Fossil finds expand early hominid anatomy

Renewed field research at the Ethiopian site of Hadar, where "Lucy" and other members of the earliest known hominid species turned up in the mid-1970s, has yielded a new batch of fossils that significantly expand the anatomical diversity of the more than 3-million-year-old species.

The finds, announced last week by project co-leaders Donald C. Johanson, William H. Kimbel and Robert C. Walter of the Institute of Human Origins in Berkeley, Calif., promise to reignite debates over whether Lucy and her cohorts represent one species or two, and whether at least some members of the species spent more time in trees than walking upright.

During two months of field exploration that began last October, a 10-member scientific team from the United States and Ethiopia found 18 fragmentary fossils that represent 15 individuals belonging to Lucy's species, *Australopithecus afarensis.* The specimens lay on the surface of heavily eroded layers of fossil-rich earth.

"We found fossil remains of hominids [the evolutionary family that includes modern humans] throughout the geologic horizon at Hadar," says Johanson, who led the team that discovered Lucy. "There should be many more to come in future field work."

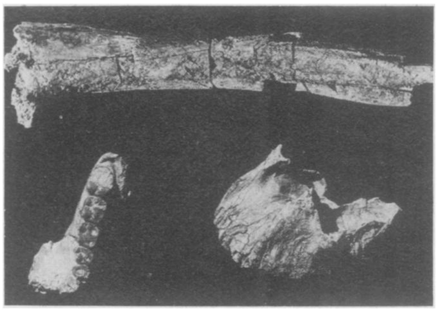
A total of 15 tooth and jaw fragments possess characteristics similar to previous *A. afarensis* finds, but three fossils show anatomical features new to the Hadar hominid collection.

A specimen consisting of an upper jaw and partial face has bony pillars on each side of the nasal opening that resemble those of *A. africanus,* a South African hominid dating to at least 2.5 million years ago. But the shape and depth of the jaw clearly place it within Lucy's species, Johanson asserts. Moreover, the specimen contains much shallower roots for the front teeth than previously observed in *A. afarensis.*

A lower jaw with some teeth still in place shows primitive features much like those of 8- to 12-million-year-old extinct apes recently linked to *A. afarensis* (SN: 6/23/90, p.390), Kimbel says. The row of cheek teeth curves inward, and the premolar tooth behind the small canine has one cusp — features found on some previous *A. afarensis* specimens but not on later hominids.

Finally, a robust upper right arm bone with its ends chewed off, perhaps by a hyena prior to fossilization, preserves two large grooves for muscle attachments near its top end. Such shoulder muscles offer powerful assistance in motions such as hoisting the body with the arms.

While the fossils await further study, scientists who argue that smaller Hadar hominids spent much of their time in trees (SN: 7/2/83, p.8) will likely greet the new limb bone with enthusiasm.



New A. afarensis *finds include an upper right arm bone (top), a lower jaw with some teeth (bottom left) and an upper jaw with part of the face intact.*

Institute of Human Origins

A. afarensis certainly spent some time in the trees, but analyses of its feet, legs and knees indicate it was well on the way to a full-time upright stance, Johanson argues in anticipation of any new tree-dwelling hypotheses.

Although the recent finds reveal that *A. afarensis* was more anatomically diverse than previously realized, "nothing in the sample screams out: 'More than one species,'" Kimbel maintains.

Researchers led by Walter also collected volcanic ash and rock samples, which they expect to yield more reliable age estimates of Hadar's sediments.

— B. Bower

Slowing down light in milk and white paint

A glass of milk presents a formidable obstacle course to a beam of light. Microscopic globules of fat and protein, evenly dispersed throughout the liquid, continually change the light beam's direction, forcing it to follow a zigzag path. This "scattering" is so efficient and effective for all colors of light that milk appears both opaque and white.

Dutch physicists have now discovered that the scattering process is more complicated than researchers thought. The obstacles — whether globules in milk, water droplets in clouds, or tiny beads of pigment in white paint — not only change the light's direction but also significantly retard its speed.

"We were looking at the propagation of light in disordered materials," says Ad Lagendijk of the University of Amsterdam and the FOM-Institute for Atomic and Molecular Physics in the Netherlands. "I was astonished by this reduction in the speed of light. To me, it was unbelievable." Lagendijk described his group's discovery this week at an American Physical Society meeting in Cincinnati.

The researchers stumbled upon the effect while studying the scattering of light by concentrated white paint — microscopic beads of the pigment titanium dioxide suspended in a liquid. While interpreting their data from different experiments, they found to their surprise that they always got contradictory results.

Further experiments and analyses revealed that the problem lay in the conventional assumption that scattering occurred instantaneously, or equivalently, that light traveled at its normal speed through the medium. By adjusting the speed of light in their calculations, the Dutch researchers found that they could get all their experimental data to agree.

Lagendijk and his colleagues developed a new theory to account for this unexpected behavior. They propose that light not only scatters but also enters an obstacle and stays trapped inside for a while before it escapes and shoots off in a new direction. In other words, the obstacles themselves significantly delay the scattering of light. In milk or white paint, this happens so often that light appears to travel at only one-tenth its usually assumed speed in these materials.

"This phenomenon is particularly strong when the dimensions of the obstacles . . . are of approximately the same size as the wavelength of light," Lagendijk says. In effect, an obstacle acts as a "resonator," or cavity, which must be "filled up" with light before it can fully redirect a beam.

The finding affects scientists' interpretations of a variety of experiments involving the propagation of waves through disordered materials. "If you fail to take this delay into account, you come to totally different conclusions about the propagation of light in that medium," Lagendijk says.

In particular, the delay phenomenon affects the determination of a key parameter known as the mean free path — the average path a wave travels before it's scattered. Researchers use this quantity to characterize a disordered material and to make predictions about the material's behavior.

"If you use the wrong speed, you get the wrong mean free path," Lagendijk says. "It makes it harder to predict what happens in such materials."

The discovery that light slows down much more than expected when traveling through materials such as milk and white paint demonstrates that even a mature field of physics may yet harbor hidden treasures, Lagendijk says. "It is surprising that such fundamental experiments can still be done in the 1990s with essentially no more knowledge about light propagation than at the beginning of this century."

— I. Peterson