

ANTHROQUEST

news of human origins, behavior and survival

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EXPEDITION TO VIETNAM

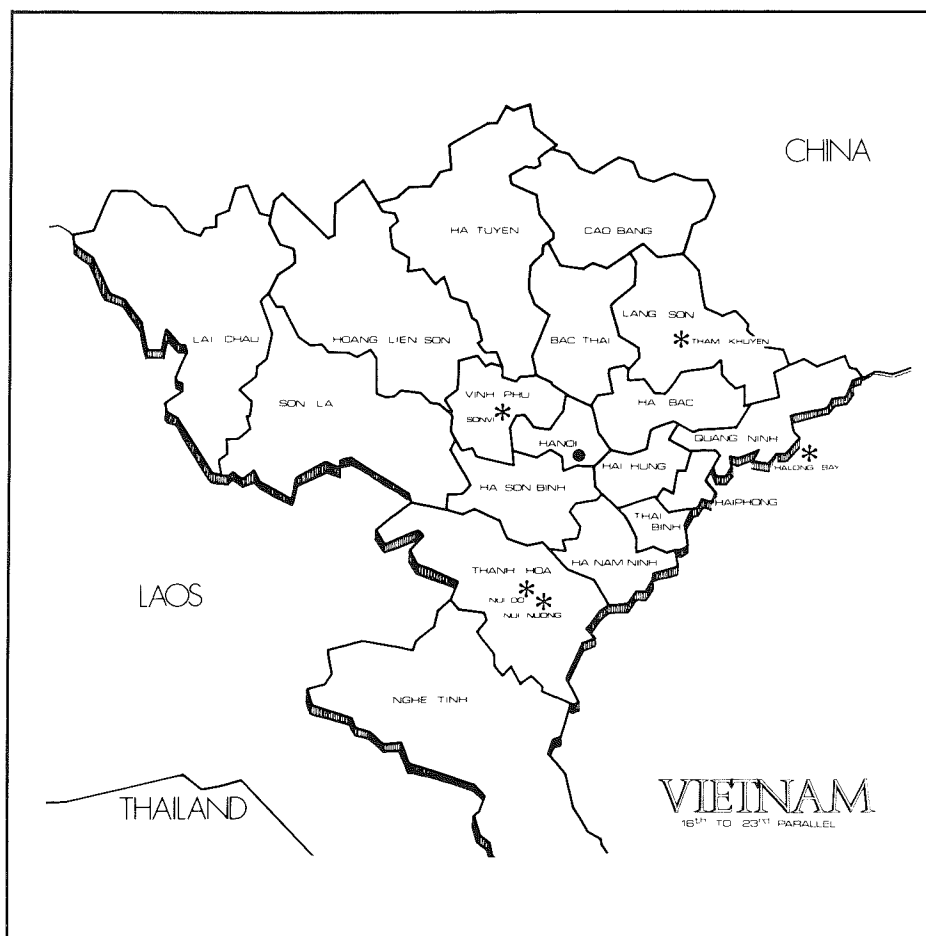
The Search for Ancient Cultures, Early Humans and Giant Apes
in the Asian Pleistocene Record

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No country on earth now is more isolated than Vietnam; Antarctica is literally a more cosmopolitan place. And no nation is more deeply estranged from Vietnam than the United States, for reasons obvious and not so obvious. In spite of Vietnam's isolation, local researchers have carried out an intensive archaeological and paleoanthropological research campaign during the past three decades. In fact, throughout the 1950s and 1960s Ho Chi Minh himself was a major booster of archaeological research in Vietnam, especially those aspects of the field that might have nationalistic applications.

In the West, anthropologists had little knowledge of the research taking place in Vietnam except for occasional notes in a scientific journal which were often based on translations of Vietnamese articles. With the liberation and reunification of North and South Vietnam in 1975 Vietnamese scholars began to strengthen ties with Eastern Bloc scientists from the U.S.S.R., Bulgaria, East Germany, and others in an effort to exchange information and more widely disseminate the

Map of northern Vietnam showing localities (*) visited during expedition.

continued on page 12

THE L.S.B. LEAKEY FOUNDATION

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

The Foundation sponsors:

International research programs related to the biological and cultural development of humankind.

Long-term primate research projects which may help us to understand how we evolved as a species.

The training and education of students in these fields.

Conferences, publications of scientific papers, and educational programs designed to disseminate knowledge relevant to our changing views of humanity's place in nature.

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PRESIDENT'S MESSAGE

Dear Fellows and Members of the Leakey Foundation:

It has been curiosity and the quest for knowledge that has molded humankind through evolution for millions of years, and this quest will lead us to the future.

The idea of the Leakey Foundation, created 20 years ago has been a great one, and has already fulfilled a wide diversity of needs. The Science and Grants Committee continues to grow in strength and diversity, and the research grants submitted to us for funding show more creativity than ever before.

The Foundation remains healthy and spirited, not because of one individual or a few of us, but because of all of us — all of you!

We still are able to fund the largest part of the grant requests that we receive, but we look forward to the day when any valuable research proposal will be fully funded, and we can encourage even greater numbers of young talented students to enter the field. Our success in meeting the Getty Challenge will make this goal a reality.

There have been several changes at the Foundation. *Elizabeth Brady*, has retired from her position as editor of *AnthroQuest*, a post she has held for seven years. Liz did a superb job with *AnthroQuest*, taking it from a 4-page to a 24-page newsletter that publishes in-depth articles on the newest developments in anthropological research. She even thought up the name!

There is no way to thank a volunteer adequately for an effort of this magnitude, but perhaps her thanks has come from the scientists as well as members who wrote often and praised the Foundation for the publication of such timely information.

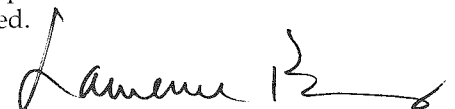
Meanwhile, in the tradition of volunteerism that is a hallmark of all that the Foundation does, we are *seeking a volunteer to assume the position of Editor*. If you are interested please contact the Foundation. Thanks to Elizabeth Brady, we have a fine formula for a well-respected and timely publication, and the Leakey Foundation has an extraordinary number of current projects that will provide great reading in the months to come.

This issue is our first experiment with *desktop publishing*, an effort to cut costs and still maintain the quality of *AnthroQuest*.

Deborah Spies, our Administrative Director, has left us for a new position as Manager of Community Services at the Times Mirror Company in Los Angeles. Deborah was a highly valued staff member who was the glue that kept the Foundation running smoothly and efficiently. The Board of Trustees is very grateful to Deborah for her years of dedicated service.

Jean Hogue, who has been with the Foundation for several years, is now our Office Manager. She is doing a splendid job of handling the day-to-day affairs of the Foundation until we find a replacement for Ms. Spies.

The *Development Office* in San Francisco, staffed by Executive Vice-President *Barbara Newsom* and Director of Development *Melinda McGee*, is working diligently against the deadline of the *Getty Challenge Grant*. We will be able to match dollar for dollar any contribution that comes to the Foundation from now until the end of 1987. Pledges for support will be honored if they are paid by the end of 1988. Our success in this campaign will make a tremendous difference to the field of human origins research. Every dollar will be doubled; your support at this time in the Foundation's history is needed and greatly appreciated.



THE MURIQUIS OF BRAZIL

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A Muriqui of Brazil

Of some 200 recognized varieties of primates in the world, over half are currently in some jeopardy. Seventy five taxa are officially listed in the International Union for Conservation of Nature's "Red Data Book," thirty-one are classified as endangered; that is, their numbers are at critical levels and they will go extinct unless measures are taken to protect them. *Human interference with natural primate populations is almost entirely responsible for the precarious status of these primate species.*

Threats to primates are severe today, largely as a result of worldwide human population growth and development. Hunting and poaching are among the most obvious dangers, but they are often regional and species specific. In some areas, primates such as West African chimpanzees are hunted as prized sources of meat; in parts of East Africa, chimpanzees are protected by strong cultural taboos. Other primates, such as Indian rhesus monkeys, have been

extensively trapped for export to developed countries for biomedical research. In fact, the first field studies of rhesus macaques were the direct result of the introduction of the Salk polio vaccine in the 1950s. As rhesus monkeys became increasingly valuable to medical research, field studies of natural populations became increasingly important. The result of heavy trapping for export purposes led to drastic population declines in parts of their range; fortunately, there are now strict regulations restricting the export of macaques, chimpanzees, and many other primate species.

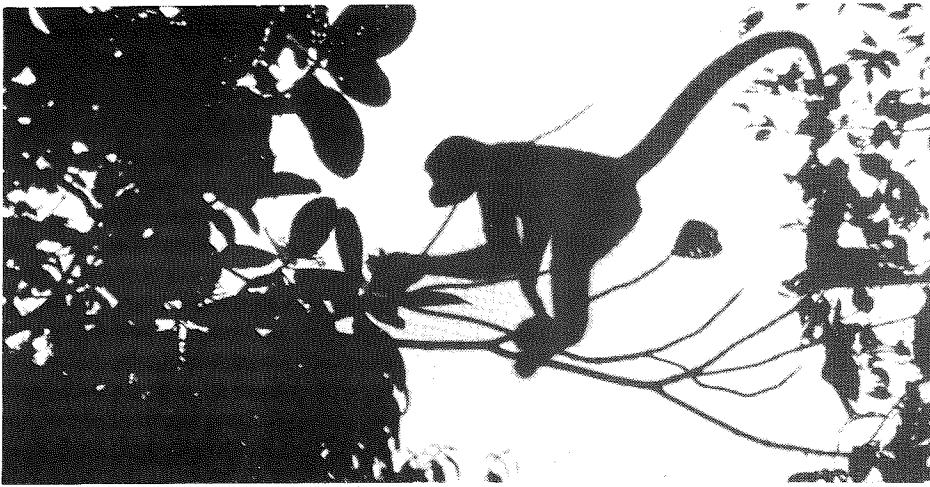
However, the most ubiquitous pressure facing wild primate populations the world over comes from the destruction of their habitats. Over 90 percent of all primates inhabit the tropical forests of Asia, Africa, and Central and South America. In most cases, the countries with the largest stands of tropical forest also support the greatest diversity of primates. In fact, just five countries (Brazil, Zaire,

Columbia, Madagascar and Indonesia) support 75 percent of all primate species. The world's tropical forests are disappearing at the appalling rate of 10 to 20 million hectares per year; this is the equivalent of losing a forested area the size of California every two years.

The consequences of habitat destruction to the survival of primates are diverse. Some species have adapted to human encroachment by exploiting cultivated crops. However, with the expansion of agriculture, a lethal cycle begins in which the primate loses. As their natural habitat is destroyed and crops are planted, some primates become agricultural pests, placing them in direct conflict with humans. Even where primates do not interfere with human settlements, their populations are threatened as their forests are cut. Species that have highly specialized diets cannot adapt as their native forests disappear. Populations are often isolated from one another in areas too small to support viable groups. After several generations, their reproductive rates suffer as inbreeding depression sets in. Even in relatively large forest tracts where selective logging is the predominant threat, important primate food species are removed or damaged.

Mountain gorillas are one of the best studied of all endangered species. Our knowledge of these animals is due to the foresight of the late Louis Leakey, who made it possible for Dian Fossey to conduct her long research in Rwanda. Leakey well recognized, that gorillas, one of our closest genetic relatives, would be likely to contribute to our understanding of human behavioral evolution; this was a major impetus behind his interest in their study in the 1960s.

The field of primatology has changed remarkably since Leakey's days. The increasing rigor in ecological and evolutionary theory and in methods of data collection, as well as the data generated from a few long term studies, are all responsible for our current sophisticated knowledge of primate behavior. Longitudinal studies of well-known species will undoubtedly



A Juvenile Muriqui

continue to provide us with some of our most important insights into primate behavior. However, we will also benefit by gaining a broader comparative perspective. *Our current knowledge of primate behavior is actually based on a very small and strongly biased sample of primates.*

Research on poorly known primates can contribute much to the development of current socioecological models. However, these understudied, and often endangered, species continue to receive less attention than primates such as baboons, macaques, and chimpanzees. It is especially ironic that the same factors responsible for endangering primates — hunting and habitat disturbance — have also figured prominently in their scientific neglect.

For example, the presence of hunters and poachers make the animals extremely difficult to habituate by scientific observers. Hunted primates have already learned that humans are bad news, and their impulse is to flee. Human proximity may cause primates to shift their ranging behavior entirely; added stress may even cause pregnant females to abort their fetuses. Trying to habituate primates in areas where they are hunted may take several years, forcing the observer to postpone systematic data collection despite labor-intensive efforts. The habituation process also presents moral dilemmas. As anyone who, like myself, has habituated endan-

gered animals, knows; there is constant worry that, having succeeded in overcoming the primates' fear of humans, you have also set them up by making them vulnerable to hunters. Primates that have been subjected to severe hunting pressures in the recent past may occur in artificially low population densities or have unusual group compositions; these altered demographic phenomena inevitably affect the quality of the data collected, and can distort scientific conclusions. Only when research continues over a long term, spanning several primate generations, can the impact of past hunting practices be evaluated.

Habitat disturbance, the most universal of all threats to primates, significantly affects ecological studies of behavior because of its indirect impact on the presence of both natural predators and natural food resources. Selective logging may eliminate important primate foods, while the consequences of larger scale deforestation affect everything from birth spacing to ranging behavior to intergroup dynamics. Even where primates manage to survive, there is always uncertainty about the ways in which recent ecological changes have affected primate diets, ranging behavior, grouping patterns, and social organization. Determining the effects of these changes is more difficult for endangered primates than for more commonly-occurring species because there is rarely information about the behavioral ecology of endangered species prior

to their disturbance; that is, there is no way of evaluating what the ecological changes and the behavioral responses have been.

Let's consider the five most well-studied primate taxa: macaques, baboons, langurs, chimpanzees and mountain gorillas. The vast majority of free-ranging macaques and langurs live in areas where their natural forests have long since been destroyed. In fact, commensal relationships between humans and these primates have been so pronounced historically that it is difficult to assess what the "natural" habitat of these species is. Yet, despite human interactions, field studies of macaques and langurs have provided many of our most important insights into primate behavior.

Most of our knowledge about chimpanzees and gorillas comes from studies of two relic populations of these species, the Gombe Stream Reserve in Tanzania and the Karisoke Research Center in Rwanda. Both of these sites are isolated forests. The only forest connecting Gombe chimps with other members of their species has, since 1960, been almost completely cleared for cultivation. Similarly, the last stronghold for the mountain gorilla exists high in the Virunga volcanoes.

To illustrate some of the ways in which both theoretical and conservation goals can be advanced by the same set of data, let me introduce the species I know best, the woolly spider monkey, or muriqui (*Brachyteles arachnoides*). *In at least two respects, muriquis are the New World equivalent of gorillas; like gorillas, muriquis are the largest primate in their hemisphere.* Adult muriquis weigh up to 15 kg, nearly twice as much as the next biggest South American monkey. Muriquis also rank with the mountain gorillas among the most endangered primates in the world.

Muriquis are endemic to the Atlantic forest of southeastern Brazil, a forest that once extended continuously from Bahia in the north to Sao Paulo in the south. Over 95 percent of this forest has been cut for farm and pastureland, much in only the last 100 years. At the time of

their scientific discovery in 1806, mureiquis were so abundant that Prince Maximilian zu Wied and his party relied heavily on mureiquis for meat during their travels. Yet, despite their past abundance, habitat destruction and, to a lesser extent, hunting had reduced mureiqui numbers to less than 3000 by the late 1960s. *Now, there are only between 300 and 400 individuals known to survive; they are found in only 10 of the remaining tracts of the Brazilian Atlantic forest. None have survived more than a year or two in captivity.*

It is ironic that mureiquis, who have suffered so much from human attention, must now rely on it. When I began my research in 1982, there were numerous plans for the conservation and management of mureiquis. Like most conservation plans, those for mureiquis were intended to proceed on several simultaneous levels: protect remaining natural populations and habitats; set aside new reserves and move unprotected populations to secured areas; translocate individuals to increase gene flow between isolated populations; and establish the first captive breeding program for the preservation of the species' gene pool. However, there had been no systematic observations on mureiquis to inform these conservation plans, and with the total population numbering only a few hundred, opportunities to observe mureiquis in their natural state, and to collect data on their behavior in the wild, were rapidly disappearing.

I thus began my studies of mureiquis for conservation reasons. My goals were to collect systematic data on mureiqui feeding ecology, ranging behavior, and social interactions, and to apply these data to practical recommendations for the effective conservation of the species. At the same time, mureiquis were extremely interesting at a theoretical level, because analyses of their functional anatomy from museum specimens indicated that they exhibit a highly unusual combination of morphological traits.

Cross-species comparisons of primates have shown that a number of socioecological variables, such as group size, home range size, and the

type of mating and social system, correlate closely with the proportion of leaves, as opposed to fruit, in primate diets. These correlations have been explained by the dichotomy which exists in the ways in which primate fruit and leaf resources are distributed. In all forests, leaves are more abundant than fruit, and the difference between exploiting densely distributed leaves or widely dispersed fruits explains many of the differences between primate adaptations.

If the dichotomy between the distribution of leaves and fruits is justified, what is one to make of a species, such as the mureiqui, that exhibits prominent traits for both of these divergent dietary adaptations? On the one hand, the mureiqui's dentition, masticatory process, and digestive system resemble those found in primates that rely heavily on densely distributed leaves. On the other hand, the mureiqui's mode of suspensory locomotion has been attributed to an adaptation for exploiting widely dispersed patches of high quality fruits.

Obviously, the same data that I collected on mureiqui feeding, ranging and social behavior for conservation purposes are necessary to address this very fundamental question in primate behavioral ecology.

Since 1982, I have been monitoring a group of mureiquis in one forest tract, an 800 hectare forest located on Fazenda Montes Claros in Minas Gerais, Brazil. Like many of the remaining pockets of Atlantic forest, the forest at Montes Claros is privately owned, and has been preserved by its owner despite the economic value of the land and lumber. Although the owner continues some selective logging along the periphery of his forest, he has prohibited the hunting of mureiquis for over 40 years.

During a 14-month period of continuous observations, I found that the mureiquis devote approximately 51 percent of their feeding time to leaves, 32 percent to fruits and seeds, and 11 percent to flowers. They are highly selective of the fruits they exploit; they prefer to feed at large patches of relatively rare fruit

species, and ignore more abundant species that occur in smaller trees throughout the forest.

The 26 individuals in my study group ranged over an area of 168 hectares, roughly 21 percent of the total forest available to them at Montes Claros. They prefer primary and naturally occurring secondary forest over other habitat types, but show a great deal of seasonality in their range use; their ranging behavior corresponds closely to the availability of their preferred food sources.

Their social behavior and social organization proved to be extremely unusual by comparison to those of other primates. Mureiquis at Montes Claros live in cohesive, multi-male multi-female groups, but unlike Savannah baboons and macaques, they most closely resemble chimpanzees in the persistently strong affiliative relationships between males.

This extraordinary degree of male-bonding behavior is only approximated in two other primate species, the spider monkey and the chimpanzee. In both of these species, groups regularly fission in response to the availability of large patches of preferred fruit. Male bonding in chimpanzees is thought to be a strategy by which males cooperatively defend a community of independently foraging, widely dispersed females from other groups of males. Kinship between males facilitates their cooperative behavior; in this unusual species, females (rather than males) are the sex that typically transfers from their natal group.

Even more striking, however, are the low levels of aggression between male mureiquis. Male affinities toward one another extend beyond daily interactions to include tolerance even when one of the adult females in the group is sexually receptive. Unlike most other primates, indeed, most other vertebrates, male mureiquis show no overt competition over access to mates. The 48 copulations I was able to observe in their entirety occurred in full view of other group members; and yet, males neither displaced one another nor competed for mating

opportunities during any of these episodes.

The discovery of such strong male-bonding behavior in muriquis was unexpected. Since the study group travels together year round, male muriquis would not be expected to benefit by cooperative defense of dispersed females. The behavior of female muriquis conforms to ecological predictions based on the distribution of their food resources; female muriquis benefit by traveling together in competitive interactions with other muriqui groups at large patches of their preferred fruit resources. At the same time, they are able to avoid intragroup feeding competition by supplementing their diets with more abundant leaves when preferred fruit sources are scarce.

In other primates, female cooperative resource defense is generally associated with closed female kin groups. However, the immigration of two subadult female muriquis into the study group, and the lack of male emigration, suggest that in muriquis, males are related to one another while females disperse. This is obviously a very small sample, but if ongoing observations confirm that female transfer is typical in muriquis, muriquis will prove to be as unusual in their pattern of dispersal as they are in their male-bonding behavior.

Both female-transfer and male-bonding are quite rare across the primates. In the few species in which these patterns are found, they are correlated with highly specific ecological conditions; none of these conditions correspond to those found among muriquis.

The five years spanned by this research enabled me to document important aspects of muriqui life history. Females begin copulating when they are between four and five years of age, but they do not conceive for an additional year. After a gestation period of eight months, mothers give birth to a single infant. However, one female gave birth to twins last June, an extremely rare occurrence in any nonhuman primate. Female muriquis carry their infants ventrally for the first six months of life, after which the

infants are encouraged to ride dorsally. Females nurse their infants for about 18 months before beginning to wean them.

Because muriquis at this site have distinct facial pigmentations, I was able to recognize individuals by their natural markings. I was thus able to document variations in the behavior of individuals, including differences in the protectiveness of different mothers, as well as a number of other individually specific behavioral patterns.

Another astonishing development has been the increase in the size of the study group. In 1982 there were 22 individuals in the group; by 1986 there were 33, an increase of 50 percent. In addition, in 1986 the group began using a part of the forest it had never used previously, suggesting that the muriquis have expanded their range to accommodate the larger group size. Previously, there had been no reason to suppose that the density of muriquis at this forest was exceptionally low, although I did wonder why muriquis occurred only in a fraction of the forest available to them at Montes Claros, while sympatric species, such as howler monkeys, occurred throughout the forest. The answer may well be that muriqui numbers were low when the study began, owing either to unreported hunting pressures in the past or to an epidemic. The group composition, particularly in the juvenile classes, has changed dramatically as the study has progressed.

Perhaps continued observations will help clarify why the social organization of these muriquis is so unusual. As their numbers grow to what is likely to be a more natural population, their low levels of intragroup aggression and their cohesive grouping patterns may change. Muriquis may begin to appear more like other primates with respect to their socioecology; if not, they will contribute to the formulation of more refined models of primate behavior that are capable of explaining other "deviant" species.

The same critical information needed for muriqui conservation efforts is also of great theoretical interest. We now know some of the

important muriqui food species, many of which occur only in primary and naturally occurring secondary forest habitats. These species and habitats must be present in reserves set aside in the future to protect muriquis. Information on muriqui diet in the wild will help ensure that muriquis involved in the planned captive breeding program at the Rio de Janeiro Primate Center are fed appropriate diets. Knowledge of their cohesive social system and the strong social relationships among and between males and females will ensure that captive and managed populations are grouped in functional social and reproductive units. Data on their natural reproductive behavior will facilitate the success of captive breeding efforts.

Muriquis provide yet another example of the importance of research to conservation plans. The suggestive evidence that female muriquis, rather than males, leave their natal groups, is critical to future plans to translocate individuals to increase genetic exchange between isolated populations. If these translocations had been attempted prior to this research, it is almost certain that males would have been moved simply because in the vast majority of well-studied primates, males typically transfer between groups while females remain. However, if females generally do transfer in this species, translocating males would most probably have failed. I believe that it is still far too early to begin such drastic management schemes, particularly since deleterious inbreeding effects are not evident in any muriqui populations at present.

My caution in this case stems from a very keen awareness that my observations are based on a single population which has been subjected to disturbances in the past. Continued study of these muriquis, as well as comparative studies of different populations of muriquis in other remaining forest tracts, are needed before we can hope to gain a comprehensive understanding of their behavioral ecology. ■

THE EVOLUTIONARY HISTORY OF THE "ROBUST" AUSTRALOPITHECINES: Report from the International Workshop

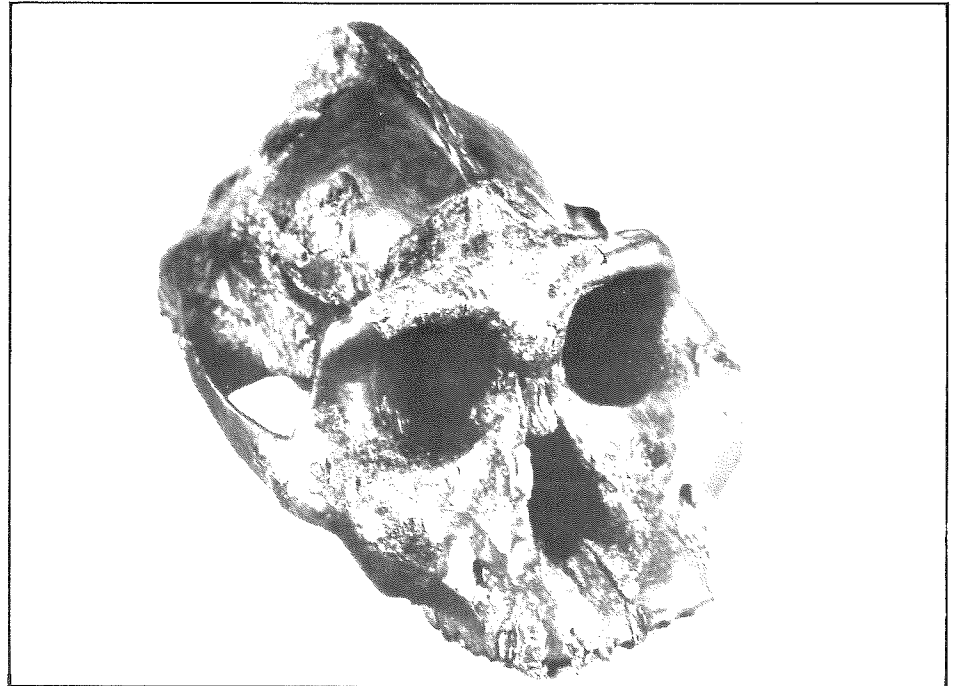
Frederick E. Grine

Department of Anthropology, State University of New York

Nearly fifty years since Robert Broom first gazed upon the face of *Paranthropus robustus*, scientists researching the origin and evolutionary history of the "robust" australopithecine gathered to debate this controversial topic. This International Workshop, co-sponsored by the Leakey Foundation, was held (March 27-April 1, 1987) under the auspices of the State University of New York at Stony Brook to discuss the origin, phylogenetic relationships, paleoecology, adaptations and extinction of the African Plio-Pleistocene hominids commonly referred to as the "robust" australopithecines. Twenty-eight papers were presented by participants during the first two days of the workshop, followed by three days of roundtable discussions.

An afternoon was spent by the participants in comparative examinations of a large collection of casts of relevant Plio-Pleistocene hominid fossils. A.C. Walker kindly brought casts of the new specimens from West and East Turkana (including, of course, the "black skull," KNM-WT 17000), and other important casts were included through the courtesy of D.C. Johanson, W.H. Kimbel, T.D. White, B. Asfaw and G. Suwa.

The "robust" australopithecines probably represent the closest cousins of our own genus *Homo*, and these "robust" specimens from southern Africa (generally referred to *Australopithecus robustus*, or *Paranthropus robustus*) and eastern Africa (generally referred to *Australopithecus boisei*, or *Paranthropus boisei*) comprise a very significant portion of the early hominid fossil record. The principal questions and issues addressed during the workshop



The "Black Skull" (KNM-WT 17000)

pertained to (1) the number of "robust" australopithecine species that can and should be recognized, and (2) the evolutionary origin and phylogenetic relationships of these forms, (3) patterns of ontogenetic development and variability, (4) paleoecological aspects such as habitats, diets and adaptations, (5) locomotion and body size, (6) the timing and causes of the extinction of the "robust" australopithecines, and (7) the archeological record and possible ecological interactions between "robust" australopithecines and early members of the genus *Homo*.

Although it is impossible to do justice to all of the papers and ideas that were presented during the course of this five-day workshop, several topics can be scored that

illustrate our current state of knowledge for this early period of hominid evolution and the major issues facing Plio-Pleistocene paleoanthropological research.

Phylogenetic relationships. A number of papers dealt specifically with the origin and evolutionary relationships of the "robust" australopithecines, and most were concerned in large measure with the significance of the "black skull" (KNM-WT 17000). A. Walker argued that this specimen represents an early, comparatively primitive member of *A. boisei*, and that *A. boisei* and *A. robustus* had different evolutionary origins. This point was taken up also by B.A. Wood, who discussed several features which suggest that the "robust" australopithecines might not represent a

monophyletic group. T. Olson noted that the "black skull" fit comfortably into his previously published phylogeny in which the "robust" australopithecines evolved as a lineage from *A. afarensis*, and in which *A. africanus* is more closely related to *Homo* than to the "robust" australopithecines. W. Kimbel, T.D. White and D.C. Johanson pointed out that for 40 morphological features of the "black skull," 11 comprise primitive features shared with *A. afarensis* while another 11 represent derived characters shared with both *A. robustus* and *A. boisei* indicating that the "black skull" should be placed at the base of the "robust" lineage.

The question of whether the "robust" australopithecines represent a single evolutionary lineage, or whether the southern and eastern African forms comprise different lines that underwent considerable convergence engendered a considerable amount of debate; and while the latter possibility cannot be discounted, Y. Rak and F. Grine, amongst others, pointed out a number of striking cranial similarities between the "black skull" and the "robust" specimens from Kromdraai and Swartkrans. It was also stressed that while many of the overwhelming number of cranio-dental similarities between *A. robustus* and *A. boisei* might be related to convergence in masticatory function, other features that are shared by them, such as the occipital marginal sinus, are unlikely to be related to chewing.

Discussion about the "black skull" also raised the interesting question about the number of "robust" australopithecine species that can and should be recognized. A number of participants maintained that, because of its peculiar combination of primitive and derived features, the "black skull" should be accorded separate specific status from *A. boisei*, and G. Suwa noted that "robust" australopithecine teeth from the Omo Basin and Koobi Fora showed different morphologies between earlier specimens and later dentitions that could be attributed to *A. boisei*. Thus, evidence emerged that earlier "robust" fossils, such as the "black skull," probably represent a distinct

species, and taking up a suggestion published by Walker, it was argued by Kimbel, White and Johanson that this species would be called *A. aethiopicus*, the name attributed in the late 1960s by Arambourg and Coppens to a mandible from the Omo. In addition, F. Clark Howell and F. Grine maintained that the "robust" hominids from the sites of Kromdraai and Swartkrans should be accorded separate specific status: *A. robustus* and *A. crassidens*, respectively.

Thus, opinions expressed at the workshop on the number of "robust" australopithecine species that are represented in the Plio-Pleistocene sediments of Africa ranged from two to four. A general consensus emerged that the Hadar and Laetoli fossils represent a single species, *A. afarensis*. R.J. Clarke proposed, on the basis of his studies of recently excavated fossils from Sterkfontein, that specimens representing two species are represented in the *A. africanus* sample from that site.

Patterns of development. M.C. Dean observed that dental development in juvenile specimens of *A. afarensis* and *A. africanus* was similar to that displayed by extant great apes, whereas juvenile "robust" australopithecines from southern and eastern Africa shared a different pattern of developmental timing. L. Martin, F. Grine and B.A. Wood, on the basis of quite different lines of evidence, demonstrated that *A. boisei* formed its thick permanent molar enamel very quickly by retaining a deciduous pattern of amelogenesis with large numbers of enamel secreting cells being active at the same time. These scanning electron microscope studies showed that while enamel was formed by individual ameloblasts at the same rate in *A. boisei* teeth as in modern human permanent teeth (about 5 μm per day), *A. boisei* molars had relatively more ameloblasts functioning at the same time. Martin and Grine also demonstrated that the permanent molars of *A. africanus* (from Sterkfontein) and *A. robustus* (from Kromdraai) followed a developmental pattern like that of modern humans, and that compared to the "megathick" enamel of *A. boisei*, rel-

ative enamel thickness in *A. africanus* and *A. robustus* is similar to that of modern humans.

Paleoecology and diet. F. Brown presented a detailed report on recent investigations pertaining to the dating and context of hominid fossils from northern Kenya and southern Ethiopia, and he showed that major changes in lake and riverine systems have occurred in this region over the past four million years. He demonstrated the presence of a lake in this basin prior to 3.5 million years b.p. and the existence of Lake Turkana since about 2.0 Myr, but that a lake was not certainly present during the intervening period. G. Denton observed that at approximately 2.5 Myr ago a major change from temperate glacial conditions to the development of the present polar ice sheet took place in Antarctica, and he suggested that a cooling event of this magnitude might well have affected climatic conditions in Africa. On this point, E. Vrba noted that a number of antelope species immigrate to Africa from Asia at about 2.5 Myr, and that perhaps as many as 50% of African bovid taxa make their first appearance at about this time. These data, as well as those for other mammalian species may indicate that substantial climatic changes occurred at about the time of the appearance of "robust" australopithecines in eastern Africa, and the possibility of ecological perturbations being associated with the appearance of *A. boisei* in eastern Africa and *A. robustus* in southern Africa was a topic of considerable discussion. P. Shipman, E. Vrba and T.D. White noted the problems associated with the sampling of ecological refugia and different taphonomic biases in the reconstruction of habitat preferences of early hominids.

With regard to australopithecine diets and adaptations, R. Kay and F. Grine presented quantitative evidence from scanning electron microscope studies of tooth wear that indicates that the diet of *A. robustus* consisted of hard objects such as seeds and nuts, while *A. africanus* likely subsisted on softer fruits and leaves. A. Walker observed that analysis of microwear on *A. boisei*

molars revealed patterns similar to those shown by living chimpanzees, although it was noted that the large, flat cheek teeth of *A. boisei* are well adapted to chewing small, hard or brittle items. Y. Rak and W. Hylander noted structural features of the face and mandible of *A. boisei* that are likely related to the stresses and strains that would be generated during heavy mastication.

Postcranial morphology and body size. Both W. Jungers and H. McHenry showed, from independent lines of evidence, that *A. boisei* and *A. robustus* were probably no larger in body size than their so-called "gracile" relatives. The "robust" australopithecines do not appear to have been all that robust after all!

Jungers also reported that body size dimorphism within the *A. afarensis* sample is comparable to that in the living chimpanzee, *Pantroglydotes*, but less than that in gorillas and orangutans. Figures on brain size reported by Falk and Holloway, together with body size information indicated that there was a tendency for relative brain enlargement in the "robust" australopithecines, although the magnitude was much less than in our own lineage.

R. L. Susman provided a detailed analysis of the recently excavated, abundant postcranial sample from Swartkrans, and he demonstrated that the pedal elements of *A. robustus* revealed a mixture of primitive and derived features, although the overall patterns was that of a terrestrial biped. In addition, he showed that *A. robustus* hand bones are extremely similar to those of modern humans, and Susman raised the intriguing possibility that because *A. robustus* possessed a human-like precision grip, it was suited to the manufacture and utilization of the tools that litter the Plio-Pleistocene African landscape.

The archeological record and the question of extinction. C. K. Brain reported on the results of his recent excavations at Swartkrans, where he has uncovered burnt bones, stone tools and bone tools with two distinct microwear usage patterns in

Member 3 together with fossils of *A. robustus*. The early African archeological record was discussed by J.W.K. Harris, who noted that the first records of stone artifacts appear at about 2.4 Myr and that there is evidence of a significantly greater ranging across the landscape by tool-making hominids at about 1.6 Myr. Is this earlier date correlated in some way with the evolutionary appearance of the "robust" australopithecines, and is the latter perhaps related in some manner to their ultimate extinction?

Although "robust" australopithecines appear in the geological record well before fossils that are attributable to *Homo*, M. Wolpoff argued that *A. boisei* shows an increase in cheek-tooth size through time that may have resulted from competitive character divergence due to the presence of early members of the genus *Homo*.

R.G. Klein noted that there is little evidence for a correlation between faunal turnovers and "robust" australopithecine extinction, as the principal faunal change-over in Africa occurred well before 1.5 Myr. Klein observed that while the last "robust" australopithecine fossils occur at about 1.4 - 1.2 Myr, the mammalian fossil record for eastern and southern Africa is comparatively poorly sampled and dated between the period spanning 1.4 Myr and 800,000 years b.p.: these hominids may have become extinct at any time during that period. Klein also suggested, however, that *Homo erectus* appears to have moved out of Africa at about 1.0 Myr and that this may have been related to some technological advance on the part of *H. erectus* that permitted a relatively rapid expansion of its niche breadth with consequences for the "robust" australopithecines. It was also noted by Klein and others that at about this same time (c. 900,000 years b.p.) there was a notable intensification of glacial episodes with concomitantly much drier periods in Africa, and this may have been related not only to the extinction of the "robust" australopithecines, but to the emigration of *H. erectus* from Africa. There was a consensus that the timing of and reasons behind the extinction of the

"robust" australopithecines are still very open questions.

This workshop was able, through an intensive five days of papers and open, frank and informed round-table discussion, to focus on a large variety of issues concerning the Plio-Pleistocene record for hominid evolution.

While the specific aim of the workshop was directed at the "robust" australopithecines — a group for which the name "robust" seems to be inappropriate except in reference to cheek-tooth size — the issues discussed in relation to increasing our understanding of the evolutionary history of our closest relatives cannot help but be relevant to a heightened appreciation of the earlier phases of our own lineage.

While we are still some distance from resolving many of the specific questions, the workshop succeeded in that it provided a forum for the synthesis of our knowledge. Not only did the workshop provide for a synthesis of much recently gained information, but it also provided clear indications of those issues and areas upon which further research work should be concentrated.

Definitions:

ameloblasts: one of a group of columnar cells that produce a and deposit enamel on the surface of a developing vertebrate tooth.

amelogenesis: enamel formation.

monophyletic: of or relating to a single common ancestral form.

ontogenetic: relating to the development of an individual organism.

phylogeny: the evolution of a genetically related group.

refugia: an area of relatively unaltered climate that is inhabited by plants and animals during a period of continental climatic change and remains as a center of relict forms from which a new dispersion and speciation may take place after climatic readjustment.

taphonomic: study of transition of skeletal elements (or animal remains) from the living animal to fossilized fragments. ■

THE TAUNG SKULL REVISITED:

New Evidence From High-Resolution Computed Tomography

Glenn C. Conroy
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Michael W. Vannier and Glenn C. Conroy with the Taung skull in front of the CT scanner.

In the past, there has been no satisfactory way for paleoanthropologists to nondestructively visualize intracranial morphology in fossil skulls in more than two dimensions. Images provided by conventional X-ray, and even by normal computerized tomographic (CT) scans, are abstract, flat, two-dimensional representations that often fail to reveal important three-dimensional relationships among cranial structures. These limitations are particularly severe in paleoanthropology where most fossil human skulls are too precious to be physically "invaded" by scientists wishing to examine intracranial morphology. An additional complication arises when fossil skulls are filled with stone matrix (as are the South African australopithecines). In such cases there is no way to accurately examine intracranial morphology or to

directly measure intracranial volume and shape without first removing the matrix in some manner. Again, the skull would have to be "invaded" by the investigator. For this reason, some of these australopithecines that are so important to anthropological knowledge still lie on museum shelves with the matrix obscuring important anatomical information.

Until now these problems have seemed insurmountable. In order to circumvent them, my colleague, Dr. Michael W. Vannier, and I have teamed up with Prof. Phillip V. Tobias of the Anatomy Department at the Witwatersrand Medical School in Johannesburg, South Africa, to develop a research strategy utilizing recent advances in computer imaging technology which enables us to produce geometrically

accurate, three-dimensional images of australopithecine skulls from their two-dimensional computerized tomographic (CT) data. These techniques can also make various portions of the australopithecine skull "transparent" on the computer screen in order to view previously hidden intracranial structures. In effect, this allows the investigator to electronically "dissect" an australopithecine skull in a totally safe, non-invasive way.

Thanks to a research grant from the LSB Leakey Foundation, these techniques, originally developed for craniofacial surgery at Washington University, were recently used for the first time on such precious South African fossil hominids as the famous Taung Skull and MLD 37/38 (*A. africanus*) housed in the anatomy department at the Witwatersrand University. These experiments were conducted this past July with members of the radiology department at the Johannesburg General Hospital (Miss R. van der Riet, Dr. B. Epstein), and the anatomy department at Witwatersrand (Prof. P. Tobias, Dr. D. Ricklan). Previously, no one has ever had the opportunity of applying this new three-dimensional computer imaging technology to the hominid fossil record.

The high-resolution CT methodology that is employed is able to distinguish between the density of stone matrix and mineralized bone in fossil skulls. This allows the computer to "remove" the stone matrix from the picture leaving behind only the true extra and intracranial osseous contours of the fossil. The procedure results in a sequence of nonoverlapping, 2mm thick CT sections of the complete fossil skull with the stone matrix "removed." The computer then "stacks together"

all these images to present the viewer with a three-dimensional, geometrically accurate image of the complete "matrix-free" skull.

Just over 60 years ago, Raymond Dart's description and analysis of the Taung child's skull triggered a revolution in human thought that continues to this day. Indeed, Discover magazine included the Taung skull among the "20 discoveries that changed our lives" in the 20th century. For many years Dart was virtually alone in his belief that the fossil skull, the type specimen of *Australopithecus africanus*, was closer to the ancestry of man than any other fossil hominoid yet to be discovered. Dart's views began to gain widespread acceptance in the scientific community only after adult australopithecine specimens had been found and for the last several decades the hominid status of australopithecines has been relatively secure.

Recently, however, the situation has come full circle in that several studies have challenged the notion that australopithecines had human-like maturational periods. In particular, these studies suggest that those of australopithecines were abbreviated relative to those of modern humans and were more similar to modern great apes in this feature.

In light of these recent studies, and particularly since the Taung skull is the type specimen of *Australopithecus africanus*, we thought it important to reinvestigate the relevant anatomy of this specimen using CT methods. Over the past 60 years, external features of the Taung skull and dentition have been studied in every possible way. Because of the dense mineralization and calcified matrix within the Taung skull, precise radiographic analyses of important intracranial structures (e.g., developing permanent teeth, paranasal sinuses and pneumatization, etc.) have proven to be impossible until now. This is particularly unfortunate since dental development patterns have been of such critical importance in evaluating australopithecine maturational patterns.

The recent advances in high-

resolution computed tomography discussed above now make it possible to rectify this situation and to make previously "hidden" structures within the Taung skull visible. In July, 1986, we had the opportunity to CT scan the entire Taung skull in sagittal, coronal, and transaxial planes. These scans show for the first time, and with high resolution, the state of development of the unerupted permanent dentition and the pneumatized portions of the facial skeleton in the Taung skull. These views allow more refined inferences to be drawn concerning the developmental patterns of this important specimen.

In terms of the dentition, it is of course obvious that the first permanent molars have recently erupted. The critical question then becomes: Is this a 5.5 to seven year old following a human dental growth trajectory; a 2.7 to 3.7 year old following an ape-like growth trajectory; or something inbetween? The answer to that question has profound implications for interpreting the evolutionary history of delayed maturation, a uniquely human-like characteristic. Two recent papers in Nature suggest that the ape-like situation prevails for australopithecines in general although neither study was able to analyze the Taung dentition because of the obscuring calcified matrix. In terms of both dental and paranasal sinus growth, however, the Taung CT scans reveal an interesting and perplexing morphology that does not fit exclusively into either the hominid or pongid pattern.

Although we are still working out the details by comparing the Taung CT's with those of young chimps and humans, we have reservations about equating the developing dentition of Taung with that of a three year old pongid. These comparisons will be published in greater detail in the near future. As one might expect, and as Dart would surely have appreciated, the Taung child shows a mosaic of ape-like and human-like patterns in its dental development.

The CT scans reveal other aspects of the Taung skull not previously known. For example, the large size and assymetric development of the

maxillary sinus is clearly evident. In addition, several of the coronal and sagittal scans reveal that the maxillary sinus extended into the hard palate. This is intriguing since an intrapalatal extension of the maxillary sinus has only been reported in chimpanzees and robust australopithecines among the higher primates. Pneumatization has also extended into the malar region, an extraordinary development in so young an individual.

Dart was not able to discern whether or not there was a frontal sinus in the Taung skull. The sagittal scans clearly show that no frontal sinus was present (however, such sinuses develop in adult australopithecines).

It thus appears that the Taung child is an interesting and somewhat perplexing mosaic of pongid-like and hominid-like morphology. The dental development patterns revealed here by CT are not entirely compatible with other dental evidence suggesting a 2.7-3.7 year old pongid-like growth trajectory. On the other hand, the precocious development of the paranasal sinuses, and particularly the intrapalatal extensions of the maxillary sinuses, suggest the retention of some pongid-like growth mechanisms in the Taung facial skeleton. It is this aspect of the Taung skull, the remodeling patterns of the face, that may be Pan-like, not necessarily the dental growth patterns. It is important not to confuse the two. Thus, we are reluctant to throw out the hominid Taung baby with the pongid bath water.

We are extremely grateful to Prof. P.V. Tobias and Dr. D. Ricklan for their hospitality, help, and enthusiasm during our stay at the University of the Witwatersrand. We particularly thank Prof. Tobias for permission to undertake the CT studies on the fossil hominids in his care. We also extend our sincerest thanks to Ms. R. van der Riet and Dr. B. Epstein (Chair) of the Radiology Department, Johannesburg General Hospital, for their support and assistance in carrying out the CT studies. We gratefully acknowledge the financial support of the L.S.B. Leakey Foundation. ■

results of their research. This exchange resulted in the organization of several small symposia and the opportunity for Vietnamese archaeologists to study abroad. Clearly, Vietnam was taking its first tentative steps toward an emergence from its self-imposed isolation.

It was in this same spirit of scientific exchange that we first approached the Vietnamese government in 1983 regarding a joint Vietnamese-American paleoanthropological research project. Working through the U.S. Committee for Scientific Cooperation with Vietnam, a private humanitarian organization based in Madison, Wisconsin that fosters scholarly Vietnamese-American exchanges, we were able to secure an invitation from the Social Sciences Committee in Hanoi which ultimately resulted in a three week visit to Vietnam in January, 1987.

The purpose of our visit was twofold. First, we wanted to study and evaluate the discoveries of Vietnamese paleoanthropologists and archaeologists who had been working in nearly total isolation from the West for at least three decades. Second, we wanted to conduct joint field investigations in Pleistocene deposits which had the potential to yield new remains of *Homo erectus* and the giant ape *Gigantopithecus* as well as diverse middle and upper Pleistocene stone tool assemblages.

With the aid of a research grant from the L.S.B. Leakey Foundation we began our Vietnam odyssey with a flight to Bangkok, Thailand. It was here that we had to pick up our entry visas which could only be issued at the Vietnamese Embassy in Bangkok. Since the U.S. currently has no diplomatic relations with the Socialist Republic of Vietnam, there is no Vietnamese embassy in Washington, D.C.

Departing from Bangkok we flew to Vientiane, Laos where we connected with our flight to Hanoi. As our 727-sized Russian made (Illuyshin) Air Vietnam jet climbed into the humid tropical sky over Vientiane we experienced the first of

many reminders of the legacy of the U.S.-Vietnam war. The pilot of our Air Vietnam flight turned out to be a former combat pilot who flew many missions against U.S. bombers over Hanoi. He flew our passenger jet as if it were a MIG 21 often making 70 degree banks and rapid changes of altitude.

As we stepped, weak-kneed, onto the tarmac of Hanoi International Airport, John Olsen remarked in jest: "Toto, I don't think we're in Kansas anymore." Indeed, we were both beginning to grasp the fact that we were about as far from Kansas (and the West) in both a geographic and ideological sense as one could get without leaving the planet! In fact, we were, euphemistically, on our own private journey to the "Land of Oz."

At the airport we were met by representatives from the Social Sciences Committee, Nguyen Van Ku, a senior official and Tran Kim Nga, a 26-year-old woman who had been assigned to us as our translator and constant companion throughout our journey. Nguyen Van Ku presented us with a detailed schedule of our visit. From the start, it was very evident that a lot of behind-the-scenes planning had gone into our visit. We would later remark that we accomplished more scientifically during several weeks in Vietnam than we had accomplished in several months on other expeditions.

Hanoi is today still a beautiful city with many moss-covered French-styled buildings and broad, clean streets overhung with large trees that provide a cool green canopy to passersby. There are virtually no cars in the city; everyone gets around by bicycle or motor bike. In the center of the city is a large lake surrounded by a wide border of palms. We were put up at the Hoa Binh (= Peace) Hotel not far from the lake. At dinner the first night, we discovered we were probably the only non-diplomatic westerners in Hanoi; the other guests at the hotel were Libyans, Palestinians, Cubans, Iraqis, and a boisterous group of East German tourists. We had truly crossed over "to the other side" in the sense that John Le Carre would use the phrase.

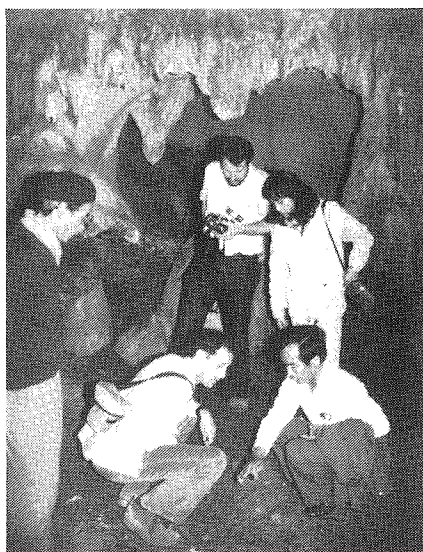
The next morning we were met by our translator, who greeted us and said we should feel free to call her, Nga, which was her given name. Nga asked us how we had slept. Not wanting to offend our host we replied "fine" but in actuality, we had been awakened numerous times during the night by the screeching of several rats fighting in the crawl space above our room and by the nervous antics of another scurrying about on the floor. Days later, when we finally told Nga about the rat we found living in our room in the drawer of a desk she replied with a droll smile, "Just one?"

Our first full day in Hanoi was spent at the Institute of Archaeology, a rambling colonial-style building in which the central coordinating institution for all archaeological and paleoanthropological research throughout northern and southern Vietnam is housed. There we met the Director of the Institute, Prof. Pham Huy Thong, and the staff of 17 full time archaeologists and paleoanthropologists. It was Pham Huy Thong who, acting through the aegis of the Social Sciences Committee, had sent us the original cable inviting us to come to Hanoi.

For the next week we spent 8-10 hours a day at the Institute which was only a five minute walk from our hotel. We first exchanged information and viewpoints on our respective research interests via a series of lectures and group discussions. We had brought a carousel slide projector so we could *visually* present, our respective research projects at various sites in Africa and Asia. The *verbal* presentation was much more difficult since nearly all of our communication had to be translated from English to Vietnamese and back to English. We did discover that a few of the Institute's archaeologists spoke Chinese so they could communicate directly with John Olsen who also speaks fluent Mandarin. After each side had presented a series of lectures, we then were allowed to study and photograph the extensive collections of excavated fossil material and artifacts housed in the Institute.

Our first field excursion took us to the site where some of Vietnam's earliest archaeological materials have been found in Thanh Hoa province, about 120 km due south of Hanoi. Traveling in a Russian-built ten passenger mini-van, we were accompanied by our translator, Nga, and Nguyen Van Ku, both representing the Social Sciences Committee and by two Palaeolithic archaeologists, Nguyen Van Hao and Nguyen Van Binh. We were, from the beginning, impressed with both Hao's and Binh's expertise in archaeology and found their participation in our field excursion both enlightening and essential. Hao and Binh represent two generations, as it were, of Vietnamese archaeology in terms of the nature of their professional training. Mr. Hao, in his early fifties, received his specialized instruction in archaeology at Beijing University during the period two decades ago when Sino-Vietnamese relations were on a solid footing. Binh, on the other hand, in his mid-thirties, spent several years in both Moscow and Sofia studying archaeology and is quite conversant in a wide range of topics in Old World prehistoric studies today. His proficiency in both Russian and Bulgarian, in addition to English, has kept Binh well aware of the development of archaeological method and theory in both the East and the West.

Traveling on one of northern Vietnam's principal highways, a pot-holed, but paved, track flanked by rice paddies and small villages, we arrived at our first destination, Cuc Phuong National Park, by noon. This park lies in a high, densely forested valley surrounded on all sides by limestone karst peaks at the intersection of Ha Son Binh, Ha Nam Ninh and Thanh Hoa provinces. Receiving some 100 inches (= 250 cm) of rainfall per year, a thick rain forest of evergreen broad-leafed trees has emerged at Cuc Phuong National Park. This rain forest, with an upper canopy reaching 60 meters in places, has a rich primate fauna that includes several species of macaque monkeys, the black gibbon, *Hylobates concolor*, and several colobine mon-



Cichon and Olsen inspecting stratigraphy in karst cave.

keys including the very rare douc langur, *Pygathrix nemaeus*. Many southern populations of the douc langur, now an endangered species, were decimated during the war by U.S. air attacks using napalm and Agent Orange.

Our primary reason for traveling to Cuc Phuong National Park was to visit an important late Pleistocene Hoabinhian rockshelter. This cave site was located on the side of a karst mountain in dense forest about 40 meters above the valley floor. It could only be reached by climbing a series of metal stairs and catwalks which clung to the side of the karst mountain. The site was originally excavated in 1966-67 by a joint Vietnam-DDR team, yielded a tightly flexed human burial inhumed in a slab-lined pit as well as masses of partly brecciated mussel shells, the latter of which is a characteristic feature of most Hoabinhian sites.

The significance of the Hoabinhian culture in Southeast Asia concerns its relationship to the origins of agriculture and the genesis of SE Asia's ethnic mosaic. The Hoabinhian culture in Malaysia and in other parts of southern Asia is associated with the first evidence of food processing tools and an early form of agriculture possibly horticultural in nature. Such evidence of Hoabinhian horticulture is very likely as old as the earliest record of food production in the

Near East. Our understanding of the Hoabinhian culture and people in Vietnam has been greatly enhanced by excavations such as those at Cuc Phuong. For example, in the lower strata of Nguom Cave in Bac Thai province, Hoabinhian edge-ground stone tools are found in association with datable materials extending back to 18,000 BP. Other sites support a date of 12,000-15,000 BP.

A total of about 100 Hoabinhian sites are now known in Vietnam of which 31 have produced human skeletons representing some 50 individuals. In 1986, a 27 meter-square test pit excavated in Dieu Rockshelter in western Thanh Hoa province uncovered 14 Hoabinhian burials including ten complete or reconstructable skulls. Some of the bodies were interred in a tightly flexed seated position with a large stone slab placed over the head, yielding the largest and best preserved sample of Hoabinhian skeletal remains found anywhere in the world. Anthropometric studies of these important sub-fossil humans are now being conducted; Vietnamese physical anthropologists look to this group for the derivation of modern ethnic Vietnamese people.

After touring the local museum and enjoying a well-prepared lunch served on a verandah overlooking the lush karst topography that Cuc Phuong National Park is famous for, we climbed back into our Russian van for the final push south to Thanh Hoa. Stopping only at Tam Diep for a pot of tea at a roadside stand, we nonetheless arrived in Thanh Hoa City well after dark where we were greeted by Mr. Pham Ho Dau, a local archaeologist and one of Nguyen Van Hao's postgraduate students. At the Thanh Hoa Hotel we were served a satisfying dinner of traditional Vietnamese fare while we discussed our itinerary for visiting some of Vietnam's earliest archaeological sites. Like most of northern Vietnam including Hanoi, both urban and rural settings are largely devoid of electricity after dark. After dinner, we retired to our mosquito-filled room in the hotel where we continued our discussion

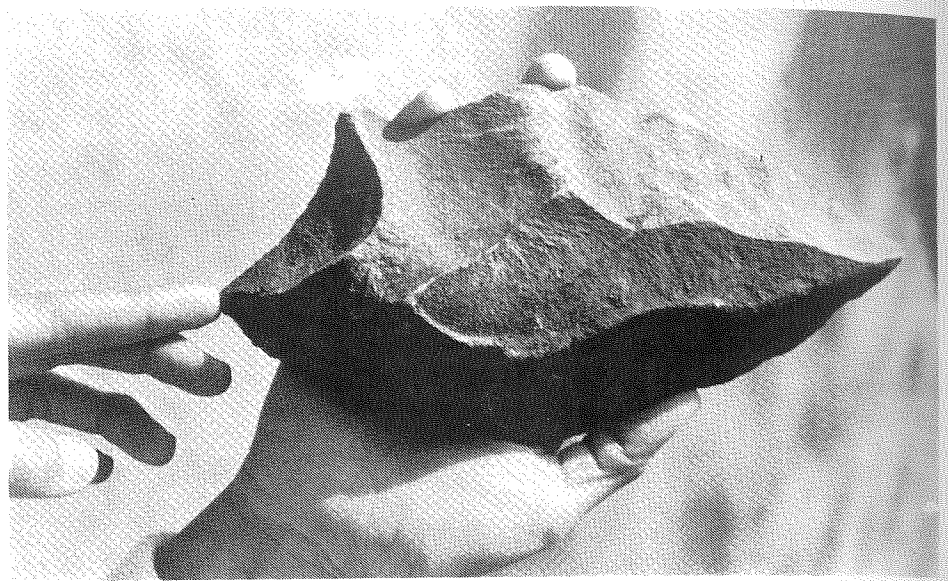
of the day's journey by paraffin lamp while listening to the Voice of America reports of battles between Chinese and Vietnamese armies on the border to the north of us.

The remainder of the week was spent in the vicinity of Thanh Hoa examining two localities that, from an archaeological point of view, are among the most interesting — and controversial — in peninsular Southeast Asia. The sites of Nui Do and Nui Nuong have yielded, over the course of the past 20 years, assemblages of stone tools that have been alternately suggested as representatives of Southeast Asia's earliest Middle Pleistocene inhabitants or, random collections of broken rocks that are not even products of human manufacture.

The Russian palaeolithic archaeologist, P. I. Boriskovsky, who initiated research at the Thanh Hoa localities while a visiting professor at Hanoi University in the early 1960s, concluded in his 1966 book, *Pervobytnoe Proshloe V'etnama (Vietnam in Primeval Times)*, that these sites contain evidence of the earliest Vietnamese stone industries.

Some Western prehistorians who have viewed the Thanh Hoa materials consider them to reflect long periods of deposition, perhaps extending back as far as the Middle Pleistocene while others believe these collections to be wholly more recent — Neolithic or even Bronze Age. Given this degree of controversy, and our experiences with similar reports of problematical earlier Pleistocene assemblages in other areas of the world, we were prepared to discover that the Thanh Hoa sites were either uninterpretable due to the circumstances of their deposition and subsequent erosion, or that they in fact reflect comparatively recent, late prehistoric human activities.

The assemblage of Palaeolithic implements from the western Thanh Hoa sites includes more than 2,500 specimens manufactured on basalt representing a typologically diverse range within which we consider the large flake tools and some of the large bifacially flaked core tools to be comparable to late Middle and early Upper Pleistocene industries



Lower Paleolithic biface from the Middle Pleistocene site of Nui Nuong.

from adjacent regions, especially south China. Having closely examined the controversial Nui Do "handaxes" in the Museum of History in Hanoi as well as the tabular, rectangular pieces labelled "cleavers" by Boriskovsky, we feel that assigning the aggregated Thanh Hoa collections to any one particular time period is incorrect. Instead, we believe that while artifact types such as Boriskovsky's "cleavers" surely represent very late prehistoric or even Bronze Age developments, other tool categories, including some of the large simply flaked core and flake implements described above, derive from Palaeolithic contexts.

We began our survey of these localities at Nui Nuong, southeast of Thanh Hoa City. Nui Nuong is today a barren boulder-strewn hill slope covered with scrubby vegetation where a series of two-by-two meter soundings have recently been excavated to illuminate the complex character of the site's stratigraphy. Basalt bedrock is visible in these test-pits at a depth of 1.5 meters. Overlying these buried outcrops are layers of fragmented basalt and soil that provide evidence of at least two distinct periods of geological deposition. The earlier episode seems to have been typified by the transport of relatively large fragments of basalt and artifacts from surface outcrops near the top of the mountain while

another, later, event is associated with what we believe are *in situ* occurrences of small stone artifacts and the waste product of their manufacture. On close examination, hard hammer, direct percussion flakes could be seen in the walls of the stratigraphic sections and, most importantly, these bear indications of varied depositional processes themselves. While some of the *in situ* artifacts appear clearly to have been transported, many are pristine with sharp working edges and distinct traces of previous flake removal.

On the surface we also found one of the large core tools described by Boriskovsky as a "cleaver" with Acheulean affinities. In our opinion, these implements are not only unattributable to any Acheulean-like industry, but exhibit a level of technological sophistication and regularity in their manufacture that strongly suggests a very late prehistoric antiquity. The character of this evidence points to an interpretation of the site as a palimpsest of human industrial activities rather than one or even only a few discreet episodes of use.

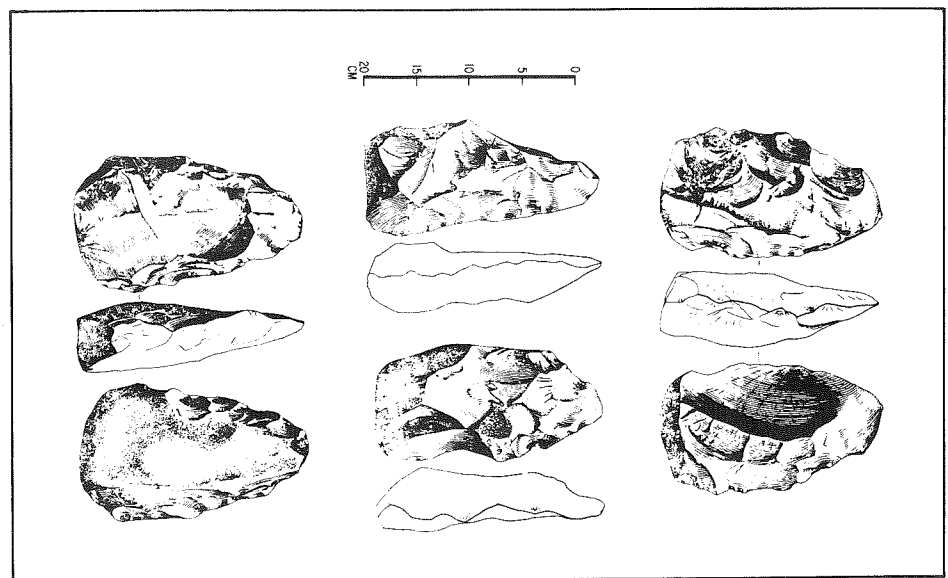
From Nui Nuong, we proceeded to Nui Do about 20 kilometers distant, on the banks of the Ma river. Unfortunately, field conditions proved too rigorous for our Russian van and after a lengthy attempt at stripping and repairing a full set of seized brakes, we decided to aban-

don the vehicle and hike the remaining 10 km to Nui Do through the Vietnamese countryside. As we walked through small villages bustling with activity as the rice-planting season fell into full swing, we quickly accumulated a horde of literally hundreds of curious, smiling children (and many adults) who accompanied us nearly to the foot of Nui Do where we once again encountered the familiar boulder-strewn, lunar-like landscape that we had come to know so well at Nui Nuong.

Looking out across the flooded rice paddies toward distant tower-karsts we could see small villages that had received the brunt of American attempts to bomb a nearby bridge over the River Ma and a petroleum refinery complex. In fact, one of the archeologists in our party pointed out the small village where he had grown up and recounted to us his memories of fleeing American bombs and machine-gun fire in his pre-teen youth.

The Nui Do site has also been the subject of recent test excavations and we were able to inspect a series of four-by-four meter soundings that had been sunk into the hillside. The uppermost 70-80 cm of these two-meter deep exposures yield cores, flakes, and unfinished tools that reinforce an interpretation of the Thanh Hoa localities as quarry-workshops rather than habitation or other specialized activity areas. The flakes that have been recovered thus far bear little indication of retouching and are all apparently produced by simple hard hammer direct percussion, leading our Vietnamese colleagues to refer to such flakes collectively as "Clactonian."

The character of these stone assemblages leads us to regard them as having accumulated over a long period of time, perhaps extending as far back as the Middle Pleistocene. This could lend credence to views that these tools were manufactured by *Homo erectus* as asserted by some of our Vietnamese colleagues. On the other hand, it is clear that only a limited range of human industrial activities are represented in the surviving Thanh Hoa sections, so a complete understanding of the



Early Paleolithic bifaces collected at the site of Nui Do.

relationship among these open-air sites and the later rockshelter and cave occurrences is not yet fully understood.

After returning to Hanoi to replace our brake-damaged Russian van we set out in a northwesterly direction to visit sites of the so-called "Sonvi Culture" in Vinh Phu province in the Red River valley. As we proceeded northward we saw increasing signs of military activity which we interpreted as the Vietnamese response to border incursions by the Chinese which we heard about nightly on the Voice of America.

After half-a-day's drive we reached the Sonvian type site at Vuon Sau, near Viet Thi, which today occupies the crest of a hillock being currently utilized for the cultivation of manioc. Artifacts, including the Sonvian index fossil, a split quartzite cobble that bears close affinities to later Hoabinhian tools, were visible in natural erosional profiles about 60 cm below the present ground surface.

More than 100 open air Sonvian sites are now known in Vinh Phu province, all of which occupy hill-tops like that at Vuon Sau. It is important to note, however, that Sonvian cultural assemblages have also been recently discovered in stratified cave deposits in Vietnam. At the Dieu Rockshelter site in western Thanh Hoa, a Sonvian

component radiocarbon dated between 11,000-20,000 BP is situated stratigraphically between an underlying assemblage of artifacts dated to 30,000 BP that is currently called simply "proto-Sonvian," and at the top of the geological sequence, by a Hoabinhian industry. The extent to which this Sonvian component fills this hiatus or simply represents a thin occupational horizon is unknown at present. Two other localities have also yielded similar stratigraphic relationships between the Sonvian and Hoabinhian components; Con Moong in Thanh Hoa province and Nguom cave in Bac Thai province. These stratified and dated occurrences of these two Upper Paleolithic cultures once and for all establishes their distinctiveness and temporal contexts.

To Vietnamese scientists, the Sonvian culture is also well known for a very important association. At Nguom Rockshelter in Bac Thai province Sonvian stone tools occur in a living floor context with burnt and broken bones and teeth of the orangutan, *Pongo pygmaeus*, along with other faunal remains. This level has been radiocarbon dated to about 23,000 BP. This is the latest dated occurrence of the orang in peninsular SE Asia. The current geographical range of *Pongo* is today restricted to limited areas on the islands of Sumatra and Borneo in Indonesia. However, in Pleistocene

times we know from fossil evidence that the orangutan ranged across southern China, Burma, Laos, Thailand, Vietnam, Malaysia and Java as well as Sumatra and Borneo. The cause of the extinction of the orangutan in peninsular SE Asia has always been a mystery. Why do only insular populations of this Great Ape survive today when suitable tropical forest habitats can be found throughout peninsular SE Asia? It now seems likely that the early humans who made the characteristic split quartzite cobble tools of the Sonvian culture were systematically hunting the orangutan. It is difficult to state for certain that early human hunting *caused* the extinction of the orangutan on the Asian continent but it certainly *contributed* to its extinction. We plan to follow up on this line of research with our Vietnamese colleagues during our next expedition.

After returning to Hanoi for a brief layover we once again set out on another field excursion which took us in an easterly direction toward Haiphong harbor and Quang Ninh province on the northeast coast of Vietnam. We had been scheduled to visit the limestone karst region of Lang Son province but those plans had to be changed when fighting broke out along the Vietnamese-Chinese border in nearby Ha Tuyen province due north of Hanoi. As an alternative a field trip was scheduled to the tower karst of Halong Bay.

The trip to Halong Bay took us through Vietnam's lowland coastal plain that terminates in the Gulf of Tonkin. This flood plain area contains many rivers and the paved road toward Haiphong took us across dozens of bridges. As we crossed the bridges our interpreter, Nga, would often mention how many U.S. planes had been shot down trying to blow up each bridge. She added that though the bridges had often been damaged they were easily rebuilt within days. When we reached Haiphong harbor at dusk, we boarded a small ferry which carried cars, bicycles and people across the inlet. Looking out across the moonlit harbor toward the sea it was difficult to imagine that hardly two decades ago this



Junks at river crossing on the way to Halong Bay.

beautiful bay had been filled with floating mines and was bombed repeatedly as a target of strategic importance during the war.

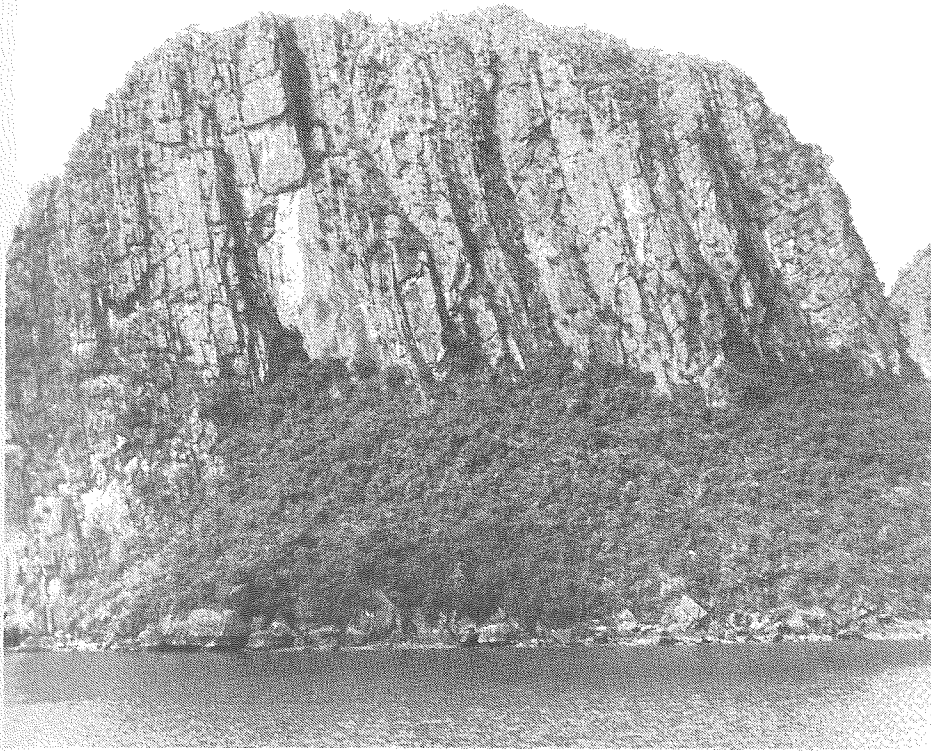
We reached Halong Bay late in the evening and checked into a restored French colonial "resort" hotel just across from the beach. Our room was something out of a Somerset Maugham novel with ornately decorated walls, high ceiling fans and beds draped with snowy white mosquito nets that were suspended from the ceiling.

We had come to Halong Bay to explore the tower karsts that lay offshore. These limestone peaks often contain caves with Pleistocene faunas. It is in tower karsts such as these that Chinese paleoanthropologists recovered the first *in situ* jaws and teeth of the giant ape *Gigantopithecus* at the site of Liucheng in Guangxi province only 150 km north of Halong Bay. The tower karsts in this part of Vietnam occur throughout Quang Ninh province and in adjacent Lang Son (see map) province and extend across the border into China.

The Social Sciences Committee arranged for the rental of a large boat that could take us miles offshore among the karst "islands" of Halong Bay. More than 3000 karst islands can be seen throughout the bay and stretching northward along the Vietnamese coast toward China. Ocean depth in this coastal area of Vietnam is less than 200 meters. Therefore in the Pleistocene all of these presently offshore tower karsts were connected to the main-

land as was most of what now constitutes the Malay Peninsula and the islands of Indonesia. As we sailed among these beautiful offshore tower karsts, so often depicted in classical Chinese and Vietnamese paintings, we could see a variety of caves and fissures in their often near-vertical slopes. Single tower karsts contained anywhere from 0 to 10 cave openings, each situated at varying heights above the present water surface level. We saw more than 100 caves and fissures during our brief survey of Halong Bay. In some of the caves and fissures it was possible to see breccias (a cement-like consolidation of dissolved limestone, sediments and often bone) in a variety of colors, usually in tones of yellow, orange and red. As to how many of these contain remains of *Gigantopithecus* and *Homo erectus* we can not answer at the present time because we were unable to dock along side many of the karsts due to the large size of our vessel. Upon our return to Hanoi we discovered from discussions with paleoanthropologists at the Institute that *no* field explorations of the limestone tower karsts of Halong Bay have ever been undertaken. Given our discovery of so many breccia-filled caves in this area we have made this a priority area for our future joint research.

Since Halong Bay very probably contains numerous fossil-rich karst caves it is worth reviewing what the Vietnamese have found at a single karst cave in Lang Son province. The site of Tham Khuyen was discovered in the mid-1960s by Insti-



Tower karst in Halong Bay. Such limestone karsts contain caves where *Gigantopithecus* and *Homo erectus* have been found.

tute scientists. It has been excavated sporadically since its discovery usually with the use of dynamite to loosen blocks of the rock-hard fossiliferous breccia. To date nearly 1000 specimens of fossil vertebrates have been collected which are currently grouped into approximately 30 genera representing 20 families. All the components of the typical south Asian *Stegodon-Ailuropoda* fauna are represented at Tham Khuyen. Remains of *Homo erectus*, represented by isolated teeth and partial jaws, are present but rare. *Gigantopithecus* also occurs, but to date less than a dozen isolated teeth of the giant ape have been found. Remains of *Pongo* are more prevalent, represented by numerous isolated teeth and several jaw fragments.

Certainly the most exciting specimen recovered thus far from Tham Khuyen is a relatively complete skull of a gibbon. This skull of *Hylobates* has a complete face and much of the cranial vault. The palate is also complete but only one side of the dentition is present. A

precise species assignment has not yet been made. Vietnamese paleo-anthropologists have asked us to join with them in the simultaneous publication of this specimen in western and Vietnamese journals which we will begin upon our return expedition.

Vietnamese scientists regard the fauna from Tham Khuyen as Middle Pleistocene, approximately 250,000 years BP. Comparisons of the faunal lists from Tham Khuyen with southern Chinese karst cave faunas would indicate that this is a reasonable assessment. The Vietnamese have interpreted this dating of the Tham Khuyen fauna to indicate that the latest worldwide occurrence of *Gigantopithecus* is now documented from Vietnam. In this regard it should be noted that many of the Chinese cave sites may actually be younger than previously thought. Re-analyses of the Chinese cave faunas by John De Vos and others indicate that there very possibly has been mixing of the *Stegodon-Ailuropoda* fauna at various south Chinese cave sites including

Liucheng (*Gigantopithecus*) cave. This could mean that the occurrence of *Pongo* and *Gigantopithecus* at Liucheng may actually date to the late Middle or even Late Pleistocene (perhaps only 100,000 years BP). The precise dating of Tham Khuyen cave will obviously be central to future studies of its hominoid remains. We are investigating the use of fission track dating or electron spin resonance to obtain an absolute date for the final crystallization of the breccia which would provide a minimum date for the faunal remains.

From our survey of the fauna from Tham Khuyen and several other karst caves in northern Vietnam it is clear that the degree of preservation is substantially better than is normally seen at similar karst localities in southern China. For example, Tham Khuyen has produced a nearly complete skull of a giant panda and the *only* skull of a Pleistocene fossil gibbon ever recovered. This is in dramatic contrast to the large numbers of isolated teeth recovered from most karst caves in southern China. Since Tham Khuyen cave has two openings it has been possible for Vietnamese scientists to accurately survey the extent of the breccia layers. Institute scientists estimate that only 3% of the fossiliferous breccia has been excavated to date. Given the fragile nature of the nearly-complete gibbon skull and the relative completeness of other specimens discovered so far, it seems quite likely that Tham Khuyen will eventually yield cranial (and post-cranial) remains of *Gigantopithecus* and *Homo erectus*. Such discoveries will result in a much better understanding of the paleobiology of these taxa and possibly shed light on the nature of interactions between early humans and this giant ape and perhaps even provide an explanation for its extinction.

It is difficult to speculate on the kind and degree of interactions that might have occurred between early humans and *Gigantopithecus*. Evidence now indicates that *Homo erectus* probably originated in Africa and spread into Asia no earlier than

one million years ago (see work by Leakey grantee, Dr. Geoffrey Pope). We know from fossil evidence that *Gigantopithecus* and *Pongo* had an Asian origin and were already well established in southern Asia by the early Pleistocene. Thus, as the first hominids spread into Asia they would have encountered *Gigantopithecus*, the orangutan and a host of other species that had had no prior experience or contact with early human hunting techniques. Based on evidence gathered from a late Pleistocene rockshelter in Vietnam we now know that early humans were preying upon and very likely hunting orangutans which is almost certainly related to the extinction of *Pongo* on the Indochinese mainland. Perhaps the hunting of *Gigantopithecus* by *Homo erectus* could have also been a causal factor in the extinction of this giant ape? We will be testing this hypothesis through the careful assessment of associations between cultural remains (tools), fauna (*Gigantopithecus* and humans) and paleobehavior (e.g., cut-marks on bones) in the karst caves we excavate during our next expedition to Vietnam.

Our first expedition to Vietnam was very brief and many of our conclusions are necessarily quite preliminary. However, the potential that Vietnam holds for future research is quite extraordinary. We were very impressed with the large number of Pleistocene sites that had been discovered by Vietnamese scientists over the past three decades and with their detailed plans for future excavations. In this regard, we are pleased to report that we have been invited to return to Vietnam in December 1987 to begin joint excavations at Tham Khuyen cave in Lang Son province and to survey and run test excavations in caves we discovered in the tower karsts of Halong Bay in Quang Ninh province. On this return expedition we will bring generator-powered lanterns and a portable pneumatic drill and we can work deep inside the caves while avoiding the use of dynamite.

Our first Vietnamese expedition also produced another concrete sign of future cooperation. Upon our departure from Hanoi, Institute

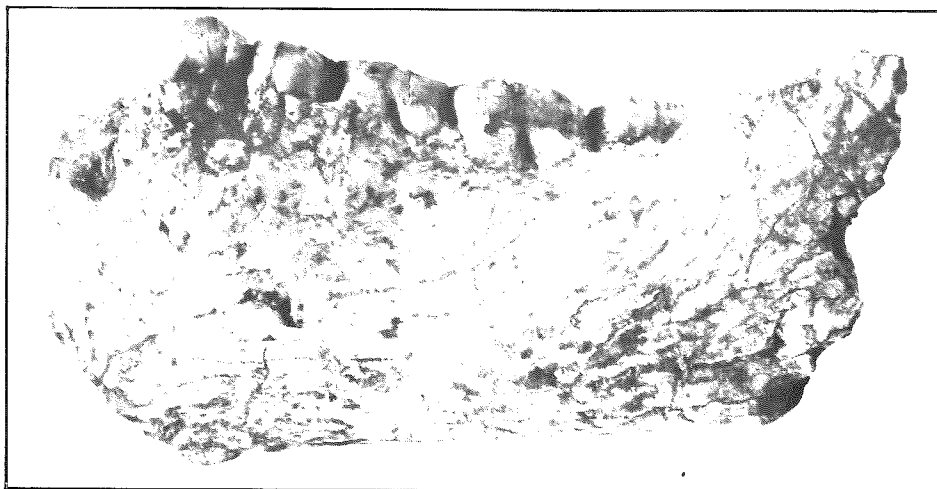
archaeologists gave us ten samples of charcoal and/or bone from a variety of late Palaeolithic and more recent sites for chronometric dating at the Accelerator Carbon 14 laboratory at the University of Arizona. The new dates will be presented in a series of joint publications.

Regarding the future of archaeological research in Vietnam we are pleased to note that the outlook is very bright. On the last day of our visit we were also able to confer with members of the Department of Archaeology at Hanoi University. In particular, we engaged in extended discussions with Tran Quoc Vuong, Head of the Archaeology Department, and professors Ha Van Tan and Nguyen Dinh Khoa. That ten doctoral degrees in archaeology have already been conferred at Hanoi University,

10% of the total number of Ph.D.'s granted thus far, attests to the importance of archaeology in the Vietnamese university curriculum. It is also important to note that in all academic contacts with our Vietnamese counterparts, we were consistently impressed with the high levels of professionalism and competence that we encountered. The prospects that future archaeological and paleoanthropological research in Vietnam will make major contributions to our understanding of Asian prehistory are very great indeed. ■

NOTE: The results of Ciochon and Olsen's current work in Vietnam together with a chronicle of their return expedition will be presented in a book to be published in 1989 by Bantam Books.

FIELD REPORT



Bonis' new specimen of the hominoid primate *Ouranopithecus* found in Greece.

REPORT ON THE EXPLORATION AND EXCAVATIONS IN NORTHERN GREECE

Louis de Bonis

Since the grant has been received, I supervised two field campaigns in Macedonia (Northern Greece). I have collected numerous new specimens of several mammals. Some of them are coming from two new localities.

One of the most important results is the discovery of a beautiful mandible of *Ouranopithecus*. This primate is now considered to be the best Miocene ancestor for *Gigantopithecus* and the Plio-pleistocene australopithecines. The new material will be carefully compared with the African discoveries, but it is possible to note for the moment that it is fairly similar to the oldest australopithecine, *Australopithecus afarensis* from Hadar.

GRANT SPOTLIGHT

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.

Peter Andrews \$7,500 funded

MIOCENE EXCAVATION AT PASALAR, TURKEY

Dr. Andrews will continue his ongoing excavations of middle Miocene deposits at Pasalar in Turkey. He expects to recover more faunal remains, hominoids in particular. Most of the work on the fossil remains will be done in Ankara. Andrews' field team includes Drs. Lawrence Martin, Elizabeth Evans, Mikael Fortelius and an ecologist.

Pam Crabtree \$1,950 funded

PRELIMINARY EXCAVATIONS AT SALIBIYA I, A LATE NATUFIAN SITE IN THE JORDAN VALLEY

Dr. Crabtree, in cooperation with the Hebrew University of Jerusalem, will excavate the Salibiya I site, a late Natufian, 9,000 B.C. archeological site located in the Jordan valley in Israel. The excavations will 1) emphasize the recovery of plant, animal and artifact remains that can inform us about Pleistocene subsistence strategies; 2) provide information on the hunter-gatherer economies that immediately preceded the beginnings of agriculture in the Levant; and 3) lead to an investigation of the effects of very late Pleistocene climatic deterioration on the complex hunter-gatherer subsistence systems that had developed during the Early Natufian period.

John H. Deacon

\$3,000 funded

THE BEHAVIOR OF EARLY MODERN PEOPLE

Dr. Deacon's research will complement a separate field study of the deposits (stone artifacts) at the Klasies River caves. New fieldwork will provide some well-documented control samples; the South African Museum collection will be the basis for showing how different styles of stone artifacts replaced one another in time.

David Helgren \$1,500 funded

GEOARCHEOLOGICAL INVESTIGATIONS IN THE WESTERN RIFT VALLEY OF ZAIRE

Dr. Helgren will analyze sedimentary unconformities and facies changes within the major depositional units in the Western Rift to build paleoterrain models. This work is key to developing efficient search strategies. Recent sedimentary analyses correlate the key Pliocene lake beds to decidedly semiarid, if not arid, environments. Dr. Helgren feels much more detailed analyses of sedimentary styles in the Western Rift are needed to better explain the patterning of regional paleo-environments during these formative periods of human evolution.

Lawrence Straus \$3,300 funded

UPPER PALEOLITHIC RESEARCH IN PORTUGAL

Dr. Straus will search for new Upper Paleolithic sites, to test-excavate known or newly-discovered ones, and to analyze existing Upper Paleolithic collections in Portugal, in collaboration with Dr. J. Zilhao, Portuguese National Archeological and Ethnographic Museum and Dr. A. E. Marks, Southern Methodist University. Very little is known about Upper Paleolithic Portugal and this is a great opportunity to fill in a huge gap for this region.

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.

DEVELOPMENT NEWS

The National Geographic Society made the first gift to the Mary Leakey Fund for Prehistoric Archeology in Africa. The Leakey Foundation is very grateful for this gesture of support, which will be matched by the Getty Challenge.

The Flintridge Foundation has generously agreed to fund the 1987 Hunter-Gatherer Fellowship. This Fellowship is of crucial importance to the goals of the Leakey Foundation and we are very pleased with the results of the research conducted by our Fellowship recipients. Announcement of the award will be made in the next issue of *AnthroQuest*.

NEW FELLOWS

The Trustees and Scientists of the Leakey Foundation welcome and gratefully acknowledge the support of the following Annual Fellows:

Ariel Appleton, Dr. & Mrs. S. Boyd Eaton, Mr. & Mrs. Richard Goldman, Mr. & Mrs. Herbert Goldstein, Lucy Grimm, Dr. Lillian Rachlin.

SCIENTISTS' NEWS

Mary Leakey recently received two significant honors; in the spring she was elected a Foreign Associate of the National Academy of Sciences, a singular honor offered to a very few non-U.S. citizens in recognition of distinguished achievement in science. At Cambridge University on June 11, she was awarded an Honorary Doctorate which was conferred upon her by Prince Phillip.

Richard Wrangham, Co-Chairman of the Leakey Foundation's Science and Grants Committee, was awarded a Fellowship from the *John D. and Catherine T. MacArthur Foundation*. The coveted Fellowship provides an annual stipend for five years for unrestricted study and research. Dr. Wrangham and family are now in the Kibale Forest in Uganda to begin a multi-year project on social organization and communication among forest chimpanzees.

Clark Howell, Science and Grants Committee Co-Chairman, was invited by the University of Istanbul to do a reconnaissance study of the Yarimburgaz Cave in Turkey. The initial visit and evaluation of the site was of great interest, and Dr. Howell plans to return for a longer season of research.

Dr. Howell has also been invited to attend the ceremony of induction of *Dr. Yves Coppens* into the French Academy in Paris this Fall.

Desmond Clark was invited to the People's Republic of China to visit paleoanthropological localities and to examine and discuss museum collections with colleagues in May.



Irven DeVore: Anthro-Photo

Wrangham, Conner, Smolker and a research assistant making underwater sound recordings of dolphins at Monkey Mia Research Station at Shark Bay, Western Australia

DOLPHIN RESEARCH — A NEW GOMBE?

Drs. Irven DeVore and Richard Wrangham spent three weeks this summer visiting Shark Bay, Australia to participate in and evaluate dolphin research being conducted there by *Rachel Smolker and Richard Connor*. They came back very excited about the work, which is the first time researchers have been able to follow individual dolphins for long periods. In Richard Wrangham's words, "This is the Gombe of the dolphins! The atmosphere at Monkey Mia was just as it was in Gombe in the early years; almost every day exciting new observations are coming in and every week the picture becomes clearer and more interesting. It is also like Gombe because dolphins are like chimps! They are smart and extraordinary animals, and offer us fantastic opportunities to see the relationship between intelligence and social behavior, and to think about the evolution of intelligence."

Among the fascinating questions the research is seeking to answer are:

Does dolphin communication include the closest parallel to human language in the animal world? What do their mysterious "whistles" mean?

Why do dolphins, unlike any other animal like to exchange objects such as fish and seaweed with each other or with people?

How do dolphins use their enormous brains in their daily lives? How clever are their foraging techniques? Do dolphins, like chimpanzees, sometimes deceive each other in social situations?

Why do groups of males "herd" females, using special calls, for up to two weeks at a time?

Why, as recorded for more than 2,000 years, do dolphins assist each other when in trouble and help humans in distress?

BOOKS

THE SEXUAL LIFE OF SAVAGES, by Bronislaw Malinowski. Beacon Press, Boston, MA, 1987, pp. 505, \$14.95.

An ethnographic account of courtship, marriage and family life among the natives of the Trobriand Islands, British New Guinea.

THE FIELD GUIDE TO EARLY MAN by David Lambert and the Diagram Group. Facts on File, Inc. New York, 1987, pp. 256, \$18.95.

An attempt to present the amateur natural scientist with a complete, systematic means of charting and understanding the course of human evolution. This book makes it possible for readers of all ages to follow the evolution and development of

human life as it has progressed from the primitive primates of 70 million years ago to modern man of the twentieth century.

LAETOLI, A PLIOCENE SITE IN NORTHERN TANZANIA by M.D. Leakey and J.M. Harris. Oxford University Press, New York, 1987, pp. 561, \$90.

A monograph of research conducted at Laetoli over the years.

FOUNDATION NEWS

Trustee *Kay Woods* and her husband *Frank* hosted a wonderful picnic at their Clos du Bois Vineyard in Healdsburg honoring *Mary Leakey*. The guest of honor was missing from the event as she had injured her hip, but *George Lindsay* brought Mary's greetings and the good news that she was recovering with great speed and good spirits. Guests included Leakey Foundation Fellows *Audrey and Barry Sterling*, *Phyllis Wattis and Bob Brownlee* as well as our newest Trustee *Eileen McKeon* who became *Mrs. Peter Michael* in July.



Mr. Gordon Getty at the Woods' picnic honoring Dr. Mary Leakey.

During *Richard Leakey's* most recent visit to the United States, the Foundation co-sponsored a lecture with the *Virginia Museum of Natural History*, whose Director *Noel Boaz* is a Leakey Foundation grantee. A dinner was held in Charlottesville honoring Science Advisory Board member, *Dr. Bernard Campbell* and Board Chairman, *Gordon Getty* with the announcement of two newly discovered species of *Hipparion* at Lake Reziyeh in Iran. If your



Mrs. Phyllis Wattis at the Woods' picnic honoring Dr. Mary Leakey.

interest in prehistory extends to collecting extinct species of the ancestor of the modern species equus, here are two to add to your collection: *Hipparion gettyi* and *Hipparion campbellensis*.

Charlottesville lived up to the renowned tradition of southern hospitality: *President and Mrs. Robert O'Neil* gave guests a splendid tour of the historic campus, and the *Leigh Middleditch's* hosted Foundation guests at a luncheon in their country home.

In Atlanta, Georgia, *Dr. and Mrs. Boyd Eaton* honored *Richard Leakey* at a luncheon with fellow Atlantans *Suzie and Eddie Elson*, *Charles Ackerman*, *Karina Miller and Beth Jones*. *Dr. Eaton* and *Dr. Melvin Konner*, participants in the Foundation's symposium on "Diet and Human Evolution" are co-authors of a new book which will be published in the spring of 1988 entitled *The Paleolithic Prescription*. They are very generously contributing a percentage of the book's profits to the Leakey Foundation, so we hope it is as successful as *Dr. Konner's* most recent book, which is still in the top ten on the best seller list of the *New York Times*.

While in San Francisco, *Richard* was also honored at a dinner given by *Danielle and Brooks Walker*. *Gruter Institute* heads *Drs. Margaret*

and *Joachim Gruter* were guests along with the *Joachim Bechtles*.

Trustee *Ann Willis* presented a Visiting Scientists Program in New York this past spring. Science and Grants members *Drs. Iroen DeVore* (who has just been named Chairman of Anthropology at Harvard) and *John Fleagle* joined *Karen Strier* in presenting a brilliant and succinct overview of the Foundation's research to invited guests. Trustee *Anthony Marshall* was so enthused that he wants to plan more programs in New York in the near future.

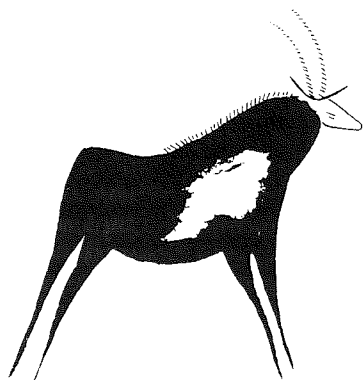
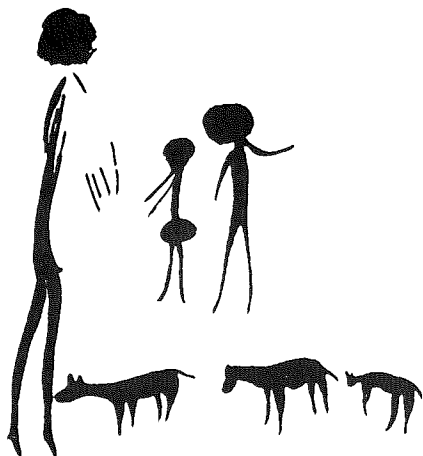
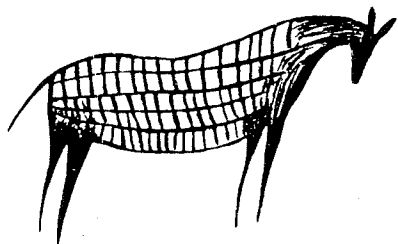
Summer travel is a tradition, but some of the more unusual travels we know of might include *Helen O'Brien's* 24-hour trip to Washington, D.C. *Helen* is a seasoned traveler, but has never made a 24-hour transcontinental trip before. Her quick round trip was to accompany *Mary Leakey* on *Donald Koll's* plane to stay with the *Melvin Paynes* on her way to Cambridge University.

Also in the category of unusual travel was a trip to Kenya by *Dr. and Mrs. Charles Morris*, Trustee *George Lindsay's* son and daughter-in-law. *Charles* had taken care of *Dr. Mary Leakey* while she was hospitalized in San Francisco and decided to check up on her while on safari in East Africa. The report is that *Mary* is great! New Fellows *Heide and Joe Betz* were in Kenya with their family, too.

Drs. Shirley Strum and Jonah Western are the parents of a son, named *Guy Strum Western*. Many Leakey Foundation Fellows have visited *Shirley's* famous "Pump-House Gang" and all of us enjoyed seeing the television special on the relocation of the troop to newer and safer territory in Kenya.

While in California, *Shirley and Jonah* spoke at an afternoon Visiting Scientists Program at *Gay and Jack Bradley's* home in Hillsborough. Guests included long-time supporters *Blanche Whittey and Emott Caldwell*; the subject of "The Human Brain: Behavioral Masterpiece or Ecological Tragedy" was so interesting that guest *Thea Bacon* became a new Fellow of the Foundation.

LEAKEY FOUNDATION NAMED FUNDS



Rock Paintings of Tanzania:
A zebra in geometric streaky style.
A man with two children and dogs.
One of the frieze of naturalistic roan antelopes.

The Foundation is seeking support for endowment funds in several areas of human origins research. These "named" funds honor a special individual and provide support in perpetuity for knowledge of our earliest ancestors. We would like to ask you to consider adding your name to the list of donors by making a contribution to any of the following named funds. Your gift will be matched by the *Getty Challenge Grant*.

MARY LEAKEY FUND FOR PREHISTORIC ARCHEOLOGY IN AFRICA

The goals of the Leakey Foundation in studying human origins are the discovery and recognition of sites, the intense and appropriate study of those sites, and the preservation of this knowledge for posterity. Mary Leakey has made extraordinary contributions to each of these levels of research.

The support generated by the fund for scientific research will continue that legacy.

DIAN FOSSEY MEMORIAL FUND FOR GORILLA RESEARCH

Dian Fossey's twenty years of research changed the world's perception of this endangered species. The work continues at the Karisoke research site in Rwanda, but research must be expanded and efforts must be accelerated to protect this threatened species.

The support generated by this fund will continue Dian Fossey's work.

MARGARET GELL-MANN FUND

Named to honor the late wife of Dr. Murray Gell-Mann, this fund will be used to finance research relevant to the preservation of the great apes or to the preservation of the physical existence or cultural continuity of hunting and gathering peoples. These are the two classes of living beings of greatest interest to the Leakey Foundation and both are in grave danger of extermination.

GLYNN L. ISAAC FELLOWSHIP FUND

During the twenty years that span the period of his work, Glynn Isaac was an acknowledged leader in the most significant advances in the understanding of human behavior from study of prehistoric cultural residues. With a deep and genuine love of teaching, Glynn was interested in training nationals from African countries in various branches of paleoanthropology.

This fellowship will enable young researchers to continue and expand the new approaches to the study of human origins that Glynn Isaac so successfully developed in Africa.



I would like to have my name on the list of contributors to the _____ Fund.

Enclosed is my gift of \$_____.

I would like to make a pledge of \$_____, payable to the Leakey Foundation by December 31, 1988. (*Your gift to a Leakey Foundation Fund will be matched dollar for dollar by the Getty Challenge Grant.*)

I would like a more complete description of the _____ Fund.

I would like information on setting up a "named" fund.

Thank you for your support.

MEMBER'S EVENTS

SYMPOSIUM THE QUEST FOR OUR ANCESTORS

OCTOBER 17-18, 1987

Indiana University
Bloomington, Indiana

"The Quest for Our Ancestors," a conference on human origins will feature state-of-the-art developments in human origins studies. Co-sponsored by the Leakey Foundation and the recently established Center for Research into the Anthropological Foundations of Technology (CRAFT) at Indiana University, the conference will include scientific presentations on Saturday and informal "hands-on" workshops on Sunday.

Symposium participants include Drs. Nicholas Toth, J. Desmond Clark, Richard Hay, Alan Walker, John Fleagle, John Yellen and moderator F. Clark Howell.

CRAFT, founded by co-directors Nicholas Toth and his wife Kathy Schick, will investigate the origins and evolution of human technology over the last 3 million years.

For more information, contact Dr. Toth at CRAFT, (812) 335-0022, or the Leakey Fdn. office, (818) 449-0507.

SYMPOSIUM NOW OR NEVER DWINDLING APES AND DISAPPEARING FORAGERS

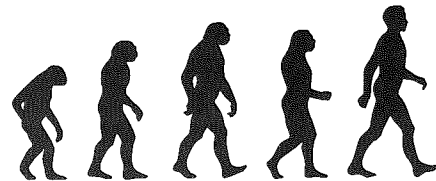
FEBRUARY 25-27, 1988

New York Public Library
Co-sponsored by the *Carnegie Corporation.*

Plans are underway for a "Now or Never" symposium to be presented in New York this winter at the New York Public Library.

Scientists will meet for two days to discuss the critical issues and crucial needs of human origins research on Great Ape and Hunter-Gatherer populations. An action plan for the study of dwindling apes and disappearing foragers will be developed and an open symposium will be held on Friday, February 26 to present current information to the public.

For further information please contact: Melinda McGee, Leakey Foundation, San Francisco office, 2237 Union St. 94123, (415) 921-8668.



LEAKEY FOUNDATION MEMBERSHIP



ALL MEMBERS RECEIVE

- Subscription to *AnthroQuest*
- Invitations to special "Members Only" events
- Advance announcements to all symposia and lecture programs
- Member's Discounts to events

ANNUAL MEMBERSHIP CATEGORIES

Students	\$20	
(with copy of fulltime student ID)		
Contributing	\$ 35 - 99	
Sponsor	\$100 - 499	
Annual Fellow	\$500+	(will receive invitations to Visiting Scientist Programs and International Travel Programs)

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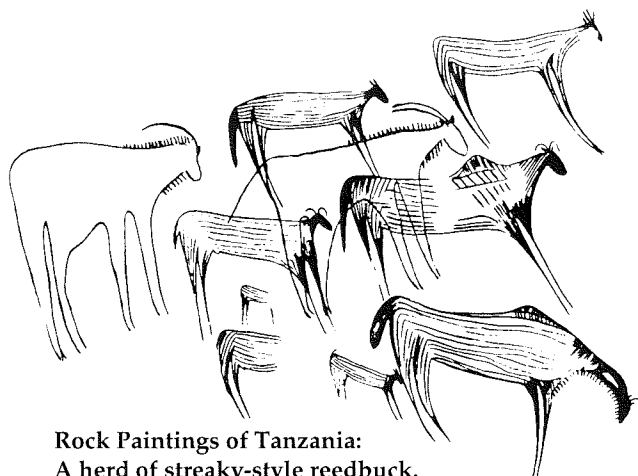
Please make checks payable to the L.S.B. LEAKEY FOUNDATION, Foundation Center 1-7, Pasadena, California 91125.

TRAVEL NEWS

A VERY SPECIAL SAFARI AFRICA TANZANIA/KENYA MARCH 1988

A very special safari is planned for March of 1988. The group will be joined by *Dr. Mary Leakey* in Tanzania to see many of the rock paintings Dr. Leakey has recorded in her book *Africa's Vanishing Art*.

Game viewing in the Serengeti and Kenya parks and an optional visit to Koobi Fora, where Richard Leakey continues to make remarkable discoveries, will be highlights of the trip.



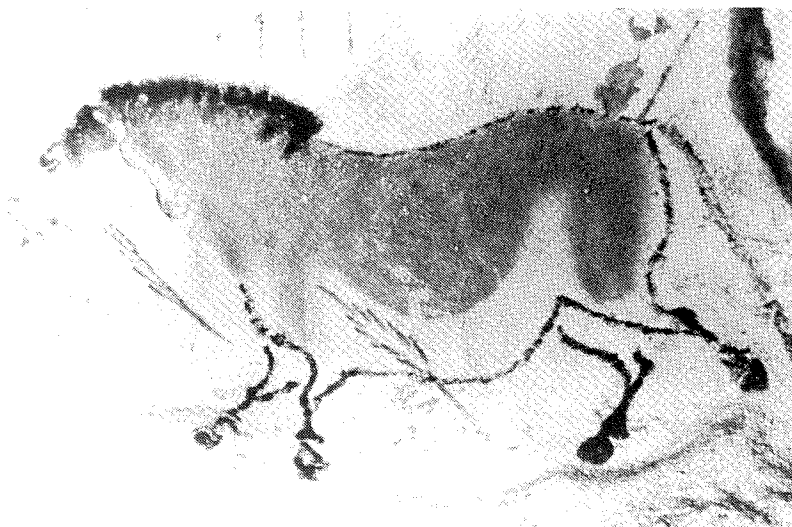
Rock Paintings of Tanzania:
A herd of streaky-style reedbuck.

THE CAVES OF FRANCE FALL 1988

The extraordinary art of the caves and "abris" of the Dordogne Valley will be the focus of a Fall 1988 Leakey Foundation trip. The most famous of these prehistoric sites, the great *Grotte de Lascaux*, is now closed to the public, but we will be able to visit this "Sistine Chapel of Prehistory" by special permission in very small groups. The tour will be enhanced by the participation of leading French paleontologists.

This area of France is extraordinarily beautiful and famous for its fine food.

If you have any interest in joining us on the 1988 Leakey Foundation Travel Program, please contact Melinda McGee for more information at (415) 921-8668.



Lascaux, cheval chinois

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