The New York Times nytimes.com

Lost in a Million-Year Gap, Solid Clues to Human Origins

September 18, 2007

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A Homo habilis, the genus thought to be first in direct human lineage.

Sometimes the maturity of a field of science can be measured by the heft of its ambition in the face of the next daunting unknown, the mystery yet to be cracked.

Neurobiology probes the circuitry of the brain for the secrets of behaviors and thoughts that make humans human. High-energy physics seeks and may be on the verge of finding the so-called God particle, the Higgs boson thought to endow elementary particles with their mass. Cosmology is confounded by dark matter and dark energy, the pervasive but unidentified stuff that shapes the universe and accelerates its expansion.

In the study of human origins, paleoanthropology stares in frustration back to a dark age from three million to less than two million years ago. The missing mass in this case is the unfound fossils to document just when and under what circumstances our own genus Homo emerged.

The origin of Homo is one of the most intriguing and intractable mysteries in human evolution. New findings only remind scientists that answers to so many of their questions about early Homo probably lie buried in the million-year dark age.

It is known that primitive hominids — human ancestors and their close kin — walked upright across the plains of Africa at this time. They were presumably larger members of the genus Australopithecus, the best known of which was the Lucy species, Australopithecus afarensis, that had thrived up to three million years ago.

At about 2.6 million years ago, some clever hominids were knapping stone tools. Then, or some time later, scientists suspect, the first Homo appeared, but there is no confirmed evidence of this step.

Subsequent finds, from a time beginning after 1.9 million years ago, revealed an early Homo identified as Homo habilis, the "handy man," a species with a somewhat larger brain and a more humanlike face, teeth and stature than the apelike australopithecines.

Habilis was generally accorded an important place as the first of the genus, preceding the more advanced Homo erectus and, ultimately, modern humans — Homo sapiens. But certainty has been elusive. A report last month in the journal Nature renewed debate over the habilis's place in human evolution.

William H. Kimbel, a paleoanthropologist at the Institute of Human Origins at Arizona State University, said that the million-year period "has long been the source of frustrating gaps" in the hominid fossil record. "It's not that sites containing rocks this age are particularly rare, or that the time period in eastern Africa has not been searched by several groups," Dr. Kimbel said. "The problem is that the fossil yield has thus far been low or poorly preserved, compared to the time periods on either side of this interval."

A succession of recent discoveries has extended evidence of hominids reaching back from three million to beyond six million years ago, close to the estimated time of the divergence of the human and chimpanzee lineages. The hominid trail from two million years forward has been fairly well worked, by fossil hunters as well as geneticists and archaeologists tracking migrations out of Africa and across Eurasia. Researchers have determined that anatomically modern Homo sapiens emerged in Africa less than 200,000 years ago.

A model with a jaw of A. afarensis, the Lucy species.

G. Philip Rightmire, a specialist in habilis and erectus research at Harvard, said searches into the mystery period had yielded mostly the remains of various species of Australopithecus, the genus that came to a dead end around one million years ago.

Bones were found in 2.5-million-year-old sediments associated with some of the earliest known stone tools, used to butcher animals. A coincidence, or evidence of the first toolmaking species? Hard to tell.

A skull and other fossils, uncovered by a team led by the Ethiopian anthropologist Berhane Asfaw, were named the new species Australopithecus garhi. The researchers said the specimen had the projecting apelike face, small braincase and limb bones suggesting descent from the much earlier Lucy species. But if this was a candidate ancestor of early Homo, "a lot of evolution had to take place rather quickly" to complete the transition, a scientist said at the time.

With one possible exception, no fossils that are conclusively Homo have appeared in that period, Dr. Rightmire said. "That suggests there was not much Homo around then," he said.

Nevertheless, Tim D. White of the University of California, Berkeley, one of the most experienced hunters of hominid fossils, said that his teams and several others were "pushing hard" to explore sites in Ethiopia and Kenya that may produce evidence of earlier Homo origins. Prospects are uncertain. Some prominent sites of previous hominid discoveries are underlain with lava flows and other geological barriers to digging into the deeper past.

At present, most paleoanthropologists think a solitary upper jaw represents the likeliest candidate for a Homo from that period. The find, reported in 1996 by a team led by Dr. Kimbel, was made in the Hadar badlands of Ethiopia, near the site of the much earlier Lucy skeleton and on a surface with a scattering of stone tools. The 2.3-million-year-old jaw was tentatively assigned to the genus Homo. Dr. Kimbel remains cautious. "The Hadar jaw could represent a population of early Homo that was specifically in the ancestry of habilis," he said. "Or it could represent a stem population from which ultimately descended all of the Homo species currently known from after two million years ago."

Alan Walker, a professor of biological anthropology at Pennsylvania State University who studies hominid anatomy, agreed that the jaw was apparently "the earliest direct evidence" of Homo. It shows that the individual had the short face and squared-off palate of Homo, but with teeth that were larger and more primitive. The only other traces of possible Homo presence before two million years ago are some loose teeth from the Omo basin in Ethiopia and some fossil fragments from Kenya and Malawi. The recent Nature report on two new fossils, a 1.44-million-year-old habilis and a 1.55-million-year-old erectus, underscored the uncertainties about early Homo, even after the dark age.

The lead authors, Fred Spoor of University College London and Meave G. Leakey of the National Museums

of Kenya, emphasized in the article and in a news release that their findings challenged the view that habilis and erectus evolved one after the other in a linear succession. Their research showed that the two overlapped for almost half a million years and, as they speculated to the media, both species could have had their origins well before two million years ago, possibly from a common ancestor.

A 2.3-million-year-old jaw, right, from Ethiopia is the likeliest candidate for a Homo from that period.

Eric Delson, a paleoanthropologist at the American Museum of Natural History and the City University of New York, said that was possible. "It's always difficult to know what is the earliest specimen of any lineage," Dr. Delson added. "One always finds something older and older."

A significant insight from the report, he said, may be the recognition that "there's more diversity of species in this time period than we expected."

Several scientists, notably Dr. White of Berkeley, took issue with the interpretation seeming to imply that evidence for the two species overlapping in time and exhibiting variable sizes was new. That, he said, had been recognized for a couple of decades.

Dr. Kimbel, who was not involved in the new research, defended the authors, saying that they had not "meant to imply that habilis could not have been ancestral to erectus, presumably on the basis of their being contemporaneous at Turkana," the site in Kenya where the fossils were found.

Susan C. Anton, an anthropologist at New York University who was a member of the Spoor-Leakey team, said, "My money is still on habilis as the potential ancestor, but there is a lot of room for additional knowledge, given the dearth of fossils."

Other scientists tended to agree but noted that habilis had been clouded with doubt. The first habilis fossils were collected in the early 1960s in the Olduvai Gorge of Tanzania by Louis Leakey, patriarch of the fossil-hunting family and Meave Leakey's father-in-law.

Is habilis really one, two, possibly three species? Some scientists are not sure. Did erectus descend from habilis in a single, unbroken lineage, a process called anagenesis? "This is the only option that is no longer on the table," Dr. Anton said.

Other experts agree that anagenesis has been refuted by recent evidence that erectus and habilis co-existed for a long time in East Africa, although perhaps in separate ecological niches. So could erectus and habilis have sprung from a much earlier common ancestor? No one can say there were no intermediate Homo species before habilis, back in the dark age. Or perhaps some habilis members left Africa earlier and, after an isolation that favors rapid evolutionary change, returned to Africa as erectus, living side by side with the habilis population that had remained behind.

A hominid site far from Africa has thus taken on new significance. In the 1990s, scientists turned up Homo fossils at the village of Dmanisi, in the republic of Georgia. The craniums, resembling fossils from Kenya, confirmed the presence of erectus on the fringes of Europe at least 1.7 million years ago.

The puzzle is, the Dmanisi fossils look like erectus, but are very small, like habilis. A few researchers raise

the possibility that a population of habilis evolved into erectus outside Africa, perhaps in or near Georgia.

"There's nothing to rule out the idea that habilis-like creatures moved into Eurasia prior to 1.8 million years," said Dr. Rightmire of Harvard. "They may have given rise to erectus, as we see at Dmanisi, and then erectus moved back, joining the surviving habilis there."

A new report, to be published Thursday in Nature, will review more skeletal evidence of the transitional aspects of the Dmanisi specimens.

An H. erectus skull

But Dr. Anton said the Dmanisi remains were important as examples of size variability within the erectus species and its adaptations to local environments, not for "any special tie to earliest Homo, such as habilis."

Writing in the Annual Review of Anthropology in 2004, Dr. Anton and Carl C. Swisher III, a geologist at Rutgers University, concluded that the relationships among erectus and various possible nonerectus Homo groups in Africa "currently are quite muddled and require substantial revisitations."

Even if the mystery of the origins of the genus Homo is a sign of paleoanthropology's maturing reach into the deep past, it still leaves the redrawing of the human family tree very much a work in progress. Daniel E. Lieberman, a paleoanthropologist at Harvard, said that filling in the tree matters to scientists, and not only out of innate curiosity about human ancestry.

"At a basic level, one wants to know when and where transformations occurred so one can put them into their appropriate evolutionary context," Dr. Lieberman said.

He said that that could reveal the dietary and environmental causes of species change, leading eventually to modern humans with the ambition to find their origins.

Dr. Lieberman said that he and colleagues "are relentlessly optimistic that we have all the information we need to answer our big questions, but just haven't figured out the order in which to connect the dots."

But the real problem, he added, with resignation tempering optimism, "is that the fossil record doesn't have enough dots."