Lucy's New Kin Take a Powerful Stand

In the mid-1970s, excavations at Hadar in Ethiopia and Laetoli in Tanzania turned up the 3- to 3.6-million-year-old remains of Lucy and her kin, the earliest known hominids, or members of the human evolutionary family. The first major discovery since then of fossils belonging to Lucy's species, *Australopithecus afarensis,* fleshes out an intriguing picture of our ancient ancestors: brawny creatures of both sexes who largely abandoned the trees in favor of efficient, two-legged walking and successful adaptation to diverse surroundings, from dry savannas to wooded lakeside locales.

"These early hominids attached themselves to a variety of ecologies," asserts Tim D. White, an anthropologist at the University of California, Berkeley. "I suspect they lived all over the place in Africa."

White directed the fall 1990 excavations that uncovered the new *A. afarensis* specimens at an Ethiopian site called Maka, about 30 miles south of Hadar. He also took part in many of the earlier discoveries of Lucy's kin.

An analysis of the fossils unearthed in 1990, published in the Nov. 18 NATURE, supports the view that *A. afarensis* specimens compose one species — rather than two, as argued by some researchers — that retained the same basic skeletal anatomy for at least 500,000 years.

Maka hominid finds include a nearly complete jaw containing most of its teeth, much of an upper-arm bone, a partial lower-arm bone, two partial jaws, and several isolated teeth. Excavations also yielded more than 100 fossils of other animals, such as baboons, antelope, elephants, and crocodiles.

Contamination of volcanic ash at Maka prevents direct dating of the remains, White notes. But the chemical composition of hominid-bearing sand and gravel matches that of soil at a nearby archaeological site dated at 3.4 million years old, he says. Moreover, both sites contain the same types of nonhuman animals, the Berkeley anthropologist says.

A. afarensis individuals varied greatly in size, according to White. Hominid teeth found at Maka span the range of known sizes for *A. afarensis.* And while the lower-arm bone corresponds to Lucy's relatively small arm, the upper-arm fossil comes from a larger, male hominid, White contends. Computer simulations of *A. afarensis* bodies generated by C. Owen Lovejoy of Kent (Ohio) State University on the basis of fossil data from Maka and elsewhere also suggest that both male and female *A. afarensis* came in a variety of sizes.

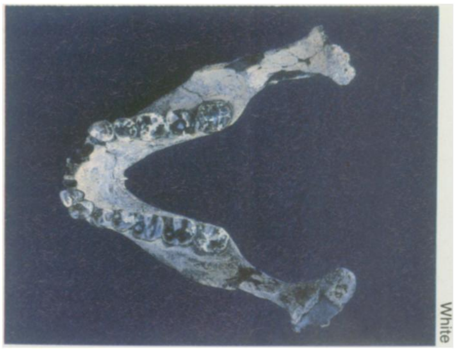
The thickness of the upper-arm bone and its deep pits for muscle attachments denote a creature of great strength. However, the bone's short length contrasts with the long limbs of tree-dwelling apes such as orangutans, White holds.

"These were muscular, burly hominids, much stronger than modern humans," remarks Steve Ward, an anthropologist at Northeastern Ohio University College of Medicine in Rootstown, who has examined the Maka fossils. "They didn't spend more than a passing amount of time in the trees."

An upper-leg bone found at Maka about 10 years ago also shows a hip attachment specialized for walking, adds Lovejoy.

These observations clash with the view that at least some of Lucy's kin spent a lot of time in the trees (SN: 7/2/83, p.8).

The Maka jaw belonged to a young adult male and closely resembles a partial jaw previously found at Laetoli, White asserts. Degeneration of the bone at the two points where it connected to the skull provides the earliest evidence of temporomandibular joint disease in hominids, he notes. *— B. Bower*


White

New hominid jaw found in Ethiopia.

A close, cheap shave for heavy atoms

By stripping nearly all of the electrons from a heavy atom such as uranium, physicists can create a unique environment for studying interactions between atomic nuclei and electrons. The highly charged, heavy nuclei of the resulting ions exert such a strong electrical force on the few remaining electrons that subtle quantum and relativistic effects — normally barely detectable — are greatly amplified.

Researchers have usually generated such ions in particle accelerators or storage rings, in which beams of these highly charged ions circulate at high speeds (SN: 5/1/93, p.287). Now physicists have an alternative source. Recently completed, the high-energy electron-beam ion trap, dubbed SuperEBIT, at the Lawrence Livermore (Calif.) National Laboratory is the first small-scale, laboratory source of such ions.

In contrast to heavy-ion accelerators and storage rings, which cost hundreds of millions of dollars to build, the construction of the SuperEBIT apparatus required a "mere" $1.5 million, says Livermore's Peter Beiersdorfer. Moreover, because ions stored in SuperEBIT are practically stationary, researchers also avoid having to correct for relativistic effects caused by the motion of ions at close to the speed of light.

The apparatus has a chamber into which neutral atoms or ions having a small charge can be injected. When an intense electron beam, highly compressed by a magnetic field, passes through the chamber, it traps these atoms or ions, keeping them inside the beam. Beam electrons then strip electrons, one by one, from the ions or atoms present, leaving behind bare or nearly bare atomic nuclei.

In addition to plucking electrons from the ions in the chamber, the electron beam can also excite one or more of an ion's remaining electrons to higher energies. These excited electrons then emit X-rays to get rid of this excess energy. Ions can even capture beam electrons, a process that also generates X-rays of characteristic wavelengths.

"The beam does virtually all of the work," Beiersdorfer says. "It ionizes all the things that we put in, it electrostatically confines them, and it excites them."

In the first experiment involving SuperEBIT, Beiersdorfer and his co-workers monitored X-ray emissions from highly charged uranium ions having just three electrons (compared with 92 electrons in the neutral atom). By precisely measuring the wavelengths of these X-rays, the researchers could calculate a quantity known as the Lamb shift, a small change in atomic energy levels caused by interactions between electrons bound to a nucleus but still moving around.

The researchers found excellent agreement between their calculated value and theoretical predictions of the Lamb shift. They will publish their results in an upcoming PHYSICAL REVIEW LETTERS.

SuperEBIT may prove useful for a variety of atomic and plasma-physics studies. *— I. Peterson*