Fossil may extend antiquity of human line

A palm-sized skull fragment found in Kenya 27 years ago represents the earliest known direct human ancestor, or member of the genus *Homo*, according to a new analysis. The 2.4-million-year-old bone pushes the fossil record of human lineage back 500,000 years, assert anthropologist Andrew Hill of Yale University and his colleagues.

Their conclusion garnered mixed reactions from other investigators of human origins. One expresses reservations about the anatomical traits used to classify the fossil as a direct human ancestor.

The fossil fragment comes from the right side of the head and includes bone above the ear, the ear opening, the jaw joint and part of the skull base.

Identification and dating of the fossil provide the first solid evidence that early *Homo* fashioned the oldest known stone artifacts, which date to between 2.6 million and 2.4 million years ago at African sites, Hill's team argues in the Feb. 20 NATURE. The specimen also dates to a time when global temperatures rapidly cooled and many new animal species appeared. Yale geologist Elisabeth S. Vrba has theorized that this climate shift caused environmental changes that facilitated the emergence of the *Homo* genus.

Although Hill's group does not assign a species to the fossil, for lack of evidence, their report will influence the current debate over whether early *Homo* included only the traditionally accepted *H. habilis* or up to three separate species. "Our report makes it easier to conceive of a radiation of two or three *Homo* species by 1.8 million years ago," Hill contends.

The researchers compared the fossil with the skulls of African apes and hominids (members of the evolutionary family that includes modern humans), including species of the smaller-brained *Australopithecus* that lived from 3.7 million to 1 million years ago and the larger-brained succession of *Homo* species, *H. habilis, H. erectus* and *H. sapiens*. Two anatomical features identify the skull fragment as *Homo*, the scientists maintain. Placement of the jaw joint indicates realignment of the cranium and face in the human direction, and the sharp angle of the bony ridge dividing the brain's temporal lobe from the cerebellum fits a distinctive *Homo* pattern, they say.

Scientists at the Institute of Human Origins in Berkeley, Calif., dated volcanic ash from the fossil's position in the Kenyan soil to about 2.4 million years ago.

Assigning the fossil to *Homo* seems reasonable, but Hill's team uses questionable anatomical traits to make its case, argues Phillip V. Tobias of the University of the Witwatersrand in Johannesburg, South Africa. In 1967, Tobias coauthored the first analysis of the skull fragment, concluding it possessed only enough evidence for classification as a hominid, not a direct human ancestor.

H. habilis possesses a jaw joint positioned much like that of *A. africanus*, which lived in southern Africa around 2 million years ago, making this trait an unlikely marker of *Homo*, Tobias holds. Moreover, the bony ridge cited by Hill's team angles sharply in another *Australopithecus* species, *A. boisei*, he contends.

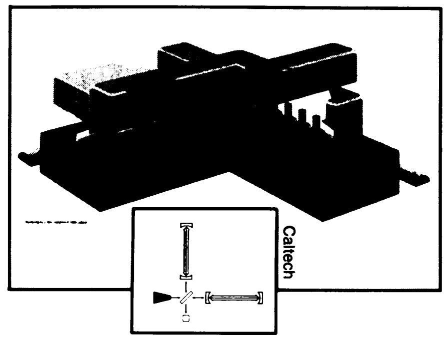
"This fossil provides tentative, not conclusive, evidence for the earliest *Homo* specimen," adds anthropologist G. Philip Rightmire of the State University of New York at Binghamton.

In a commentary accompanying the new report, Bernard Wood of the University of Liverpool, England, accepts the fragment as the earliest known *Homo* specimen. He contends that it may represent *H. rudolfensis*, a proposed species whose fossils currently are assigned to *H. habilis*. A third contemporaneous *Homo* species served as the direct ancestor of *H. erectus* and modern humans, Wood asserts.

Wood's thesis has stirred considerable controversy. Rightmire suspects *H. habilis* specimens may indeed encompass two species, but anatomical variation in early *Homo* fossils creates "a great deal of murk" for fossil classifiers, he remarks.

— B. Bower

Two sites for catching gravitational waves



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Artist's conception of a LIGO facility shows the building (located where two light-carrying pipes meet) that houses the necessary lasers, mirrors and suspended weights. Diagram illustrates how light from a laser (left) splits into two beams that travel down separate pipes, bouncing back and forth many times between mirrors attached to weights, before recombining at a photodetector (bottom).

Situated on an arid plateau in central Washington state, the Department of Energy's vast Hanford Reservation has long served as a center for the extraction of plutonium from spent nuclear fuel. Last week, the National Science Foundation (NSF) designated a site on the Hanford Reservation as one of two locations for the twin facilities of a unique, sophisticated observatory dedicated to the detection of a very different, much more elusive type of radiation – gravitational waves. The other chosen site lies in a flat, wooded area near Livingston, La., about 30 miles east of Baton Rouge.

Following more than a decade of feasibility studies and political wrangling, this decision clears the way for construction of the Laser Interferometer Gravitational-Wave Observatory (LIGO). "Overall, I am convinced that the Louisiana-Washington sites will best serve the scientific objectives of this important project," says NSF Director Walter E. Massey, who made the decision.

Consisting of two facilities separated by at least 2,400 kilometers but operating in unison to avoid false signals, the observatory will cost about $210 million and take five years to build. Last October, Congress approved $23.5 million in first-year funding to cover the costs of selecting the sites, completing the engineering design of the facilities and starting site preparation.

The building of LIGO represents a bold gamble to detect the distinctive imprint of gravitational waves resulting from such violent cosmic events as the collapse of stellar cores and collisions between black holes. The project furnishes an important means of testing Einstein's general theory of relativity, in which massive bodies such as stars influence other objects not by acting on them directly but instead by warping space and time.

When such a body abruptly changes its motion or its mass, the space-time in its vicinity undergoes a corresponding convulsion. This disturbance travels outward as a gravitational wave that jostles any objects in its path.

To detect a gravitational wave passing through Earth, each LIGO facility will have two evacuated steel pipes, 4 feet in diameter and 2.5 miles long, extending at right angles to each other. Laser light will pass up and down the pipes, bouncing between pairs of mirrors attached to heavy weights.

A gravitational wave passing through the facility would imperceptibly move one set of weights closer together and the other farther apart. That slight change in the distance traveled by the laser beams in the two branches would show up as a shift in the interference pattern created where the two beams recombine.

A team of scientists from the California Institute of Technology in Pasadena, location of an experimental prototype facility, and the Massachusetts Institute of Technology will oversee the construction and operation of the LIGO facilities.

— I. Peterson