ANTHROQUEST

news of human origins, behavior and survival

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DIET:
PALEOLITHIC GENES
AND
TWENTIETH CENTURY HEALTH

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For the past seven years we have been investigating the proposition that the major chronic illnesses which afflict humans living in affluent industrialized Western nations are largely the result of a mismatch between our genetic constitution and a variety of lifestyle factors which have bioenvironmental relevance. The diseases include atherosclerosis with its sequels of heart attacks, strokes and peripheral vascular disease; adult onset diabetes; many important forms of cancer; hypertension (high blood pressure); emphysema; and obesity. The main lifestyle variables are diet, exercise patterns and exposure to abusive substances – chiefly alcohol and tobacco. We have taken the basic position that the genetic constitution of humanity, which controls our physiology, biochemistry and metabolism, has not altered in any fundamental way since *Homo sapiens sapiens* first appeared. In contrast, cultural evolution during the relatively brief period that anatomically modern humans have existed on earth has been breathtakingly rapid, so that genes selected during the eons of hunter-gatherer existence must now function in

continued on page 19

OUR GREATEST CHALLENGE

Gordon Getty, chairman of the board of the L.S.B. Leakey Foundation, has presented our organization with its greatest challenge. He has given us five million dollars to be matched by an equal amount in contributions from other benefactors.

Such a generous gift is a tremendous spur to the Foundation as we contemplate the grants for scientific research and education that can be made with these monies. It will be possible to provide far more than seed money as we plan to meet the very urgent needs of living hunter-gatherer and primate studies.

It is also a challenge, albeit a welcome one, to raise the matching funds. Those of you who would like to share in this opportunity to widen the world's store of knowledge, please help us meet this challenge. Mr. Getty is giving us all a chance to be part, however small or large, of our scientific future.

THE L.S.B. LEAKEY FOUNDATION NEWS

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PRESIDENT'S MESSAGE

To our fellows, members and friends:

The Leakey Foundation is extremely pleased that Barbara Newsom has joined our staff as Executive Vice President. Barbara has long been a valued and active trustee and we know that her abilities will contribute greatly to the Foundation in her new capacity. I will turn the remainder of this message over to her.

Our front page news is certainly the most exciting and challenging the Leakey Foundation has ever had!

The "challenge" grant of five million dollars from the chairman of our board, Gordon Getty, will take the Leakey Foundation into a new era of research funding. When matched, it will allow us to sponsor major projects, committing to longer and more ambitious field studies than were possible before.

You know of the work of some of the more "famous" grantees of the Leakey Foundation: Louis Leakey, Mary Leakey, Jane Goodall, Dian Fossey and Donald Johanson. I hope you also know of the many "seed grants" that we have made to young scientists beginning their research. We have always been on the cutting edge of the study of human origins, and we are extremely proud of this element of our sponsorship. Only recently, The New York Times *front page carried a long article on the new discoveries of Russell Ciochon in Burma. This research was funded by several small grants from the Foundation.*

When I joined the Leakey Foundation as a fellow in 1973, our programs often consisted of a lengthy slide-illustrated lecture on one single molar. Now we learn of our ancestors' living strategies, how they walked, and even what they ate!

We have come a long way, and yet there remains a "now or never" quality to anthropological research. Further search for a large fossil database is of critical importance. Human population encroachment and deforestation threaten the few remaining groups of great apes and hunter-gatherers – animal and human alike.

For our part, we will continue to sponsor lectures, symposia and fellows' programs as well as funding research. We hope to expand our schedule of activities to encourage your interest in the work of the Foundation. We will continue to look to you, our friends, for help in meeting this new challenge.

May I underline all that Barbara has said? There is no better time than the December holidays to join in the urgent search for anthropological truths.

KENYAN STUDENT SCHOLARSHIP

The Leakey Foundation will join Rockford College, Rockford, Illinois, in supporting the scholarship program for Kenyan students recently established at the college. The Foundation's award is for $6,000 a year for three years for two students in undergraduate science. The remaining expenses will be met by Rockford College.

The grants are to be named the Louis and Mary Leakey Honor Scholarship for Kenyan Students. It is anticipated that the National Museums of Kenya will be involved in the nationwide competitive selection of applicants, who must be English speaking citizens of Kenya.

The program is being established because of the urgent need to improve undergraduate level scientific training of young Kenyan men and women for careers in the sciences. ■

BRAIN EVOLUTION AND THE FAMILY

The Newness of Mammals in the Oldness of Reptiles

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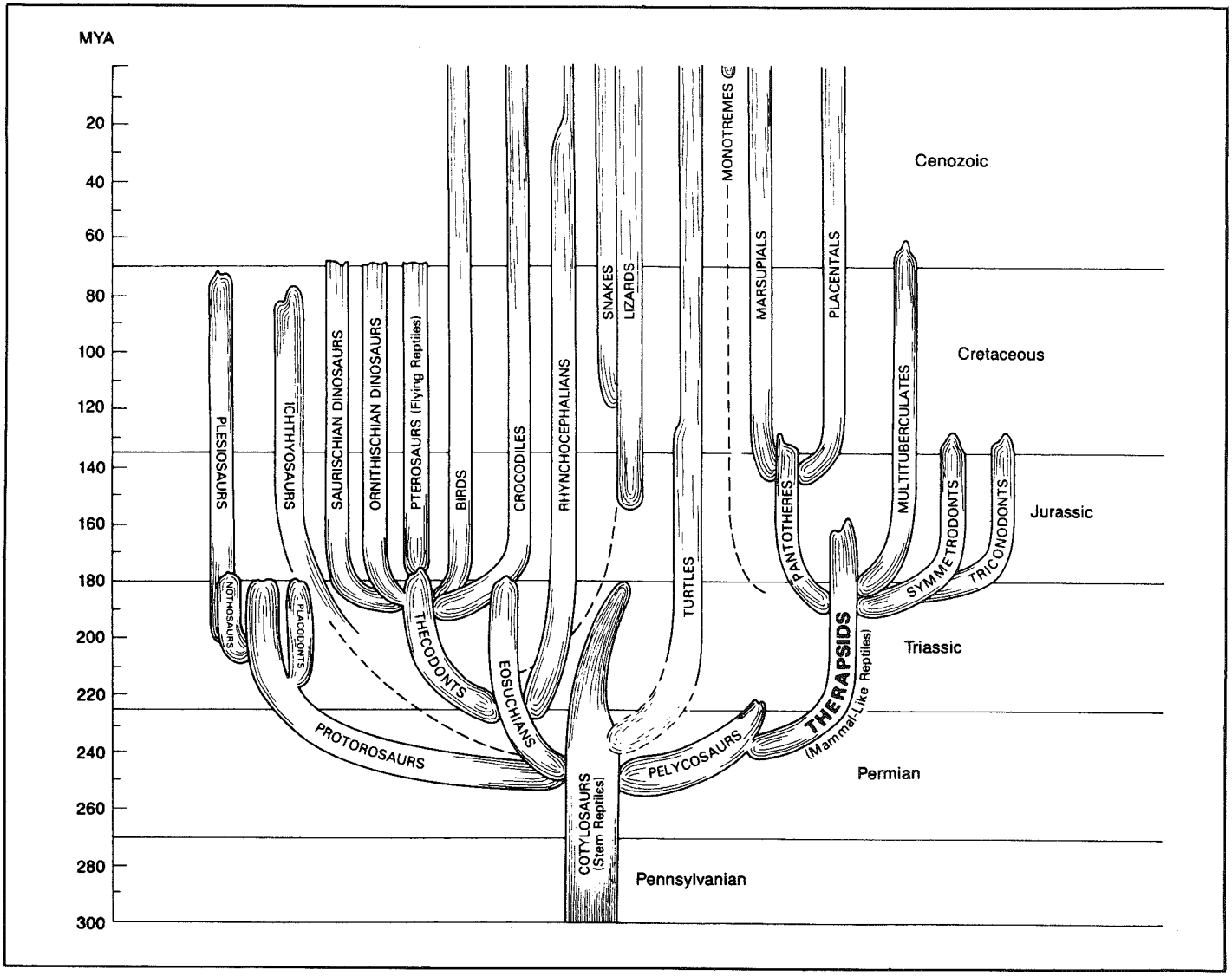


Cactus tree, schematizing evolutionary radiation of reptiles. Rightmost branch gives emphasis to the therapsid line leading to mammals. MYA indicates million years ago.

If one were to choose three outward behavioral manifestations that most clearly distinguish the evolutionary transition from reptiles to mammals, the triad would be (1) nursing, in conjunction with maternal care, (2) the separation call, and (3) play. I single out the separation call because it is probably the most primitive and basic mammalian vocalization, serving originally to maintain maternal-offspring contact.

For a further understanding of human evolution, it is of fundamental interest to inquire how these behavioral changes may have developed. The changes set the stage for a family way of life with its evolving responsibilities and affiliations. It is my purpose here to describe work that throws light on evolutionary changes of the brain that are associated with the development of family-related behavior.

Not long ago there were regional White House conferences concerned with conditions that threaten the unity, stability and health of families in modern times. It should help to allay pessimism about the future of the family if it is recalled that the family, as a biological institution, has survived 180 million years, having originated with the earliest mammals living in Late Triassic times. This is a length of time that would allow the election of more than 40 million United States presidents.

Our odyssey begins with a statement

based on what the fossil record and comparative findings have shown about cerebral evolution in terrestrial vertebrates. The human forebrain has expanded to its great size while retaining the features of three basic formations that reflect ancestral commonalities with reptiles, early mammals and late mammals. Radically different in their chemistry and structure, and in an evolutionary sense countless generations apart, the three formations constitute an amalgamation of three brains in one, a triune brain. This situation suggests that psychencephalic functions depend on an evolutionary linkup of structures underlying three quite different mentalities. For us as human beings, there is the added complication that the two older formations do not have the capacity for verbal communications.

As in other fields, progress in neurobehavioral research depends partly on the recognition of similarities and differences of things. Although reptiles, birds and mammals have all derived from the stem reptiles, I will focus on behavioral differences between reptiles and mammals because the mammalian lineage can be traced back to the mammal-like reptiles. For reasons to be explained later, we have used lizards for our behavioral work.

As a behavioral preface, consider, at this point, a striking difference between lizards and mammals. Most lizards lay their eggs and then go off and leave them to hatch on their own. Except for a few rudiments in skinks, there is no parental behavior at all. The hatchlings come into the world prepared to do everything that they have to do except procreate. It is fortunate for the young lizards that, unlike mammals, they do not vocalize and announce their presence, because otherwise their parents might be attracted to them and eat them. Such considerations drive home the fact that the transition from reptiles to mammals, which developed a close parent-offspring relationship, represents a great evolutionary leap, a real quantum jump. Unlike the situation in birds, the continued evolution of mammals is distinctive because of the progressive increase in the time and care given to the young.

How did mammals get to be the way they are? Many of the secrets still lie hidden in the Karroo beds of South Africa, where, according to the calculations of Robert Broom, there are the remains of more than 800 *billion* mammal-like reptiles. As Broom has noted, the study of these beds offers an opportunity like that of "examining the pages of a book of history." The mammal-like reptiles are of great human interest because they are so close to the roots of our family tree. Historically, there is the tendency to think of dinosaurs as the predecessors of mammals, but the mammalian line is far removed from such reptiles, leading back to a much more ancient stock that is identified with the mammal-like reptiles. In Permian times, long before the dinosaurs, these reptiles inhabited the earth when it was but one giant land mass. Their remains have been found on every continent, including Antarctica.

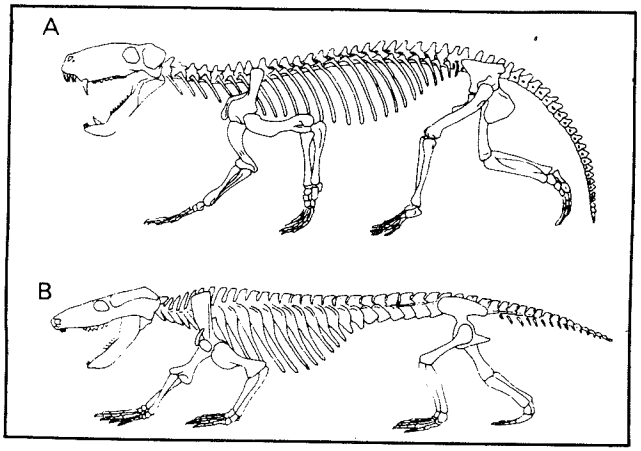
The mammal-like reptiles are known generally as synapsids because of a single temporal fossa that compares to the single fossa of mammals. The advanced mammal-like reptiles are otherwise called therapsids because the shape of the fossa is so similar to that of mammals. What were the therapsids like? There were two main varieties, carnivores and herbivores. Mammals stem from the carnivorous type. Some of them resembled dogs and wolves. Unlike their waddling predecessors, these animals had become upright and, with legs supporting them from underneath, were able to run swiftly. The jaws and teeth and other cranial features were approaching the mammalian condition.

For comparative neurobehavioral work, it is regrettable that no existing reptiles are directly in line with mammals. One of the "primitive" mammal-like reptiles was so like a lizard in appearance as to receive the name *Varanosaurus*, a term alluding to the monitor lizards, of which the Koodo dragon is an outstanding example. For this and other reasons, we have favored the use of lizards in our comparative studies.

In neurobehavioral work, it is requisite to be familiar with the entire behavioral profile, or what ethologists refer to as the ethogram, of an animal. Altogether, one can recognize in lizards more than 25 special forms of basic behavior patterns that are seen in mammals, including human beings. The most prominent forms are as follows:

1. Selection and Preparation of Homesite
2. Establishment of Territory
3. Use of Home Range
4. Showing Place Preferences
5. Marking of Territory
6. Patrolling Territory
7. Ritualistic Display in Defense of Territory, Commonly Involving the Use of Coloration and Adornments
8. Formalized Intraspecific Fighting in Defense of Territory
9. Triumphal Display in Successful Defense
10. Assumption of Distinctive Postures and Coloration in Signaling Surrender
11. Use of Defecation Posts
12. Foraging
13. Hunting
14. Homing
15. Hoarding
16. Formation of Social Groups
17. Establishment of Social Hierarchy by Ritualistic Display
18. Greeting
19. Grooming
20. Courtship, with Displays Using Coloration and Adornments
21. Mating
22. Breeding and, in Isolated Instances, Attending Offspring
23. Flocking
24. Migration

First and foremost in this list are activities that involve selection of a homesite, establishment of a territory and familiarization with a surrounding home range. The items in the lower part of the



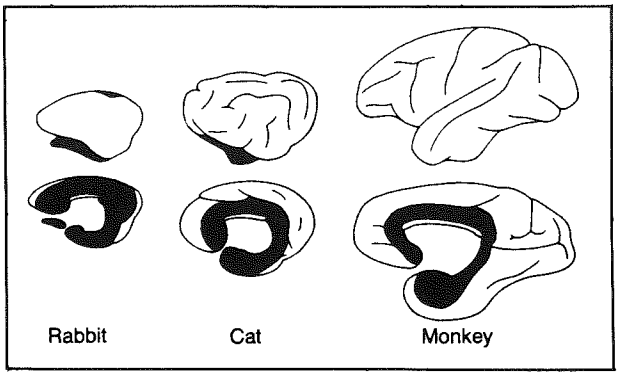
Two representative carnivorous therapsids (A. Lycaenops *and* B. Thrinaxodon*) illustrating mammal-like features.*

list refer to kinds of behavior involved in social interactions and in procreation. Notably lacking is the family related, behavioral triad consisting of nursing (in conjunction with maternal care), audiovocal communication and play.

Fossils obtained from the Karroo beds indicate that several lines of mammal-like reptiles were independently acquiring mammal-like characters. How does one explain this directional evolution, this independent acquisition of the same kind of "inventions," so to speak? Certain therapsids in one of these lines, presumably the cynodonts, capitalized sufficiently on the inventions to survive and provide the stock from which mammals are derived. There appears to have been a cooling trend during the latter part of the Triassic period, and one of the biological inventions may have been endothermic thermoregulation. As supporting evidence, the fossil record shows bony changes of the cranial skeleton indicative of acquisition of hair and sweat glands, nasal warming of the air, and more efficient mastication. It is also suggested that if a cooling trend occurred, the advanced therapsids may have retained their eggs and developed placentation. It must be left to the imagination how milk glands evolved from sweat (or sebaceous) glands. Still crying for explanation is another development, namely diphyodonty, with so-called milk teeth making room for a permanent set of teeth.

Several authorities believe that the tiny transitional mammals lived in the dark floor of the forest and were, perhaps, nocturnal. If so, it is evident that under such conditions audiovocal communication would have been a valuable adjunct to olfaction and vision for maintaining maternal-offspring contact. For sucklings, any prolonged separation from the mother is calamitous. As mentioned earlier, the so-called separation or isolation call may represent the oldest and most basic mammalian vocalization, serving originally to maintain maternal-offspring contact.

The mammal-like reptiles were evidently hard of hearing, and it is quite possible that they may have been mute like most of today's lizards. Two small bones of the jaw joint (the quadrate and articular) were becoming smaller, but they had not yet migrated and become transformed into the hammer (malleus) and anvil (incus) of the typical mammalian ear. If, like many extant lizards, the advanced therapsids had been cannibalistic, it is evident that it would have been counterproductive for their young to call attention to themselves by sounding a separation call. The young of the Komodo dragon must take to the trees for the first year of life to avoid being cannibalized, while immature rainbow lizards must hide in the underbrush in order to prevent a similar fate. With the evolution from reptiles to true mammals there appears to have come into being the primal commandment, "Thou shalt not eat thy young or other flesh of thine own kind."



Brains of three familiar animals, illustrating that the great limbic lobe of Broca (shaded) exists as a common denominator in the brains of all mammals. The limbic cortex and associated structures of the brainstem constitute the limbic system, a derivative from early mammals.

Judged by the few available cranial endocasts, the therapsid forebrain was relatively long and narrow, being suggestive of the reptilian type of forebrain in which the cortex is rudimentary. It is inferred that in the earliest mammals the cortex began to balloon out and become further differentiated. Based on recent findings, I am going to suggest that the behavioral triad typical of mammals (nursing, in conjunction with maternal care; audiovocal communication for maintaining maternal-offspring contact; and play) may have evolved *pari passu* with a division of the limbic system that has no distinctive counterpart in the reptilian brain.

In a paper appearing in 1878, the French physician, Paul Broca, referred to a large annular convolution of the medial surface of the brain as the great limbic lobe because it *surrounds* the brainstem. It was Broca's special contribution to show that this lobe is present as a common denominator in the brains of all mammals. The limbic lobe contains most of the phylogenetically old cortex. In 1952, I suggested the term *limbic system* as a designation for the limbic cortex and structures of the brainstem with which it has primary connections. It has been shown to be both a structurally and functionally integrated system. Since, as defined, it forms a major part of the forebrain in the most primitive extant mammals (opossum, ground shrew and hedgehog, for example), it may be regarded basically as a paleomammalian formation.

An accumulation of experimental and clinical findings during the past 45 years has provided evidence that the limbic system derives information in terms of emotional feelings that guide behavior required for self-preservation and the preservation of the species. Evidence of the emotional nature of the subjectively derived information is based on reports of patients with psychomotor epilepsy. Seizure discharges arising in or near certain parts of the limbic cortex result in the generation of affective feelings that, according to the particular case, range from intense fear to intense ecstasy. It is of profound epistemic significance with respect to ontology and belief that such discharges may also generate free-floating, affective feelings of what is real, true and important. It is one thing to have such an animalistic brain to assure us of the authenticity of food or a mate, but where does confidence lie if we must rely on this same brain to supply the feeling of belief and conviction in regard to our neocortically derived ideas, concepts and theories?

Consider neurobehavioral findings on the separation (isolation) call. On the basis of sampling thus far, such calls appear to be characteristic of mammals. As was noted, the separation call may represent the most primitive and basic mammalian vocalization, serving originally to maintain maternal-offspring contact. Possibly as a protection against predators such as owls, the calls of many small mammals are ultrasonic.

Studies of brain mechanisms of separation calls have been largely performed on monkeys. Among the macaques and the great apes, cooing occurs between mother and infant for assuring an acceptable distance of separation. Jane Goodall refers to such calls in the chim-

panzee as the "hoo whimper." In human infants, separation calls have been variously characterized as hunger cries, pain cries and the like, but as Peter Wolff has noted, the so-called hunger cry can be more predictably elicited by separating an infant from its mother.

Relevant to the distress of separation, it is of interest that it has been shown in the squirrel monkey that doses of morphine, insufficient to interfere with the general behavior of the animal, eliminate the production of the separation call, and that treatment with the antagonist naloxone hydrochloride reinstates the calls. Is it possible that one of the attractions of opiate drugs is that they provide some people a surcease from persisting feelings of "separation" or alienation?

It would appear that the cingulate gyrus, that comprises the evolutionarily newest part of the limbic system, combines a representation of three forms of behavior that characterize the evolutionary transition from reptiles to mammals, namely nursing in conjunction with maternal care, audiovocal communication for maintaining maternal-offspring contact, and play.

The neocortex expands progressively in higher mammals. It reaches its greatest development in human beings and, neurologically, there can be nothing more certain than that the neocortex is necessary for language and speech, and that we owe to it the infinite variety of ways in which we can express ourselves. One of the great neurological mysteries is how the jump was made from limbic affective vocalization to neocortical propositional speech. It has been said that among human infants, regardless of race or geographic location, spontaneous babbling involving vowel-consonant combinations begins to occur at about the age of eight weeks. How might such a harbinger of speech have developed? In this respect, it is of interest to consider both the separation call and the so-called chuck, respectively, as prototypes of vowel and consonant sounds. The separation call of higher primates has the character of slowly changing tone which, in the human, has predominantly the vowel sound *aaah*. It is an innate sound that originates as a result of one of the most distressful mammalian conditions, namely separation. Hence, it is a sound that is associated with great motivation to communicate. Perhaps the second most important sound is one made during nursing and characterized as chucklike. The sound is like that heard when the sucking lips of the infant suddenly break contact with the nipple, *'tsik*. Its consonant quality is self-evident. It is otherwise familiar to us as the sound made by someone who is encouraging a horse to get moving. Its use in maternal-offspring communication can be illustrated by the squirrel monkey. When the sound is made by the mother, it is an encouragement to the infant to resume nursing, whereas the infant emits the sound when searching for the nipple. Later on, when the infant begins to wander afield, the mother makes the call as a means of bringing the infant back. Here, one might say, we have in the separation call and the chuck basic sounds later incorporated as vowels and consonants in speech.

Audiovocal communication becomes of the utmost importance in mammals for maintaining maternal-offspring contact. Perhaps we can trace to this situation the evolutionary roots of unity of the family, unity of the clan, unity of larger societies, as well as the human philosphic yearning for an abstract kind of unity.

When mammals opted for a family way of life, they set the stage for one of the most distressful forms of suffering. A condition that, for us, makes being a mammal so painful is having to endure separation or isolation from loved ones and, in the end, the utter isolation of death. When we add to this the realization that our soft, pulsating, plantlike brain spends its life imprisoned in a bony shell, it drives home what basically lonely creatures we are.

As members of the class of mammals, we find our greatest warmth of companionship within the body of the human family. Yet even here we find a pervading feeling of isolation that seems to be goading us toward communication with other beings in the universe. Some 180 million years ago there must have been a first time when the first mammalian ancestor let out a separation call. Who, living 180 million years from now, would ever imagine that one could pin down to the very second the first time that humanity sent an isolation call crying into the universe? Since sending it out on Pioneer 10, Carl Sagan and others have begun to speculate about a Noah's Ark big enough and fast enough to take humanity to everlasting life in the cosmos.

In the meantime, there seems to be more than enough to do for those of us left behind. One of the greatest challenges at the present time is to live peacefully together as an extended human family, a problem that is becoming increasingly difficult, not only because of crowding at home, but also because of worldwide crowding and the competition for vital resources. The adoption of a family way of life appears to have put the mammal in a bind with respect to crowds. Peaceful groups of mammals tend to average about 12 individuals. Even herd animals tend to group as families. It would seem that the limbic and neocortical systems have few "wired-in programs" for dealing with crowded conditions. When people meet in large numbers, they seem to do best in situations in which they are eating together, such as at feasts and music festivals, or when they are taking advantage of the mammalian trait of play, as when participating in local, national or international games, including the Olympic games. Yet even here there may be a childlike, fine line between having fun at play and getting mad and fighting.

It may be imagined that originally a parental concern for the young led to a sense of responsibility. A parental concern for the young may generalize to other members of the species, a psychologic development that amounts to an evolution from a sense of responsibility to what we call conscience. Family oriented structures should allow us to obtain a holistic view of the world and to work for the future of the human family as though it were an extension of our own immediate family. In the higher region of the brain, it would seem, we have been provided vision for proceeding in a firm way to play out our hopes for our children and our children's children. This seems to be the blind message of evolution. Given the human capacity to recognize gradations of "yes" and "no" on various issues and to decide accordingly, who can argue that we are entirely the product of our genes and that there is not some degree of freedom to change the way things are?

Adapted from Dr. MacLean's article in the ***Archives of General Psychiatry****, April, 1985. These thoughts constitute a follow-up to his article in* ***AnthroQuest****, No. 24, Winter, 1982.* ■

APE MEDICINE?

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Most of the foods eaten by primates in the wild provide good nutrition. Carbohydrates, fats or protein are the object of selection, or occasionally minerals such as salt. A few cases of food selection are more puzzling, however. Monkeys and apes may eat small amounts of fruits or leaves with little nutritional value but known to contain powerful drugs. Are they getting high? Or can they choose natural products as medicines, to fight disease or reduce pain? Humans are the only species known to use natural chemicals for specific cures, and our ability to do so has probably been an important part of our culture since long before history began. If primates can do it too, we can envision a slowly growing use of herbals by human ancestors over millions of years.

It isn't usually easy to find out why animals choose their particular foods, because each item is a cornucopia of natural chemicals with different effects in different species. A poison for humans may be harmless to a monkey; when a baboon eats a fruit that would be toxic to people it may merely be having a snack, rather than dosing itself with a drug. So it is exciting to find a case where curious behavior suggests deliberate intake of a powerful drug.

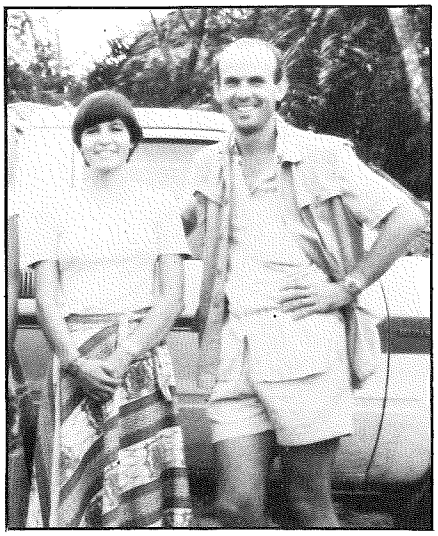
Original oil painting of chimpanzee by Miss Fleur Cowles auctioned at the Gala Dinner given in her honor on Nov. 21, 1985, in Beverly Hills. The establishment of the Fleur Cowles Great Apes Research Fund was announced and the evening was attended by many illustrious humans.

When chimpanzees in Gombe National Park, Tanzania, wake up in the morning they normally climb down from their nests and walk directly to a nearby fruit tree for a solid breakfast. On some mornings, however, they ignore rich fruit sources and travel instead for as long as twenty minutes to reach a patch of grassland. Once there, they look around until they find a patch of *Aspilia pluriseta* (Compositae), a multi-stemmed shrub two to three meters tall. They come to eat the leaves but, remarkably, they do not merely strip each stem with sweeps of their closed fist as they typically do when eating leaves of other species. They treat *Aspilia* leaves with extraordinary care. Closing her lips gently over a young, three centimeter long leaf, a female might hold it for several seconds, perhaps touching it lightly with her tongue, before opening her mouth and trying another. Soon she will find one she likes. She pulls it off the stem but then again behaves oddly. Rather than chewing it, she takes it into her mouth and rolls it around with her lips closed but jaw slack. After a quarter of a minute she will swallow it, occasionally with a grimace. Then on to the next. In ten minutes she may take no more than 30 small leaves.

It is impossible for us to tell for certain whether chimpanzees chew *Aspilia* leaves merely by watching them. Fortunately, however, we can look at their dung. Jane Goodall analyzed chimpanzee dung for many years and consistently found one curious leaf that was never chewed; whole leaves were present, lightly damaged by folding, perhaps, but otherwise looking fresh and unharmed. We know now that these are leaves of *Aspilia*, and that both in Gombe and in the Mahale Mountains National Park, where Toshisada Nishida and his colleagues have been studying chimpanzees since 1964, they are never chewed. The leaves of three different species are swallowed by Gombe and Mahale chimpanzees, and in Gombe they are almost always swallowed at dawn. Why should this undistinguished-looking leaf be treated in such an odd way?

An obvious possibility is that *Aspilia* leaves contain, perhaps on their surface, a chemical with special properties. In April, 1984, Eloy Rodriguez, of the University of California at Irvine, undertook the task of looking for the chemical needle in the *Aspilia* haystack. Within a few days, he and his students had isolated and identified a striking and highly reactive red oil, thiarubrine-A. Rodriguez knew nothing of thiarubrine-A's biological properties, because so far as he was concerned this was a newly discovered chemical. By an extraordinary coincidence, however, it transpired that only a few weeks earlier, a close colleague of his, Neil Towers, had isolated the same chemical from Canadian plants in his laboratory at the University of British Columbia at Vancouver. Towers had found that thiarubrine-A was an astonishingly powerful toxin, with deadly effects on a range of pathogens such as bacteria, nematodes and fungi.

Could chimpanzees be swallowing *Aspilia* leaves to obtain small amounts of thiarubrine-A? Analysis with a scanning electron microscope shows that surface cells are ruptured during passage through the gut. Furthermore the amounts of the chemical needed are extremely small; it kills *Candida albicans* or *Staphylococcus albus* at 0.1 – 1.0 parts per million, for instance.



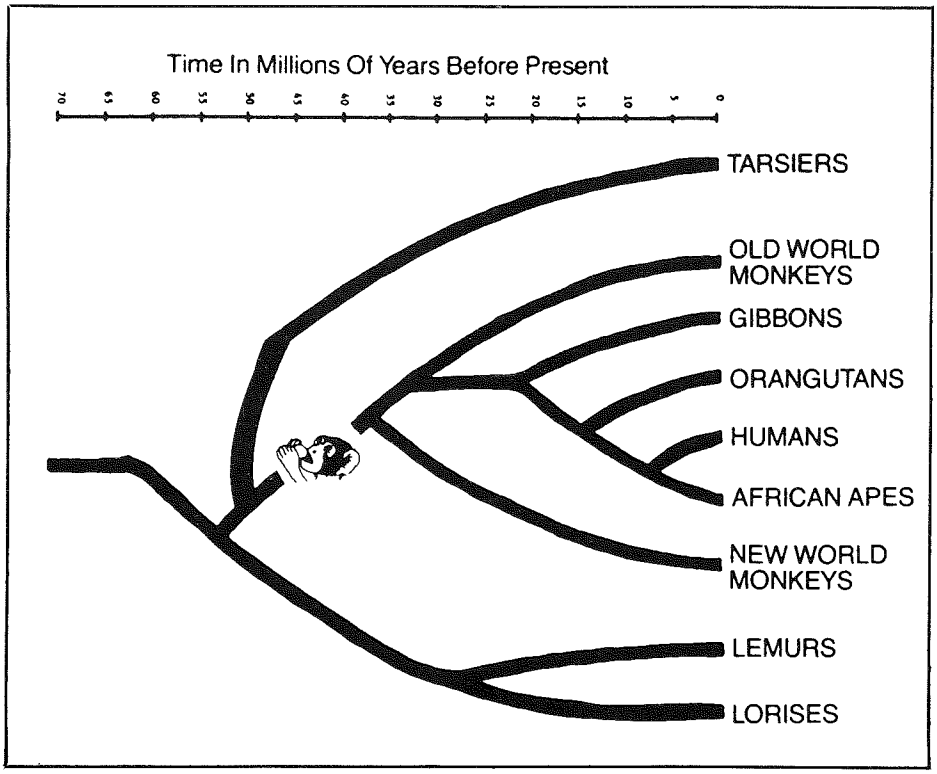
Dr. Richard Wrangham and his wife, Dr. Elizabeth Ross.

But if chimpanzees use *Aspilia*, could humans too? By visiting herbaria and research centers in East Africa, Rodriguez, Towers and I have now found 30 uses of *Aspilia* leaves by African peoples. They use them mostly to treat surface wounds, such as cuts and burns, and for stomach aches. People use the same three species that chimpanzees use, but a species that chimpanzees do not use (*A. congoensis*) is not used by people either. It is beginning to look as if chimpanzees and people have similar ideas about *Aspilia* leaves.

But what do the leaves do? Perhaps they control worms in the gut. But other effects are possible too. Sometimes chimpanzees seem to eat more than usual after swallowing *Aspilia*. Could it be a euphoric? And whatever the leaves do, there are surprising observations that are not yet explained. For instance, although young and old chimpanzees all swallow *Aspilia*, females do it more often (about one day in 10) than males (one day in 30). And why do Gombe chimpanzees swallow *Aspilia* leaves at dawn, whereas Mahale chimpanzees take them at any time? The story is only beginning to unfold. Over the next few years we hope to find out whether rudimentary medicine is practiced among wild chimpanzees, and if so, exactly what help it gives. Who knows, perhaps chimpanzees will show us a drug that can one day be used in the Western world.

Editor's Note: The reader may recall a story told of Orson Welles when he was a very young prodigy. At 18 months of age, it is reported, the precocious infant peered out of his crib and said to the family doctor, "The desire to take medicine is one of the greatest features which distinguishes men from animals." Could Welles have been wrong? ■

A NEWFOUND ANCESTOR?



Amphipithecus *or some related animal may link the higher primates (monkeys, apes and humans) to the lower primates (tarsiers, lemurs and lorises). There is still considerable controversy over which lower primate branch gave rise to higher primates.*

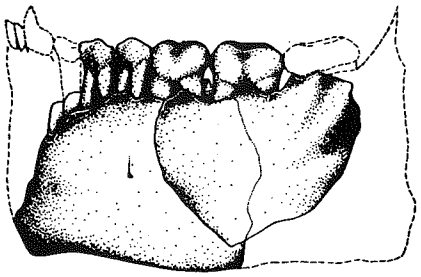
A new analysis of fragments of a fossilized primate jaw and teeth found in Burma has stirred up an old scientific debate over which prosimian branch led to the anthropoids, and where. This report, published last August, was researched by paleoanthropologist Russell L. Ciochon of the State University of New York at Stony Brook, paleontologist Donald Savage of the University of California at Berkeley, and Burmese scientists Thaw Tint and Ba Maw. The research of the two Americans was supported by the Leakey Foundation.

The fossils under analysis were those of the primate *Amphipithecus mongaungensis*, dated at 40 to 44 million years. Ciochon and his colleagues believe it to be the earliest known anthropoid that might be the common ancestor of monkeys, apes and humans.

"*Amphipithecus* can be viewed as a 'missing link' between lower and higher primates," Ciochon said. "We can now say that the origin of higher primates was very probably an Asian event."

Other scientists disagree since the evidence is still very limited. *Amphipithecus* fossils were first discovered 48 years ago and a new jaw fragment was

Russell L. Ciochon



Our knowledge of Amphipithecus *comes from fragments of two separate jaws. One portion (left) was found in 1923, another (shown overlapping) in 1977.*

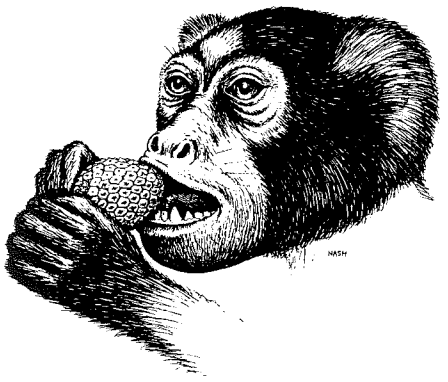
found in 1978 during a survey in Burma's Pondaung Hills, having weathered from claystone beds near the site of earlier finds.

Basing his conjectures on the size of the jaw and teeth, Ciochon thinks that the animal was two and one half to three feet tall and weighed 15 to 20 pounds. Most probably it lived in trees and ate fruit. Like higher primates, *Amphipithecus* had a deep and thick jaw, fused in front and not jointed like the jaws of nearly all prosimians. Two horizontal ridges cross the inside of the jaw, another distinctly anthropoidal trait. Two of the molars are anthropoid-like with front and back parts of equal width.

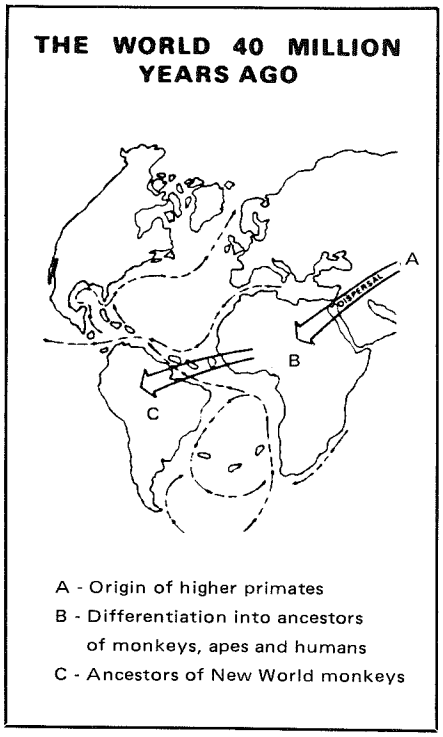
Amphipithecus's molars also share some characteristics of its prosimian ancestry. Ciochon and his fellow researchers find it has similarities with a family of lower primates called adapids from which modern lemurs and lorises are descended. Here the scientists run into debate with others who favor another prosimian group called omomyids, related to modern tarsiers, as the one which gave rise to anthropoids.

If Ciochon is right in his analysis, the Asian origin of these fossils could change the geographic history of evolution. He thinks that it is probable that anthropoids evolved from lower primates about 40 million years ago in Asia and spread over a long period of time into Africa by crossing a narrow, swamplike sea. Some early anthropoid forms could have reached South America to evolve into monkeys, crossing a series of volcanic islands in the Atlantic Ocean when it was much narrower than it is today. ▩

Stephen Nash



The researchers' conception of Amphipithecus mogaungensis, *an animal about the size of a gibbon ape that probably lived in trees and ate fruit.*



Ciochon's scenario of the geographic evolution of primates.

DIET AND HUMAN EVOLUTION SYMPOSIUM

On Sunday, February 9, 1986, the L.S.B. Leakey Foundation will present a one day symposium titled "Diet and Human Evolution: From Foraging to Fast Foods." It will be held in Zellerbach Hall at the University of California, Berkeley, from 9:30 a.m. to 5:00 p.m. The symposium is co-sponsored by the California Academy of Sciences and the University of California, Berkeley.

Among the distinguished speakers will be archeologist Mary D. Leakey, who, with her late husband, discovered fossil bones at Tanzania's Olduvai Gorge and other East African sites which helped rewrite the history of early humanity. Dr. Leakey, Ms. Jane Brody, a *New York Times* nutritionist, Drs. Richard Wrangham, S. Boyd Eaton, Melvin Konnor and Solomon Katz will place human evolution and diet in the context of archeology, anthropology, sociology and modern medicine. (Please see cover article.)

Human diet today is a far cry from that of our forebears of just a few thousand years ago. Although we are almost identical genetically, our physiology must now cope with an array of foods vastly different from those with which it originally evolved in the forests and savannas.

What happens when a "foraging" physiology meets a "fast food" diet?

The "Diet and Human Evolution" symposium will seek answers as to how diet has affected the genetic, physiological, cultural and sociological development of humans. Such a study cannot be done independently of social and environmental contexts. Speakers will refer to the social roles of men and women, their work, food preparation and dietary taboos, birth spacing, weaning, settlement patterns and adjustment to the seasons. Recent research, some of it not yet published, will be presented at this very timely and interesting symposium. ▩

GREAT APE RESEARCH FELLOWSHIP

L.S.B. Leakey Foundation/ New York Zoological Society

The second Great Ape Research Fellowship has been awarded to John C. Mitani of the Rockefeller University in New York. He will receive $20,000 to conduct field studies of the orangutans of the Gunung Nature Reserve, West Kalimantan, Indonesia. The animals will be observed in three different forest habitats to discover whether habitat variation affects orangutan ranging behavior. Their natural vocal repertoire will be taped for comparison with the vocalizations of the other great apes. Observations of sexual behavior and experiments using a field playback technique of recorded vocalizations are planned to resolve differences arising from prior field studies. This project will contribute to our understanding of the causes of intraspecific variation in orangutan behavior and promises to clarify some fundamental aspects regarding what may be unique primate mating and vocal systems.

The Leakey Foundation awarded the first Great Ape Research Fellowship last year to Dr. Caroline Tutin for her proposal, "The Behavior and Ecology of Sympatric Gorillas and Chimpanzees in Gabon." (See page 14.)

In the tradition of boundary-breaking research, these fellowships fund new and exciting long term study projects dealing with wild populations of great apes in new, unstudied habitats. Due to the extremely rapid rate of habitat loss, there is real urgency in these field studies. ■

NEW FELLOWS

The L.S.B. Leakey Foundation is pleased and honored to welcome as new fellows: Mr. and Mrs. Fulton Haight, Santa Monica, California, Mr. Marc E. Leland, Washington, D.C., Mr. and Mrs. Charles Luckman, Los Angeles, California. ■

FRANKLIN MOSHER BALDWIN FELLOWSHIPS AWARDED

The Franklin Mosher Baldwin Fellowships, instituted in 1977, provide funds for the Third World that are available from very few other sources.

The following Baldwin Fellowships were recently awarded:

Paul Menega,
a Tanzanian student, will receive $7,000 for dissertation research involving analysis of Plio-Pleistocene and Pleistocene sediments based on data he has collected at Lake Natron. His work will be supervised by Dr. Maurice Taieb at the Centre National de la Recherche Scientifique, Marseille, France.

Idemudian Omokhodion,
who will receive a $2,000 research grant, plans to systematically investigate habitation sites outside the main urban centers in Benin, Nigeria, and obtain information about the relationships between the cities and hinterland. Until the colonial period, which began at the end of the last century, Benin was the center of intensive local cultural development as well as trade with Europeans dating from the late 15th century.

Zefe Kaufulu,
awarded $1,070, will participate in paleoanthropological research at Koobi Fora, Kenya, mapping stratigraphy in fine detail. This round of investigations in the area seeks to understand the overall distribution of artifacts and bones relative to paleogeography, and to identify traces of fire and clarify its relationship to hominid activities. ■

The grant program, the major purpose of the L.S.B. Leakey Foundation under the guidance of the distinguished Science and Grants Committee, depends upon public support for its success. Every penny of your contribution dollar directly supports the grant awards.

GRANT SPOTLIGHT

Nancy Handler *$1,335 needed*

REPRODUCTIVE BIOLOGY, SOCIOSEXUAL BEHAVIOR, LIFE HISTORY PATTERNS OF *PAN PANISCUS*

This research is part of an ongoing study begun in 1980. The present project will examine the relationship between group composition and sexual behavior of the chimpanzees, focusing on key females representing five different reproductive classes.

Wayne R. McGuire *$3,600 needed*

MALE PARENTAL CARE IN THE MOUNTAIN GORILLA

This study will evaluate the impact of male parental care on immature survival in the mountain gorilla, determining how regularly a female is given help in infant rearing by a male, the kind of assistance given and why.

Beverly Strassman *$4,000 needed*

THE ECOLOGY OF POLYGYNY AMONG THE DOGON

This research will investigate female reproductive strategies in the Dogon millet farmer society. It will test the hypothesis that polygyny reduces female fitness by lowering the nutritional status of women and children, contributing to the selective factors for and against the evolution of polygynous mating systems in *Homo sapiens*.

David Thomas Nash *$2,761 needed*

HAYSTACK CAVE: A CASE STUDY FOR EVALUATING PRE-CLOVIS OCCUPATION IN THE INTER-MONTANE WEST

Nash plans a four month season of excavation at the Late Pleistocene site of Haystack Cave in central Colorado. Test excavations have provided the first collection of vertebrate remains for this time (14,935 years ago) in this area. The data will expand our knowledge of early American hunter-gatherer cultures.

Nicola Stern *$1,600 needed*

METHODOLOGY FOR RECONSTRUCTING THE RANGING BEHAVIOR OF PLIO-PLEISTOCENE HOMINIDS

The goal of this research is to work toward the development of a methodology for assessing the goodness of fit of alternative models of the ranging behavior of Plio-Pleistocene hominids to the archeological data.

Mary C. Stiner *$3,000 needed*

FORAGING ECOLOGY OF PREMODERN HOMINIDS

This grant is for the taphonomic analysis of existing collections of faunal materials in order to learn how hominids were able to expand into and dominate a carnivore niche in temperate climates. Data from sites in central Italy will be compared.

Jennifer Thompson *$2,488 needed*

PALEODEMOGRAPHIC ANALYSIS OF EAST AFRICAN AUSTRALOPITHECINES

The goal of this research is to examine the Plio-Pleistocene hominid dental and gnathic remains housed at the Kenya National Museums in order to estimate the age of death of the australopithecines.

Adrien Hannus *$5,000 needed*

REPLICATION OF MAMMOTH BONE SPECIMENS

Stabilization efforts on a crucial suite of mammoth bone specimen tools from the Lange-Ferguson site, a Clovis mammoth kill-butchering locality, have failed and the overall condition of the fossils is rapidly deteriorating. This grant is for immediate action to produce casts to be made in Sioux Falls, SD. The fossils are important in extending our knowledge of Clovis tool kit strategies.

Donald C. Johanson *$3,691 needed*

DEVELOPMENT OF FOSSIL PREPARATION AND CASTING FACILITIES IN ETHIOPIA

These funds will go toward the continuing work in preparing sets of casts for the Institute of Human Origins facility in Ethiopia.

Steven Kuhn *$2,850 needed*

TECHNOLOGICAL ORGANIZATION IN THE PONTINIAN

Research will focus on the nature of technological organization in the Pontinian, a Middle Paleolithic industry found in coastal areas of central Italy. Lithic collections from a number of sites will be analyzed.

John H. Langdon *$1,000 needed*

FUNCTIONAL MORPHOLOGY OF THE MIOCENE HOMINOID FOOT

This grant will aid in the publication of completed research supported in part by the Leakey Foundation which will provide the first comprehensive comparison of the primate foot. It will offer important insights into the probable locomotor patterns of Miocene hominoids and contribute to our understanding of the positional behavior of later hominoids.

Berhane Asfaw *$2,475 needed*

PLIOCENE CRANIAL REMAINS FROM ETHIOPIA

Asfaw will document hominid fossils of Pliocene age, especially the frontal bones from Laetoli and Hadar. The data will be used in his Ph.D. dissertation at Berkeley.

Brenda Benefit and Monte L. McCrossin *$5,000 needed*

PALEOANTHROPOLOGICAL EXCAVATIONS AT THE MIDDLE MIOCENE SITE OF MABOKO ISLAND, KENYA

Previous collections from this site have indicated a highly diverse mammalian fauna important in primate evolution. This new research hopes to recover additional specimens which will help to clarify monkey-ape divergence and other problems of the hominid line.

M. McCready and R. Moise *$9,909 needed*

AKA NET HUNT FILM PROJECT

This film will be part of a longer one dealing with net hunting, ritual, cosmology, dance and other aspects of the culture of the Aka pygmies of the Central African Republic. The film will show that net hunting is the single most important subsistence activity, reflecting aspects of the Aka social, political and cosmologic world.

Kim Hill *$1,752 needed*

PRELIMINARY SURVEY OF CUIVA FORAGERS IN WESTERN VENEZUELA

This grant will support a preliminary anthropological reconnaissance in the area of western Venezuela inhabited by the Cuiva, traditional hunter-gatherers, to assess the usefulness and logistics of carrying out long-term research there.

Mary Ellen Morbeck *$2,500 needed*

SKELETAL ANALYSIS AND BIOMECHANICS OF GOMBE CHIMPANZEES

Using the unique skeletal remains of free-ranging chimps collected at Gombe by Jane Goodall, Dr. Morbeck proposes to determine size and shape properties and bone mineral content of limb bones in order to describe and explain morphological variation relating to locomotion and posture. The more we understand the factors that shape bones during life, the better we can interpret morphological variation in the fossil record.

Galen R. Burgett *$1,848 needed*

FORMATION PROCESSES OF ARCHEOLOGICAL FAUNAL ASSEMBLAGES

Burgett intends to develop controlled observations on the agents and processes which affect the formation of faunal assemblages at archeological sites. The resulting data will be analyzed in order to identify the causal agents of bone modification. By being able to distinguish between bone modification by non-human and human carnivores, it will be possible to assess the role of scavenging among Plio-Pleistocene hominids.

Geoffrey G. Pope *$5,000 needed*

PALEOANTHROPOLOGICAL RESEARCH IN LAMPANG, THAILAND

Dr. Pope plans a brief follow-up field season to recover more artifacts, fauna, and radiometric and paleomagnetic samples from three hominid activity localities in northern Thailand. Core artifacts recovered from earlier excavations were located below deposits dating to 0.8 to 0.6 million years ago; this is the earliest dated evidence of hominids on mainland Southeast Asia. (See page 17.)

Brian Fagan *$7,322 needed*

RADIO PROGRAMS IN PALEOANTHROPOLOGY

These funds are for the expansion of the National Public Radio series, "Patterns of the Past," by 30 programs devoted to paleoanthropology. The programs will cover major discoveries and academic developments in the field from a multidisciplinary perspective with a strong emphasis on recent discoveries and research, and will be broadcast in 1986.

Martin H. L. Pickford *$7,500 needed*

PALEOENVIRONMENTS OF MIOCENE AFRICAN HOMINOIDEA

An understanding of the environmental setting in which Miocene hominoids lived is crucial to the study of their evolution and for reconstructing their lifestyle. An approach which has proved particularly valuable is the study of land snails. Dr. Pickford will study East African fossil land snails in close association with fossil hominoids to determine the paleoenvironments of the sites at which they were found.

Brian D. Corner *$1,000 needed*

DEVELOPMENT OF THE HOMINOID TEMPORAL BONE

Most traditional studies have focused on the differences in morphology between humans and pongids involving adaptations to bipedalism and changes in the brain case and masticatory apparatus using adult specimens. Corner proposes a comparative study of an age series of great ape and human temporal bone anatomy. Knowledge of temporal bone growth can provide a clearer understanding of the complex interplay of forces molding temporal bone anatomy.

Mary Rogers *$5,363 needed*

FEEDING ECOLOGY OF LOWLAND GORILLAS IN GABON

An investigation of the feeding ecology of the lowland gorilla (*Pan p. gorilla*) is proposed involving the examination of the food eaten and in what proportions. Foraging behavior and home range will be monitored to see how seasonal changes in food availability influence gorillas' daily lives.

Christopher Ruff *$4,000 needed*

LOWER LIMB ANALYSIS OF EARLY HOMINIDS FROM LAKE TURKANA AND OLDUVAI GORGE

The proposed research will involve biomechanical analysis of lower limb bones of some 50 specimens of early *Homo* and *Australopithecus* dating to between 0.6 and 2 million years ago.

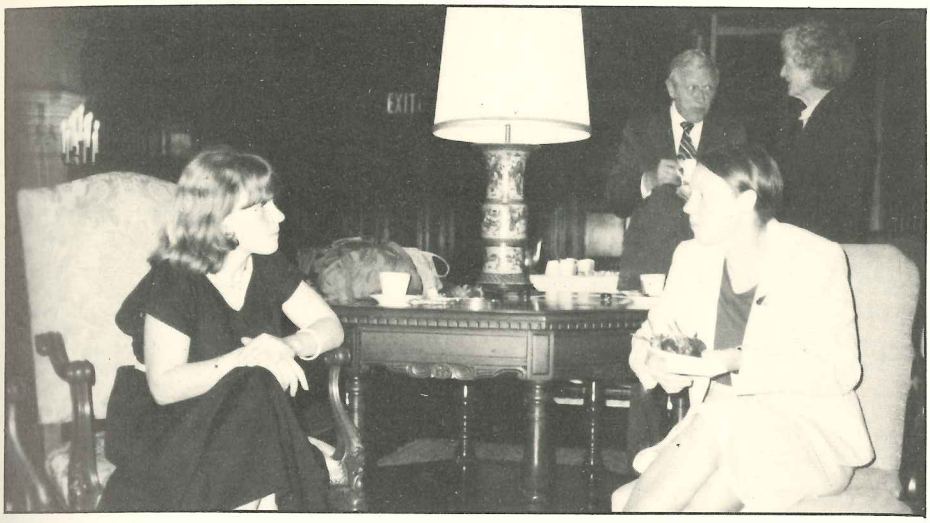
GRANT GUIDELINES

The L.S.B. Leakey Foundation supports research related to human origins, behavior and survival. Priority is given to studies in the areas of human paleontology, archeology and environmental studies of the Miocene, Pliocene and Pleistocene; into the behavior of the Great Apes and other Old World Primate species; and into the ecology and adaptation of living hunter-gatherers. Eligibility is limited to applicants who are doctoral candidates or engaged in postdoctoral research. Potential applicants are encouraged to submit a Petition for Grant Application. On invitation of the Science and Grants Committee, those with projects falling within the range of priorities of the Foundation will be asked to submit a formal application. Deadlines for submission of the formal application are: March 1, June 1, Sept. 1, and Dec. 1.

For further information and application forms contact the Leakey Foundation, Foundation Center 1-7, Pasadena, CA 91125. ■

FIELD REPORTS

Excerpts from reports by Leakey Foundation grantees on their work in progress.



Dr. Christiane Denys (left) speaking with Dr. Kathleen Galvin of the Leakey Foundation staff. In rear: George Jagels and Elizabeth Waldron, loyal Foundation members.

EAST AFRICAN FOSSIL RODENTS

Foundation grantee Dr. Christiane Denys of Paris visited Los Angeles in the spring and several trustees, fellows and Foundation friends enjoyed a special evening reception where they heard a first-hand report of Dr. Denys' research on East African fossil rodents from Olduvai and Laetoli. She brought to life the excitement of locating and interpreting the remains of these tiny creatures which can convey an extraordinary story about the earth's chronology and ecology. Comparing her work to that of a detective searching for crumbs (teeth only 1mm in diameter!), Dr. Denys described how 1,000 pounds of sediment were dried, divided into smaller, more manageable portions and screened twice on site: once to separate the clay from the sand and the second time to separate the sand from the bones. A third screening was undertaken at her laboratory in France; not until the remaining sediment was viewed through the microscope did she know whether she had been successful in her quest (seven rodent genera were discovered). The sediment also yielded remains of snakes, lizards, and shrews as well as the first evidence of the dormouse in East Africa.

Dr. Denys explained that rodent species are classified on the basis of the teeth's shape and arrangement. A rodent has two upper and two lower incisors, but no canines; tooth size helps make the determination between species. To illustrate, she removed from her backpack a small plastic box with granules which an ordinary mortal would overlook completely. Dr. Denys told her listeners that, surprisingly, elephants are very similar to rodents in their adaptation to eating grasses; in fact, one rat species' teeth are shaped very much like an elephant's. Rodents provide an excellent means of dating in many locales; however, in East Africa, the rodent population has been very stable and has not changed much over time. In contrast, pigs evolved very quickly, she noted. In addition, rodent remains found at Olduvai indicate that the paleoclimate was much drier than it is today.

A bit of background: Rats originated in China over 55 million years ago. They shared a common ancestry with primates initially but separated early on. South America is home to the largest rodents in the world: five meters long, replete with horns!

Dr. Denys is one of four researchers studying East African fossil rodents. When asked how she became involved in such specialized research, she traced her interest in fossils back to the tender age of eight years. Dr. Denys thanked the Leakey Foundation for the opportunity to travel to Kenya and Tanzania to undertake this research. She hopes to travel to Nairobi for three months to analyze the National Museums' as yet unstudied rodent collections spanning various time periods. Dr. Denys also pointed out that scientists do not yet know how to relate East African rodents to their South African counterparts.

The Foundation thanks Dr. Denys and hopes all grantees will contact the Foundation office (818) 449-0507 when planning a visit to the United States, and particularly California.

– *Deborah Spies*

PREHISTORIC HUNTER-GATHERERS INTHE RIFT VALLEY OF KENYA

Stanley H. Ambrose
Department of
Earth and Space Sciences
University of California
Los Angeles

During Louis Leakey's expeditions to the Rift Valley in Kenya in the 1920s, he recognized an important prehistoric culture which he named the Kenya Aurignacian. He later renamed it the Kenya Capsian but it is now known as the Eburran. Louis Leakey spent several seasons excavating Gamble's Cave where the evolution of the Eburran could be documented in great detail, and he devoted considerable space to its description in his book, *Stone Age Cultures of Kenya Colony*. The Eburran culture was considered significant because it was thought to have evolved directly out of the Acheulian, reflecting the evolving modern man with remarkably early fishing and pottery. Mary Leakey continued investigations of the Eburran at other sites in the Rift Valley until 1940. The Leakeys documented a long series of changes in Eburran technology and economy as climate changed from wet to dry and as hunting and gathering gave way to herding and farming between 12,000 and 1,500 B.P. After World War II their work focused more on the Early Stone Age and further knowledge of the

Eburran was mainly acquired as a byproduct of research with different objectives. Nonetheless, enough information had accumulated by the 1970s to evaluate the relationship of the Eburran to other prehistoric cultures and the nature of the local transition to farming and herding.

Archeologists and historians are divided over whether the local transition to farming and herding resulted from independent invention, the migration of populations or the adoption of agricultural practices by the indigenous hunter-gatherer populations. However, with the accumulation of over 150 radiocarbon dates on Later Stone Age and Neolithic sites in highland Kenya and Tanzania, it has become clear that there were no occupations that dated to between 6,000 and 3,000 B.P. The transition to farming and herding is virtually undocumented and the location of Eburran hunter-gatherers for three millennia is unknown.

It appears that earlier Eburran hunter-gatherers were relatively sedentary and preferred to live on the ecotone between montane forest and open savanna where they could exploit the resources of a variety of habitats. This ecotone was apparently located 360 meters lower in altitude 8,500 years ago than at present. This is not surprising since at the time a wetter climate prevailed and montane forests expanded at the expense of savannas in many parts of Africa. The modern hunter-gatherers of the Rift Valley, named the Dorobo or Okiek, also prefer to settle on this ecotone, but their adaptation is considered to have been greatly modified by interactions with herders and farmers. Indeed, some scholars consider them to be merely refugees from other tribes, thus implicitly questioning the relevance of the Dorobo for understanding ancient hunter-gatherers. The adaptation of the Dorobo does seem unusual when compared with that of better known hunter-gatherer populations such as the Kalahari San of southern Africa, mainly because they are semi-sedentary and gather virtually no wild plant foods, relying instead on wild game, honey and some traded agricultural products.

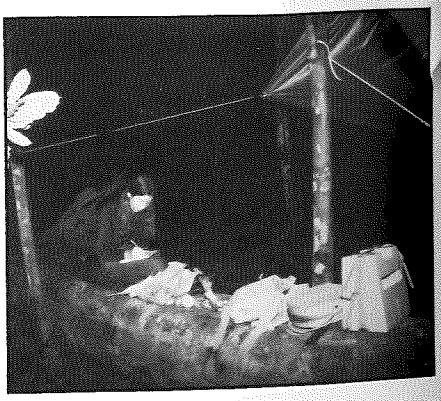
In 1982 I was able to go to the Naivasha Basin in the Rift Valley to test the ecotonal settlement preference model, research in part made possible by a grant from the Leakey Foundation. I discovered a large rock shelter, known to the local people as Twilight Cave, 100 meters above the modern forest-savanna ecotone. Seventeen radiocarbon dates were obtained on the five meter deep archeological sequence, revealing that the shelter was first occupied by Middle Stone Age toolmakers over 26,000 years ago. The shelter was abandoned during the peak of the last Ice Age and then reoccupied by the makers of two successive Later Stone Age cultures before 16,000 B.P. Layers dating to between 7,000 and 16,000 B.P. were removed by water from heavy rains during the early wet phase, destroying the evidence of 9,000 years of activities in the shelter. Those layers dating between 7,000 and 5,400 B.P. reflect occasional use of the site by Eburran hunters. The prey they brought there mainly included animals that preferred forest and ecotone habitats, suggesting that montane forest surrounded the area. Between 5,400 and 4,400 B.P. the site became the focus of intensive occupation by Eburran hunters. Increasing proportions of open savanna species in the food debris suggest that the ecotone was in the site's vicinity. Plant remains, comprising thick layers of grass that may have served as bedding were found in levels dating between 5,400 and 5,200 B.P. In most cave sites where there is good plant preservation, plant food debris is readily apparent. However, no plant food remains were recovered at Twilight Cave. After 4,400 B.P. the intensity of site use declined and the proportions of open plains game in the faunal assemblage increased, suggesting that the shelter was no longer a favored location for Eburran settlement and that the ecotone had risen to even higher altitudes. Domestic cattle, sheep and goats appear to have been adopted by Eburran hunters by 3,300 B.P.

Shortly thereafter Twilight Cave was abandoned and layers of wind-borne sandy silts were deposited. Occupation abruptly resumed at 2,600 B.P. but the site's occupants were the makers of the Elmenteitan Neolithic culture. Precisely the same sequence of sedimentary and cultural changes were observed by Louis Leakey over 50 years ago. He believed that the Elementeitan evolved from the Eburran but the expected transitional stages have not been found, so it is likely that this culture reflects the appearance of a new population.

I believe the most important contribution of this research to paleoanthropology is the light it sheds on the antiquity of the modern Dorobo hunter-gatherer adaptation. The early Eburran hunters, like their modern counterparts, appear to have gathered very few plant foods and were relatively sedentary. They may thus serve as more relevant sources of models than the Kalahari San or the pygmies for adaptations to non-marginal habitats in Africa where hunter-gatherers have long since been replaced by herders and farmers. If so, then the Dorobo deserve intensive ethno-archeological study before their lifestyle is abandoned.

Dr. Caroline Tutin, co-director of Station d'Etudes des Gorilles et Chimpanzees, Reservé de la Lopé, Gabon, was elected last year as the first recipient of the Leakey Foundation Great Ape Research Fellowship. Her proposal, "The Behavior and Ecology of Sympatric Gorillas and Chimpanzees in Gabon," was awarded $20,000 for field expenses.

Dr. Tutin is shown above with two young chimpanzees confiscated from poachers by the Gabonese authorities; below, at an overnight camp in the forest during the census project.



THE SAVANNA CHIMPANZEES OF MALI

Jim Moore
Department of Anthropology
Harvard University

M. Mamadou Diakite (Eaux et Forets, Mali) and I made a three week survey of the distribution of chimpanzees (*Pan troglodytes verus*) and other large mammals in southwest Mali during December, 1984. We covered about 650 km by road and about 100 km on foot.

Southwest Mali below the latitude of Manantali is primarily dry woodland. Much of the terrain is rocky and hilly, with frequent plateaus of annual grassland transected by rocky ravines containing canopies of deciduous and some evergreen trees. Between these plateaus is sparse open woodland in which most trees are only two to five meters tall; near slopes where water collects there are scattered larger trees that are important for chimpanzees.

This region of Mali is very sparsely populated, apparently due to a combination of poor soils and a high incidence of trypanosomiasis in cattle and onchocerciasis (river blindness) in people. Many people live in small hamlets throughout the area. They are predominantly agriculturists, tending millet, corn and peanut fields; hunting is traditionally important and large mammals are generally scarce. We were told that elephant and giraffe were present in the survey area within the last 20 years, but have not been seen for years. Chimpanzees have escaped most of the hunting because they are considered too human to eat; they are sometimes killed for medicinal and magical purposes, and chimp skins are available in Bamako for use in making bags to hold magic materials.

We found chimpanzee nests nearly everywhere we looked for them and I made a variety of measurements on about 170. Analysis of these data is not complete, but it is interesting that a number of the nests were quite low (two to four meters) from the ground and some of these were built directly on easily-climbed main trunks. A study of chimp nests in a similar habitat in Senegal found the animals apparently selecting high nests, probably to avoid predation by leopards. The Senegal study was conducted in a national park where predators have been protected for some years; the only predator we saw on our survey was a lion which local informants told us had probably come from Senegal across the Faleme River. It seems possible that Malian chimps have learned that most of the major predators have been shot out.

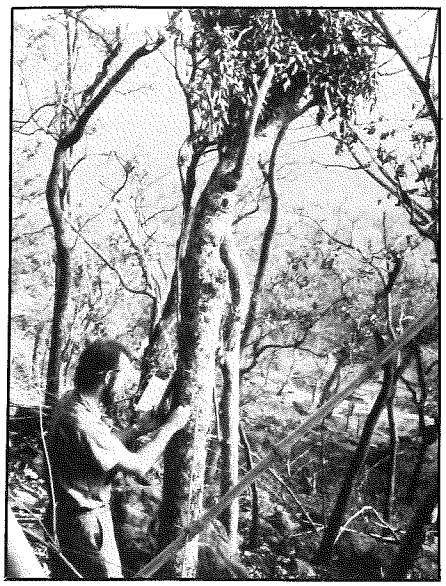
The village of Solo is in a steep-sided box valley. There are many caves in the area, and one evening a villager asked us if we would like to see where the "early people" had lived and hidden their weapons in one of these caves. The next morning we went to have a look. The cave is known to most of the village but people seem reluctant to enter the deeper chambers. They told us of a giant python that lived there, "at the point where the cave slopes downward and the weapons were all left." Several long passages, hands-and-knees in guano at best, ran from a large entry room. I went as far back as I could without coming to a downward slope (or a python), but the terminal bottleneck looked as though it had been large enough to pass through before the guano built up to today's height. I found one broken pot or calabash and a small piece of quartz that must have been carried in, but nothing else.

I have no idea how long ago the caves near Solo were used, but the area is fertile, there are springs and the cliffs are awe inspiring; I suspect people would have gravitated to the area whenever they were near. I gave the piece of quartz to Carole Sussman, who is studying microwear on quartz; on microscopic examination she could find no obvious signs of use wear.

Now to the results of our survey of the chimpanzees of Mali:

After about three weeks in the capitol city, Bamako, Mana Diakite and I traveled by train to Kayes where we hired a Land Rover and driver for the survey. We stopped at 23 villages and hamlets to ask local people about wildlife in the area. We surveyed the area near eight of these villages on foot.

We found chimp nests on all eight foot surveys, and at 13 of the 23 villages people said chimps were usually or sometimes present nearby. At eight villages we were told that chimps were never seen; foot surveys at two of these discovered numerous nests. We saw eight chimpanzees near Binda, one group containing two adult females, two adult males, one subadult male and one juvenile; another pair of adults, one male and one female, interacted briefly



Jim Moore measuring diameter of chimp nesting tree in recently burned arid habitat, Gioungioudala, Mali.

with the larger group. We saw roughly 200 nests. They were observed up to 20 km from the nearest permanent river, although in most cases they appeared to have been built within 10 km of available water.

We found nests almost as far north as Solo and were told that chimps do live in the hills between Solo and Koundian. I would guess that the northern limit of chimpanzees in Mali is south of a line projecting due east from the Senegal border to Manantali, and from Manantali to Kita and thence to Bamako.

With only a single sighting, and that after we were guided to an area chimps had been seen in earlier in the day, I cannot make a transect-based density estimate for the animals. I had hoped to use nest counts to estimate chimp populations but our search patterns were non-random and recent fires through most of the area had singed many of the trees, making it impossible to estimate ages of many nests.

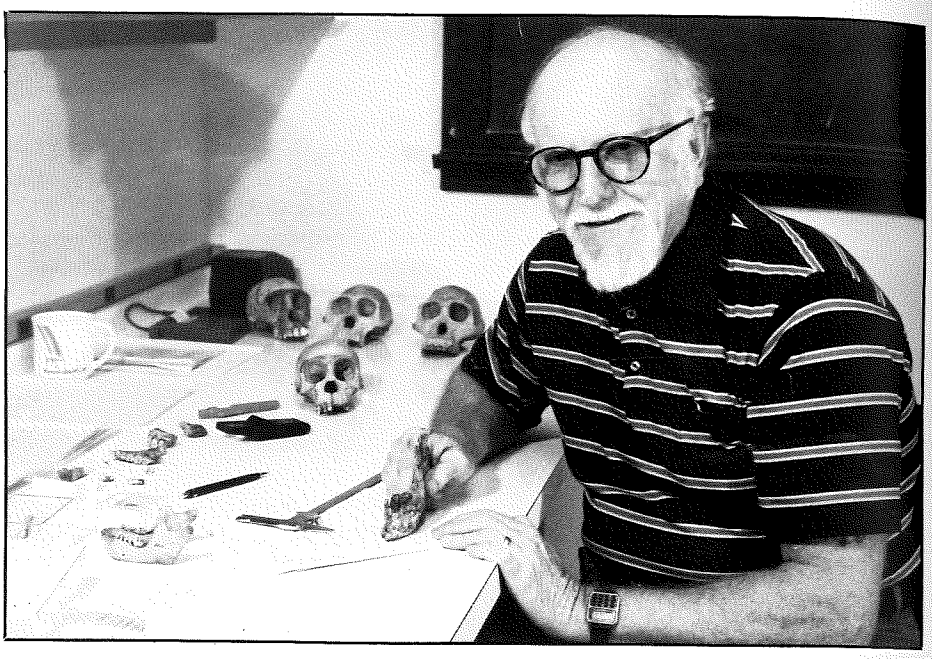
In Bamako I was told that there are several small populations of chimpanzees east of the Bafing. Taking everything into account, my best estimate of the chimpanzee population of Mali is somewhere between 500 and 1,000 individuals, assuming a relatively even distribution of chimps throughout the area judged to be suitable habitat.

Although this is a reasonably large population, I believe chimps in Mali are extremely vulnerable. People in the villages generally were able to tell us

exactly where chimps were last seen and are clearly familiar with their movements. If they wanted to hunt chimps, the villagers could do so with ease. If anything were to disturb the balance (e.g. an illegal export market), the chimps probably could be exterminated within a year.

Hunting for meat, medicine and magic charms is widespread and wildlife was scarce in the area we surveyed. All animals are used for magic and traditional medicine to some degree: Skins and dried parts of chimp, black colobus, serval, leopard, elephant, hippo and many others are available in the Bamako market, and lizard skin wallets and purses are sold throughout the city. Most of the skins for medicine and magic are sold in pieces a few inches square.

Chimpanzees in Mali are of interest to primatologists mainly because they are living in an extremely arid habitat; their behavior adaptations to this habitat may provide insights into the process of early hominid adaptation to the savanna. Although they are widely distributed and enjoy some degree of protection, human predation on other animals is ubiquitous and patterns of human land use probably affect all species present. Under these conditions of strong direct and indirect human influence, it would be hard to disentangle human and environmental influences on the chimps. Unless human impact on the environment is minimized, I believe that the limited resources and personnel available for arid area chimp research would be better spent at a more protected site, such as the Mahale Mountain region in Tanzania.



Daris R. Swindler of the Department of Anthropology at the University of Washington, Seattle, is at work on Sivapithecus *fossils from Pakistan. Dr. Swindler measured, photographed and studied all the fossils uncovered there during the past 12 years. This Siwalik material comes from a critical time period (7 to 12 M.Y.) for hominoid evolution and is crucial for reconstructing that evolution. It will prove important for further comprehensive comparisons with the China material from Yunnan. "Whatever the final disposition of* Sivapithecus *may prove to be," says Dr. Swindler, "our cursory observations suggest that the Siwalik sivapithecines are early ancestors of the orangutan."*

THE MOUNTAIN GORILLA SOCIAL SYSTEM

David P. Watts
Karisoke Research Center, Rwanda

With the aid of Rwandan field assistants and two expatriate research assistants, data is being collected regularly on the movement patterns of four study groups of mountain gorillas. Additional data is collected less regularly on two other, non-habituated groups. Several other "fringe" groups are also occasionally followed. I plot daily routes on a topographic map of the study area and thus have a record of approximately how much time each group spends in each area that it enters and of intervals between revisits.

This data is being added to comparable data from 1981 through the beginning of 1984 that covers, to a variable extent, the home range use patterns of seven social groups of gorillas, and my own previous data from 1978-79.

I have started an analysis of the ecological context of these groups' interactions and the social dynamics that characterize them.

Two interactions that have occurred in recent months deserve some comment, because they confirm earlier ideas about gorilla social dynamics and raise additional, unanswered questions. Both involve the silverbacked male, Tiger, who was solitary at the beginning of the study but now has a group that includes one female.

In early June, Tiger encountered another lone male who was not yet fully grown and who had recently left his natal group. The two fought, and Tiger pursued the other male for a long distance and essentially chased him back to his group, which he rejoined. This was a clear indication of the high level of competition that a male faces in attempting to establish a home range of his own. It poses again the questions of why all-male groups exist, why males migrate into such groups and are tolerated by other group members, and why a male immigrant might subsequently decide to emigrate and become solitary.

The series of interactions in which Tiger acquired a female from Nunkie's Group was extraordinary and fascinating. It started in late June, when Tiger encountered the group; he pursued them for a full week (several times right through the night), during which time there were innumerable chases, displays and at least two fights between the males. It was a spectacular instance of the extent to which a lone male will expend energy and take risks in an attempt to gain mates, and of the difference in the quality of relationships

between males with established groups, on the one hand, and between group males and solitary males, on the other. It was also striking what an active role the females in Nunkie's Group took in trying to drive Tiger away, and puzzling why females who were carrying small infants would take the risks involved in thus confronting a potentially infanticidal male. Tiger remained solitary after the interaction, but five weeks later made another onslaught on the group (again at night – he may have learned that the ensuing confusion was to his advantage), during which a female transferred to him. This particular female did not appear to have close social ties to anyone in her group other than her daughter, which made her a likely candidate for emigration, but it is puzzling that she transferred to a male with whom she had matured in her natal group. Finally, it was extraordinary that Nunkie's Group became fragmented during the confusion of both interactions. Individuals simply lost contact with the group and remained apart from it (while searching for it for from three days to five and a half weeks) or, in the case of one female, apparently migrated to another group after remaining isolated for several weeks.

I regularly participate in antipoaching patrols with Parc National des Volcans guards as part of the Mountain Gorilla Project work, as do other Karisoke personnel. It remains a daily struggle to try to keep the park free of snares, bow and arrow hunters and woodcutters. It is obvious that the Mountain Gorillas Project work has had a significant impact, however. A number of poachers have been caught and imprisoned, and we believe that others have simply abandoned the effort because their snares are cut so often and the risks are too great. Those who continue can wreak considerable havoc if they set a line of, say, 150 snares that remain undetected for a week or two. I am convinced, however, that the level of poaching would be utterly devastating were it not for the MGP effort.

EARLY PALEOLITHIC ARTIFACTS FROM THAILAND

Geoffrey G. Pope
Department of Anthropology
University of Illinois,
Urbana

Mainland Southeast Asia is of great importance in understanding the scope and timing of hominid evolution. Because of its geographical location, geological setting and habitat diversity, Northern Thailand has been the focus of paleoanthropological research during the last few years. For decades scientists have accepted the proposition that hominids must have reached mainland Southeast Asia before they reached Java or China. Yet until recently no datable associates of artifacts, fauna or Pleistocene hominids have been recovered in reliable chrometric frameworks. With the support of the Leakey Foundation recent work in Thailand is beginning to change this situation.

During December of this year I returned to northern Thailand and collected a few artifacts exposed on the surface of fluvial deposits which underly a basalt flow south of the city of Lampang. The location of the site is contiguous with another site (now destroyed) which had previously yielded similar artifacts according to Per Sorrensen.

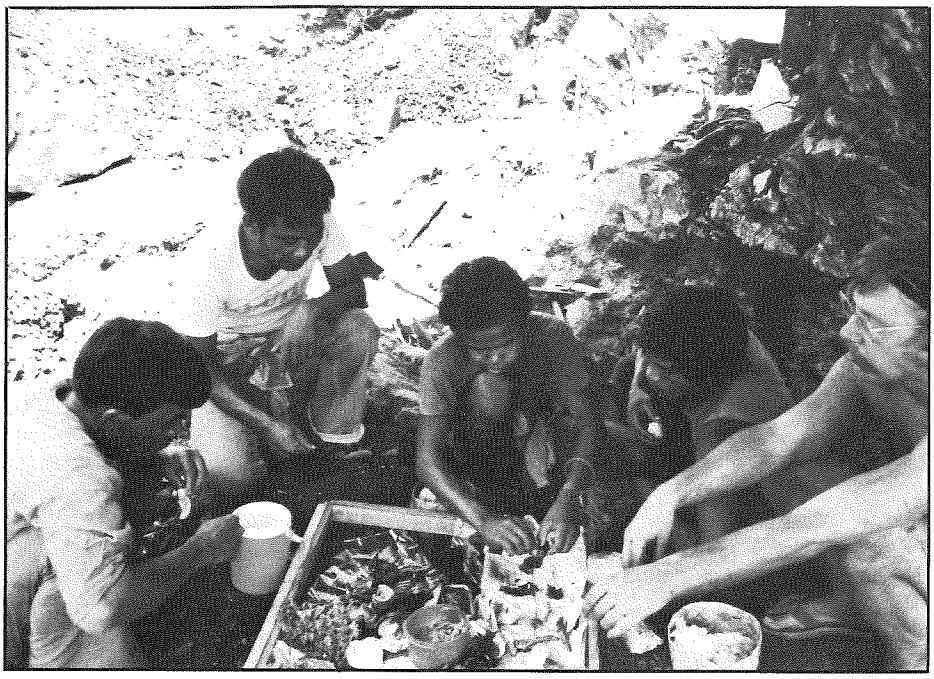
Sorrensen has long contended that these artifacts were of Middle or even Early Pleistocene age. The problem was that no radiometric dates could be used to support these early estimates.

This has now changed and k-ar ages for the stratigraphically higher Lampang basalt have placed a minimum age of 0.7 million years for the artifacts. The basalt is also known to be paleomagnetically reversed at the bottom, a fact which tends to corroborate the radiometric dates. This, then, presents the earliest evidence of hominids in mainland Southeast Asia.

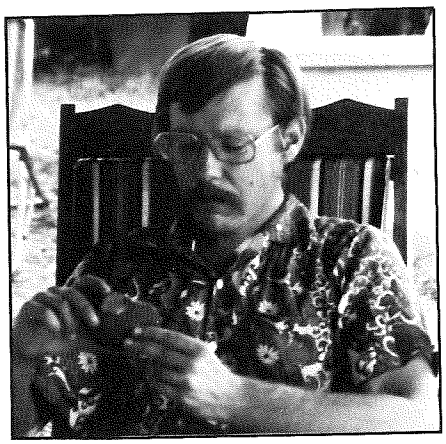
Yet the artifacts are not only important because of their age, but also because they may offer a tantalizing clue to a Paleolithic tradition or facies not previously recognized in Southeast Asia. Furthermore, they are not only similar to Sorrensen's artifacts but also to one from the nearby rock shelter locality of Kao Pah Nam recovered during previous excavations of the Thai-American expedition.

The distinctiveness of these artifacts lies in their common method of manufacture. They are steeply faceted at one end only. One or two "back-nicks" have been removed from the ventral surface. The selection of the raw material is also the same – river-rounded, indurated sandstone cobbles.

The Thai artifacts also bear a striking resemblance to artifacts reported from



A field lunch at Kao Pah Nam rock shelter.



Inspecting a recent archeological find at expedition headquarters.

caves in southernmost China. Chinese scientists have had difficulty in interpreting these finds because they are so dissimilar to other Chinese archeological assemblages.

We are still dealing with a mere handful of artifacts from widely scattered localities. To my mind, this means the similarity between the assemblages is even more remarkable.

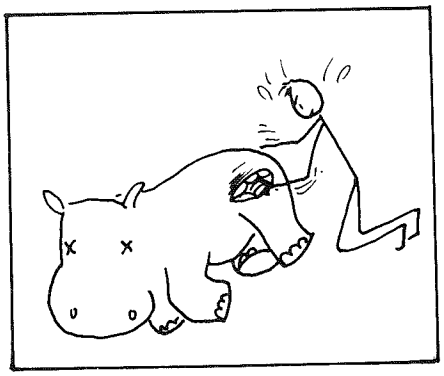
The function of the artifacts can only be guessed at this stage of research. Whether or not they were core or utilized tools is uncertain and the subject for continued research.

It is essential that these intriguing indications of early hominids be enlarged on. We also need to conduct rigorous excavations at these locations and obtain more radiometric dates. These will be the prime objectives of the expedition when we return to the field at the end of this year. Further research can only result in increasing our understanding of the actual antiquity and adaptations of early hominids in the Far East. ■

SO YOU THINK THEY ATE MEAT?

by Carole Sussman

Finding cutmarks on animal bones has led scientists to speculate that early hominids ate meat. I would like to offer a few alternate hypotheses. . .



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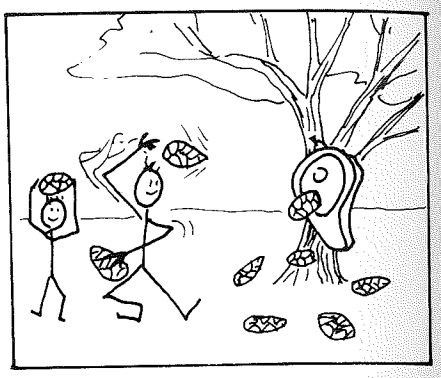
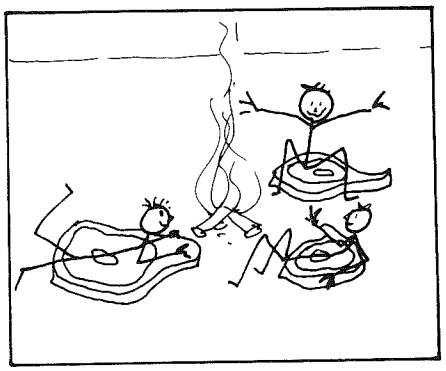
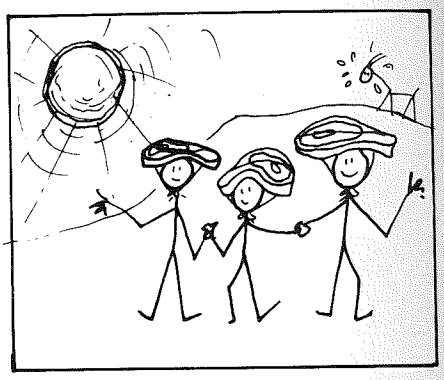


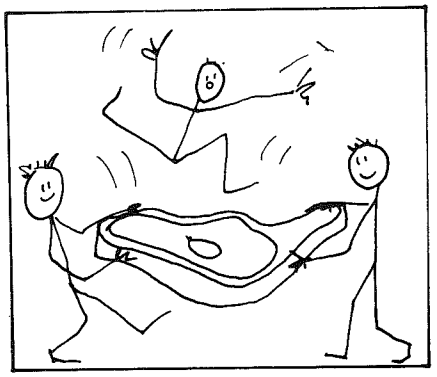
DARTBOARD



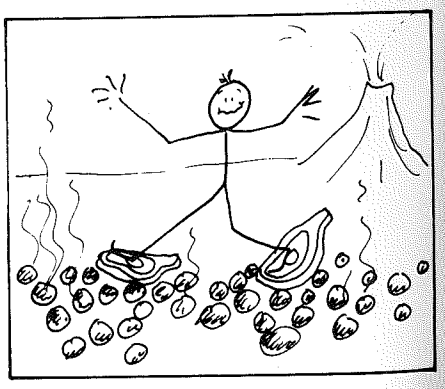
CUSHIONS



HATS



TRAMPOLINE



FOOTWEAR

Drawn for ***Interim Evidence****, the publication of the Foundation for Research into the Origins of Man (FROM), now integrated with the Leakey Foundation.*

continued from page 1

an Atomic Age milieu.

In order to better understand our current lifestyle/genetic discord and to appreciate what steps might be taken to eliminate its harmful etiologic consequences, we needed to determine, as best we could, the actual constituents of our ancestral lifestyle. For most people speculation about our Stone Age ancestors exerts a strong fascination: How did they live, what did they look like, how did they differ from us and how were they similar? For us, the effort to characterize their nutritional practices and the exercise patterns necessitated by their daily activities has been exciting as well as scientifically rewarding. The bulk of our understanding has come from the fields of paleontology, anthropology, epidemiology and nutritional science.

Paleontology is the study of fossil remains. For example, the stature of Paleolithic humans can be estimated from the length of femora (thigh bones) according to a formula which relates total height to femoral length; it is not necessary to have all the bony components of a skeleton to make this determination. Such studies have shown that humans living in the eastern Mediterranean area 30,000 years ago were probably tall; males averaged 177.1 cm (5'9¾") and females 166.5 cm (5'5½"), whereas in 1960 Americans averaged 174.2 cm (5'8½") and 163.4 cm (5'4½") respectively.

Skeletal height and pelvic depth both probably reflect nutritional factors, especially protein intake. With the advent of agriculture, animal protein intake decreased markedly so that average stature for both men and women ultimately declined by over 10 centimeters. The same phenomenon, a decrease in the animal protein content of the diet around the time that agriculture first appeared, is also documented by analysis of strontium/calcium ratios in bony remains. Strontium reaches the skeleton of living animals mainly through ingestion of plant foods so that herbivores have higher strontium levels in their bones than do carnivores. Studies of strontium/calcium ratios in the bones of humans who lived just before and during the changeover to agriculture confirm that the consumption of meat declined relative to that of vegetable foods around this period.

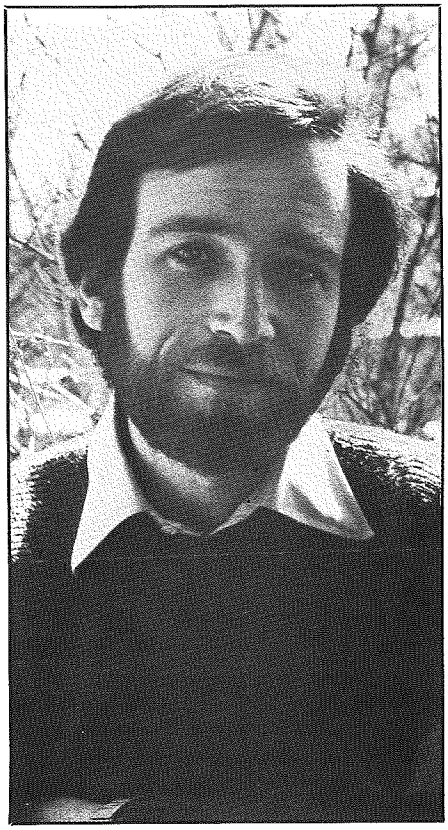
Skeletons also indicate muscularity; the prominence of muscular insertion sites and the area of articular surfaces both vary directly with the forces exerted by the muscles acting on them. Analyses of these features show that preagricultural humans were apparently generally stronger than those who lived thereafter, including us today. Because of their hardness, teeth are very well represented in paleontological material. It is a telling comment about our current consumption of sugar (which approaches 125 lbs per person per year in the United States) that only about two percent of teeth from the Late Paleolithic period exhibit dental caries whereas some recent American populations have had more than 50 percent of their teeth so affected.

Foraging.

Anthropology is a broad discipline which includes the study of recent hunter-gatherers whose lives can be considered to mirror those of our remote ancestors in many ways. Of course, there are important differences: Such people have been increasingly forced from the most environmentally desirable areas into desert, arctic or jungle habitats where the food quest must be far more difficult than it was for Paleolithic hunter-gatherers who exploited the most abundant and fruitful regions then available without competition from encroaching civilization. On the other hand, the technology of recent foragers is more advanced than that available to those living 25,000 years ago; an excellent example is the bow and arrow, perhaps developed no earlier than 10 to 15 thousand years ago. Nevertheless, study of recent hunter-gatherers does provide a kind of window into the Stone Age world; the nutrition, physical attributes and health of individuals who have such parallel lives must be reasonably similar despite the millennia which separate them in time.

Anthropologists have studied over 50 hunter-gatherer societies sufficiently well to justify nutritional generalizations about them. When data from these groups are analyzed statistically, the average values all center around a subsistence pattern of 35 percent meat and 65 percent vegetable foods (by weight). There is, of course, considerable variation; artic peoples may eat up to 90 percent animal products, whereas arid desert dwellers may obtain only 15 percent of their diet from such sources. Nevertheless, these data allow us to reasonably conclude that Paleolithic humans had a roughly similar range of subsistence patterns.

Epidemiology is the study of disease patterns. When a pathologic condition, such as lung cancer, is common in a specified population, for example cigarette smokers, and uncommon in another specified group, such as nonsmokers, differences between the two groups may bear on the etiology of the disease condition under scrutiny. Information derived from various epidemiologic investigations can be used to help estimate what sorts of diseases might have afflicted Paleolithic humans and which ones must have been uncommon. For example in today's world, people who consume a minimal amount of saturated fat tend to have little coronary heart disease and a relatively low



Dr. Melvin Konner.

incidence of cancer involving the breast, uterus, prostate and colon. If we could be confident that the Stone Age diet contained little saturated fat we could rationally assume that individuals living then had a lower incidence of heart disease and cancers related to fat intake than do persons living in affluent industrialized Western nations today. Similar arguments might be made concerning hypertension (as related to dietary sodium, potassium and calcium) and, of course, lung cancer and emphysema (cigarettes). A tempting assumption is that, since illnesses of this sort tend to become manifest in older persons, Paleolithic humans (whose life expectancy was less than ours) would not have had the opportunity to develop them, no matter what their lifestyle. However, epidemiologists and pathologists have shown that young people in the Western world commonly have developing, asymptomatic forms of these illnesses, but hunter-gatherer youths do not. Furthermore, those members of technologically primitive cultures who survive to the age of 60 or more remain relatively free from these disorders, unlike their "civilized" counterparts.

Nutritional science furthers evaluation of Paleolithic life by providing analyses of the foods such people were likely to have eaten. An understanding of their overall nutrition is impossible without knowing that, although they ate more red meat than we do now, they nevertheless consumed much less saturated fat since wild game has less than a fifth the fat found in the domesticated animals currently bred and raised for meat production. Similarly, nutrition analyses of the wild uncultivated fruits, vegetables and nuts eaten by recent hunter-gatherers allow us to estimate the average nutritional values of the plant foods our ancestors ate. To this end we have been able to accumulate nutritional data characterizing 26 different wild animals ranging from kangaroos to wart hogs and 45 different wild vegetable foods – mainly roots, beans, nuts, tubers and fruit but including items as diverse as truffles and seed pods. The search for this information has been challenging but entertaining; how else would one learn that bison meat contains only 40 mg of cholesterol per 100 grams of tissue or that the Australian green plum has the world's highest known vitamin C content (3150 mg per 100 grams)!

When information from these disparate scientific disciplines is correlated and coordinated, what is the picture that emerges? What was the diet of our ancestors; what are other important ways in which their lifestyle differs from ours; and do these differences have any relationship to the chronic illnesses from which we suffer, but from which recent hunter-gatherers seem immune?

To address the most straightforward, but certainly not unimportant, issues first, it is clear that our Stone Age ancestors were rarely if ever exposed to tobacco and alcohol. The manufacture of barley beer can be dated as early as 7000 years ago, but there is no convincing evidence for consumption of alcohol before this time and recent technologically primitive groups have not been found to regularly manufacture alcoholic beverages. Similarly, there is no indication that tobacco was available prior to the introduction of agriculture and unacculturated hunter-gatherers studied in this century have not been observed to use tobacco products. But Late Paleolithic peoples were probably not altogether free from abusive substances; several recent hunter-gatherer groups have used some form of consciousness-altering drugs for ceremonial purposes and it seems likely that similar agents may have been available in the Late Stone Age although their use could hardly have been as prevalent as is currently the case.

The physical demands of life in the Late Paleolithic period insured that our ancestors, both men and women, were strong, fit, lean and muscular. Their bones prove that they were robust – they resemble those of today's professional athletes. Furthermore, hunter-gatherers studied in the last 150 years have been trim and athletic in their appearance.

Modern nutritionists generally feel that items from four basic food groups – meat and fish, vegetables, nuts and fruits, milk and milk products, and breads and cereals – are necessary for a balanced diet. But during the Paleolithic period older children and adults derived all their nutrients from the first two groups: wild game and vegetables, fruits and nuts. Except for very young children, who were weaned much later than they are today, no one had any dairy foods at all and they apparently made comparatively little use of grain. Their only "refined" carbohydrate was honey, available infrequently and obtained painfully. They seem to have eaten little seafood until fairly late in prehistory, though this assumption is questionable since the ancient sea level was much lower (because of water locked up in the extensive glaciers of that period) and the sites of Paleolithic seacoast dwellers are now under water.

After weaning, Paleolithic humans drank water, but the beverages we now consume generally deliver an appreciable caloric load as they quench our thirst. Mundane as it is, this example illustrates a pervasive pattern – caloric concentration. Since our meat is fatter it contains more calories per unit weight (typically three to four times as many) than does wild game. Though there are important differences, fresh vegetables available today are reasonably close nutritionally to what preagricultural humans ate. However, the plant foods we eat are commonly refined and adulterated so that their basic caloric load is multiplied: french fries have more than twice and potato chips over five times the calories present in an equal weight of baked potato. Pumpkin pie has ten times the calories found in the same weight of pumpkin served alone.

The salt added to our foods as a seasoning and as a preservative insures that we now consume an average of six times the daily sodium intake of Paleolithic humans. In a similar vein, the

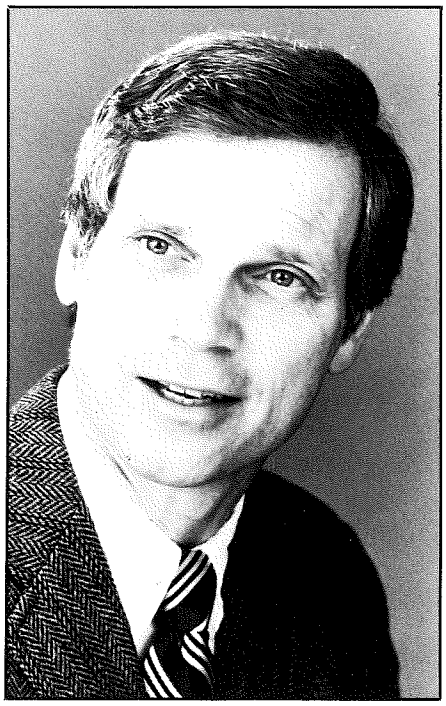
process of refining carbohydrate foods provides us with quantities of sugar and white flour far in excess of what was available to our ancestors while reducing our complex carbohydrate (starch) and dietary fiber intake much below the levels they consumed. Not only do we eat twice the fat eaten by Stone Agers, its nature is different. Structural fat is a necessary constituent of cellular membraneous structures; this type of fat is predominantly polyunsaturated in nature and was the major fat consumed by our remote ancestors. Conversely, depot or storage fat is the main type found in the adipose tissue stores of domesticated animals; this variety of fat is largely saturated and is very prominent in today's diets. Like game available now, the wild animals eaten 25,000 years ago had minimal depot fat; accordingly humans then ate considerably more polyunsaturated than saturated fat – but the reverse obtains in 20th century affluent Western nations.

To summarize, these observations indicate that the Cro-Magnons and similar Late Paleolithic peoples consumed nearly three times the amount of protein we do, about a sixth of the sodium, more potassium, more calcium (which is very interesting in view of the prevalence of osteoporosis in today's society), and considerably more vitamin C (though not the amounts megavitamin enthusiasts would recommend). They ate about the same amount of carbohydrate that we do; however, it was predominantly in the form of starch and other complex carbohydrates, providing a good deal more dietary fiber than we have in our diet. They ate very little refined carbohydrate or simple sugar, mainly natural sugars in fruit together with relatively small amounts of honey. They ate only half the fat we consume in 20th century America and their fat was more polyunsaturated than saturated in nature.

Certain aspects of our ancestors' physical fitness bear further emphasis: Their "exercise program" was lifelong, it developed both endurance and strength, it applied to men and women alike, and the activities which comprised their "workouts" varied predictably with seasonal changes. Today's fitness enthusiasts might well ponder these Paleolithic training guidelines. Preagricultural humans were more like decathalon athletes than either marathoners or power lifters; our genes appear to have been programmed for the synergism which results when endurance and strength occur together. A lifelong program was unavoidable for them; for us it requires strategic planning. Really long term training in just one exercise mode is almost impossible to maintain; over-training, boredom and burn-out tend to overcome even the most intense dedication. Paleolithic men and women were spared these phenomena because the activities of each season differed from those of the next. The Russians have perhaps unconsciously recreated these circumstances in a training approach they call "periodization." This system employs planned daily, weekly and quarterly variation in the mode, volume and intensity of exercise so that training remains fresh and invigorating, not dull and endlessly repetitive. Perhaps this recapitulation of our ancestral pattern partially explains the success Russian athletes have experienced in international competition.

What about the proposition we advanced at the beginning of this article: Do the diseases of civilization result from the mismatch between our genes and our current lifestyle? The evidence is strong that such a connection exists. In important respects the lifestyle of Paleolithic humans, that for which our genes have been selected, parallels recommendations made by the American Cancer Society, the American Heart Association, the American Diabetes Association and the Senate Select Committee on Nutrition. Furthermore, recent hunter-gatherers have been essentially free from the chronic illnesses which kill most Americans.

Anthropology, paleontology, medicine, epidemiology and nutrition can be likened to the facets of a prism, each providing a different view of the same subject. Our subject is the health and disease of persons living in affluent industrialized Western society and when views provided by diverse scientific disciplines converge, the resulting implications acquire profound significance. There is nothing especially distinctive about human hunter-gatherers in biochemical and physiological terms. What they ate and how they lived fall well within the broad mammalian spectrum. During the past 10,000 years, however, humans have exceeded the bounds. Many of the lifestyle factors we now take for granted (particularly sedentary living, alcohol, tobacco and our high salt, high saturated fat, high refined carbohydrate diet) are unique in free-living vertebrate experience. They constitute a deviation so extreme that our bodies have responded by developing forms of illness not otherwise seen in nature. These are the diseases of civilization.



Dr. S. Boyd Eaton.

Drs. Eaton and Konner will be among the speakers at the Leakey Foundation symposium on diet in San Francisco, February 9, 1986. ■

GLYNN ISAAC — 1937-1985

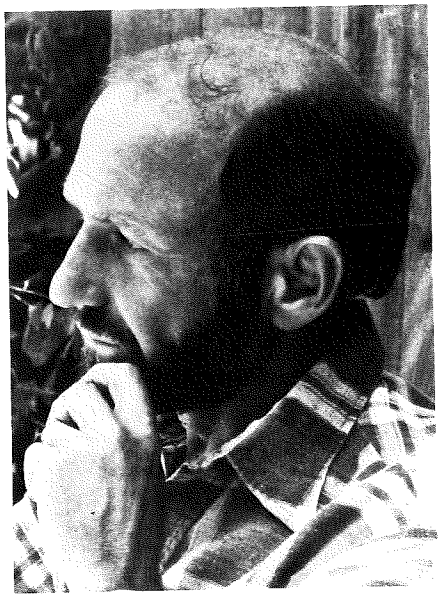
Glynn Llywelyn Isaac, professor of anthropology at Harvard University, internationally known for his study of human origins and for his archeological work in East Africa, died in Tokyo on October 5. He was 48 years old. Long a good friend of the Leakey Foundation, one of the first highly promising students of Louis Leakey, he had also been a sometime Foundation grantee.

The exact cause of his death is unknown. He became ill while in Beijing, China, attending a conference of the National Academy of Sciences and was flown to the U.S. Naval Hospital in Tokyo. En route to the United States for treatment, he collapsed at the Tokyo airport and died.

"At times like this it's natural to say that people are irreplaceable, but he truly is," said his longtime friend and colleague David Pilbeam, also a professor of anthropology at Harvard. "His joy of life, his love of anthropology and archeology, his total commitment as a teacher and, perhaps above all, his complete generosity of spirit make him totally and tragically irreplaceable. Just looking at the list of invited lectures that he did over the last few years – the Royal Society of London in 1980, the Darwin Centenary Conference in Cambridge in 1982 and many others – shows that he was the spokesman for the field of paleoanthropology."

Dr. Isaac came to Harvard with the Peabody Museum in 1983 after 17 years of teaching and research at the University of California in Berkeley. Several of his Berkeley students followed him to Harvard and will now also find him irreplaceable.

His first professional years were spent in Africa in the early 1960s as Warden of Prehistoric Sites in Kenya and Deputy Director to Louis Leakey at the Centre for Prehistory and Paleontology in Nairobi. Of his many fieldwork expeditions in Africa, the best known is that to Koobi Fora where, as co-leader with Richard Leakey of the National Museums of Kenya, he and his team were responsible for the excavation of nearly 20 archeological sites ranging in age from about two million to 1.3 million years ago. The data from these sites are being used to widen the



understanding of the processes of change in behavior and ecology that led to humans as we know them today. More recently, Dr. Isaac became interested in the role that changing diet may have played in human evolution.

"Professor Isaac's death is a great loss to Harvard, to the Department of Anthropology, the Peabody Museum and the academic community as a whole," said Stanley J. Tambiah, chairman of the Department of Anthropology at Harvard. "He was an active field archeologist, at the cutting edge of paleoanthropology, a dedicated teacher and an internationally recognized scholar. That a man of such dynamic energy and passionate engagement with life should be suddenly struck by death comes as a great shock to us all."

"Although his research area, human origins, is notoriously contentious, Glynn and his research were held in universal esteem – a tribute to his unmatched energy, integrity, and to the broad vision he brought to his work. Despite his many honors, he maintained an air of boyish congeniality in his lab. We have lost a warm and generous friend; anthropology has lost one of its brightest stars," Irven DeVore, a colleague in the Harvard anthropology department, said.

Dr. Isaac is survived by his wife, Barbara, and two daughters, Gwyneira and Ceri.

BOOKS

ONE LIFE: AN AUTOBIOGRAPHY, by Richard Leakey. Merrimac, 1984. pp 207. Illustrated. $18.95.

Born in Kenya, the son of famed Louis S. B. and Mary Leakey, Richard Leakey accompanied his parents on digs on the plains of East Africa all his youth. He became absorbed in archeology and anthropology and has spent his life restoring and identifying the fossils of the area and searching for others. In recent years his main purpose has been the development of the Kenyan National Museum system, staffed by Kenyans and operated to make the data of human evolution available to a wider audience. Only mildly technical, his autobiography tells his story with energy and appeal.

ANCESTORS: THE HARD EVIDENCE, edited by Eric Delson. Alan R. Liss, Inc., New York, 1985. pp 351. Illustrated.

Eric Delson of the American Museum of Natural History, here reports the outcome of the April, 1984, exhibition of original human fossils at the museum, and of the symposium and comparative study sessions which accompanied it. In general, the book surveys the present status of paleoanthropology and indicates directions for future study. The exhibition was partially funded by the Leakey Foundation.

THE SURVIVAL OF CHARLES DARWIN, by Ronald W. Clark. Random House, New York, 1985. Illustrated. $19.95.

Darwin is portrayed as a "reluctant revolutionary" torn between his duty to write of his discoveries and his love of a quiet life. After the appearance of "The Origin of Species," it was not Darwin but his friend Thomas Henry Huxley who took on the challenge of defending the theory of evolution. One of the main reasons we still admire Darwin is apparent when he speaks for himself herein, the sensitive observer absorbed in nature. The second half of the book deals with Darwinism after Darwin.

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BOOKS

HUMANKIND EMERGING, edited by Bernard G. Campbell. Little, Brown and Co., Boston, 1985. pp 517. Illustrated.

Fourth edition of a work dealing with introductory anthropology, physical anthropology and human evolution. The main focus is on paleoanthropology. Campbell's material shows the reader what we know of how, when and where we humans came to exist. This edition includes the most recent fossil finds as well as the latest interpretations of both new and older discoveries.

ANTHROPOLOGY: CONTEMPORARY PERSPECTIVES, edited by David E. K. Hunter and Phillip Whitten. Little, Brown and Co., Boston, 1985. pp 279. Illustrated.

In this, the fourth edition of the work, the editors have attempted to convey the excitement and relevance of contemporary anthropology to beginners. Almost one third of the articles are new. Sherwood Washburn and Richard Leakey are among the contributors. An admirably useful glossary is included.

ADAPTIVE RESPONSES OF NATIVE AMAZONIANS, edited by Raymond B. Hanes and William T. Vickers. Academic Press, Orlando, Florida, 1983. pp 536. $49.00.

The essays in this volume deal with cultivation, hunting and fishing, nutrition and settlement pattern of the Amazonian peoples of today. Contributing scientists include Kristen Hawkes and Kim Hill.

PRIMATES IN NATURE, by Alison F. Richard. W. H. Freeman and Co., New York, 1985. pp 588. Illustrated. Paperback $17.95; cloth $27.95.

Dr. Richard of Yale University here presents an overview of primate behavioral ecology, analyzing such vital aspects as reproduction, dietary patterns, population characteristics, social organization and interaction with environment. An extensive bibliography of primate references is included.

CHILDREN OF THE FOREST, by Kevin Duffy. Dodd, Mead and Co., New York, 1985. pp 224. Illustrated. $14.95.

This is an account of Duffy's solitary visit among the Mbuti, nomadic pygmy hunter-gatherers, in the Ituri forest of equatorial Africa. He engagingly captures the Mbuti culture, which may be the most ancient surviving on earth. Written for a wide audience, the book is straightforward and informative.

PRIMATE EVOLUTION AND HUMAN ORIGINS, edited by Russell L. Ciochon and John G. Fleagle. Benjamin Cummings Publishing Co., Menlo Park, CA., 1985. pp 396. Illustrated.

These 44 original articles bring together a selection of publications from the past twenty years, providing material that has shaped current views of primate evolution and human origins. The fossil evidence, increasing dramatically over the last two decades, has engendered many new interpretations, clarifying some areas and creating controversy in others.

FAUNAL REMAINS FROM KLASIES RIVER MOUTH, by Lewis R. Binford. Academic Press, Orlando, Florida, 1984. pp 287. Illustrated. $39.50.

This monograph deals with the animal bones found at South African cave sites dating from the Lower Paleolithic. Its purpose is to demonstrate effective archeological theory analysis. See Dr. Binford's article in *AnthroQuest*, Summer, 1985.

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