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Research Related to Human Origins, Behavior and Survival.

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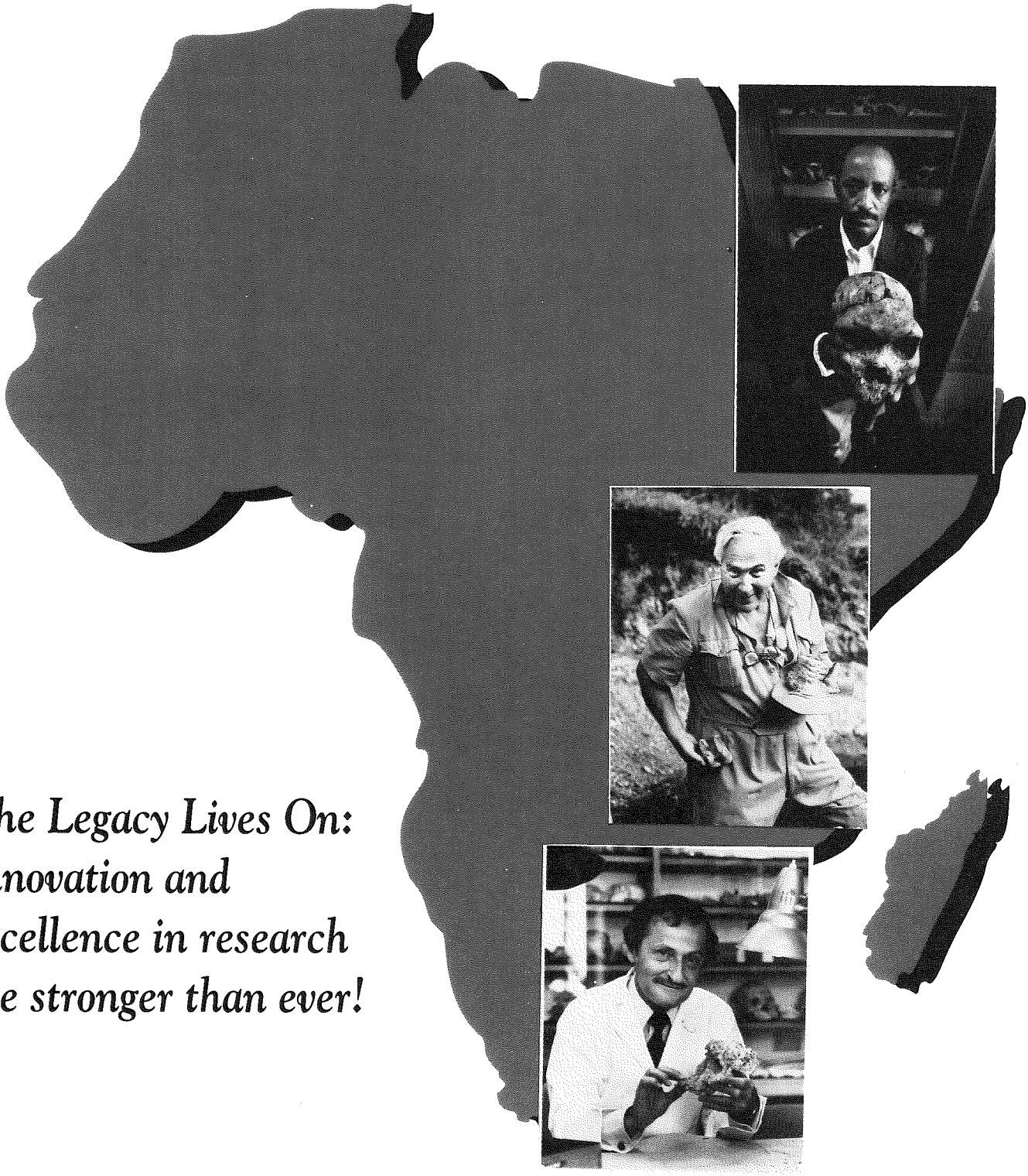

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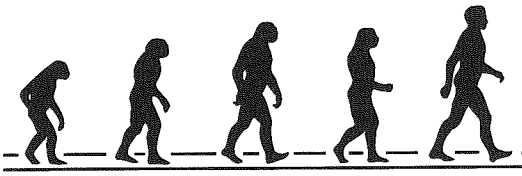

The L.S. B. Leakey Foundation was established in 1968 by a group of eminent scientists and informed lay people who recognized a critical need to strengthen financial support for new multidisciplinary research into human origins, our evolving nature and environmental future. It was named in honor of the man who has become known as the "the Darwin of pre-history," Dr. Louis S. B. Leakey.

The Foundation sponsors

- International research programs related to the biological and cultural development of humankind.
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- Advanced training and education of students in all of these fields.

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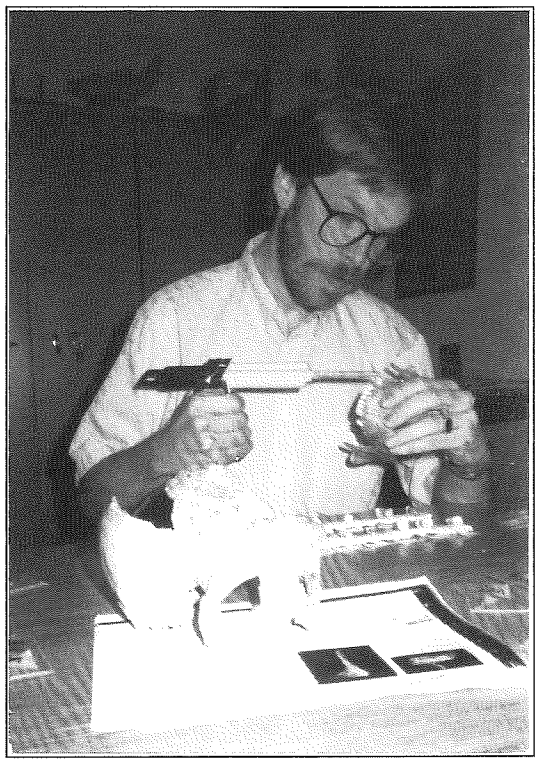
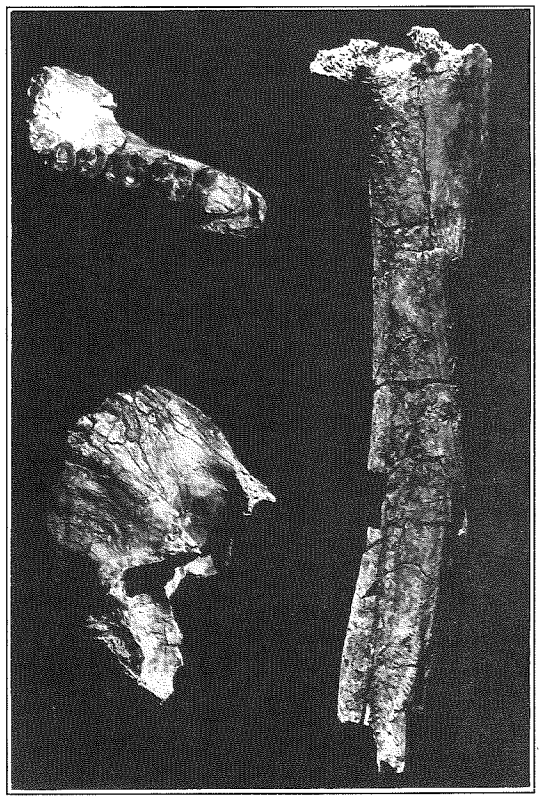
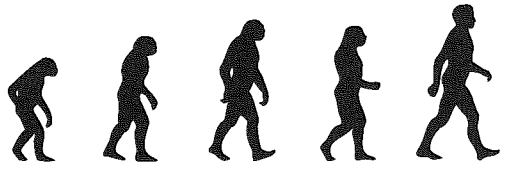
In This Issue







President's Message

This, your latest issue of AnthroQuest, once again shows that the Leakey Foundation continues to provide important support for vigorous and ongoing programs on discovery.

The Foundation has always encouraged international research over a broad area dealing with man's evolving nature, environmental future and origins. This season's Grant's Awarded list outlines in brief examples of new ventures scheduled for action. Still, the overall success of the grants program relies on public support; sponsors may indicate the particular project or specific research to which they wish their contribution be applied and the options cover a very wide range of interest.

Before long the scientific work put "on hold" last spring will move ahead as world tensions ease.

From time to time we review our main objectives and fine-tune our methods and direction. The exercise leads to a clearer understanding of purpose. The picture is one we can be proud of: significant research, overall financial strength, educational progress and membership participation are solid features of our track record.

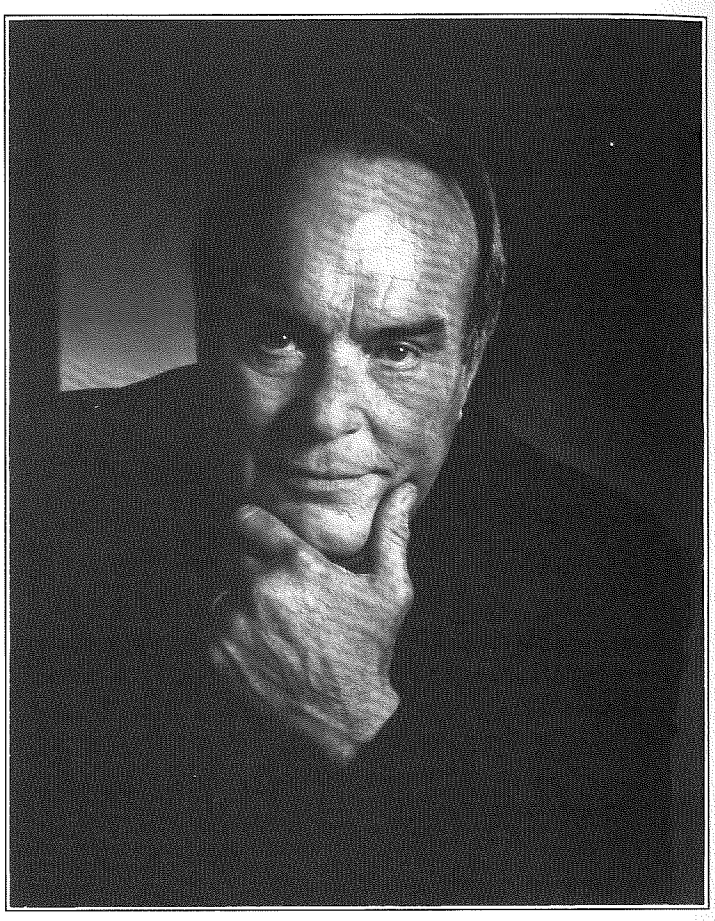
Living in a time of transition, ours is a period of change fueled by advancing technology or set back by ignorance. While prehistory may not hold all the answers, it surely offers clues to our patterns of performance for good and our capacity for evil.

Louis Leakey's early warnings about the possible fate of our species hits home and hard; we either get a firm grip on our destiny and treasure the gifts we have -- or perish. He implored us to use our wisdom to avoid self-extinction.

Meanwhile, as nations, we stumble into cultural conflicts: worlds ancient and modern clash with terrifying consequences. Third world struggles and Western ideas fail to mesh. Global institutions committed to peaceful accord drop the ball. The playing field tilts and desperate people pay the full price for all our failures. Death and destruction plague our follies. Even nature herself deals out devastating terror by drought, hunger, tidal wave, earth tremor or volcanic blast.

We have no shortage of mysteries, puzzles abound in every direction: we probe the sky wondering which starry specks of early light hold the key to the universe, its beginning, its possible end. We search remote corners of the earth collecting ever more fossil fragments to add to the great jigsaw picture of early mankind. Field researchers ponder the life-style of primates, seeking a ghostly image of our ancestors and maybe catch a reflection of ourselves. Others collect data on disappearing tribal peoples.

All to what avail?



Photographed by Yousuf Karsh

One view says we're hard-wired for violence, born of tooth and claw aggression. Another says we have the brains to work out differences because our seed-line has evolved so far to build something we call civilization. Our survival is in the balance.

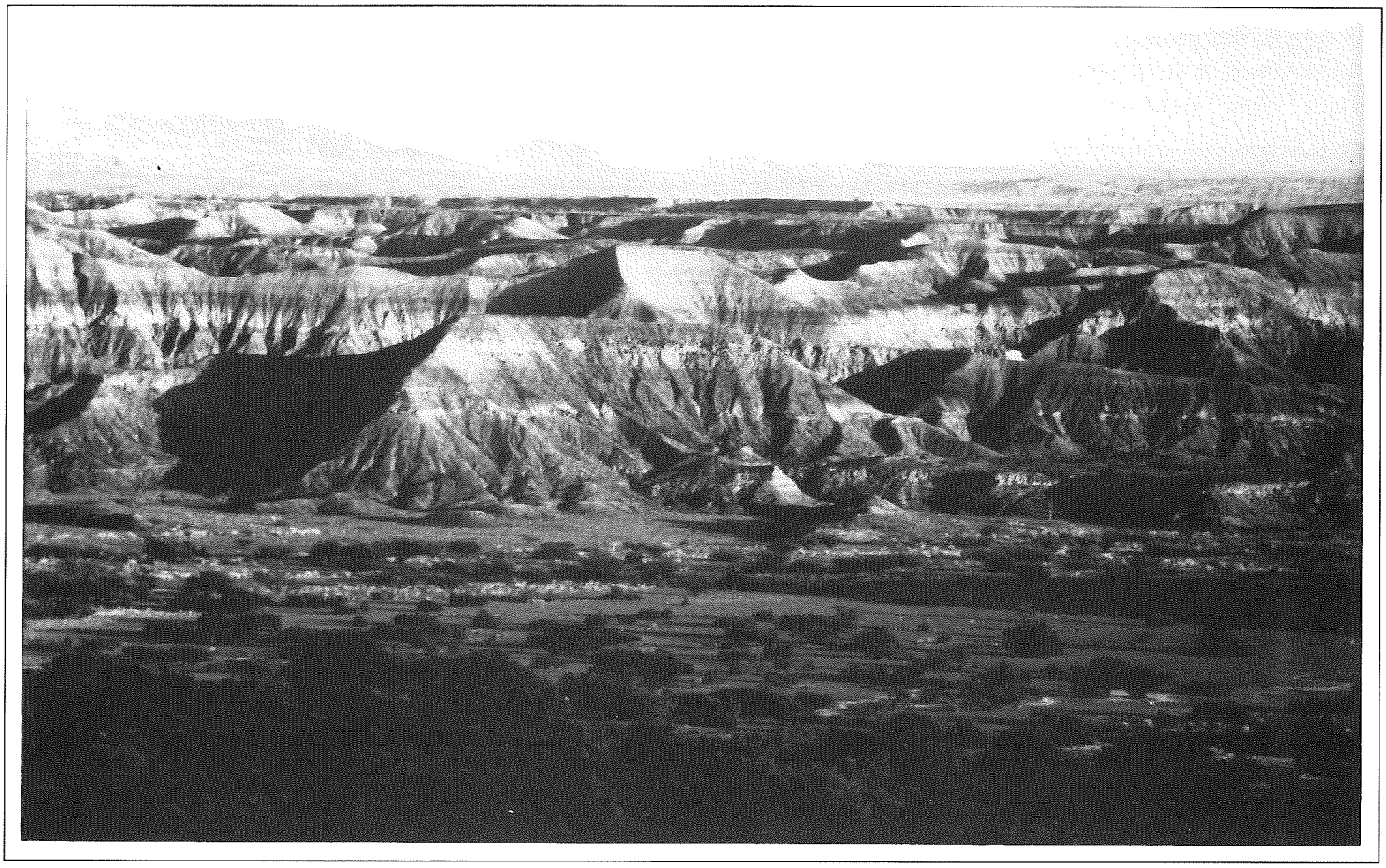
Of course we must have faith in an ability to further open our minds, and perhaps advance beyond mere rationality to embrace compassion with creative intelligence.

Our memories hold the past, at least the past we want to know. Our hopes leap toward tomorrow, searching for a better yet-to-be. Our job is to go the full distance in a spirit worthy of our species.

Thank You,

Mason Phelps

The Importance of Ethiopia



Fossil-bearing deposits at Hadar, Ethiopia. These deposits span a time range between 3.0 and at least 3.5 million years ago. Photo courtesy of Institute of Human Origins, Berkeley, California

For centuries, Ethiopia has been known as a strange and special place. In 1773, when the Scottish explorer James Bruce first returned from Ethiopia (then Abyssinia), his tales were considered so extraordinary that he was accused openly of lying. Who could believe in a highland, African country ruled by a Christian king, an empire with its own written language, snow-capped mountains on the equator, and churches dug out of stone? Indeed, the emperor — who, legend has it, was descended from the Queen of Sheba and King Solomon — the mountains, the only indigenous, African written language, and the stone churches all proved to be real.

For paleoanthropologists, Ethiopia has proved no less astonishing. Without a doubt, the rich evidence of our ancestors' earliest lives yielded up by Ethiopian sediments has effected a revolution in the study of human origins.

Interest in the prehistory of Ethiopia began with some initial discoveries in the earliest part of the twentieth century, but the first era of intensive research in Ethiopia wasn't until the 1960's. A joint Kenyan-French-American expedition explored the area adjacent to the Omo River, which flows southward to make a huge delta at the northern end of Lake Turkana. For many years, the extensive badlands of the Omo were the home to repeated successful expeditions, led by F. Clark Howell of the University of California, Berkeley, and Yves Coppens of the College de France and Musee de l'Homme--both long-standing members of the Foundation's scientific committees. Many years of thorough work at the Omo produced a wealth of fossil animals, numerous hominid remains, and some of the earliest archaeological sites — all placed within a well-understood, well-dated geological framework.

This standard framework was the truly special aspect of the work. It was the key that, back in the mid-1970's, permitted scientists to begin interlocking information from such diverse regions of East Africa as the Omo, Olduvai and East Turkana. After years of work in these separate areas, it suddenly became possible to correlate dated geological horizons from one area with strata from another. Knowledge of the various animal species helped, too: anthropologists and paleontologists used clusters of animal species that regularly occurred together (faunas) at the Omo to estimate ages of other localities with the same animals. For the first time, the sequence of evolutionary changes in our own lineage could be considered on an ecological and regional basis. It was a major breakthrough.

The second era of Ethiopian research came with the expeditions to the Hadar region, which were, again, a joint American-French effort -- this time led by Maurice Taieb of the Laboratoire de Géologie du Quaternaire, CNRS, and the then young and relatively unknown anthropologist Donald Johanson. Johanson rose to international prominence for one of the team's early discoveries. In 1974, they were working in the wonderful, fossiliferous areas of Hadar and were fast running short of funds, so Johanson applied to the Leakey Foundation for an emergency grant to keep the project going. Although most funding agencies cannot deal with such urgent requests, the Leakey Foundation can, and did.

The extra weeks in the field paid off better than anyone could have anticipated. A month later, Johanson's sharp eyes lit on a promising bit of bone ... then another, and another. Within days, the team had recovered the amazing fossil hominid that came to be known worldwide as Lucy. She is of the earliest (about 3 million years) and certainly one of the most complete hominid skeletons ever found. Lucy's discovery was followed in subsequent years by more fossils, until there was an abundance of partial skulls, teeth and jaws, and limb bones from Hadar. Archaeological sites were found, too, including some that pushed the manufacture of stone tools back to 2.5 million years.

Since that time, the Hadar hominids have been pivotal in virtually every study of early human evolution in the years that followed their discovery. First of all, they are very old — at least a million years older than the most ancient hominids then known from other sites. In tracing human origins, scientists hope to go right back to the initial divergence between the lineage that evolved into apes and the one that became ourselves, so "very old" is also "very important."

Second of all, the Hadar fossils showed some astonishingly primitive and apelike features, while clearly proclaiming their hominid status. For example, they were unquestionably upright and bipedal creatures, with noticeably humanlike teeth, and yet their brains were small, perhaps one-quarter the size of modern humans'. The combination of a smallish braincase and rather large and strong chewing muscles created bony crests and ridges that adorn the skull where muscles attach.

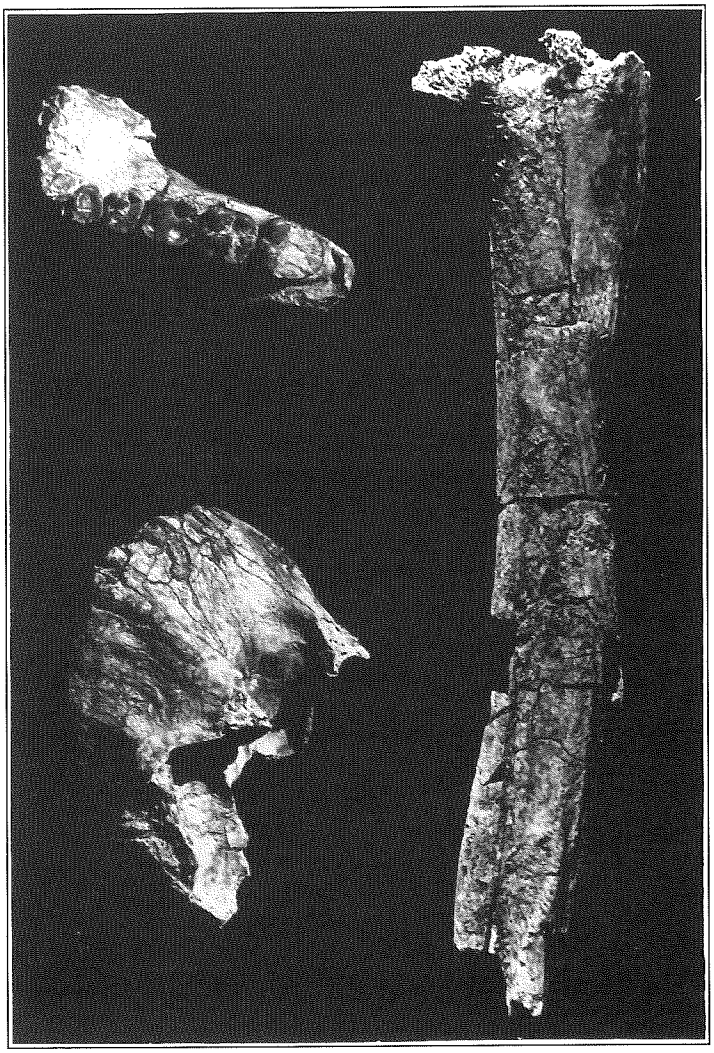
By human standards, the teeth are large but unmistakably human in pattern and the upper and lower jaws protrude in an almost chimpanzee-like way. Strikingly, the upper canine or "eye" tooth is intermediate in form between the apes' large, elongated, and pointed tooth, honing against its partner like a pair of scissors, and the small, gently pointed tooth of humans, which protrudes little below the cutting edge of the front incisor teeth.

The dental and cranial remains rapidly became the focus of considerable discussion. The question was deceptively simple: how many species of hominids were present? The answer was flatly contentious.

With time, more fossils, and careful anatomical analysis, the Hadar team reversed their original position and decided that they had only one hominid, albeit a species with a lot of variation in size. The same type of creature seemed to be present at a somewhat older Tanzanian site, Laetoli. In 1978, the team named the new species *Australopithecus afarensis*, proposing boldly that it was the first, ancestral hominid: the one that gave rise to all other hominids known from elsewhere.

If the Hadar team was correct, then they had found our roots, quite literally. But many anthropologists disagreed with the Hadar team and made no bones about challenging their conclusions. For a few years, discussions waxed hot and academic meetings took on the air of hand-to-hand combat before things cooled off.

At issue was a fundamental problem in paléontology. *How do you define a species in the fossil record?* In living animals, scientists usually rely on the biological species concept, which says that two populations of similar animals are distinct species if they are unable (or unwilling!) to produce viable, fertile offspring in the wild. As a quick and dirty means of assessing species status in the field, you often look for clear differences in morphology (body shape), size, and behavior, especially behavior related to breeding. It's also wise to check to see whether or not you can find what look like hybrids living in the areas where the two possible species meet.



Three fossil hominid specimens of ***Australopithecus*** *found by the Institute of Human Origins' 1990 Hadar expedition. Photo courtesy of Institute of Human Origins, Berkeley, California*

This is all very well for living animals, but how do you see fossils interbreeding or not interbreeding? You don't, of course, so what paleontologists generally do is try to measure how much the morphology of the possible species varies and then compare that variation with what is known about living animals that are accepted as good species.

The thorn in the side of those attempting such an analysis is *sexual dimorphism*, the natural variation between males and females of the same species. Sexual dimorphism doesn't refer to the obvious, genital differences between the sexes or to their secondary sexual characteristics, such as the different distribution of fat and body hair in males and females. These are traits of the soft tissues that are not preserved in fossils anyway.

Sexual dimorphism is concerned with the variability between males and females in body size and robustness that are reflected in bony structures that do fossilize. In humans, for example, men are generally taller, broader, and more muscularly built than women, from head to toe. In other primates, like baboons or gorillas, the sexual dimorphism is even more exaggerated; males may weigh two or three times as much as a female of the same species. Males also sport long, daggerlike canines and hulking browridges on their skulls, while females have more rounded, shorter canines and smoother brows.

Sexual dimorphism and variability within a species were the crux of the "how many species?" debate. Tim White, of the University of California at Berkeley, was at the forefront of the discussion. He argued that the Hadar and Laetoli fossils were united as one species because they shared a consistent suite of anatomical features. He felt this fact was more important than the marked dimorphism in body size within the fossil sample.

One species or two, the variability in body size was impressive. If you considered it to be one species, then *A. afarensis* ranged in size from the smallest, Lucy-sized petites, which were about 3'3" tall and less than 75 lbs. in weight, to the extra-largest, presumed males, who weighed in at 5'7" and 150 lbs.

Other scholars disagreed with White, feeling that the dimorphism was too great to be accommodated in a single species. Still others challenged the *afarensis* concept because they believed that the collection of fossils showed at least two distinct patterns of morphology. Such differences in shape (as well as size) might indicate differences in function — in how a species habitually moved, for example — that could not be subsumed within a single species.

Not only the classification but also the interpretation of the Hadar and Laetoli remains was controversial. For example, Randall Sussman and Jack Stern, anatomists from the State University of New York at Stony Brook, contended that the Hadar bones showed adaptations for climbing in the trees as well as bipedal walking on the ground. They pointed to features in the strong shoulders and arms as well as in the curving toe bones that suggested some ability to grasp branches. Others, like C. Owen Lovejoy of Kent State University and Bruce Latimer of the Cleveland Museum of Natural History, countered that *A. afarensis* was too well adapted as a biped to spend much time in the trees; those features were simply primitive ones from our ape-ish ancestry that were retained until evolutionary processes could remodel them.

The entire situation was complicated not only by the anatomical and biological issues but also by a

Fossil recovery operations at the **Australopithecus** *arm (humerus) bone locality during the Institute of Human Origins' 1990 Hadar expedition. Photo courtesy of Institute of Human Origins, Berkeley, California*

political one. In 1982, the Ethiopian government decided to declare a moratorium on paleoanthropological research within their borders. A major factor in their decision was the lack of a clear set of policies, guidelines, and priorities that would help them decide *who* should be granted permits for *which* studies *where*. But, for the time being, no new fossils would be forthcoming from Ethiopia for some time to come.

Obviously, detailed analyses that would make the most of the fossils in hand — and that might help resolve the rapidly proliferating differences of opinion — were a top priority for scientists on all sides of the debate. By the late 1980's, a hard-fought consensus seemed to be emerging. Many years of hard work and meticulous study convinced many paleoanthropologists that the Hadar team was correct: *Australopithecus afarensis* was a valid, if variable, species.

Then, in 1990, Ethiopia again re-opened her borders to paleoanthropological research (see *New Directions in Ethiopian Science, facing page*). In the metaphorical driver's seat was Berhane Asfaw, an Ethiopian Ph.D. educated at the University of California at Berkeley who is now the paleontology coordinator for the Ministry of Culture and Sports Affairs (the government body that has jurisdiction over permits for paleoanthropological research) and Director of the National Museums of Ethiopia in Addis Ababa.

Asfaw's appointment symbolically marked the opening of the third era of Ethiopian-based research into human origins. With new government policies in hand and a thorough understanding of the scientific issues involved, Asfaw has been instrumental in setting up new, collaborative projects between his countrymen and scholars from other nations who wish to explore Ethiopia's fossil riches.

One of the three international expeditions to Ethiopia in 1990, an IHO team led by Donald Johanson, William Kimbel, and Robert C. Walter, returned to Hadar with Leakey Foundation funding. Even their first field season has produced a new bundle of surprises in the form of 15 hominid fossils. Although they obviously hoped to enlarge their sample of *A. afarensis* fossils, what they found at Hadar in 1990 was hardly "more of the same"!

One fossil — a piece of the lower face and upper jaw of a large individual whose position in the rock indicates that it is the same age as Lucy — shows new fea-

(Continued on p.21)

New Directions for Ethiopian Science

Dr. Asfaw (on the left) directs the inventory team across Pleistocene outcrops in the Kesem-Kebena region. Several new localities rich in Acheulean tools and vertebrate fauna were identified here in 1988-89 by the project. Photo courtesy of Tim White.

Berhane Asfaw wasn't satisfied. He had come to the United States for top-notch training in his chosen academic field, physical anthropology, with financial support from the Leakey Foundation's Baldwin Fellowship. He returned home to Ethiopia and took charge of his own modern prehistory laboratory. Soon he also became the director of the National Museum in Addis Ababa.

But that wasn't enough. Asfaw knew that much of his country remained untapped for hominid fossils and tools. The few areas that had been searched produced fossils that jostled the limbs of our family tree. Part of his job was to care for those pieces of the past that had already been uncovered, but Asfaw yearned for a way to know how much remained to be discovered. So in 1988, he enlisted space-age technology, one of the pinnacles of human culture, to aid the search for clues to human origins.

For nearly three decades, anthropologists and geologists have searched once lush river basins in the Ethiopian section of Africa's Great Rift Valley for clues to the origin and evolution of our hominid ancestors. At times the search has been most rewarding, as in 1974, when Donald Johanson's discovery of the 3.0-million-year-old remains of Lucy added *Australopithecus afarensis* to the hominid honor roll and put the site of Hadar on a par with such African localities as Olduvai Gorge and Koobi Fora. But by and large, the fossil resources of Ethiopia remain relatively unknown compared to what has been unearthed to the south in Kenya and Tanzania.

That may not be true for long. Last year, three international teams of researchers returned to Ethiopia for the first anthropological field work there in eight years. The mere fact that field work had been renewed after the rewriting of government antiquities laws was significant, but it was

Vertebrate fossils are stored in this room of the Paleoanthropology Laboratory at the National Museum of Ethiopia, headquarters of the Ministry of Culture's inventory project. Photo courtesy of Tim White.

eclipsed by the bounty of fossils that each team found. "It was like a harvest," says Asfaw, paleontology coordinator for Ethiopia's Ministry of Culture and Sports Affairs.

Asfaw says that the teams turned up remains of at least 30 hominid individuals. Johanson and his colleagues from the Institute of Human Origins discovered parts of fifteen individuals at Hadar; University of California at Berkeley anthropologists Tim White and J. Desmond Clark returned to the Middle Awash and found fossils from thirteen individuals; and John Fleagle of the State University of New York at Stony Brook led a team to the new site of Fejej, which turned up teeth from a pair of hominids that may be as much as 4 million years old.

The fruitful first season must be especially satisfying for Asfaw. It not only confirms that Ethiopia still holds significant keys to our knowledge of human evolution, but it underscores the critical need for the project that he began in 1988: surveying the Ethiopian rift to identify the best places to look for future fossil finds.

Asfaw's survey technique starts by analyzing images from NASA's orbiting Landsat satellites and from the space shuttle to locate likely fossil-bearing deposits. Within the past decade, the resolution of images from these space-based remote sensing sources has improved to the degree that a discriminating researcher can distinguish different rock types. So the survey team can focus on potentially productive areas before heading out into the rift to continue the survey in the traditional way—on foot. In just three years, Asfaw says, the survey has discovered 34 new sites in Ethiopia from the Kenya border to the southern end of the Afar. Such an intensive, targeted survey sets up a framework for subsequent excavation, so that time and money can be used to maximum effect.

The past ten years of Asfaw's life have been a story of personal and professional promise and success. He came to the United States in 1981 as the first Ethiopian recipient of the Leakey Foundation's Baldwin Fellowship, which supported his Ph.D. studies at the University of California at Berkeley. When Dr. Asfaw returned to Ethiopia in 1988 to help care for his country's prehistoric resources, he realized that many unknown fossil sites must lie between the handful of famous sites of the Omo Basin in the south and the Afar Triangle in the north. "All these very important anthropological areas were discovered by accident," says Asfaw. "Nobody went looking for them."

So he decided it was time to start looking for more sites. Asfaw knew that during the years he had spent in Berkeley, the rift had become a less remote place. Roads and dams had been built that undoubtedly, and unknowingly, destroyed prehistoric sites. Saving as many sites as possible for the future depended on creating a complete map of the rift's prehistoric sites.

The Ethiopian government approved of Asfaw's idea, but his initial proposal for funding was turned down by both the National Science Foundation and the National Geographic Society. Asfaw decided to start the survey anyway on a shoestring budget, aided by Tim White and Asfaw's former graduate school colleague Gen Suwa, now a professor at Kyoto University. Ethiopian geologist Giday WoldeGabriel, a former Baldwin Fellow and researcher at the Los Alamos National Laboratory, and several other Ethiopian researchers contributed to the field work.

"We do a big chunk of the work in the lab to target an area before we go to the field," says Asfaw. In 1988, that preparation paid off in their initial, two-month exploration of the Kesem-Kebena Basin, a section of the northern main Ethiopian rift south of the Afar. The team found many new localities, including some of Pleistocene age that yielded Acheulian tools.

When it came time for Asfaw to rewrite grant applications, he received funding from both the National Science Foundation and the National Geographic Society. In 1989, the team returned to the field for two months. They found thirteen additional sites with the potential for hominid fossils, including six in the area of Fejej, which seems destined to become another household name for anthropology aficionados. Asfaw says, "The time depth here is much, much greater than in the Afar," with sites ranging in age from Oligocene to Pleistocene, and most containing vertebrate fossils. He recalls one 40-kilometer stretch of sediments that was "littered with stone tools." The 1990 survey lasted only a month but added four other sites in this area.

After choosing a suitable area from satellite images, the survey team drives to the region and walks its sediments in straight lines, or transects, to get a sense of the paleontological prospects. No fossils are collected unless someone finds a distinctive type of animal that could help determine a date for a locality. What happens instead is lots of documentation: written, photographic, and video records of the site, its fossils, and its artifacts. Each new locality gets a name and a place on an ever-growing site map.

This sort of work may not share the glamour of excavating fossil skeletons or caches of stone tools, but Asfaw sees establishing Ethiopia's prehistoric inventory as a primary task for now.

When not working on the survey project, Asfaw has his hands full with the other task that has occupied him since returning to Ethiopia. He has created a modern, well equipped paleoanthropology laboratory at the museum in Addis Ababa. Facilities include a fossil casting lab, photography studio, computers, a library, and space to curate and store specimens. But Asfaw is proudest of the lab's archive of field site data from the Ethiopian rift survey. "The field records are the most important part of this lab," he says. "For any kind of work we'll do we have complete information."

The laboratory's Ethiopian staff includes three geologists, eight prehistorians, and two technicians. Asfaw gives each staff member topics to study as a way to develop areas of interest and knowledge. He expects the lab workers to contribute firsthand to ongoing research. In addition, he will encourage some of his staff to pursue graduate education abroad, and hopes that the Leakey Foundation can help sponsor these students. Asfaw foresees sending selected workers abroad for two or three years, and if they want to complete a Ph.D., they must first return to Ethiopia and secure a job, and then come back each summer to participate in field work. Asfaw plans to work closely with the students to help guide their studies. He recalls being a geology student in Ethiopia with a deep interest in, but little knowledge of, human evolution: "There was only me who was interested in the field. I had to learn everything in Berkeley." Now he hopes to extend the knowledge he's gained to other Ethiopians.

Although the survey has already begun to fulfill its promise, much work remains to be done. Asfaw says that about 20 percent of the targeted land has been covered. Initial estimates allowed ten years to survey the Ethiopian rift. The team will work four more seasons and then evaluate whether the project will continue. Knowledge gained from the field so far will help improve predictions for the best areas to explore from analyzing satellite images. The Autumn 1990 issue of the journal National Geographic Research contains a detailed report of the survey to date.

Now that the survey team has placed new sites on the map, the next step will be for researchers to move in and begin systematic excavations. That will help solve what Tim White sees as an endemic problem in his field.

"A very tiny amount of evidence production is being done in paleoanthropology," says White. "The limited amount of field work is truly the bottleneck that keeps us from knowing the things we want to know."

Blake Edgar is Assistant Editor of "Pacific Discovery", a quarterly publication of the California Academy of Arts & Sciences in San Francisco.

The Leakey Foundation's Baldwin Fellowship has contributed over $155,000 towards the education of Ethiopian students, including two new students this year (see "Grants Awarded" on p. 15). For more information on Baldwin Fellows, see "Where Are They Now?" on p. 20

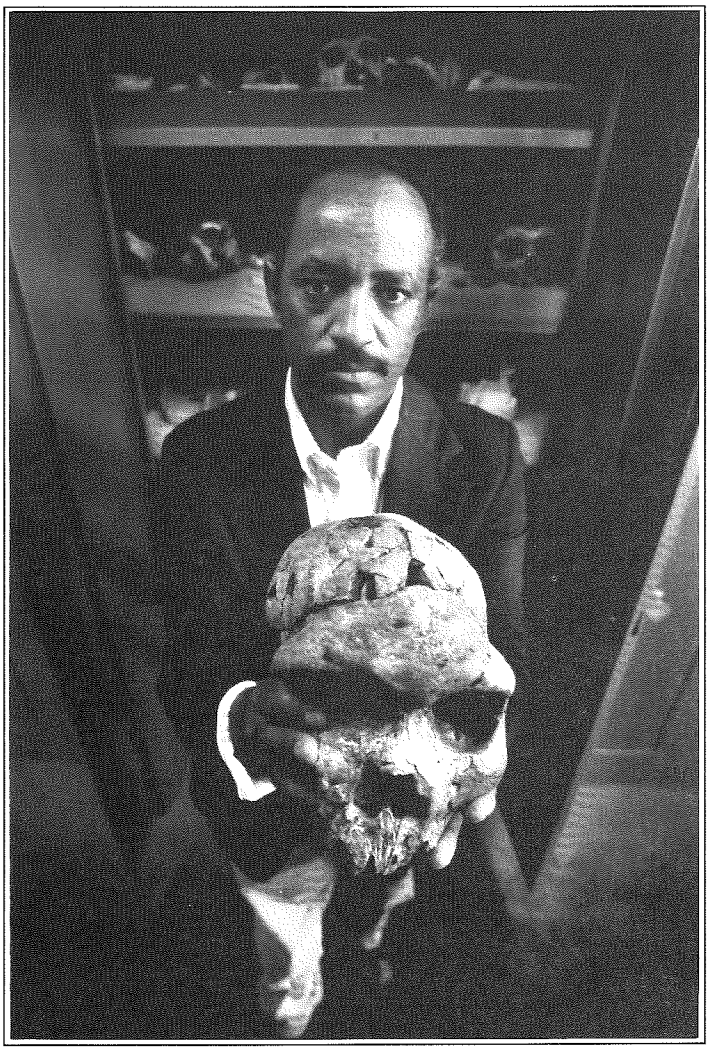


Photo of Berhane Asfaw courtesy of the San Francisco Chronicle. Berhane's education was made possible by the Leakey Foundation's Baldwin Fellowship Program.

GRANTS

Nancy Czekala and friend at Karisoke Research Center. Photo courtesy of Nancy Czekala.

Where Do Gorilla Babies Come From?

The obvious answer, of course, is "from gorilla mothers." A more sophisticated answer is developing from information gathered by Nancy Czekala, of the Zoological Society of San Diego, and Pascale Sicotte, of the University of Montreal during a recent project sponsored in part by the Leakey Foundation. Their quest was to learn how gorilla reproduction is regulated by hormones.

One of the most discouraging problems in attempts to conserve both lowland and mountain gorillas has been their low reproductive rate. Even in the wild, it takes a long time and good luck to produce a healthy, newborn gorilla and in captivity, baby gorillas are all-too-rare an occurrence. In fact, previous studies of captive gorillas showed that a staggering 65% of all mature females were subfertile.

Is this normal for gorillas or is it a special problem related to the stresses and constraints of the captive situation? What were the hormonal triggers that permitted successful impregnation? There was only one way to find out and this ambitious project undertook it.

The simplest way to monitor hormone levels — in captive animals — is to measure the amount of various reproductive hormones that are excreted in the urine. These results can then be compared with behavioral changes, such as genital swellings on females, females receptivity, and observed copulations to make a clear pattern.

But Sicotte and Czekala were determined to collect the same sort of data from wild mountain gorillas — a much more demanding task. Czekala's report to the Foundation is a model of understatement. She writes,

"The urine collection procedure was extremely successful. Although somewhat difficult initially, due to my unfamiliarity with the individual gorillas and gorilla groups, once we were comfortable with each other the collection process became very simple. The arduous physical nature of the collection, however, made us value each sample we collected."

What she and Sicotte did was follow along observing the group known for its silverback, Beetsme, waiting for the three nonpregnant females — Papoose, Mawingu, and Shingaza — to urinate. Then one or the other of them moved up, syringe in hand, and suctioned urine droplets off of leaves, grass, or ground. It is not, as Czekala says, one of those skills they teach you in school.

These daily samples provided a fascinating look at the typical cycle for a mountain gorilla.

So far, the researchers have analyzed the levels of two hormone derivatives — estrone conjugate and pregnanediol glucuronide — in all three females. Papoose, who was already a mother, actually became pregnant while she was being monitored, so the rise and fall of her hormones is an especially valuable indication of what a successful cycle is like.

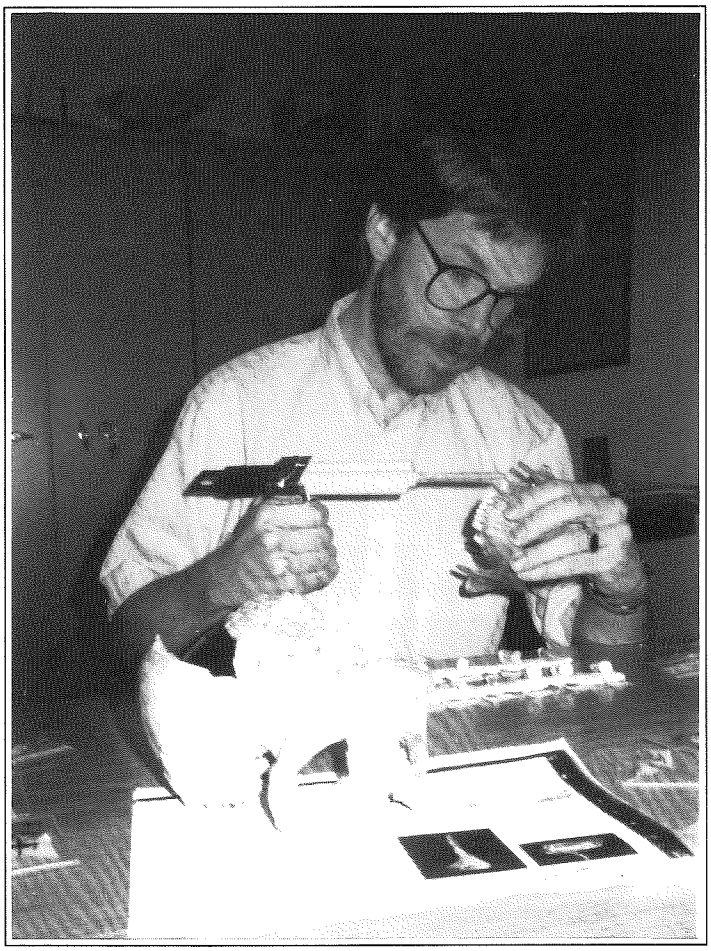
On the days when Papoose copulated with the silverback males in the group, her estrone conjugate concentrations peaked, as they do in fertile lowland gorillas in captivity. But her levels of the other hormone derivative — pregnanediol glucuronide — were generally well below levels measured for lowland gorillas. Some 10 days after copulation, both hormones rose, indicating pregnancy.

The samples from Mawingu, who had never been a mother before, told a similar story. Estrone conjugates were high on copulation days, while pregnanediol glucuronide levels were low. Sixteen or seventeen days after the copulations, both hormone levels rose and the researchers believe that Mawingu, too, became pregnant. In contrast, Shingaza (who has never had a baby) did not conceive, despite copulating with Beetsme, and her hormone profile was different.

Undaunted by the logistical difficulties of gathering such detailed information under field conditions, Czekala and Sicotte have moved us a few important steps closer to understanding gorilla fertility. By inference, they are also closing in on the pressing problem

of gorilla infertility, which threatens the continued existence of the species as much as loss of suitable habitat. If gorillas aren't breeding, it won't be too many years before the question is no longer one of where gorilla babies come from, but what gorillas were anyway.

Nancy Czekala, an endocrinologist at San Diego Zoo, began her project on gorilla reproduction three years ago with support from the Kelco-Merck Foundation and more recently from the National Geographic Society and the Leakey Foundation. In 1988 Pascale Sicotte also received a grant from the Leakey Foundation ($4,500) for her dissertation research, during which she developed the field collecting techniques used so successfully this year.



Clark Larsen "measures up". Photo courtesy of Clark Larsen

Living with Stress in Yugoslavia

It is widely agreed that Neandertals lived a rugged and difficult life; every massive bone in their body, crested with markings from powerful muscles, bespeaks their daily struggle. But Leakey Foundation grantee Clark Spencer Larsen, an anthropologist at Purdue University, decided to examine the rigors of their lifestyle from a new perspective.

Larsen chose to focus on one of the most important samples of Neandertals, those from the Yugoslavian site in northwest Croatia known as Krapina. The site was discovered and excavated at the turn of the century by an enterprising and energetic young Croatian scientist, Dragutin Gorjanovic-Kramberger. It was his careful work and dogged persistence with these precious fossils — the first Neandertals known outside of western Europe — that earned him (and Croatian science in general) international respect. The Croatian Natural History Museum in Zagreb, founded by Gorjanovic-Kramberger, now houses the hundreds of Neandertal fossils which attest to occupation of the Krapina cave between about 70,000 and 50,000 years ago.

The point of Larsen's study was to assess the level and timing of physiologically-important stresses during the growth of a Neandertal. While worries and anxieties may have marred Neandertals' days and given them wrinkles or gray hairs, as they do us, what Larsen wanted to document was the sort of stress that results from severe nutritional problems and infectious diseases. As a specialist in human osteology, he knows that the teeth preserve an enduring record of these events.

The principle is a simple one. As an individual — Neandertal or human — grows from birth to physical maturity, there is a more-or-less continuous process of forming tooth germs, which move upwards to break through the gums as they grow into full teeth. Like us, Neandertals had two sets of teeth; the "milk", "baby" or deciduous teeth of the toddler and small child are gradually replaced by the more numerous and larger adult or permanent teeth.

It is the shiny, white enamel that covers the teeth which contains the record of stress. If malnutrition or serious disease strike as the enamel is forming, the body cannot make enamel normally. Instead, the

enamel is defaced with pits, grooves, circumferential lines or other defects. Because the cells that form enamel die once their task is completed, there is no possibility of any healing or repair of these pathologies, which are called by the general name hypoplasias. A second type of pathology, hypocalcification, indicates periods when the stress was so bad that growth was disrupted.

Therefore, by observing the frequency of hypoplasias and hypocalcification in the Krapina sample, Larsen could make an estimate of the severity of stress. What's more, because the teeth are formed and erupt in a known sequence — for example, the front or incisor teeth form and erupt before the cheek teeth or molars — it is possible to discover when in an individual's life the stresses occurred.

Larsen's work on more than 300 teeth, from an estimated 25-50 individuals, told a sobering tale. The frequency of enamel defects of various types was high. He believes that these defects more probably attest to periodic shortages of food than to recurrent bouts of disease, but, he emphasizes, no conclusions can be final until his analyses and comparisons with data from other populations have been completed.

Still, Larsen's work evokes a haunting image of Neandertals struggling to survive in Ice Age Europe, at times battling severe cold and in milder periods, simply working incredibly hard every day to keep warm, to care for their kin, to find enough to eat. Perhaps they sat at the entrance to the Krapina cave, hungrily surveying the cruel landscape outside and wondering when and where the animals and plants they needed would found.

Dr. Larsen needed only $2,665 in order to collect necessary data from Neandertal teeth during a three-week study at the Croatian Museum of Natural History; sophisticated microscopic equipment was available through Northern Illinois University.

Jean Hudson with Aka pygmies. Photo courtesy of Jean Hudson.

Hunting with the Pygmies

For her doctoral dissertation research at the University of California at Santa Barbara, Jean Hudson formulated an ambitious project. She would live with the Aka pygmies of the Central African Republic, studying their hunting practices and strategies. Hudson's study falls into an increasingly important category known as ethnoarchaeology. Rather than simply observe and document what the Aka said and did about hunting, Hudson's aim was to monitor temporary hunting camps scientifically, from their first day of occupation until they were abandoned. Once a camp had been left, she excavated each camp as if it were an archaeological site, plotting the position of all discarded items and collecting the animal bones for more intensive laboratory study.

Some of the results of Hudson's work have just been published in a fascinating book entitled *Human Predators and Prey Mortality* (1991), published by Westview Press in Boulder. The editor, Mary Stiner, is another Leakey Foundation grantee with strong interests in ethnoarchaeology.

Hudson's article is an eye-opening discussion of what have been called nonselective hunting strategies. She explains that this formidable term "simply means that the hunters do not choose their prey individually according to any criteria of age or gender."

Some of her most interesting results come from the analysis of a camp where one nonselective strategy,

net hunting, had occurred. Net hunting involves 30 or more people acting cooperatively to set up a barricade of nets; they then frighten the animals, driving the game into the nets where they are dispatched by other hunters. The most common animal captured by net hunting was the blue duiker, a small forest antelope weighing roughly 10 lbs.

You might expect that the animals caught by a nonselective method would mirror the prey population from which they were drawn. But Hudson found surprising contradictions in her data.

Blue duikers have been studied extensively in Gabon by Dubost, who censused the animal populations and counted the frequency of duikers in various age classes. When Dubost's information is compared with Hudson's net-hunting data, two striking differences are found. First, the net hunters seem to miss the youngest duikers, which make up about 25% of the live population. Second, the net hunters caught many more subadults, aged about 24 months, than expected.

Hudson explains these findings in terms of duiker behavior. Very young duikers — those less than 10 months in age — tend to lie immobile when startled, relying on camouflage rather than speed to protect them. Thus, this age group doesn't jump up and run into the net when the beaters come by and they don't often get caught by the Aka.

The excess number of subadults caught in nets can be explained in terms of the interactions between duiker behavior and hunting behavior. Duikers live in territorial family groups of a male, a female, and their immature offspring. As subadults, the offspring are expelled from the home territory, striking off on their own to seek mates and new territories.

In a "packed" area, like the one where Dubost studied duikers, there are lots of resident adults and very young animals, and only a few, mobile subadults. But hunting by the Aka changes this arrangement. Aka persist in hunting in one area until the game is so decimated that hunting is no longer successful; then they move to a new area. But a census in a once-heavily-hunted area in the process of recovering would be likely to reveal a different age structure. With many of the resident adults now dead, most of the prime territories would be vacant and a large number of subadults would move in to claim them. Hudson believes the overabundance of subadult duikers at the net hunting camp she studied reflects just such a recovery process.

Hudson's is a cautionary tale about interpreting the past too facilely. What her work shows is that hunting is a subtle process, with results that vary not only by technique by also by the habits of the prey. Simple generalizations about selective or nonselective hunting techniques must be cast aside in favor of richer, more thoughtful interpretations.

Jean Hudson received $7,880 from the Leakey Foundation for her year-long study of the Aka, a study which has led to her doctoral dissertation, numerous publications and conference presentations

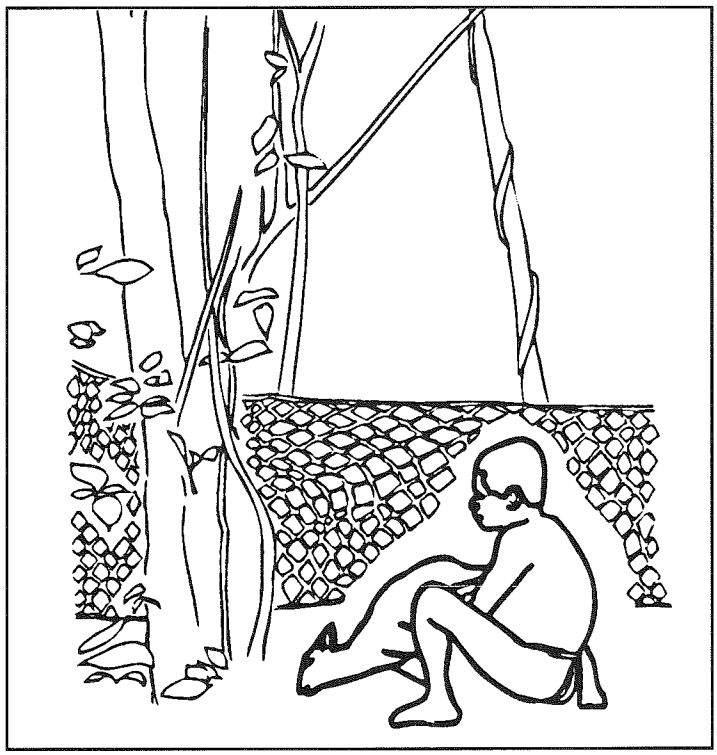
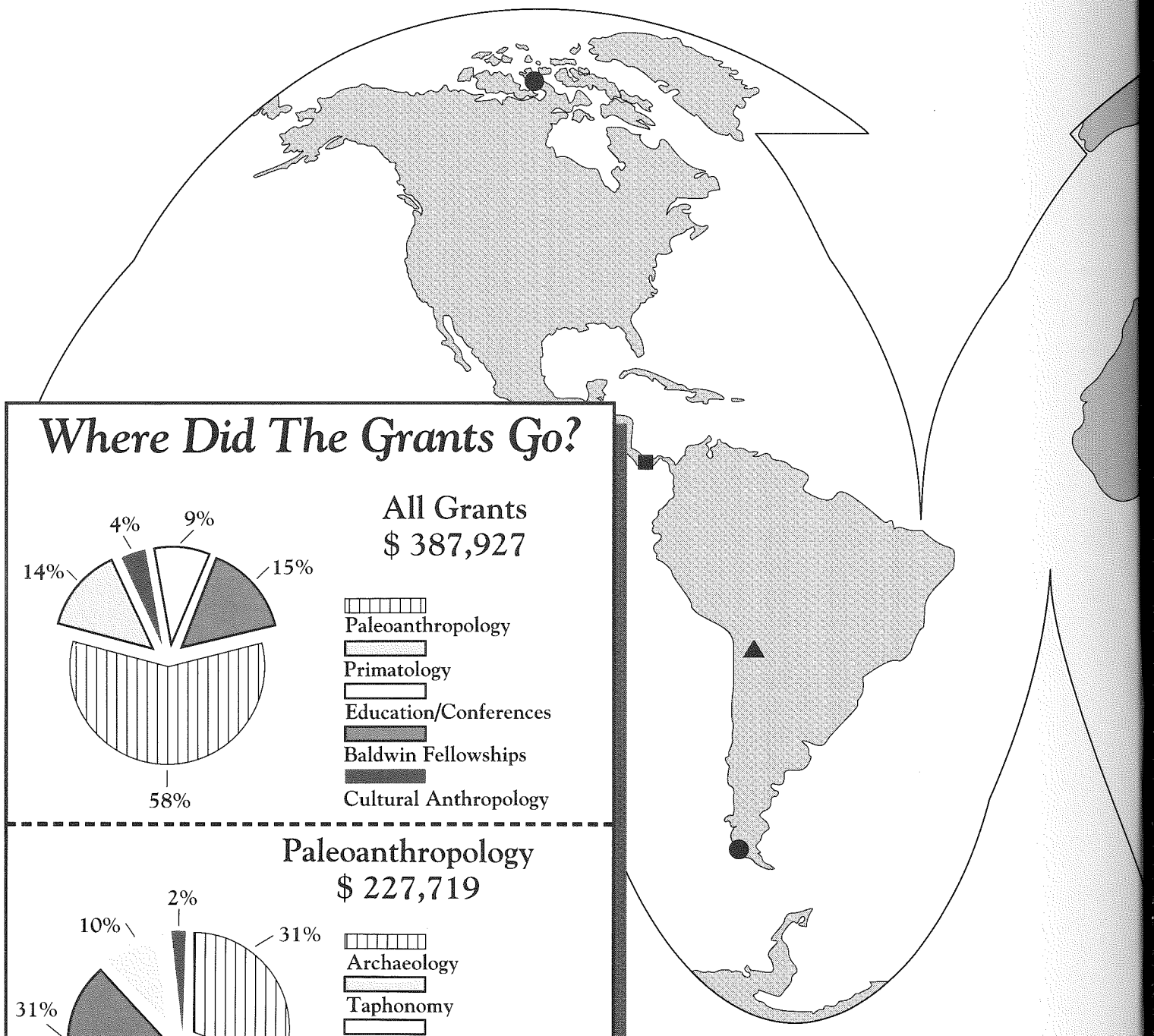


Illustration courtesy of Jean Hudson.

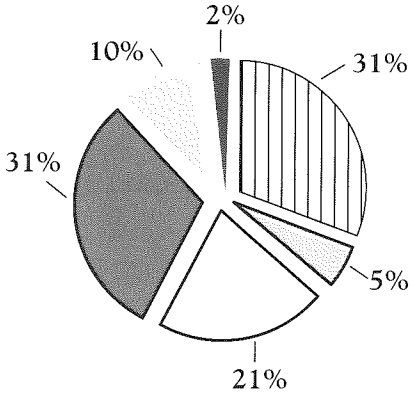
GRANTS



Where Did The Grants Go?

All Grants
$ 387,927

- Paleoanthropology
- Primatology
- Education/Conferences
- Baldwin Fellowships
- Cultural Anthropology



Paleoanthropology
$ 227,719

- Archaeology
- Taphonomy
- Morphology (fossils & living)
- Fossil Exploration
- Geology & Paleocology
- Genetic

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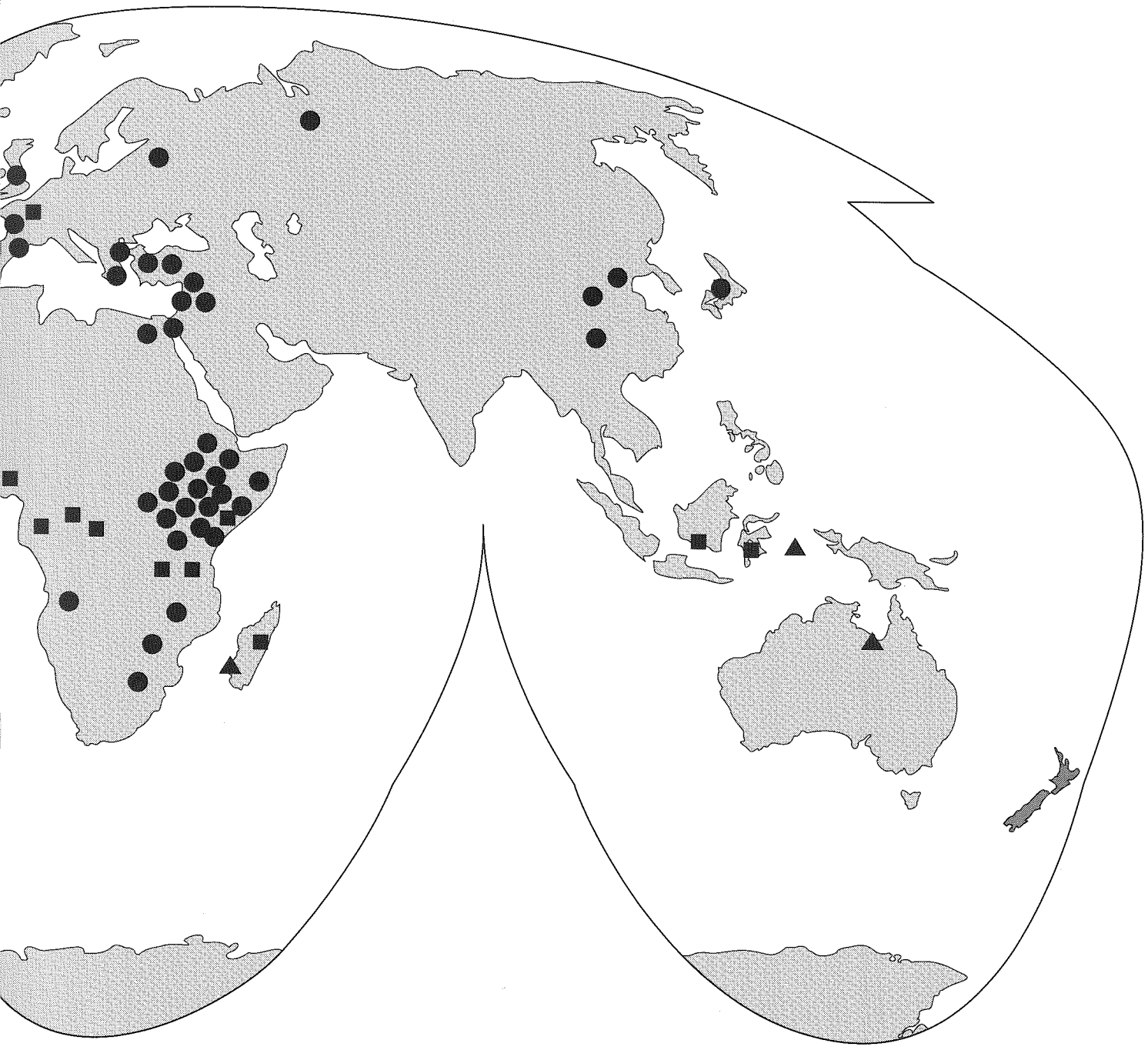

■ Primatology

▲ Cultural Anthropology

● Paleoanthrology

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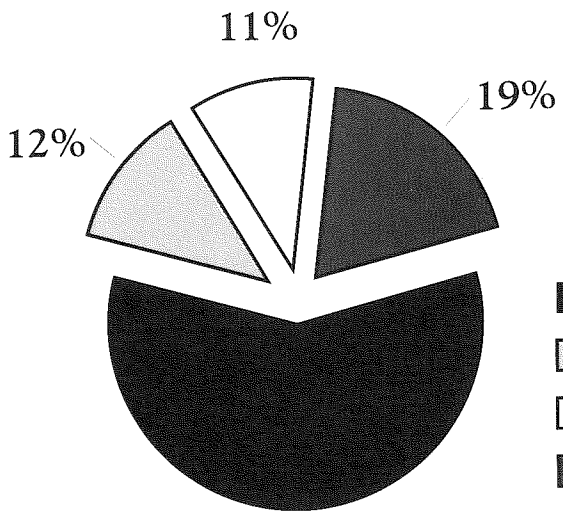
GRANTS



SPRING 1991

Total Grants Awarded in Spring Granting Session and by Designated Gifts

$139,785

- Paleoanthropology
- Primatology
- Education & Conferences
- Baldwin Fellowships

***The L.S.B. Leakey Foundation awards grants during three granting sessions: Fall, Winter and Spring*

PALEOANTHROPOLOGY

Andrews, Peter (British Mus Nat'l History) $2,500
Miocene Excavations at Pasalar, Turkey

Cope, Dana (Colorado State U) $2,500
Intra- and Interspecific Cranial and Mandibular Variation in *Cercopithecus*

Dean, David (CUNY) $3,000
The Middle Pleistocene *Homo erectus/H. sapiens* Transition: New 3D Data Collected by 3D Digitizer and CAT-Scan

Goebel, Frank (U Alaska-Fairbanks) $3,000
Archaeological Perspectives on the Origins of the Upper Paleolithic of Siberia

Graham, Russell (Illinois State Mus) $3,000
Taphonomy of a Natural Catastrophic Death Assemblage of Caribou: Perspectives on Bear Utilization of Carcasses in the Arctic

Grayson, Donald (U Washington) $2,000
The Middle Paleolithic Mammals of Couche 8, Grotte Vaufrey, France

Harris, Jack (Rutgers U) $2,000
Comparative Study of Hominid Land Use in the Pleistocene at Koobi Fora, Kenya

Harrison, Terry (New York U)..... $7,500
Paleoanthropological Research in the Manonga Valley, Northern Tanzania

Hoffecker, John (Argonne Nat'l Lab) $1,000
Zooarchaeology of Mezmajskaya Cave (Northern Caucasus, USSR)

Hublin, Jean-Jacques (College de France) $3,500
The Zafarraya Mousterian Site, Spain

Kelly, Alison (Rutgers U) $5,000
Local and Regional Land-Use in the Kenyan Middle Stone Age

Koufos, George (Aristotle U) $1,500
Excavations For Hominioids in Late Miocene of Chalkidiki, Northern Greece (*Ouranopithecus*)

Lupo, Karen (U Utah) $500
The Economic Anatomy of Selected East African Prey Species

Madrigal, Cregg (Rutgers U) $2,500
Zooarchaeology of Plio-Pleistocene Archaeological Sites at West Turkana, Kenya

Martin, Lawrence (SUNY-Stony Brook) $9,000
Kappelman, John (U Texas)
Excavation and Extension of Survey of the *Sivapithecus* Bearing Sinap Formation, Turkey

Namwamba, Fulbert (U Utah) $5,000
Correlation of Pliocene Strata between Baringo and Turkana Using Tephra

Grants Awarded

Odhiambo-Nengo, Isaiah (Harvard U) $4,000
Morphological Convergence as a Tool for Reconstructing Substrate Utilization and Hand and Foot Posture in Quadrupedal Catarrhines

Rosenberger, Alfred (Smithsonian) $3,000
New Approach to the *Oreopithecus* Dilemma: Computer-Assisted Visualization of Molar Morphology

Scott, Katherine (U Oxford) $2,000
Excavation of the Mid-Pleistocene Channel Deposits at Stanton Harcourt, Oxfordshire, England

Semaw, Sileshi (Rutgers Univ) $3,500
Landscape Approach to Early Pleistocene Archaeology of the Middle Awash, Eithiopia

Sikes, Nancy (U Illinois) $1,500
Stable Isotope Analysis of Paleosols in Pleistocene Archaeological Sites in East Africa

Waddle, Diane (SUNY, Stony Brook) $3,000
A Quantitative Study into the Origin of Modern Humans

Walker, Alan (John Hopkins U) $7,000
Excavation at the Site of an *Australopithecus boisei* Cranium, Kenya

Ward, Carol (U Missouri) $4,000
Comparative Functional Anatomy of *Afropithecus* and *Proconsul*

PRIMATOLOGY

Condit, Vicki (Emory U U) $5,000
Mothers, Adult Male-Infant Interactions, and Female Reproductive Strategies--Tana River National Primate Reserve, Kenya

Galdikas, Birute (Simon Fraser U) $3,500
Wild Orangutan Life Histories at Tanjung Puting National Park, Indonesia

Grieser, Bettina (U College London) $6,000
Impact of Group Size and Tourists on Gorillas in Kahuzi-Biega National Park, Zaire

Kalkstein, Tina (New York U) $200
Interactions between Barbary Macaques and People at La Montagne des Singes, Kintzheim, France

Parish, Amy (UC-Davis) $2,000
Reproductive and Nonreproductive Aspects of Bonobo Sociosexual Behavior, Phase 2

EDUCATION AND CONFERENCES

Celebi, Hurkan (British Mus Nat'l History) $5,000
Attend Postgraduate Seminar in Museum Conservation at the Institute of Archaeology, London University

Heltne, Paul (Chicago Academy Sci) $5,000
Understanding Chimpanzees: Diversity and Survival, An International Symposium

Yirga, Solomon (SUNY) $5,000
To Pursue Post-Doctoral Training in Primate and Human Evolution at SUNY Stony Brook, Department of Anatomical Sciences

BALDWIN FELLOWSHIPS

Fessaha, Nardos (Ethiopian) $8,500
First year of an MA program in Anatomy at Howard University School of Medicine under the direction of Dr. Raymond Bernor; focus vertebrate paleontology and evolutionary biology.

Hundie, Girma (Nat'l Museum Ethiopia) $8,500
First year of an MA program in African Prehistory at the University of Florida, Gainesville under the direction of Dr. Steven Brandt; focus LSA and food production.

Mutundu, Kennedy (Nat'l Museum Kenya) $8,500
First year of two-year award towards a PhD in Archaeology at Washington University under the direction of Dr. Fiona Marshall; focus on zooarchaeology, ethnoarchaeology (pastoralism).

Saanane, Charles (Dept Antiquities, Tanzania) $1,085
For completion of MA thesis at University of Rutgers under the direction of Dr. Rob Blumenschine; focus taphonomy.

Where Are They Now?

The Leakey's Foundation's Franklin Mosher Baldwin Fellowships, established in 1977, are an innovative attempt to usher in a new era in African paleoanthropology.

The fellowships were the brainchild of Ned Munger, then the President of the Leakey Foundation's Board of Trustees, and Elisabeth G. O'Connor, the widow of Franklin Mosher Baldwin. Mosher, a distinguished attorney, took a lively interest in the search for human origins until his death in 1962.

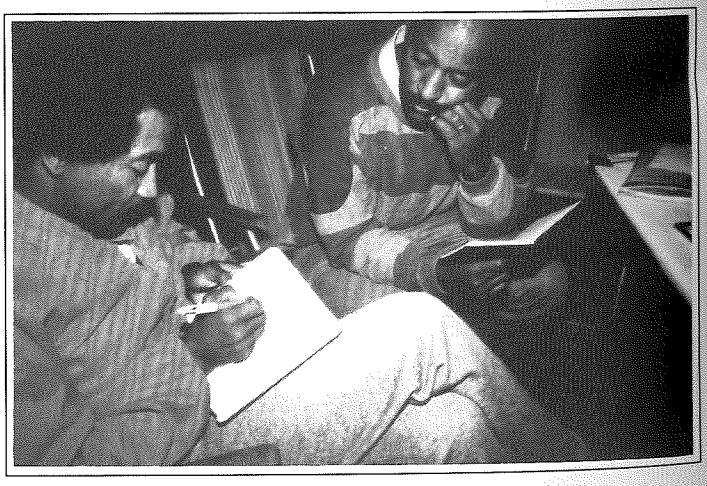
Hoping to honor her late husband's dual interests in early man and education, O'Connor was more than receptive to Munger's suggestion. It would be a fitting tribute to establish a program to educate African scholars in prehistory and paleoanthropology. With the magnificent donation of $500,000, the Franklin Mosher Baldwin fellowships were born.

The dynamic and exciting program was based on a realistic assessment of needs and priorities. Since developing nations must serve their own most pressing concerns — basic issues such as literacy, public health, agriculture, and communications — educating their brightest young people for the study of man's origins was unlikely to be on the top of their list. Yet Africa possesses such extraordinary resources in this area — rich fossil and archaeological sites that cannot be duplicated elsewhere — that the stewardship and careful use of these assets is a task of international importance. By enabling the brightest and best young scholars from these nations to obtain first-class educations, the Leakey Foundation is helping to equip these individuals to assume a leadership role in the future of paleoanthropology, primatology and archaeology in their nations.

Since 1978, 59 Baldwin Fellowships have been awarded, totalling more than $550,000. Recipients include young men and women from thirteen African nations: Ethiopia, Kenya, Malawi, Nigeria, Somali, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe. Some are still studying in the United States at the University of Illinois, Indiana University, Rutgers University, Howard University, the University of Colorado - Boulder, and the University of Florida - Gainesville. Others, having finished their degrees, are teaching at universities throughout Africa or have taken up influential administrative roles in their governments.

Here is a sampler of some of the current activities of a few Baldwin Fellows, in addition to Berhane Asfaw who is featured in New Directions For Ethiopian Science (p. 9). The accomplishments of the fellows are a clear measure of the success of this unique program, funded by O'Connor's original gift and your continuing support:

- **Admed Dualeh Jama** (MA from UCLA; PhD candidate at University of Uppsala) is the Director of Archaeology at Somalia Academy of Science and Culture and teaches archaeology at the Somalia National University.
- **Yusuf Juwayayi** (PhD from UCB) is the Deputy Head of the Department of Antiquities and a senior lecturer at the University of Malawi.
- **Dovi Kueivi** (PhD from UCLA) is the General Director for the National Scientific Research Institution of Togo as well as a professor in the Department of History at the University of Benin.
- **Joseph Maitima** (MA from Duke) now the Director of the Palynological Laboratory at National Museums of Kenya, is currently finishing up his PhD dissertation on aspects of paleoenvironments in Kenya.
- **Francis Musonda** (PhD from UCB) is the Keeper of Prehistory at the Livingstone Museum, Zambia.
- **Giday WoldeGabriel** (PhD from Case Western Reserve) contributes to Ethiopian research while working at Los Alamos National Laboratory, where he previously held a post doctoral position in the Earth and Environmental Science Division.



Dr. Asfaw and geologist Dr. Giday WoldeGabriel complete the daily field logs during 1989 inventory work in the Kesem-Kebena area. Photo courtesy of Tim White.

(The Importance of Ethiopia continued from p.8)

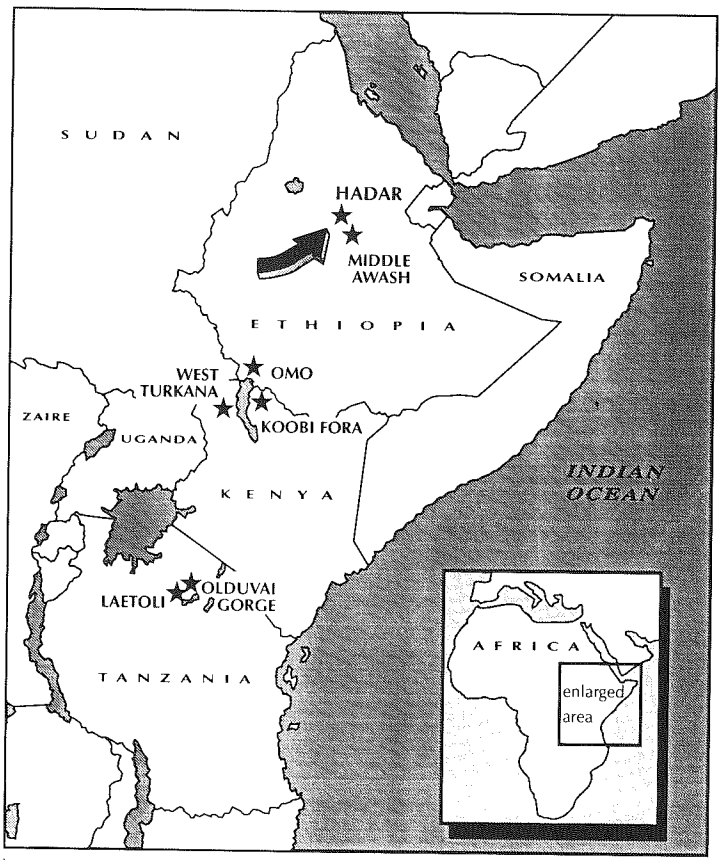
tures, not seen before in *afarensis*. The old argument has suddenly reared its head again: Is this evidence of another, new species or it is just a wider range of anatomical variation within *Australopithecus afarensis*?

As Bill Kimbel of IHO says, "It has to remain a viable alternative that there is more than one species at Hadar and we have to re-evaluate it every time we get new evidence. But I do think so far that it's the best hypothesis. We need to keep asking, 'Is this the simplest, the most probable, the best explanation?' The new material will raise those arguments all over again."

Another surprise is the astonishingly powerfully-built humerus, or upper arm bone, that the IHO team recovered. The bony ridges and scars formed by the attachment of strong shoulder muscles are bound to resurrect the tree-climbing argument again, too. Finally, geological samples were taken so that new, radiometric dates can be run which the team hopes will resolve questions about the dates of the older beds at Hadar. These were originally thought to be almost 4 million years old, but later work and correlations with other sites suggested a more accurate date might be around 3 million years. Robert Walter and Paul Renne, geochronologists at IHO, and Jim Aronson of Case Western Reserve University, will use new and sophisticated laboratory techniques to try to improve the precision and accuracy of the dates.

All in all, Ethiopia has once again proven itself a treasure trove of fossils that stretch and challenge our understanding of human evolution. Nothing is obvious or simple; rarely can debates be settled with a single specimen or an isolated piece of information. As detailed analyses of the new material proceed, the intriguing story of our past will grow ever more complicated and subtle.

The Leakey Foundation has played an important role in supporting many aspects of the research discussed in this article. Some $360,000 has funded field research in the Hadar region and at Laetolil, as well as detailed stratigraphic and radiometric studies, research on the animal fossils by various scholars, and anatomical studies of the hominid fossils themselves. Many of these projects also received funding from the National Science Foundation and the National Geographic Society.



Location of Hadar & other East African Hominid Localities. Illustration by Douglas Beckner, courtesy of Institute of Human Origins

PROFILE

Spotlight on David Pilbeam

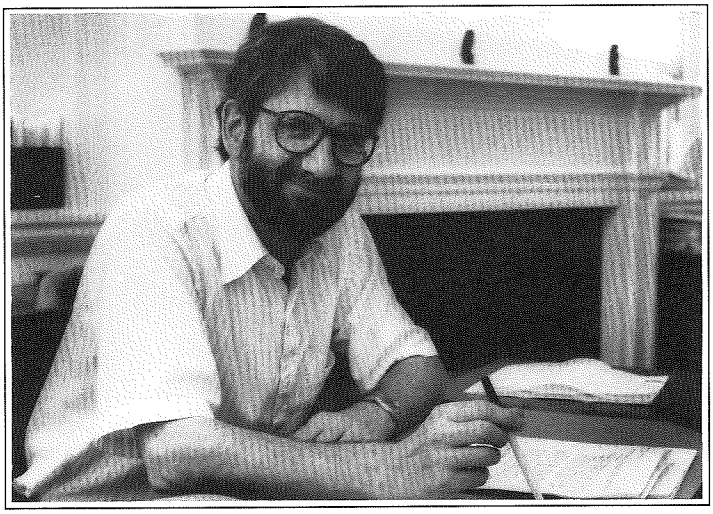


Photo of David Pilbeam by Jane Reed

David Pilbeam is a long-standing member of the Leakey Foundation's Scientific Advisory Council. He is also director of the Peabody Museum of Archaeology and Ethnology and Associate Dean for Arts and Sciences at Harvard University. Below, he discusses his views of human evolution with Peter Costa, Director of the Harvard University Office of News and Public Affairs.

Costa: *Before we discuss the origins of humankind, perhaps we should spend some time talking about the controversy between creationists and evolutionists. Creationists argue that evolution is merely a theory with no more validity than their own theory, creationism, which happened to be anti-evolution. How would you respond to that charge?*

Pilbeam: I'd respond in two ways. First, any theory in the sense in which they're using the term has to be, at least in principle, open to refutation and I've never heard any creationists talk about what new discovery or what new piece of data would lead them to cease believing in that particular theory.

The second point: I think they use the word "theory" in a way that is the normal colloquial usage, which is as when someone says, "Oh, that's just a theory," which means it's speculative. Without being too pedantic about things, it's worth noting that scientists normally use the word "theory" to describe a substantially supported interpretation of a body of data — probably a quite diverse and extensive body of data — that is very widely accepted. In that sense, then, evolution is a widely accepted theory: many predictions that it makes are validated by observation, by collecting data, and so forth.

Costa: *For example, let's take Einstein's theory about gravity. I think it was Stephen Jay Gould who may have written that because it was only a theory of gravity apples would not suddenly stop falling to the ground.*

Pilbeam: Yes. It's a very well-structured explanation for the way a certain aspect of the world works. And the theory of evolution helps to explain an enormously diverse range of different kinds of data, data that are collected about the past, but also lots of data about the present. It's very difficult to explain almost anything in genetics, say, without recourse to evolutionary theory.

Another problem with creationism as it's manifested in the United States — where it is, in fact, a very particular and specific theological argument which has clear statements and expectations about the age of the Earth, for example — if that version of creationism is correct, then it's not only biologists and evolutionists who are out of a job, but physicists and chemists as well. We won't hear very much about that. If creationism is correct, then it means that very large amounts of physics and chemistry cannot be right and I think that will come as a great surprise to many physicists and chemists.

Costa: *Is there a so-called canon for evolution and would you ever consider having undergraduates study creationism?*

Pilbeam: There are certain works that are seminal if not canonical in evolution, that is to say they were extremely influential, and many of those great works can still usefully be read by students today. One of them in particular, Darwin's *The Origin of Species* — the book that really kicked it off — should be required reading for every beginning evolutionary biologist. It's still full of the most incredible range of wisdom and observation.

Costa: *Let's turn for a few minutes to the origins of humankind. The central question is, do humans and apes share a common ancestor?*

Pilbeam: Yes, they do, and the best evidence that they do comes from studying comparative genetics of these species. Humans and chimps are about 98 percent similar in their DNA, which is just a little bit more similar than either of them is to the gorilla. Both the chimp and the gorilla are African apes still living today — unfortunately endangered — in tropical Africa, and although we have no direct fossil evidence of the very, very earliest human ancestors

(hominids), the chances are very good that they lived in Africa as well and that we probably shared a common ancestor with the chimp and then with the gorilla somewhere between 5 million and 8 million years ago. But that there is a common ancestor is quite clearly the case and that it lived surprisingly recently is also now quite widely agreed upon.

Costa: *It seems, from my reading, that there are a couple of hallmark signs one looks for in determining who is human and who is not. One seems to be cranial capacity — larger brain, usually over 900 ccc — and upright walking, bipedal motion. Could you comment about that and tell us when we became human by those two indicators?*

Pilbeam: Those two indicators don't show up at the same time. Hominids were bipedal long before they had expanded brains. We don't have a really adequate fossil record for hominids until just a little under 4 million years ago. So we really don't know what the very earliest hominids were like. But by 4 million years ago it's clear that we're dealing with animals that lived in Africa — not in forests but in wooded areas and more open country areas. They were bipeds, although the general consensus now is that they were not exactly bipedal in the way we are. They probably still climbed in trees quite a bit more than humans do or did until recently.

"...if...creationism is correct, then it's not only biologists and evolutionists who are out of a job, but physicists and chemists as well...If creationism is correct, then very large amounts of physics and chemistry cannot be right..."

They had brains barely bigger than those of apes of the same body size — roughly chimp size — and they would have ranged between 30 and 60 kilograms [66 and 132 lbs.] as adults. Their brain volume would have been about what it is for a chimp, which is roughly a quarter the size of our adult brain volume.

The first indication that there is any significant increase in brain volume above that would be a little bit before 2 million years ago when we get hominids with brains up to 700 cc's, which is about half of our volume — we average around 1400 cc's. Then there's a second jump to an average of around 1000 cc's by about a million years ago. Then the final jump would be to the average we find today — maybe a little bit bigger because these were on average bigger-bodied people than we are now — and that would have been achieved by about 100,000 years ago.

Costa: *Nevertheless, the ratio of brain size to body weight is important in species, and in the case of humans, we have the highest ratio.*

Pilbeam: No, that's not true. If you look at just the brain to body weight ratio I think it's the case that mice do as well if not better than humans, and there are a number of primate species, small monkeys, that have higher brain to body weight ratios.

Of course, when that was first discovered what it meant was that people interested in human brain evolution went away and thought of a different way of calculating it so that humans came out on top. It always seems to be the case that we will go on changing the rules of the game until we can figure some measure or some ratio or some index where humans come out ahead.

If you're talking about success biologically, rodents have done very well, cockroaches have done very well, cattle have done very well. But it is the case that it's the brain and what the brain produces that really marks us among mammals as being uniquely different. It's behavior really that makes us different.

Costa: *Could you talk about that transition from the trees to the ground?*

Pilbeam: That period is unfortunately not sampled yet. The question in my mind is when we start discovering fossils from the correct time period whether we will be able to recognize our ancestors because I suspect they may look a little bit different from the way many of us have expected them to look. Given the fact that there is no direct fossil record, all that one can do is try to speculate on what might have happened.

"It's behavior really that makes us different."

Continued on p.30.

EVENTS

Aug. 19 - Sept. 5: *Safari to Kenya and Tanzania: An Anthropological Search for Early Man*

Trace the evolution of early man, experience the fascination of the African bush, and marvel at the mystery and wonder of Africa on this unique expedition safari hosted by Dr. Richard E. Leakey, Dr. Mary Leakey, Dr. Irven DeVore, and Dr. Shirley Strum. Call or write the Leakey Foundation for a brochure, or call Peck Judah Travel Service to make your reservation (415) 421-3505 or 1-800-336-7790. There are a few spaces still left.

October 10 -12: *Leakey Foundation Annual Meeting, Leakey Prize Symposium and Award Ceremony, Cambridge, MA*

The Leakey Foundation's Annual meeting will be held at Harvard University on October 11 & 12. A symposium in honor of the first recipient of the Leakey Prize will be held the afternoon of Oct. 12 at the American Academy of Arts and Sciences. Tentative speakers include: Dr. Ofer Bar-Yosef, Dr. Kristin Hawkes, Dr. Maryellen Ruvolo, and Dr. Richard Wrangham. For details call the Leakey Foundation Office (415) 834-3636.

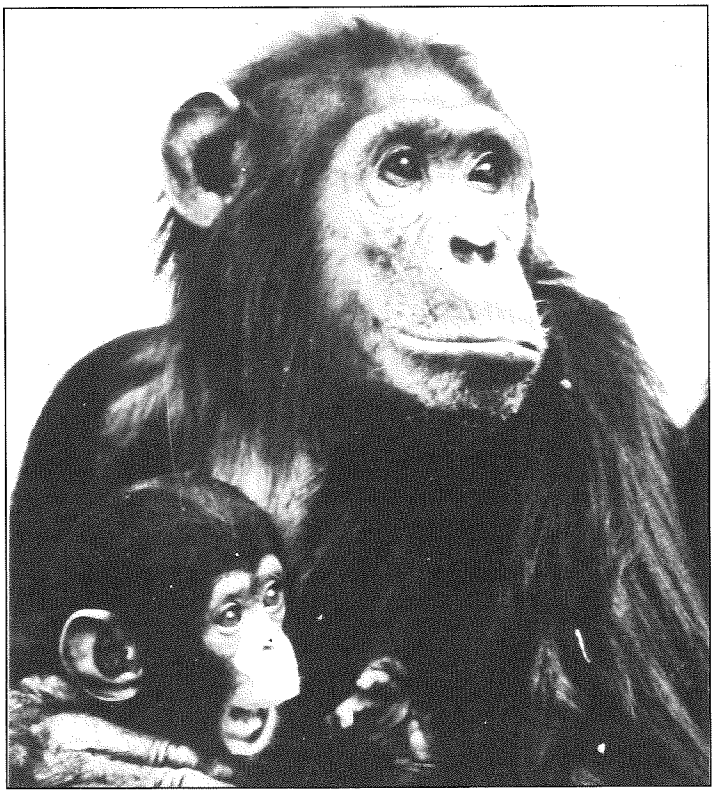


Photo by Kenneth Love

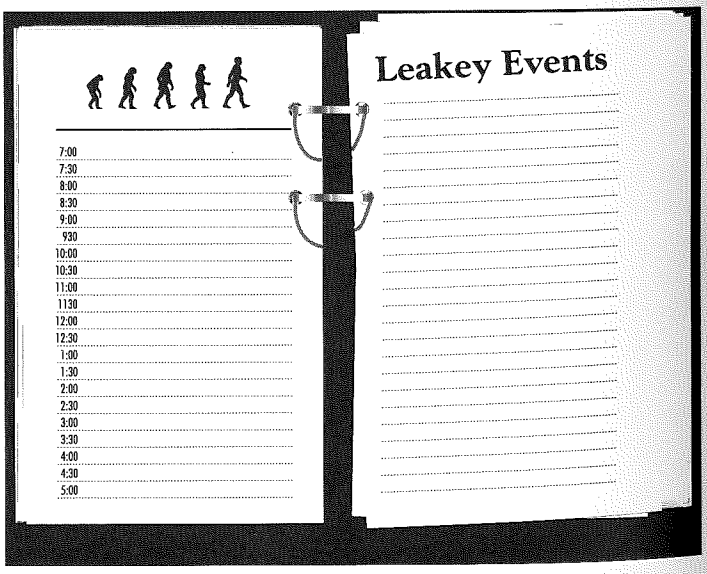
December 11-15: *Understanding Chimpanzees: Diversity and Survival*

An international symposium hosted by Dr. Jane Goodall and Dr. Richard Wrangham (Leakey Foundation SAC) designed to convene leading researchers of chimpanzees and bonobos to share information about current research and chart a path for future research and conservation efforts. Co-sponsored by the Leakey Foundation and other organizations, this symposium is a follow-up to a similar one held in 1986 which dramatically advanced the collaboration and communication between researchers on chimpanzees and bonobos. Most significantly, the 1986 symposium focused on data which led to the listing of chimpanzees and bonobos as endangered species, considerably enhancing their protection in the wild.

Several Great Ape Research and Conservation Fellows will be attending the conference. Since 1984, the Leakey Foundation and Wildlife Conservation International, a division of the New York Zoological Society, have jointly funded this fellowship. Recipients speaking at the conference include: Christophe and Hedwige Boesch, G. Isabirye-Basuta, John Mitani, and Caroline Tutin.

There will be public sessions, films and vidos throughout the academic sessions. These will take place on November 16, 19, December 3, 10 and 15, 1991. Please call Kathleen Conn at the Chicago Academy of Sciences for more information (312) 943-7056.

February 26-28, 1992: *Dr. Richard E. Leakey will speak at the San Diego Zoo, specific date TBA.*



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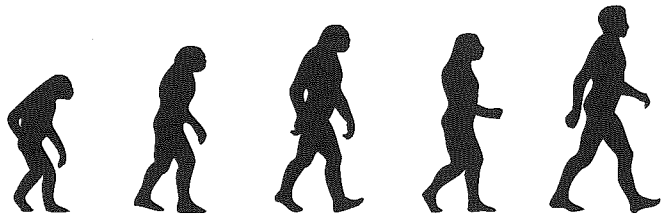
For Research Related to Human Origins, Behavior and Survival.



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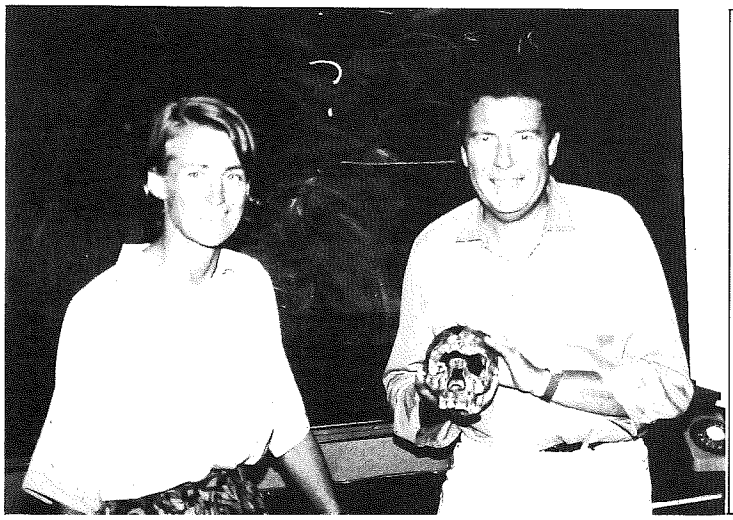
The Allen O'Brien Memorial Lecture

FEATURING...

Dr. Meave Leakey & Dr. Alan Walker



"Adventures With The Missing Link"

November 7, 1991	*American Museum of Natural History*- New York City - 7:30 P.M. For information, please call (212) 769-5700
November 10, 1991	*Museum of Natural History* - Los Angeles - Afternoon For information, please call (213) 744-3342
November 12, 1991	*California Academy of Sciences*-San Francisco - 7:30 P.M. For information, please call (415) 750-7128

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Phillip V. Tobias to Receive First Leakey Prize

Phillip V. Tobias was awarded the first Leakey Foundation Prize for Multidisciplinary Research in Ape and Human Evolution.

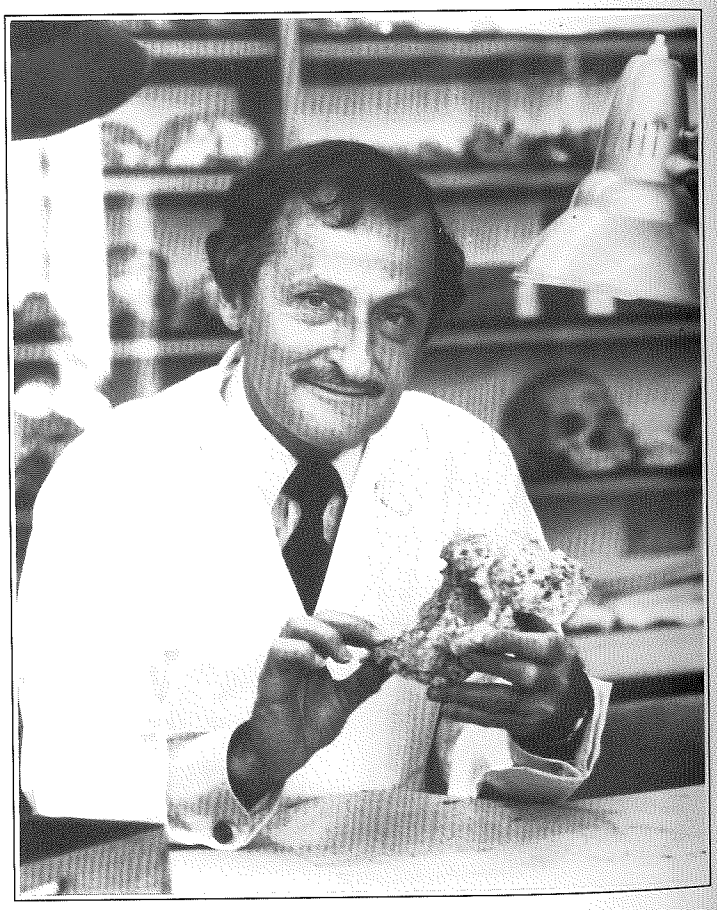
Phillip Valentine Tobias, Professor in the Department of Anatomy and Human Biology, and Director of Paleoanthropology at the University of the Witwatersrand Medical School in Johannesburg, South Africa, has been named the first recipient of the Leakey Foundation Prize for Multidisciplinary Research in Ape and Human Evolution.

The Prize rewards intellectual achievement and expresses appreciation for research performed with courage and perseverance in the fields of human evolution. It honors a scientist who transcends the boundaries of a single discipline with work linking widely differing branches of sciences. The $25,000 prize and the accompanying medal and certificate will be awarded October 12, 1991, a dinner following a symposium dedicated to the recipient and co-sponsored by the Peabody Museum of Harvard University, the American Academy of Arts and Sciences in Cambridge, Massachusetts, and the Leakey Foundation.

Born in Durban, South Africa, on October 14, 1925, Tobias was educated at the University of Witwatersrand and Cambridge University. He has been on the faculty at Witwatersrand since 1951, where he was a colleague of Professor Raymond Dart, the discoverer of the first australopithecine skull.

Tobias' work centered principally on genetics and hereditary diseases, despite his awareness of the important new fossils then being found in South Africa. "In 1945," Tobias recalls, "I organized and led the first expedition that brought back fossil baboons from Makapansgat, and several successive expeditions in 1946 which paved the way for the finding in 1947 of the first *Australopithecus* fossil there. Nevertheless, I did not carry out any laboratory researches on the South African australopithecine remains as such. The reason was that I did not want to encroach on a field I considered to be the preserve of Professor Dart and Dr. Robert Broom. So I eschewed laboratory work on these fossils and concentrated instead on the physical anthropology and genetics of the living and recently dead. Thus, it was Dr. and Mrs. Leakey's generous offer to undertake the definitive study of the cranium, that properly speaking, brought me into the field of human evolution." (p.72-4, *Human Origins: Louis Leakey and the East African Evidence*, Issac and McCown, eds.)

Tobias has been involved with many scientific organizations, both internationally and within South Africa: for example, the Institute for the Study of Man in Africa, the Pan-African Congress on Prehistory and Human Paleontology, the Royal Society for South Africa, and the Centre for the Study of the Mountain Gorilla. Tobias is also known for his outspoken stand against apartheid, working with organizations such as the Academic Freedom Committee of the University of Witwatersrand, the National Education Union of South Africa, and the South African Institute of Race Relations. "There is a message of hope in the story of evolution in spite of man's inhumanity to man that we see as we look around," Tobias says. "Another intriguing aspect of the evolutionary story gives powerful justification for the brotherhood of man. This 5'7", million-year-old called *Australopithecus* is the great-great-great-grandfather of us all: black, white, and yellow."



Photographed by Struan Robertson

REVIEWS

Members may enjoy reading the following books. They are not available through the Leakey Foundation but can be ordered through your local bookstore or library.

Olduvai Gorge.

Vol. 4. The skulls, endocasts and teeth of Homo habilis. *P. V. Tobias. Cambridge University Press: Cambridge and New York. 1991. 2 vols, 921 pp, ISBN 0-521-20072-5. $175.*

Phil Tobias' latest magnum opus is the long-awaited description and analysis of the Olduvai fossils assigned to the species *Homo habilis*, which was of course named by Louis Leakey, Tobias and John Napier in 1964. This forms the fourth volume in the series of monographs about Olduvai begun by Louis in 1965 with a survey of the fauna and geology and continued by Tobias with a description of the cranium of "Zinjanthropus", or *Australopithecus boisei* in 1967 and by Mary Leakey with a report on the archeology of Beds I and II (in part) in 1971. The current work concentrates on four partial skulls with teeth, OH (Olduvai Hominid) Numbers: 7, "Johnny's Child" (the type lower jaw and middle part of the braincase); 13, "Cinderella" (most of the lower and upper jaws and rear of the braincase); 16, "George" (a badly broken-up and incompletely reconstructed braincase and most of the teeth); and 24, "Twiggy" (a flattened skull partly reconstructed but still distorted). An additional 15 fragments are also included. Each specimen is described, illustrated and compared in detail. Two further chapters survey the dental anatomy and the information to be learned from "brain casts" (endocasts) of this species, while long summary chapter reviews all known features of *Homo habilis*, evaluates its evolutionary position (basically between *Australopithecus africanus* and *Homo erectus)* and its relationship to the Oldowan culture, and concludes that the development of speech can be suggested as the most important factor in the origin of genus *Homo* and would have been present in *Homo habilis*. The data presented here will be evaluated and employed in comparative analyses for decades to come; these volumes are a tribute not only to Phillip Tobias, but also to Louis and Mary Leakey who discovered the fossils and chose Tobias to be their primary interpreter.

Eric Delson
Lehman College of the City University of New York.

A Provocative New View of Human Evolution

Narratives of Human Evolution *by Misia Landau – Yale University Press, New Haven, CT. $22.50 hardbound*

This is a book guaranteed to make you stop and think — the sort of book with an argument so simple, clear, and innovative that you wonder why you never saw it before.

Landau's basic premise is that theories in paleoanthropology are, intrinsically, story-telling. However soundly the scientific observations are based, at heart the theories attempt to explain — to recount — how humans came to be. Landau convinces us that, because the subject is truly a historical narrative, the scientists constructing those theories consciously or unconsciously borrow the structure of a common form of literary narrative, the folktale.

Folktales, like theories of human evolution, share a series of structural slots comprised of stock characters and events that are shuffled and rearranged to make each story unique. For example, there are a series of characters — the hero (our evolving hominid), the villain or dragon (obstacles or dangers to be overcome), the enabler or donor of magical powers (natural selection which gives the hero a big brain or special tools), and the maiden or prize (anything precious that is won or accomplished). There are also a mythic series of events: the initial safe, untroubled state (life in the trees); the departure onto a journey marked by a series of tests or dangers (invasion of the terrestrial world); the discovery of a means to overcome these trials (bipedalism, tools, enlarged brain); the final test and the completion of the transformation into true humanity (development of modern social and cultural attributes).

From this perspective, Landau then takes a hard look at some of the major figures in paleoanthropology and their theories. She starts with Darwin, Huxley and Haeckel in the nineteenth century, moving on to Arthur Keith and Grafton Elliot Smith in the early twentieth century, and finishing up with Raymond Dart, Phillip Tobias, Donald Johanson and Tim White in more recent decades.

In one sense, Landau's theme seems to condemn the field as a non-science: "...there is no escape. It is story-telling that makes us human....", she says (p. 176). In another sense, she points out, it is the very poetic richness and the mythic resonances that give human evolutionary theories their power, their appeal, and their significance. Because of these deeper truths, we are able to mine these theories for new hypotheses that can be tested and that may, in the end, eliminate certain versions of the story as contradictory to the facts. The bottom line is that being aware that a theory is a narrative story does not deny its possibilities of being insightful, illuminating, or even accurate.

This is excellent, thought-provoking reading recommended for any reader, from layperson to scholar. - **Pat Shipman**

Dragon Bones and Drugstores

Illustration courtesy of Dragon Press Pasadena, California

Traditional oriental pharmacies are wild and wonderful places. Even today, when many Asian Countries have enthusiastically propelled themselves into the fast-moving age of microelectronics, shoppers can find an intriguing assortment of medicinals for sale in places such as Singapore and Hong Kong.

About five years ago, I wandered into a drugstore a little off the beaten track on Kowloon and discovered a bizarre juxtaposition of magic and science. Just down the street from the alley where snakes are caged (many Chinese believe that snake soup will fortify them against the chill of winter), was a thoroughly modern-looking storefront, complete with shiny chrome-edged display cases and a sign in English as well as Chinese.

But next to the aspirin and antibiotics a different sort of potion was for sale: fresh staghorn, the aphrodisiac of choice if money is no object. A further look revealed other fantastic merchandise -- dried and shriveled stuff of dubious origin, jars of desiccated; seahorses and star-shaped flower pods, urns of oily black liquid, ginseng root, and more.

Ironically, it was in just such a place as this that the first clue to a still-enigmatic giant ape was discovered. In 1935, German paleontologist Ralph von Koenigswald was looking through a dusty drawerful of "dragon bones" in a Hong Kong apothecary when he spotted a molar so big he was certain it had to belong to a species yet unknown to science. He subsequently named the species *Gigantopithecus blacki*, in honor of Davidson Black, his friend and colleague (the first to discover and name Peking Man) who had died a year earlier.

Von Koenigswald was digging for bones in a drugstore because of the unusual faith some Chinese people have in the healing powers of fossils -- "dragon bones."

For a thousand years at least, poor peasant farmers of rural China have diligently mined the karst hills, rich storehouses of all kinds fossils, to supplement their income.

But von Koenigswald was neither the first nor the last paleontologist to exploit this unusual source of fossils. As early as the 1870's, British geologists noticed fossil teeth in traditional drugstores and, in 1899, K.A. Haberer made a famous collection of Chinese fossil "dragons" which he brought back to Munich when the Boxer rebellion cut his travels short. In 1935, Pierre Teilhard de Chardin, the French paleontologist, and von Koenigswald simultaneously turned up some of the first known fossil orangutans in the same way. Soon to follow was von Koenigswald's discovery of *Gigantopithecus*, the largest ape that has ever been discovered.

"After the first discovery of orangutan teeth in Chinese chemist's shops," writes von Koenigswald in his book *Meeting Prehistoric Man*, "I missed no opportunity of looking for teeth in such shops both inside

and outside China. They were enormously widespread in the East.... The Chinese often pretended not to have any teeth in stock, since they knew only too well that, as a European, I did not believe in their magic efficacy. But when they saw my prescription they gave me a friendly smile, and always managed to find a little packet of carefully wrapped dragons' teeth in some corner or other.... I always feel a peculiar sensation when the dragon's teeth are spread out before me in a Chinese apothecary's shop, and I look to see whether there may be teeth of a new, hitherto unknown species among them."

A recent expedition funded in part by the Leakey Foundation sought more remains of Gigantopithecus, this time in Vietnam. The project is described in the book *Other Origins* by Russell Ciochon, John Olsen, and Jamie James. According to that book "The magnitude of the dragon bone trade...is revealed by a customer's report dated around 1900, which states that in excess of twenty tons of fossil bones and teeth were being loaded at Chinese ports annually..." And that was just a portion of the haul that was shipped out of China in a given year.

The practice remains so widespread that Russell Ciochon, like von Koenigswald before him, makes the traditional pharmacy his first stop in every Chinese city he visits. Among other things, he has found primate teeth and remnants of the once predominant panda.

A perfectly preserved rhinoceros tooth -- long extinct in Southeast Asia -- weighed out to cost him about $15. But he had to talk fast to prevent the pharmacist from grinding the fossil into powder.

Adapted from an article by Carol Harker in the Iowa Alumni review, 1991, with permission.

In Memory of Dr. Allan C. Wilson

Dr. Allan C. Wilson, Professor of Biochemistry at the University of California at Berkeley, died of leukemia on July 21, 1991. He was 56 years old.

Born in Ngaruawahia, New Zealand, Dr. Wilson earned his Ph. D. in Biology from the University of California at Berkeley in 1961 and joined the faculty there in 1964.

Dr. Wilson was a frequent and popular speaker at anthropological symposia, including the fall, 1990, Leakey Foundation symposium at Rutgers University, at which he delivered the after-dinner speech. He was widely known as an innovative thinker and a pioneer in the application of molecular techniques to anthropological and evolutionary problems. In 1986, Wilson received a John D. and Catherine T. MacArthur fellowship--known in the popular press as a "genius" award -- for his creative and ground-breaking contributions to science. He was also elected a member of the Royal Society of London and the American Academy of Arts and Sciences.

Dr. Wilson is perhaps most famous for his work on the controversial "Eve" theory. Research in collaboration with Rebecca Cann and Mark Stoneking suggested that the mother of all modern humans lived in Africa only 200,000 years ago.

His quick mind, maverick views, and stimulating ideas will be sorely missed by all those interested in anthropology. Those who had the opportunity to become his friend will also regret the loss of his gentleness and kindness.

(Profile continued from p.23)

I don't think it's too outrageous to speculate that our immediate hominid precursor would have been more or less like a chimpanzee. It would have been a quadruped when it was on the ground, walking on the backs of its flexed fingers — which is why it's often referred to as knuckle walking — and climbing in the trees with its long arms and long hands. Bipedalism evolved from quadrupedalism of that kind.

As to why it evolved, there have been many different suggestions, some of them more fanciful than other. But using the terminology of evolutionary theory, if you could think of a way of selecting for animals that have to travel longer distances during the day or that have to carry something, or maybe do both, then you might very well see an animal that is quadrupedal like a chimp becoming increasingly bipedal.

Now, how could you get an animal to more a longer distance each day? Well, you could move its preferred food sources further apart. Supposing an animal is feeding on certain kinds of food that it collects from tree and you have an environmental change so that the clusters of trees are no longer so continuous but are spread out so that you have selection pressure to make the animal move further — that might do it.

Of course, once you begin to be a little bid bipedal, which means that you would be bipedal a little bit of the time, you are able to carry things more effectively. For example if you want to carry food away from where you've collected it back to another place to eat it, or if you want to carry food to share with another individual, or if you want to take food away from other individuals to reduce competition, or any of the above, you might well end up favoring the emergence of bipedalism.

Costa: *So you've taken us humans now to upright walking-on-two-feet bipedalism and my question is, when did we develop language and the use of tools?*

Pilbeam: Tools is easy to answer; language is very difficult to answer.

It's very likely that right from the beginning hominids were using tools at least to the extent that chimpanzees living today are using tools. Chimps use a whole range of natural materials: wood, even stone, twigs, long pieces of grass, crumpled-up leaves as sponges and washcloths. A whole range of activities like that were probably going on with early hominids, but it's not until early hominids began to fabricate tools out of stone that you get a record, because wooden tools don't get preserved. That doesn't begin until around 2-and-a-half million years ago. That's when the very first stone tools are being flaked, when hominids pick up two rocks and bash one against the other, knock off a sharp piece and start to use it to cut meat, to cut vegetables, to cut pieces of wood, to cut up skins, and so forth. Then by a little under 2 million years ago the next interesting step that happens is that hominids are starting to make tools that are really quite carefully patterned; they're relatively large, symmetrical tools. These are the so-called hand axes.

From then on for more than a million years, tools that hominids are making really don't change very much. Things begin to speed up over the last few hundred thousand years and you begin to get much more elaborate and complex tools made. Then there's a final kind of kick around 40,000 years ago when you get what's technically called by archaeologists the Upper Paleolithic industries.

The question of language — that's much more difficult to call. Some people have argued that the kind of brain that was capable of producing tools would also be one that's capable of producing some kind of language. I think that's a plausible argument but the key would be that it's *some kind of language*. It's unlikely to have been language in its fully modern human form. If you're going to be very conservative and say, well, we will only admit the existence of fully modern human language capabilities when we see clear signs in the archaeological record that hominids were behaving recognizably like living groups do today, then its really quite recent.

Costa: *Did hunting help accelerate the formation of language? In other words, you would have to say to your companions, "You go there, I'll go here, and we'll catch the behemoth between us."*

Pilbeam: Certain kinds of hunting, very elaborate kinds of hunting of the sort practiced by a number of human groups....into recorded history — yes, that requires language. What you then have to ask is, what's the archaeological evidence for hunting of that degree of sophistication and complexity? Archaeologists disagree as to when the full package had finally evolved, but I think they all agree that it's really quite late, that it's in the last 100,000 years, and some of them would argue that it's quite a bit more recent than that.

This article is excerpted from "A Conversation with David Pilbeam" by Peter Costa, with permission from the Harvard University Gazette, where it originally appeared.

Welcoming New Fellows

The Leakey Foundation welcomes the following new members to the Society of Fellows. Each Patron makes an annual contribution of $1,000. Fellows contribute $500 each year to the Foundation's Research and Education Program.

CORRECTION: In the last issue of AnthroQuest the name of Leakey Foundation Fellow Mrs. Abigail Bernhardt was inadvertantly misspelled. Our apologies for the mistake, Mrs. Bernhardt!

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We also welcome three new members to the Board of Trustees:

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Meet the Challenge:

This year, a special challenge fund has been established through the generosity of the Chairman and President of the Board of Trustees. They will match, dollar for dollar, any gift of $500 or more and welcome these donors into the Society of Fellows. Benefits of membership include: invitations to visiting scientist programs including private dinners and receptions; participation in Leakey Foundation travel to anthropological sites; and special gift books and videos. Please consider additional support for the research and education programs you read about in AnthroQuest.

Thank you.

Leslie Anne Fox
Executive Director

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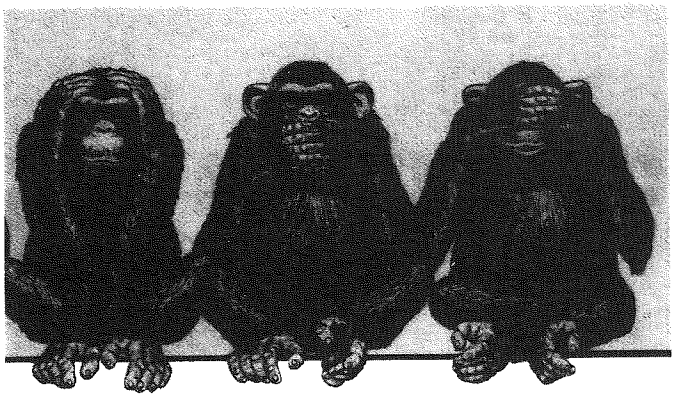
SCIENTISTS *Under The Microscope*



On Tuesday, June 11, 1991, an eclectic group of anthropologists, museum and medical professionals, and representatives from the computer industry gathered at the IBM Scientific Center in Palo Alto, California, for Prehistory in the Future, a demonstration of potential applications of computer technology to anthropology. The demonstration was co-sponsored by the Leakey Foundation and IBM.

Over 40 people turned out to see the presentation and participate in a discussion revolving around the possibilities and problems of creating an international physical anthropology database based upon existing museum collections. Participants included representatives from the Natioanl Museum of Natural History, the California Academy of Sciences, Stanford University, and University of California, Berkeley and Santa Cruz.

The colloquium, which was initiated by Dr. Robert Taylor of UCSF, was led by William Hanson of IBM. Speakers included Horace Flatt and Ralph Berstein, discussing the evolution of image processing, automated and interactive image analysis. Dr. Patrick Mantey used the new "electronic" library system at UC Santa Cruz as an illustration of a large data base, its uses and needs. Walter Hartwig closed the presentations by explaining the link between the technology and the potential applications from the perspective of a physical anthropologist.

The Leakey Foundation is pleased to have been involved with what is sure to be a recurring issue in matters of preserving the past.

To all members of the Leakey Foundation: *Beginning in 1992 AnthroQuest will be a bi-annual publication with issues produced in the Spring and the Fall.*

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