Anthropology

Bruce Bower reports from Toronto at the annual meeting of the American Association of Physical Anthropologists

Jawing with an ancient ape

A fossil jaw found on Maboko Island in western Kenya suggests that an ape-like creature that lived between 14 million and 16 million years ago was a close relative of the as-yet-unidentified common ancestor of modern apes and humans, according to the specimen's discoverers.

Monte L. McCrossin of the University of California, Berkeley, and Brenda R. Benefit of Southern Illinois University in Carbondale unearthed the lower jaw in 1988. Based on an analysis of the bone and the eight teeth it retains, they assign the fossil to the species *Kenyapithecus africanus*, previously known from fragmentary remains.

The presence of deciduous teeth, which fall out during dental development, indicates that the jaw belonged to a juvenile, perhaps 6 or 7 years old, McCrossin says.

Tooth shape and arrangement in the fossil resembles that of modern apes more than other groups of ancient apes from around the same time period, McCrossin asserts.

K. africanus displays a thick jaw that slants forward slightly, he points out. Large incisors at the front of the mouth jut out and apparently helped to crack open hard fruit and nuts before these foods were crushed and chewed by thickly enameled cheek teeth, according to McCrossin.

Excavations at Maboko last year uncovered several lower-body bones that probably belonged to a single *K. africanus*, Benefit says. Two fossils — the top of an upper-arm bone and the top of an upper-leg bone — fit neatly on the shafts of a *Kenyapithecus* arm and leg bone, respectively, collected at the same site in 1933 and now housed in Kenya, she adds.

These reunited fossils will greatly increase understanding of how *K. africanus* moved about, Benefit notes.

However, anthropologists have not established the evolutionary connections among *Kenyapithecus* and the more than 20 other ape-like genera that lived between 25 million and 5 million years ago, says Carol V. Ward of the University of Missouri in Columbia. Some of these groups probably developed similar skeletal traits in the absence of any ancestral links to each other, Ward holds, a process that throws a monkey wrench into current fossil comparisons.

An ancestor's unusual shape

In 1924, anthropologists working at the Sudanese site of Singa found the upper portion of a skull embedded in rock along the Nile River. Some investigators consider the Singa skull an example of an anatomically modern human ancestral to Khoisan hunter-gatherers still living in Africa. Others argue that the specimen represents a more primitive, or archaic, form of modern humans that lived around 100,000 years ago.

New evidence supports the latter view, reports Christopher B. Stringer of the Natural History Museum in London, England. Measurements of the Singa skull's shape more closely match those from archaic *Homo sapiens* fossils than those from anatomically modern humans, Stringer asserts. Preliminary efforts to date two animal teeth found in the same sediment as the Singa skull place them between 97,000 and 160,000 years old.

Some type of disease may have altered the shape of the Singa skull and thus misled earlier investigators, Stringer contends. The brain case appears low for an archaic human and shows significant widening toward the middle. Computed tomography (CT) scans reveal thickened bony tissue in central skull bones that may have contributed to the specimen's shape, he maintains.

The right side of the fossil sports a small hole where the bones of the middle ear normally lie, Stringer notes. He considers this an inborn defect.

"This fossil has unusual features, and we need to understand its pathologies much better," Stringer says.

Physics

Ivars Peterson reports from Washington, D.C., at an American Physical Society meeting

Physics in storage rings . . .

Strip all but one of the 92 electrons from a uranium atom and the result is a highly charged positive ion. Add an electron to a calcium atom and the result is a negative ion that barely holds on to its extra electron. Neither type of charged particle lasts long enough to be studied in typical laboratory settings.

Researchers can now investigate the characteristics of these particles by injecting streams of them into new, specially designed storage rings. Confined and focused by magnetic fields, such beams circulate through a sequence of vacuum chambers. Continually speeding around this atomic racetrack, individual ions remain far enough from their neighbors and sufficiently isolated to survive for long periods.

. . . with stripped atoms

At the Institute for Heavy Ion Research (GSI) in Darmstadt, Germany, researchers are starting to use a new storage ring to look at the behavior of highly charged ions. With only one or two electrons, the positively charged nuclei of these ions exert such a strong force on the few electrons present that subtle quantum and relativistic effects — barely detectable in a hydrogen or helium atom — become greatly amplified. By detecting X-rays emitted by these tightly bound electrons as they jump from one orbit to another, researchers can generate data to help test theories of how electrons interact.

"One-electron atoms are the simplest systems we can calculate, and from the experiments, we get a very stringent test of the theory," says GSI's Paul H. Mokler.

Researchers at GSI have also observed for the first time an extremely unusual type of radioactive decay in which the electron (beta particle) produced by the decay of a "parent" nucleus stays bound to the newly created "daughter" nucleus instead of speeding off. The physicists started with highly charged dysprosium ions. Although neutral dysprosium-163 is stable, the naked nucleus — the atom stripped of all 66 of its electrons — is unstable and decays by emitting a beta particle to create a holmium-163 nucleus, which captures the beta particle and hangs on to it as an orbiting electron. Extremely rare if not impossible in neutral atoms, "bound-state beta decay" may play an important role inside stellar plasmas during the synthesis of elements via nuclear fusion reactions.

. . . with negative ions

Torkild Andersen and his collaborators are using the new storage ring ASTRID at Aarhus University in Denmark to investigate the weak interactions of electrons loosely bound to atoms and simple molecules. These fragile negative ions hold together long enough in the storage ring to allow researchers, for the first time, to measure accurately how long the particles retain their charges. The lifetimes range from 10 microseconds to 100 milliseconds. The examples studied so far include singly charged, negative ions of helium, beryllium, and calcium and a molecular ion consisting of two helium atoms bound together with an extra electron (He_2^-).

"We have been able to show that the lifetimes are considerably shorter than expected from theory, and the theory is now going to be revised," Andersen says.

Some negative ions are so delicate that the heat (blackbody radiation) of the apparatus itself at room temperature is sufficient to knock out the extra electron. "This was a surprise because . . . you don't expect this energetically weak blackbody radiation to remove electrons," Andersen says. But "if you go to a very weakly bound system, it will be the controlling factor." For example, the binding energy of the extra electron in a negatively charged calcium ion is sufficiently low that the ion's measured lifetime of 490 microseconds is determined almost entirely by environmental blackbody radiation.