The Politics of Paleoanthropology

Personalities and publicity enliven efforts to decipher the story of human origins

Early man has been in the news a lot in the past few years. He has made the cover of *Time* and is the subject of books and television documentaries.

The field of paleoanthropology naturally excites interest because of our own interest in our origins. And, because conclusions of emotional significance to many must be drawn from extremely paltry evidence, it is often difficult to separate the personal from the scientific in disputes raging within the field.

Paleoanthropology has a history of being dominated by individualists, and the late Louis Leakey, perhaps the most colorful of them all, bore major responsibility for enlarging the endeavor by drawing in the public's interest—and along with that, money.

Leakey died in 1972, the last of the old-time paleoanthropologists. The years since then have witnessed the emergence of the modern brand of paleoanthropology, characterized by the cooperation of a large number of disciplines and the use of a number of new technologies for dating and analysis of fossils. But modern as the undertaking has become, it continues to be riddled with controversies and dominated by personalities.

Center stage, at least in the public eye is now jointly occupied by Leakey's son Richard and Donald C. Johanson, a paleoanthropologist at the Cleveland Museum of Natural History. The personalities of these two, both 37, are enlivening the continuing debate over when earliest man—that is, the line leading to modern humans—first emerged. This investigation has replaced the search for the "missing link" after a variety of missing links—that is fossils representing the transition from ape to human—were discovered in Asia and South Africa.

The very nature of paleoanthropology encourages divisiveness. The primary scientific evidence is a pitifully small array of bones from which to construct man's evolutionary history. One anthropologist has compared the task to that of reconstructing the plot of *War and Peace* with 13 randomly selected pages. Conflicts tend to last longer because it is so difficult to find conclusive evidence to send a theory packing. Louis Leakey's personal ideas about the extreme antiquity of the *Homo* line thus continue to divide the field years after his death.

Although new finds and analytic techniques have laid some controversies to rest—we know now, for example, that walking upright preceded the extraordinary brain growth that led to *Homo*—new ones have arisen. But Richard Leakey and Donald Johanson still address the central question: When did the line that culminated in the evolution of *Homo sapiens* diverge from the Australopithecine line, which coexisted with *Homo* for perhaps several million years? Following in his father's footsteps, Richard holds to the belief that the *Homo* line is very ancient, having diverged 5 million to 8 million years ago. Johanson contends that the crucial events in the evolution of modern man occurred between 2 million and 3 million years ago. The first examples of man's most immediate known ancestor, *Homo erectus*—and the earliest human fossils found until then—were unearthed in Java and China around the turn of the century. Then, during the 1920's to the 1940's two well-known individuals, Australian anatomist Raymond Dart and Robert Broom, a Scottish natural scientist, located extensive hominid fossil deposits in limestone quarries in South Africa. These finds, of creatures more primitive than *Homo erectus*, appeared to confirm Darwin's belief that the earliest origins of man would be found in Africa. After much speculation, the prevailing belief came to be that these represented two distinct and coexisting species—*Australopithecus robustus*, characterized by a wide face and extremely heavy and powerful jaw, and a smaller, gracile *Australopithecus*, which Dart named *africanus*. The dating of these finds was uncertain because there was no way to date the geological formations in which they were found, but later correlations with animal bones found in East Africa around Ethiopia's Omo River put the oldest ones at well over 2 million years old.

Meanwhile, the focus of the search for man's origins moved to East Africa, where Louis Leakey, the Kenya-born son of English missionaries, began his fossil-hunting career in the 1930's. Leakey made his most significant finds at Olduvai Gorge in Tanzania with his archeologist wife Mary.

One of the great milestones of paleoanthropology was the discovery in 1959 by Mary Leakey of the skull christened *Zinjanthropus* (meaning East African man). This was eventually established as the first Australopithecine to be found in East Africa and was the first to be reliably dated at 1.8 million years, by the newly developed potassium-argon method. Some years later Leakey found remnants of a skull, more human in appearance, which he dubbed *Homo habilis*. Louis believed that *Homo habilis*, and not the Australopithecines, was the ancestor of modern man, and his belief appeared to be vindicated the year of his death, when his son Richard discovered a *Homo habilis* skull, the famous 1470, which was originally believed to be close to 3 million years old.

Richard Leakey

A native of Kenya, whose national museums he directs, Leakey is the preeminent figure in East African paleoanthropology.

The 1470 skull lay below a layer of volcanic ash, called the KBS tuff after the geologist, Kay Behrensmeyer, who identified it. The tuff was originally dated by the potassium-argon method at 2.6 million years but has since been dated firmly at 1.8 million years. The tiff over the dating of the KBS tuff was a major

0036-8075/81/0814-0737$01.00/0

Cleveland Museum of Natural History

Evidence for a new species

Donald Johanson (left) and Tim White with fossil fragments, mostly jaws, which they believe are remnants of one species, Australopithecus afarensis. *Intact human and chimp skulls (in front of Johanson) are shown for comparison.*

dispute and its repercussions are still felt in the field. Leakey and his co-workers had a major stake in the earlier date because it pushed the known evidence of the *Homo* line back about a million years. But there was strong evidence to the contrary, supplied by extensive stratigraphic work done at Ethiopia's Omo River 150 kilometers upstream from Kenya's Lake Turkana, under the direction of F. Clark Howell of Berkeley. Omo supplied a model of clear geological layers which made it possible for other researchers to reconstruct with great accuracy the evolutionary course of pig fossils embedded there. It so happened that the Omo pig fossils dated at 1.8 million years were identical in evolutionary development to pig fossils found in the same layer as the 1470 skull near Lake Turkana. Further potassium-argon dating of purer specimens of the KBS tuff confirmed the 1.8 million date. But Leakeys' people continued to look for reasons why the tuff was older, constructing hypotheses for how the Turkana pigs might have been isolated for millions of years and evolved faster than the Omo pigs. Most paleontologists regard this as unlikely because one of the rules of paleontology is that, if you find species at the same state of evolution in different places, it can be assumed that they occupied the same niche in time.

According to Tim White, who originally worked with the Leakeys and is now associated with Johanson, the rift between the Leakey and Johanson factions can be traced to the fuss over the KBS tuff. Others say things were not that simple, but in any event what was in essence one big happy paleoanthropological family in the early 1970's had become marked by a distinct schism by the end of the decade.

The schism has been aggravated by Johanson's major fossil finds in the Afar triangle in northeastern Ethiopia in the mid-1970's, a collection whose star is the famous "Lucy," a skeleton said to be 40 percent complete, making it the most complete early hominid, as well as one of the oldest, ever found.

Johanson, then still a year away from getting his Ph.D. at the University of Chicago, was one of the leaders of a French-American expedition that set up camp in Hadar, near the Awash River, in 1973. The Americans were looking for hominid fossils; the French, led by geologist Maurice Taieb and paleontologist Yves Coppens, were looking for animal fossils. It was during their second field season in 1974 that Lucy was found; the following year, amazingly, they came upon a whole population of hominid bones, of varying ages and both sexes from approximately the same age as Lucy. The total collection was a staggering find—more than most paleoanthropologists could expect in a lifetime of fieldwork. Johanson first thought they represented two different species. But then he got together with Tim White who was familiar with some fossil teeth and jaws that Mary Leakey had found at Laetoli, just south of Olduvai Gorge and 1000 miles away from Hadar. White and Johanson saw great similarity between the Hadar and Laetolil fossils and ultimately concluded that the whole batch represented one species. The fossils from both areas were dated at over 3.5 million years old, which made them the oldest bipedal hominids ever found. Although they bore a strong resemblance to *Australopithecus africanus* specimens from South Africa, the two decided that aspects of the jaws and crania and teeth were even more primitive than *africanus*. Yet because large portions of Lucy's pelvis and leg bones had been preserved they knew the creature walked upright, or was bipedal. They therefore devised a new species name for it, *Australopithecus afarensis* (after the Afar triangle where most of the specimens were found) and declared that this could be the common ancestor of the *Australopithecus* and *Homo* lines. So Johanson, in addition to redrawing the human family tree, has established himself as one of the world's most visible anthropologists.

Although most scientists are inclined to accept Johanson and White's claim that the Afar fossils deserve a new taxon, the feeling is by no means unanimous. Leakey does not accept the new designation, nor does he believe the collection represents a single species. He believes two species at the very least are represented there, possibly including *Homo*. Lucy he considers more primitive than the rest because of her small size, large back teeth (molars diminish and front teeth get bigger as *Homo* emerges), and primitive-looking jaw. He prefers to speculate that she is a late survival of *Ramapithecus*, an apelike creature whose latest remnants are 8 million years old and whose method of locomotion is unknown because of the absence of any evidence besides jaws and teeth. Leakey also says there is "growing suspicion" among some investigators that the dating of the collection—3.5 million years—is wrong and that the correct date is closer to 3 million. In that case, footprints discovered by Mary Leakey at Laetoli, dated at 3.6 million years, would be by far the oldest evidence yet found of hominid bipedalism.

The Afar collection thus poses a fascinating challenge for scientists concerned with within-species variation, since there are never enough fossils to offer conclusive evidence on the range of variation within extinct species. The only rule for making such determinations is that what we observe today as normal within-species variability can be applied to the past. White and Johanson believe the

wide variation in the Afar fossils can be explained by sexual dimorphism, or large size differences between males and females. But there remains a dispute over whether the dimorphism exceeds even that of gorillas, where there are huge sex differences. The answer depends on which statistics you put the heaviest emphasis on. It also relates to whether or not the investigator is a "lumper" or a "splitter"—that is, whether one is conservative and likely to ascribe a wide variety of types to a single species, or whether, like Louis Leakey, one is inclined to ascribe differences in appearance to the fact that more than one species is represented.

Although many other scientific issues cut across this schism—a major one, for example, is the question of what circumstances gave rise to hominid bipedalism*—the field seems to have become to some extent polarized between the Leakey and Johanson theories.

It takes more than merit for the student of early man to gain celebrity status in the paleoanthropology game. Otherwise, some anthropologists say, F. Clark Howell of the University of California at Berkeley might become a star because of his work at Omo and his contributions toward making the field a truly interdisciplinary undertaking. But Howell never found a hominid, an accomplishment that is the quickest route to public recognition, and also, not coincidentally, to getting funds for fieldwork. (It was after the Zinj discovery that the National Geographic Society began supporting the Leakeys.)

Because the physical evidence is so thin, luck plays a larger role in paleoanthropology than in some other sciences. Leakey had the luck to be born into the ruling dynasty of East African paleoanthropology; Johanson had the good fortune to find Lucy.

The publicity these two have generated has been extraordinary and there is no end in sight—particularly since they will be relying increasingly on money they themselves generate now that government funding is contracting (the National Science Foundation's anthropology budget for fiscal 1982 will be about 40 percent below the 1980 budget in constant dollars). The careers of the two men look increasingly similar. Both have now written best-selling books with the aid of science writers, and both have made films. Leakey's series, "The Making of Mankind," is now running in Britain and will come to U.S. television in the fall. Meanwhile, Johanson has participated in making two films; one, *Lucy in Disguise*, is to be sold to educational institutions; the other is to be aired on the TV show "Odyssey." Leakey in 1975 helped create the Foundation for Research into the Origins of Man (FROM), based in New York, which gives out research grants and promotes the education of Third World scientists. Now Johanson plans to quit his job as research director at the Cleveland Museum of Natural History to become director of a new International Institute for the Study of Human Origins, a "human evolution think tank" which will also train Third World scientists at Berkeley.

Bob Campbell

***1470 Skull of* Homo habilis**

Discovered by Richard Leakey's team near Lake Turkana in 1972, this skull was originally dated at 2.6 million years and hailed as the earliest example of Homo *ever found. Its age was subsequently revised to 1.8 million years.*

There is definitely an absence of consensus among their colleagues on the merits of the Leakey-Johanson differences. Richard Leakey on the one hand is seen as a political genius, and a superb organizer who has raised impressive amounts of money for the field and pioneered in getting East African scientists trained in paleoanthropology; as a magnanimous figure who is eager to share the fruits of his expeditions with all who wish to study them; as a statesman above petty battles. He is also seen as an expert whose knowledge of East African mammals in unparalleled and whose scientific judgments are not impaired by the fact he has no university degree.

Others see Leakey as a nonscientist who parades his lack of credentials in the many speeches he delivers. The "deficiencies in his education" show up in "sheer ignorance of basic evolutionary principles and the non-African aspects of his field," wrote C. Loring Brace of the University of Michigan in a scathing review of two books, *Origins* and *People of the Lake*. Brace contends that Leakey's (now abandoned) endorsement of the idea that the Lake Turkana pigs could somehow have evolved at a different rate from the Omo pigs is a reflection of antiquated views on evolution. Nonfans of Leakey see him as the center of a clique that wants to build its own scientific empire in East Africa; a clique of what Tim White terms "academic loyalists" devoted to Louis Leakey's stubborn adherence to unfounded theories about man's origins. Critics also say that a favorite Leakey theme—that man is innately a cooperative and food-sharing creature rather than a bloody aggressor—is at best only thinly supported by available evidence.

Johanson, on the other hand, does not seem to have as many detractors. The main scientific criticism of him is that he has jumped the gun in establishing a new species. His former co-worker Coppens, at the Musée de l'Homme in Paris, for example, believes there are at least two, maybe three or four species represented by the Afar and Laetoli collection. But the sharpest criticism of Johanson, which also is directed at his right arm Tim White, is that he unnecessarily badmouths the Leakeys. Russell Tuttle of the University of Chicago, for example, wrote a review in *Lucy* that "we find friends romanticized . . . while rivals are vilified." Johanson is thought in some quarters to be a publicity seeker; Alan Walker, anatomist at Johns Hopkins University, told *Science* that he thinks Johanson wants to be famous: for that, he either needs a controversy or more new bones. Since he hasn't been able to get back to Ethiopia lately to prospect, he's doing his best to inflate the Lucy controversy, Walker believes.

As for mutual problems, a common complaint is that others are too slow to publish in the scientific journals—that they are flinging around arguments and interpretations without giving others something solid in print to evaluate. The Leakey and Johanson camps also claim each others' popular books are filled with inaccuracies.

White and Johanson in particular complain that while Leakey refuses to accept the designation and placement of *Australopithecus afarensis*, he will not offer an alternative. Johanson relates that when he and Leakey taped a show with Walter Cronkite ("Walter Cronkite's Universe") in April, Cronkite asked each to draw his version of the human family

*C. Owen Lovejoy of Kent State University has stirred up a controversy by postulating basically social reasons for this development (*Science*, 23 January, p. 341).

tree on a blackboard. Johanson did so. Then Leakey took the marker and drew a large red X through Johanson's tree, and then drew a large question mark on his side. Johanson was so taken aback by this he says that he cannot remember anything about the rest of the show. Leakey acknowledges his behavior caused "some consternation" and explains that he had consented to appear on the show with the understanding that the discussion would be about larger issues, and not about his professional differences with Johanson.

As is usually the case, extensive publicity has distorted the public's perception of what really are the important questions in the field of paleoanthropology. One anthropologist, Milford Wolpoff of the University of Michigan, explains that now that so many specialties are involved in the pursuit, the people who find the fossils are not necessarily the ones best equipped to interpret them.

Whether or not this is the case, it is true that the real advances are coming not in the field but in the labs. Potassium-argon dating, which had just made its debut when the Zinj skull was dated, revolutionized dating of fossils from East Africa. Detection of geomagnetic reversals which enable dating of strata affected by reversal of the earth's magnetic field, which is the only direct dating technique available for South African fossils, has only been available for the last dozen years. Knowledge about the mechanics of locomotion has enabled scientists to determine that hominids walked fully upright for a long time before their brains evolved to human size, and that bipedalism was a stable rather than an awkward partly formed adaptation 3.5 million years ago. Technological aids include tomography on bone cross sections that reveal areas of greatest strength and stress, which can contribute to knowledge about physical activities and capabilities.

Extensive work is also being done on the diet of Australopithecines, with the aid of electron microscopy. Alan Walker, for example, is using the technique to find out what the robust ones ate. Using highly accurate replicas of fossil teeth (the only part of the skeletal anatomy to directly interact with the environment) he has already been able to determine that *robustus* was not a grass eater because grass causes microscopic scratches from siliceous infillings. So more likely they were browsers or leaf eaters. A diet of roots is easily detected because the grit causes heavy damage to tooth enamel.

As Walker observes, paleoanthropology or the search for the origins of man is the driving force for the development of many accessory disciplines. Ralph Holloway of Columbia University, who describes his calling as one of the "parasites" of paleoanthropology, is a paleoneurologist who examines casts of the insides of skulls in order to find out more about brain development. "In the past we have relied almost entirely on brain size to determine the stage of advancement" of a species, says Holloway. But this is a crude and even misleading measure, for the really important changes lie in brain organization. Although the outlines are only dim in hominid brains, certain bulges can speak volumes. For example, a well-developed Broca's area, just above the left temporal lobe, is associated with motor control of the vocal apparatus, which can yield clues about when speech may have developed. The hottest question in paleoneurology, according to Holloway, is the location of the lunate sulcus, a vaguely moon-shaped crenellation in the occipital area which encompasses the primary visual cortex at the back of the head. In chimpanzees this area is clearly visible; in humans it can't be seen at all, having been pushed out of sight by development of the association cortex. Holloway has been examining an endocast of the Taung skull (the first *Australopithecus africanus* found) and believes the sulcus is more hidden than in chimps—a clue as to when and how the ape brain evolved in a human direction.

Other important work is being done in analysing the faunal associations with certain layers. Fossil pollen experts also supply data about the environment.

The latest bit of technology being put to the service of paleontology is radioimmunoassay. Molecular biologists have already been able to demonstrate that the protein structure in humans bears a 98 percent similarity to that in apes. Now Jerold Lowenstein of the University of California School of Medicine in San Francisco has been able to identify species-specific proteins by inducing immune responses in rabbits from the injection of ground-up bones of various fossil species. He thus has been able to establish that the Tasmanian wolf was more closely related to an Australian marsupial wolf, despite close morphological correspondences with a South American hyena. This technique thus raises exciting possibilities for untangling the human family tree. The development of finer techniques for the physical and chemical analysis of substances is also giving a boost to paleoecology which through study of animal bones and fossil pollen is beginning to yield a much fuller picture of the environment in which early man lived.

> It is the individual who finds the hominid bone who is going to be in the limelight.

Paleoanthropology is a small, elite field. The numbers of professionals connected with it continue to grow as hyperspecialization sets in and additional advances take place in the lab rather than in the field. It tends to be dominated by particular personalities and no matter what new technologies come to the service of the profession, it is the individual who finds the hominid bone who is going to be in the limelight—also in the money. The element of luck adds a piquance to an undertaking that by its nature is of intense public interest. As one observer says, "you can have equally fascinating scientific squabbles about aphids—the difference is, no one outside the field cares."

Despite the bickering, paleoanthropology is in pretty good shape. Fossils are easier to find now that geologists know more about which formations are likely to contain them (in the first 50 years of exploration, according to one author, only five hominid fossils were found). Also, says David Pilbeam of Yale University, "the kinds of questions now being asked are more answerable." Futile debates over eternal mysteries—such as why did man develop such a large brain—are being abandoned in favor of more practical pursuits, such as multidisciplinary attempts to reconstruct the total physical environment of a particular creature. One large question is likely to remain unanswered, though, and that is whether *Homo sapiens* is a "successful" species in the larger evolutionary sense. Pilbeam notes that the average species lasts anywhere from 200,000 to 2 million years. Since the oldest securely dated modern humans only go back to 40,000 years ago, "so far as longevity as a species, mankind hasn't even entered the race yet."

—CONSTANCE HOLDEN