Leakeys thought him to be; he is no longer believed to be a link between homo sapiens and premen. According to the potassium-argon process of dating, Zinjanthropus is about 1,750,000 years of age. Since he was found, the Leakeys have discovered remains of other, more ancient hominoid types.

The Olduvai Gorge, where the Leakeys have worked since the early 1930's, is rich with the remains of prehistoric men and animals. Over two million years ago it was the site of a lake; then, in time, it became a desert; later, some 400,000 years ago, it became a swamp. Today, after many climatic changes and volcanic upheavals, it is a gorge set in the semiarid plain of western Tanzania. When it was a lake, prehistoric men and animals gathered along its shore line and left their remains which are being studied by the Leakeys today.

Besides Zinjanthropus, other hominoids found by the Leakeys at Olduvai include *homo erectus*, living over 500,000 years ago and similar to types found in Java and China, and *homo habilis* dating back almost 1,800,000 years ago. It is Dr. Leakey's belief that Zinjanthropus and *homo erectus* do not figure in man's development and are evolutionary dead ends. Quite possibly, according to Dr. Leakey, it is *homo habilis* that is heading towards modern man. Much work remains to be done in this field.

The Olduvai Gorge has produced the remains of many ancient, extinct animal types. Many animals that lived by the old lake were gargantuan in size; for example, remains have been found of a pig as big as a rhinoceros, pelorovis, a six-foot sheep having a horn span of four or five yards, a giant baboon larger than a gorilla, and a giant ostrich-like bird that stood over twelve feet high. Perhaps one of the most interesting animal finds made at Olduvai was the remains of a dinotherium, an elephant-like creature living 400,000 years ago whose tusks grew down from its lower jaw rather than up, as in the case of mammoths or present day elephants.

Almost too modern to mention is a prehistoric rhinoceros that roamed the earth some 200,000 years ago. Its skull was twice the size of the present day black rhino.

The Leakeys have only scratched the surface in the Olduvai Gorge. There are undoubtedly many prehistoric relics, human and animal, waiting to be discovered.



# Archaeologists trading whisk brooms for lasers

By JOSEPH B. VERRENGIA  
Of The Associated Press

When British archaeologist Howard Carter unearthed King Tutankhamen's tomb in 1922, he revealed history's most dazzling cache of artifacts using tools found in any gardener's shed — trowels, a fine screen to sift tonnes of Sahara sand and wheelbarrows to cart off golden loot.

As the millennium turns, researchers in Egypt's Valley of the Kings and thousands of other archaeological sites worldwide still lay bare the bones of lost civilizations using the most humble of household utensils.

But the Victorian image of a linen-suited scientist pursuing lost worlds with a whisk broom has been zapped into oblivion by lasers and particle accelerators. The search for ancient cultures now is an expensive, high-tech enterprise that borrows from space exploration, medical research and nuclear physics.

Orbiting satellites use radar-like electronic machetes to "clear" the jungles that obscure long-buried cities and tombs. DNA analysis of mummies and skeletons determines family relationships and human migration patterns. And electron microscopes examine the silica skeletons of grain from humankind's first harvests.

"Men and women in white coats, tolling away in their laboratories, have become as important as rugged field workers slogging away under the hot sun," said Christopher Scarre of Cambridge University in England. "One day we may be able to excavate a site

without ever setting a spade to earth." Already, high-tech methods are revealing surprises, even at the most famous and well-documented sites.

Egypt's pyramids director, Zahi Hawass, believes conventional digging has uncovered only 20 per cent of his nation's ancient monuments. Now the work Carter made famous is being accelerated by remote sensing.

In the Nile Delta, French marine archaeologist Franck Goddio is using the global satellite navigation system to map Cleopatra's palace, submerged beneath Alexandria's murky port. Nearly 2,000 years after her suicide by snakebite, authorities hope to reopen the site as an underwater park.

In nearby waters, Goddio also has found Napoleon's flagship and other vessels destroyed in 1798 by British Admiral Horatio Nelson.

At the Giza Plateau, archaeologists are using remote sensing and animation graphics to map the vast public works system that supported the Pyramids' construction by 20,000 labourers more than 4,000 years ago.

Pyramid workers typically died in their 30s, two decades earlier than royalty. Many suffered from spinal trauma, broken bones and amputations. Some had syphilis. How do we know? Genetic analysis and CT scans.

In Peru, U.S. pathologists using CT scans determined that the Ice Maiden, a mummy of an Inca girl, died of a blow to the head as a human sacrifice 500 years ago, rather than freezing to death as was initially surmised.

At Angkor in Cambodia, NASA researchers using a synthetic aperture radar mounted on a DC-8 are mapping 1,000 temples obscured by the dense forest canopy, as well as a network of now-dry canals and reservoirs. In AD 1100, the images suggest, Angkor may have been the world's largest city, with one million people.

Halfway around the world in the Valley of Mexico, different technologies are peeling back the past.

Later this year, researchers expect to pierce the core of the massive Pyramid of the Moon, perhaps revealing the contents of a royal tomb that has lain undisturbed since it was sealed 2,000 years ago.

This part of the job remains slow and dirty. Blame it on the architecture. At Teotihuacan, just north of Mexico City, AD first-century pyramids are built more like a huge Tootsie Pop with layers of unstable rubble covering a deeply buried tomb.

Burrowing into the Moon temple, archaeologists can hear the footsteps of tourists ascending the same impossibly steep stairs once climbed by astronomer-priests and their unlucky sacrificial victims.

"We might find Tutankhamen of the West," said forensic anthropologist Michael Spence of the University of

Western Ontario in London, Ont. "Or, we might find nothing."

At the far end of Teotihuacan's crepe Avenue of the Dead, researchers have reassembled the remains of 200 people sacrificed during the city's zenith in AD 200 at the Temple of the Feathered Serpent, or Quetzalcoatl.

Spence and others are applying crime lab methods to preserved biological evidence — DNA, bone isotopes and skeletal traits — to reconstruct the story behind this ancient mass grave.

Many victims have bound hands. But none show broken ribs that might confirm historical accounts of gladiatorial hearts being ripped from chests in homage to the gods. "We think they were buried alive," Spence said.

One doomed young man tried to kick his way to freedom. Discovering his 1,800-year-old agony was underway.

"Sometimes at night, when you think about what you've done and seen, it gets kind of spooky," Spence said. "You hear the echoes of some long-past grief."

Of course, not every ruin needs lasers, robots or satellites. Consider Stonehenge, the ring of stone pillars that has brooded over Salisbury Plain in England for 5,000 years.

Aubrey Burl, a British authority on

stone circles, recently abandoned a life-long index card system for a personal computer. In minutes, he was able to compare 1,300 sites throughout the British Isles and northern France.

Burl's new book, *Great Stone Circles*, has had news for the cloaked druids, naked nature-lovers and day-tripping tourists who flock to the megalith.

Bravely sky-worshipping ancestors of modern Britons are widely thought to have hauled its massive stones hundreds of kilometres from Wales, then erected them to precisely intersect with the seasonal journeys of the sun and moon. A "lovely story," Burl sniffed. But look again.

Stonehenge is not really a circle at all, he said. And, almost certainly its blocks are leftovers from the Ice Age that Neolithic engineers prised from nearby fields.

Moreover, Stonehenge's shape and carvings are similar to those found in Brittany, the western province of modern-day France, Burl added.

Stonehenge is French? "I won't say Stonehenge is a mongrel, but it certainly is a hybrid," Burl said. "The entire design is foreign. It is a paradox of construction and nationality." In other words, still a bit of a mystery.