

# ANTHROQUEST

news of human origins, behavior and survival

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## THE CHINESE PALEOLITHIC AN OUTSIDER'S VIEW

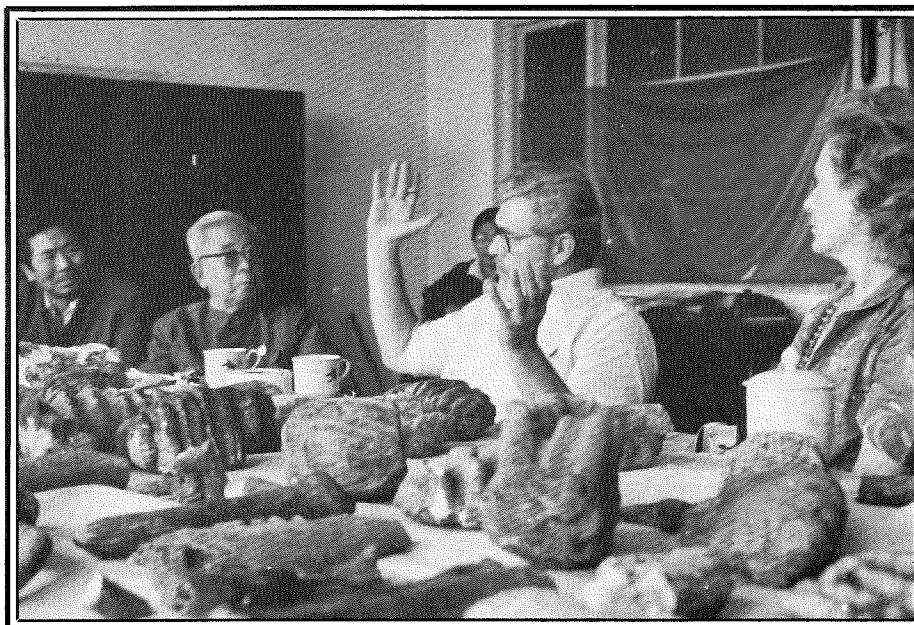
Lewis R. Binford and Nancy M. Stone

Department of Anthropology  
University of New Mexico, Albuquerque

Under the partial sponsorship of the L.S.B. Leakey Foundation, we recently made a research trip to China where we were treated to a major tour of Paleolithic sites (Map, page 15) and were permitted to see many of the assemblages in some detail. Our primary focus for research was the famous site of Zhoukoudian. We were given limited access to the faunal remains recovered from this

site, and the report on this aspect of our work is currently in press. What we wish to share in this paper are some of our impressions after seeing the Paleolithic material and a peek into some of the research currently underway on materials we learned about as a result of our China trip.

It is perhaps best to begin by pointing out some of the views of the past to which the Chinese are heavily committed. Perhaps the most striking posi-



*Professor Jia Lanpo, Lewis Binford and Nancy Stone with fauna from Kehe.*

tion about which there appears to be no argument among the Chinese scholars is that hominids radiated into China quite early, and through exclusive processes of local development these founder populations were transformed into the contemporary peoples of Asia. The major support for this interpretation rests with the study of comparative anatomy, and one must admit that in some anatomical characteristics there is a positive analogy between the ancient hominid remains

from China and selected modern Asian populations.

Given a mixture of national pride and the hypothesis of local development it is not surprising that much contemporary Chinese research is directed toward finding the "oldest" evidence for hominids within modern China. Three sites are currently cited as being the earliest ones in China; we had the oppor-

tunity to see recovered materials from all three.

Sites More Than  
700,000 Years Old

### Yuanmou

One site from south China, Yunnan Province, known as the site of Yuanmou Man (Site 18 on Map), has been painstakingly excavated by Zhou Guoxing,

continued on page 14

## 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 S.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 view of humanity's place in nature.

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Telephone (818) 449-0507

# PRESIDENT'S MESSAGE

*From the Elizabethan age of Shakespeare, where there was religious prohibition of new ideas, before the nature of fossils was properly understood, before the length of geological time was appreciated, and before there were words or concepts to deal with events remote in time or hidden in nature, we have the following quotation from Francis Bacon:*

"The transmutation of species is, in the vulgar philosophy, pronounced impossible. Certainly it is a thing of difficulty, and it requireth deep search into nature; but seeing there appear some manifest instances of it, the opinion of impossibility is to be rejected, and the means thereof is to be found out."

*In the next 250 years, collectors would make a great many observations of fossils, plants and animals. The data from this work would lead to Darwin's great generalization of the theory of evolution.*

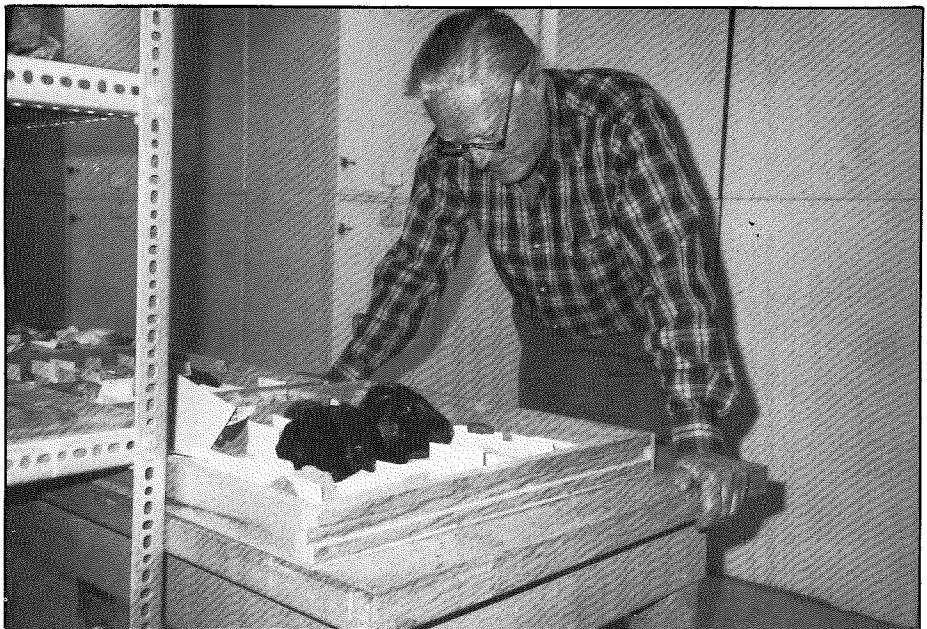
*From the study of our human origins, we find that two streams of evolution have met and merged: the biological and the cultural. The two streams seem often to be in conflict, threatening.*

*From the original simple hunter-gatherer communities, to farming, to complex life in our ancient civilizations, we have recently entered a time of excessive and rapid change, which stresses us all. Great ape habitats and hunter-gatherer communities are rapidly disappearing. It is urgent to study these sites and protect them.*

*Fortunately, the Leakey Foundation has the Gordon Getty endowment, announced late last year, as a financial challenge to be matched. We also have a great number of grant proposals and an able Science and Grants Committee inspired to lead us into new scientific ventures.*

*Please take time to write the Leakey Foundation with your ideas of how to manage the challenges of the future.*

Lance R



*The annual meeting of the Leakey Foundation was held in May on the south rim of the Grand Canyon. On an afternoon free of meetings, President Larry Barker inspects specimens at the Northern Arizona Museum at Flagstaff, an institution which specializes in Colorado Plateau artifacts.*

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# THE ORIGINS OF MANKIND

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**Richard E. Leakey**  
Director  
National Museums  
of Kenya, Nairobi



Mr. Leakey addressed the Commonwealth Club of California in San Francisco last February. Excerpts from the talk follow. For his speaking engagements this fall, see the Calendar on page 22.

Today we know a great deal about human origins, but we still have very considerable gaps in our knowledge. What I would hope to do is illustrate not only what we do know, but perhaps more importantly, what we don't know.

There are a number of sources of conflict. There are a number of areas of doubt. There are, in fact, centers of education being developed in your country which set out to establish that evolution isn't even true. This is an extraordinary concept, taking into account the wealth of knowledge that we actually have. And I would like to place on record my amazement that in 1986 there are really people who don't believe that we evolved.

Traditionally, the study of evolution has involved looking at a series of fossils

that appear to represent change through time. Today it is more complex. We are able to look at changes in the environment and the context in which these events occurred — so that we not only can see what happened, but begin to understand why. A good number of people still believe that all of evolution was geared in some way to produce us — that we are the ultimate in evolutionary design. This is difficult to maintain, and the fossil record doesn't support it. The giraffe has evolved, the squirrel has evolved — all forms of life have evolved. And one cannot say that we are the most successful, and therefore the most evolved, because success must be measured against something.

Our own species, *Homo sapiens*, hasn't been around very long. One hundred thousand years ago, although there were probably people that we would like to call *Homo sapiens*, their physical appearance would have only just been within the modern range of variability.

One hundred thousand years in the life of a species is very little time. Some species go back 50 or 60 million years virtually unchanged. Look to the crocodile, look to many of the fish, look to the many other life forms that surround us. They have a far longer success time on this planet than we do. And it is perfectly possible that we will bring about the extinction of our own species as a result of our technological excesses.

Nevertheless, it is not my purpose to discuss that specifically. Let me instead make some brief remarks about the fossil record itself, give you some sense of why I have such confidence that we have evolved.

Today the species *Homo sapiens* shows little genetic diversity. The accents of great genetic diversity within the single species *Homo sapiens* imply that there may have been a relatively recent event producing fully modern people.

This has by no means been agreed upon by all scientists, and at the moment the fossil record for *Homo sapiens* is far from complete. But it is reasonable to tell you that approximately one hundred thousand years ago we see the first evidence for fossil forms that are sufficiently similar to ourselves to be included within *Homo sapiens*.

If you go further back in time, the

immediate similarity in the fossils to modern people becomes more difficult to sustain. As we go back toward one million years there is evidence of our ancestral people, not only over most of Africa but across much of Asia, the Far East, and even in parts of southern Europe.

These people have been called *Homo erectus* — the first erect *Homo*. As will be clear in a moment, all these ancestors were erect, and it was perhaps a misnomer. Nevertheless, the concept of an erect hominid was novel when the name was first defined and *Homo erectus* is a species that is widely distributed across Kenya.

It is difficult to find evidence for mankind beyond Africa earlier than one million years. Various attempts have been made, but the record is simply not there. The record for man in Africa goes further back. You can go back nearly two million years and find fossil traces of creatures that fit the bill as our ancestors. There is evidence for a creature that was as upright and bipedal and upstanding as we are, that had its hands free, and also had a slightly enlarged and different brain shape from that seen in the other apes and other upright creatures with which it coexisted.

We can take the expansion of the brain, which I believe is a central issue in the development of our species, back to just over two million years. But we can take the age of technology back to about 2.5 million years. There are stone implements from that time that suggest that the threshold of humanity had been crossed.

We used to define man as a creature who could make tools to a certain regular pattern. Jane Goodall, another ethnologist, soon proved that definition wouldn't work because other creatures, such as the chimpanzee, also make tools to a set and regular pattern. Nevertheless, I think the manufacture of a stone tool to a precise shaped pattern does imply a mental ability and intellectual capacity slightly beyond that seen in our closest relatives, the chimpanzees. I believe if you're going to make an axe out of a piece of rock, you have to pick up a piece of rock that contains the axe in it. If you get the wrong sized rock, or the wrong shaped rock, you can't make that tool. The intellectual capacity to

choose, at least in its earlier stages, probably goes back as far as 2.5 million years.

There were other coexistent species that had specialized or adapted in a different way in Africa. The so-called australopithecines — bipedal apes or early humans — didn't evolve further, but became extinct a million years ago. Their principal role could be seen as providing a more complex substrate from which to derive our own species. They have also provided a lot of discussion about their origin as well. Some of you are familiar with the question of whether this was the common ancestor of all later forms. The famous Lucy skeleton from Ethiopia has been put forward as the common ancestor candidate of all the bipedal apes. She may be, and she may not; it is not my purpose today to discuss the pros and cons of that argument. But I would like to take you to the point that there must, at some stage in time, have been a common ancestor.

What is it that we are looking for in that earliest record of humanity? To me, the most fundamental question is the development of the ability to walk on two legs. This ability to be bipedal — freeing the hands — is central.

At the moment, the earliest record of an upright ape walking as we do is close to four million years ago. The earlier fossil record doesn't help in answering that question of when man became bipedal. Nevertheless, little work has been done in deposits older than four million years. Perhaps as work moves into some of these earlier strata the answer will appear and I believe it will indicate the origin of mankind, because to be bipedal means to me that an extremely important step has been taken.

We need to go back to an even earlier stage to understand the origin of all apes. Apes are known in both Africa and Asia. African apes seem to be different from Asian apes and we seem to be closer to the African branch than to the Asiatic branch. Yet the fossil record suggests that the Asiatic branch originated in Africa as well. There is much to be learned about these specific questions: How did these ancient apes, 15 or 20 million years ago, live? Were they forest bound? How did they move? Did they clamber through the trees, or were some of them terrestrial? Can we expect to find that first evidence of the shift from four-leggedness to two-leggedness as far back as 20 million years?

Whatever the outcome, it is clear that

the story will be told from work being done in Africa. It is not because of any sinister political reason for us to have originated out of Africa, it is just that the genetic material from which we arose happens to have been initially isolated there. The environmental and habitat conditions for the development of our species were also prime in Africa at the appropriate moments in time. There are some who have said it is bad enough to have evolved, but to have evolved in Africa is an anathema. Well, those people are going to have to live with it for a very long time, because this almost certainly is the case.

The final point I would make, and that really is the bottom line: Did we split from the apes? Probably not yet. And that, I think, is the issue.

### *Answers to Questions from the Floor:*

#### **Q. Do your investigations provide clues concerning the use of language among primitive hominids?**

A. Unfortunately, the fossils don't include language. One can simply proceed on the basis of informed opinion. My own opinion is that speech goes back much further than has been generally recognized.

#### **Q. When did the family unit as we know it become the accepted way of life for primitive man?**

A. The family unit, the bonding of individuals particularly for the benefit of the offspring, is very difficult to look at from the fossil record — behavior doesn't fossilize. There is some evidence that the prolonged period of infancy goes back at least to the time of *Homo erectus* about 1.5 million years. To say that this is evidence of a family is a jump in logic.

#### **Q. Have radical climatic changes involving ice ages, continental plate shifts, drought, and the like had a significant effect on mankind, possibly similar to what we might expect from nuclear warfare or some other man made form of self-annihilation?**

A. The current view is that extinction of the dinosaurs was due in part to a collision with an interstellar asteroid. It wasn't that this asteroid squashed all the dinosaurs, but that the impact caused such a cloud of dust, smoke, and general atmospheric contamination that the

world's temperature dropped very dramatically and caused the dinosaurs to die out. When it became possible for the sun to filter through again, new forms of life began to evolve and take up the now empty niches. Clearly, a nuclear holocaust could have a similar effect, and the notion of a "nuclear winter" is very real and very frightening.

#### **Q. When and where did the races separate? Please discuss the problem of race relations and how some people use evolutionary theory to support their prejudices.**

A. Race and color are totally separate issues. In a biological sense, races are populations of people who became isolated for one reason or another for sufficient periods of time to develop characteristics particular to that population. Culture, beliefs, ideology, and geology have all contributed to an isolating mechanism in the development of the races as we currently see them. There is nothing in evolutionary theory that supports racism. It has been used, but it is a complete misuse of what we know about evolution and genetics. The best way to treat it is with scorn and derision.

#### **Q. Is there a viable solution to Africa's overpopulation and starvation problems?**

A. Great strides are being made in Africa today in terms of dealing with the population problem, but there are things working against us. Africa is currently bedeviled by the extraordinary notion of the Catholic church that family size shouldn't be controlled in the Third World. Millions of children face certain death because their parents were told not to practice family planning.

#### **Q. If Africa were left to its own development would it ultimately return to a tribal lifestyle?**

A. Africa was not nearly as tribal before the arrival of Europeans as it was after their arrival. One of the great efforts on the part of the colonial powers was to develop tribal identity, and in so doing, prevent the development of a national identity. Left to its own devices, tribalism would rapidly disappear in Africa. ■

# FIELD REPORTS

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



Elliott Haimoff in China.

## THE BLACK CRESTED GIBBONS OF YUNNAN PROVINCE, CHINA

Elliott H. Haimoff  
Department of Biology  
University of California  
Los Angeles

For several decades, the slash and burn cultivation and the regular hunting carried out by the local inhabitants of southern and western Yunnan Province, in addition to the recent expansion of the rubber industry in this region, have resulted in a vast and continuous reduction of the primate population numbers and their forest habitats. Yunnan Province now has only patches of isolated forests left in various states of disturbance, being hardest hit during the Cultural Revolution of the 1960s and 1970s, when much of the forests and wildlife was devastated as a result of the economic growth and development.

Since all gibbon species are strictly arboreal and generally restricted to good quality or undisturbed primary forests, they are by far the most vulnerable of all primate species in China to be threatened with extinction as a result of

habitat destruction and hunting pressures. Only 1,000 years ago, the black crested gibbons (*Hylobates concolor*) were observed and noted to have inhabited at least 10 Chinese provinces in tropical and subtropical forests as far north as 33 degrees, but are now in greatly dwindling numbers and restricted to only two provinces in the extreme southern portion of China (Yunnan and Guangdong) in scattered patches of remaining forests. This gibbon species has recently been placed on the list of top priority endangered and protected animals in China (along with others such as the giant panda and golden monkey), and is now considered to be one of the rarest of all animal species in China.

There are currently believed to be three subspecies of concolor gibbon in southern China: 1) the Hainan black gibbon (*H. c. hainanus*), inhabiting Hainan Island just off the southern coast; 2) the white crested gibbon (*H. c. leucogenys*), inhabiting only a small strip at the extreme southern portion of Yunnan Province; and 3) the black crested gibbon (*H. c. concolor*), currently inhabiting several game reserves

and forest tracts throughout central, western and southern Yunnan Province.

The Hainan black gibbon has been virtually wiped out on Hainan Island, and only a small relict population of about 30 to 40 animals is left on two of the remotest mountain peaks. The white cheeked gibbons have been hunted so heavily that they are now limited in range to only one game reserve on the border with Laos, and number no more than about 50 animals in China. The status of the black crested gibbon remained a question until now, since it apparently had a much wider distribution than any other concolor gibbon subspecies.

The first steps in conserving, preserving and saving the concolor gibbons in China would be to study them so that their ecological requirements and behavior patterns may be better understood for the implementation of conservation measures. However, the concolor gibbons have never been the subject of any systematic behavioral or ecological study and no surveys have ever been conducted. Since they have been briefly noted to be the only gibbon species to inhabit subtropical forests and exhibit polygamy, whereas all other gibbons live in tropical rain forests in monogamous groups, studying the concolor gibbons in China is of extreme importance not only for their conservation but also in addressing many issues of evolutionary biology.

Upon my trip to Yunnan Province and the Kunming Institute of Zoology (a branch of the Academy of Science) in December, 1984, I was able to acquire an agreement from the scientists at this institute to conduct a research project in collaboration, consisting at first of a three month pilot study to locate a suitable site and suitable study animals. During this pilot study, the Chinese scientists I worked with were Yang Xiao-Jun, He Swing-Jing and Chen Nan, all field primatologists at the Kunming Institute of Zoology. The study was conducted at three sites in Wuliang Mountain Game Reserve and one site in Ailao Mountain Game Reserve.

The Wuliang and Ailao mountain ranges sprawl for hundreds of kilometers in south-central Yunnan Province. They are part of the Transverse Himalayan mountains and belong to an extension of the Yun-Ling range to the north of the province. The decision to visit three sites in Wuliang was based on reports of gibbon sightings made by local hunters or other Chinese scientists. One

visit was made to the field station belonging to the Kunming Institute of Ecology in Ailao, but because we heard so few gibbons and saw so many villagers carrying guns through the forest, we decided to concentrate our resources in Wuliang.

The annual average rainfall in Wuliang and Ailao is about 1,750 to 2,000 mm and the annual average temperature is about 11°C. The seasonality at these sites is very marked, with a distinct dry season from December to June and a wet season from June through November. Reports have been made of hip-deep snow in January and February. Our project was conducted at the tail end of the rainy season and it rained during 75 percent of the afternoons we spent in the field and 10 percent of the days.

In any field study of a primate species, the most difficult aspect is being able to distinguish adult males from adult females and to be able to distinguish the ages of any offspring seen or heard. Perhaps the most striking features in all subspecies of concolor gibbon are the sexual dichromatism exhibited and the clearcut sexual dimorphism in their loud calls.

The fur of the infants of both sexes is fluffy and creamy or whitish colored, changing to sleek black at about one year of age, thus associated or correlated with the weaning of the infants. In males, this change to a black coat is retained throughout life. In females, the black gives way to a beautiful creamy, golden or orange color at or around sexual maturity, with a period of several months during this transitional period when females have patches of both black and creamy colored fur. It is therefore relatively easy to distinguish between adult males and females and to be able to identify subadult females while they are changing color, but impossible to differentiate the sexes of the juveniles and early subadults or even to distinguish between these two stages of development from field observations alone.

The vocal behavior of concolor gibbons has by far been the subject of more studies than that of any other gibbon species. The findings all indicate clearly that this species as a whole produces male dominated bouts of interactive vocal behavior, whereas all other gibbon species produce female dominated duets. This research has also identified clearly and distinctly that there is an extreme form of sexual

dimorphism in the vocal behavior between males and females and that none of the sounds made by the males is produced by the females and vice versa. It is therefore relatively easy to identify adult males from adult females from their loud calls alone. Since it has also been documented that the offspring call along with the parent of the same sex (but not as well as the parent), it is also possible to use the vocal behavior as added evidence with direct observations to estimate the size and composition of gibbon groups.

Our survey walks usually began sometime between 6:30 and 7:00 A.M. and lasted from two to five hours depending on the length of the route, the terrain and the number of encounters with gibbons. Since primates are generally regarded to be most active and hence most detectable during the early morning hours (which is when the gibbons always called), most routes were designed and selected to be completed by about 11:00 A.M. The main method we used to locate gibbon groups is known as the "fixed point count." The observers space themselves at various points in the forest and generally remain in their spots on the trail, recording all gibbons seen or heard and then repeating the procedure at other points in the forest. Group densities and the relative abundance of gibbons could then be determined by triangulation of the data collected. Since the adult family groups of all gibbon species are known to produce loud calls or songs audible up to two or three kilometers at a predictable time of day, this method has been used very effectively and efficiently during several previous studies. The technique has been demonstrated clearly to produce accurate group counts in about a week of observations.

Because of the very steep and mountainous terrain of the study sites and because the gibbons were unhabituated, only spot observations were possible and we were never able to follow the animals for any long distance. These gibbons were unusually shy and wary of humans, perhaps as a result of their being hunted for hundreds or even thousands of years.

A preliminary study of the ecology of black crested gibbons was also conducted. Whenever gibbons were seen or their precise location positively documented, a collecting program of plant and fruit specimens was undertaken. The steep sides of the mountain foothills made the collecting difficult and

the measuring of large trees almost impossible. The plant cover in both Wuliang and Ailao mainly consists of subtropical evergreen broadleaf forests; all of the plant samples collected belong to the families Fagaceae, Theaceae, Magnoliaceae, Lauraceae and Elaeocarpaceae. The tree height averaged 14 to 15 meters and the canopy was rarely closed but averaged 10 to 12 meters. Under the canopy was a thick secondary undergrowth of arrow bamboos (*Sinarundinaria hitida*), ferns (*Plagiogyriacorn munis*) and attaching plants (*Rabus spp.*).

Gibbons were always observed and heard in good quality or undisturbed broadleaf evergreen forests but never in forests near villages or where logging had been conducted. At the southern end of Wuliang, gibbons were also sighted in forests that were a mix of pine and broadleaf evergreen trees, but they were never sighted in forests of strictly pine trees, and it is not known if they exploit pines for food, travel, sleeping, etc.

Although there are still many biases to be accounted for in the density estimate of these gibbons, our census estimates that their total population in Wuliang is 246 groups. A tentative average group size of about seven or eight animals seems reasonable. The groups in Wuliang were found to comprise one adult male, from one to four adult females and about five or six offspring. These estimates are compatible and similar to previous ones.

Our tentative conclusion that this species is polygamous contravenes all evolutionary models previously proposed for gibbon social structure and social behavior; other gibbon species exhibit monogamy, frugivory and territoriality.

Since the loud calls of the black crested gibbons are the loudest sounds made by any animal in the forests of China, it was relatively easy to document and record them. Although a detailed spectrographic and statistical analysis is planned, some of the data can be presented now. For the practical purposes of this study, dawn was defined as the time when one could distinguish the green of the leaves, about 6:50 A.M. These gibbons never called in the pre-dawn hours, and always at or just after dawn. The average call duration was 10 minutes, and the gibbon groups at all the sites were observed to produce only one calling session, if any, during the day. They always called after

SCHOOL OF  
AMERICAN RESEARCH  
ADVANCED SEMINAR

“THE ORIGINS OF  
MODERN HUMAN  
ADAPTATIONS”

*Erik Trinkaus  
Department of Anthropology  
University of New Mexico  
Albuquerque*

From April 21 to 25, 1986, an Advanced Seminar was held at the School of American Research (Santa Fe, New Mexico) to discuss the cultural and human biological events and processes that were involved in the emergence of “modern” human biological and behavioral patterns during the Upper Pleistocene. The advanced seminar included O. Bar Yosef (Hebrew University), L.R. Binford (University of New Mexico), J.P. Rigaud (Director of Antiquities, Bordeaux), F.H. Smith (University of Tennessee), C.B. Stringer (British Museum – Natural History), R. White (New York University), M.H. Wolpoff (University of Michigan) as paper contributing participants, J. Buikstra (University of Chicago) as discussant and Erik Trinkaus as organizer and paper contributing participant. The Advanced Seminar was sponsored in part by the L.S.B. Leakey Foundation, the School of American Research and by Jean M. Auel.

The purpose of the seminar was to focus on the general nature of the problems facing those who wish to understand the Upper Pleistocene biological and behavioral events and processes involved in “The Origins of Modern Human Adaptations.” It was fully recognized that there are a number of gaps in our knowledge that need to be filled before we can hope to fully resolve the current controversies in later Pleistocene paleoanthropology. These include geographical and temporal gaps in the paleoanthropological (human paleontological and paleolithic archeological) record, inadequate chronological control of much of the earlier Upper Pleistocene, incomplete analysis of the known paleoanthropological record according to state-of-the-art archeological, taphonomic and functional anatomical techniques, and inadequate interregional comparisons of paleoanthropological remains. A number of these gaps are currently being filled, in



*Elliott Haimoff (front row center) among colleagues.*

a night of heavy rain and most often when it was cloudy or drizzly. The only times when it seemed that none of the gibbons called were when it was windy.

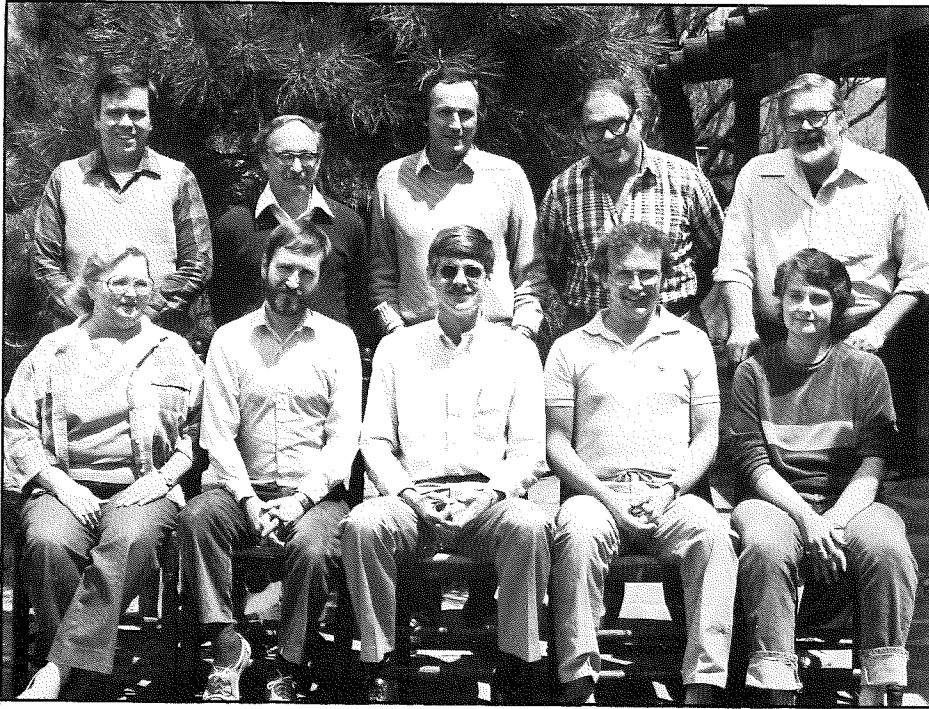
There were no observations at all of lone males calling on their own. Adult males in groups produced three different types of calls: 1) throat sac inflation sounds, known as “booms”; 2) short sounds much like “aa”; and 3) long sounds that often change in pitch, known as “multi-modulated” sounds. Adult females produced only a long series of sounds that rose in both pitch and volume and then declined. The male contribution was more conspicuous.

The structure of these calling sessions was relatively simple in comparison with that of all other gibbon species. The males were always the ones to initiate and produce the early part with long modulated sounds and then alternating between long sounds, short sounds and booms. At various points their mates joined in with their “great calls” and the males became silent. The males always followed the great calls with short codas comprised of a set of multi-modulated sounds. It was clear that the calling was male dominated in the black crested gibbons, as it is with other concolor gibbons, whereas it is strictly female dominated in all other gibbon species.

While much more thought must be invested into how these animals evolved their ecological and behavioral niche, it is altogether possible that there may be more plasticity in the adaptability of

the concolor gibbons than in any other gibbon species. That is to say, an ancestral gibbon species may have found itself in an environment not suitable for classical frugivorous gibbons but suitable for a folivorous or langur species. The apparent similarities between concolor gibbons and various langur species may eventually shed light on the evolution of gibbons. The evolution of the concolor’s loud calls into male dominated social behavior is also compatible with the model of a polygamous primate species.

It is very fortunate that the most extensive anatomical study ever done on any gibbon species was conducted on the concolor gibbons at the Kunming Institute of Zoology by Wu and Ye (1978). Various features of the anatomy show that this species is polygamous and must be able to eat and digest only leaves for several months each year. The intestinal tract is proportionately much longer than that of any other gibbon species, its length per body weight almost within the range of the leaf eating langur species. For a primarily frugivorous diet, where the fruit digests very rapidly, a short digestive tract would have been selected for; leaves digest very slowly and a longer digestive tract is necessary to process such foods. This is not to say that concolor gibbons do not eat fruit since they were observed during this study to do so, but this hypothesis suggests that they may have adapted to eating either leaves or fruit or any combination of both.



Seated: Jean Auel, C. B. Stringer, Erik Trinkaus, Randall White and Jane Buikstra. Standing: Fred Smith, Ofer Bar Yosef, Jean Phillippe Rigaud, Milford Wolpoff and Lewis Binford.

part, by ongoing research of the participants and other members of the field and others will undoubtedly be addressed in future research. However, it was the consensus of the participants that some agreement on more general issues is necessary before it will be possible to understand fully the evolutionary processes involved in the emergence of "Modern Human Adaptations."

The general problem which the Advanced Seminar addressed developed from the following generally recognized dichotomy. At some time during the later phases of the last glacial age, certainly by the middle of the Upper Paleolithic (*sensu lato*), there were "anatomically modern" human hunter-gatherers across the Old World engaged in cultural behavior similar to that known ethnographically and ethnohistorically for recent human hunter-gatherers. At a previous time period, prior to the Upper Pleistocene and extending to an as yet to be determined extent into the Upper Pleistocene, there were anatomically archaic humans with a total behavioral pattern that was significantly different from that of recent human hunter-gatherers in terms of technology, subsistence patterns, organization and communication. During the Upper Pleistocene, during the periods generally recognized archeologically as the later

Middle Paleolithic (*sensu lato*) and early Upper Paleolithic (*sensu lato*), a number of interrelated human behavioral and anatomical patterns emerged and coalesced into the biobehavioral system which we recognize as that of recent hunter-gatherers.

From these observations, several general questions emerged during the course of the Advanced Seminar, questions that became increasingly evident as central to any eventual understanding of this period of human biocultural evolution. What were the sequences of events involved in this biobehavioral process, both within and between major geographical regions, and what are the significances of the regional differences? What were the chronological relationships between evolutionary events in adjacent geographical regions, and to what extent can we understand the processes in one region independent of other geographical areas? Is the emergence of the "modern" human hunter-gatherer pattern best seen as a geographically variable cumulative process in which the "appearance" of the recent human pattern is a threshold effect in the human behavioral evolutionary sequence, or was there a major structural reorganization of biobehavioral complexes (ones that are archeologically and paleontologically identifiable and analyzable and presumably of primary

behavioral significance) at some point during this transitional period that produced for the first time in human evolution a novel and truly "cultural" (in the recent ethnographic sense) human adaptive system? If such a structural reorganization took place, to what extent can we interpret the first appearance of "modern human" behavioral complexes entirely in terms that we use for recent human hunter-gatherers?

In addition to these general issues, a number of more specific issues emerged, some of which are relatively directly related to the above general issues and all of which are interrelated during the Upper Pleistocene in a complex manner that is currently beyond the capabilities of the field to resolve satisfactorily. These more specific issues are as follows:

1. To what extent can the concept of "culture," as known and defined in the ethnographic present, be applied to archaic members of the genus *Homo*?

2. Should geographical regions be viewed during the Upper Pleistocene primarily in terms of local sequences, or as some combination of "corridors" and/or "cul-de-sacs"?

3. Are periods of time that we perceive as transitions (cultural and human biological) best seen as resulting from local evolution combined with inter-regional diffusion (demic and cultural) or from some level of populational and cultural replacement?

4. Can the perceived tempo of human behavioral or biological change be best characterized by one continuous (if exponential) curve, or can we more accurately describe the tempos of change before and after this Upper Pleistocene transitional period by different curves with contrasting slopes? Related issues concern the extent to which the time scale utilized will emphasize or obscure small scale fluctuations in tempo, and whether we need significantly different curves to characterize accurately the tempos of change in human biology versus behavior during the Upper Pleistocene.

5. In attempts to interrelate the implications of the human paleontological and archeological records for behavioral shifts during the Upper Pleistocene, it became apparent that it was necessary to distinguish between the implied behavioral capacities of the humans involved and their actual habitual behavioral patterns.

6. What was the significance of the appearance of intentional burials among



late archaic humans (Neanderthals) and did their presence imply the same complex of behaviors associated with ritual disposal of the dead among recent humans?

7. What was the extent of planning depth present among late archaic humans, how did it change with the emergence of a modern human behavioral pattern, and how do we identify it in the paleoanthropological record?

8. Were there significant changes in site structure during the Upper Pleistocene, presumably implying changes in the level and nature of the organization of space?

9. How can we identify, from the paleoanthropological record, the nature of utilization of the landscape, including the exploitation of geographically dispersed resources and possible periodic movements of social groups on that landscape?

10. To what extent did fluctuations in climate during the Upper Pleistocene influence the behavioral responses of human groups and promote the geographical expansion or retraction of paleontologically and archeologically defined complexes?

11. Were there major changes in human life cycle parameters during the Upper Pleistocene, involving reproduction, growth rates and longevity? If so, how were they interrelated with changing patterns of selection, demography, group size and distribution on the landscape?

12. What was the nature of Upper Pleistocene human symbolic behavior, and how is it reflected in the archeological record? Furthermore, to what extent are preserved "art" objects from the Middle and early Upper Paleolithic best seen as part of an evolving information system (as mnemonic devices) and/or as personal ornaments emphasizing increasingly complex social roles?

13. A related concern involves the nature of changes in language during the Upper Pleistocene. Did it emerge in its fully modern structural form only at the time of this Upper Pleistocene coalescence, or was it present in a similar but less complex form previously?

This Advanced Seminar was thus able, through the forum of an intense small group discussion during five days, to focus on both general and more specific issues concerning Upper Pleistocene human biobehavioral evolution and the emergence of the adaptive pattern we associate with recent human hunter-gatherers. We are still far from resolving

many of the issues involved, but this discussion was successful in providing a new synthesis of where we are and what are the major issues facing us in Upper Pleistocene paleoanthropological research.

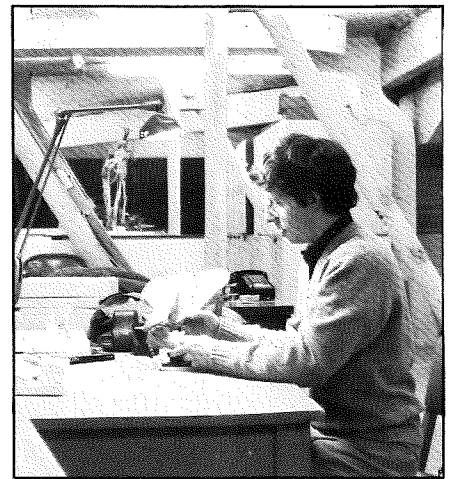
### LOCOMOTION OF THE MIOCENE HOMINIDS: A STUDY OF FOSSIL FOOT BONES

J. H. Langdon  
*Department of Anthropology  
Yale University*

The search for the common ancestors of humans and the great apes is conducted now among fossil beds of the Miocene period. Over a thousand hominoid specimens have been recovered from Africa, Europe and Asia dating between eight and 21 million years ago. Shortly before the Miocene, the Old World monkeys diverged from the common lineage. During this interval, many hominoid species appeared and became extinct. One apparently gave rise to gibbons and siamangs. A second, named *Sivapithecus*, may be linked with the orangutan. A third as yet unidentified form was the last common ancestor between the African apes and humans.

While relationships are sorted out from the evidence of the jaws and teeth, another story is unfolding from different studies of the skeletal remains. Contained within the bones and their geological contexts are clues about their lifestyles — what they ate, where they lived, and how they moved about. As this evidence is pieced together, we may arrive at a better understanding of why certain events happened. Why did the number of hominoid species multiply so rapidly in the Miocene, then dwindle to the half dozen or so known today? Why are monkeys so difficult to detect among the fossils through the first half of the Miocene and then very common, perhaps at the expense of the apes, in the latter half? Current theory suggests that changing climatic conditions coincided with competition, leading to a sharing of resources (niche partitioning) in which the monkeys were able to dominate.

I have chosen to investigate the events of the Miocene with a study of



*John Langdon at Smithsonian primate collection.*

the locomotor patterns, as indicated by the foot skeleton. Supported in part by the Leakey Foundation, I was able to visit collections in Nairobi, Vienna, Budapest, London and the United States to compare nearly 100 Miocene foot fossils with over 300 specimens of living higher primates. The structure of the foot was found to tell much about the way the animal contacts the ground and transmits the forces of locomotion.

Locomotion is a particularly interesting question since the Old World monkeys and each of the living hominoids have different styles of moving about. The monkeys assume a dog-like posture which distributes weight on all four limbs. Forces are passed longitudinally along the foot, which provides a very effective lever action for running and leaping. The bones fit tightly together and restrict joint movement to prevent the foot from collapsing. By reducing bone and muscle mass within the foot, the monkeys have a very efficient design. A grasping first toe, as a primate hallmark, is not strong but can effectively brace the animal on tree limbs and provides dexterity and slight suspensory abilities.

The apes share several adaptations which make such an efficient running gait impossible. The arms are elongated and are used frequently in over-the-head climbing and hanging activities. Body posture is thus more upright, even in quadrupedal stance, and the lower limbs bear much of the body weight. The feet are therefore specialized for climbing, grasping and supporting large body forces. The first toe is very strong and participates in a powerful grasp capable of suspending the body or propelling it up a verticle trunk. Major stresses are

passing from the first and second toes to the ankle, running diagonally across the foot. The joints are loosely constructed to allow the foot to adapt to more complex surfaces. The bones are robust and the intrinsic musculature is well developed.

All of the apes share efficient climbing abilities in the trees, although these have taken separate paths of specialization. All have given up the possibility of great speed on the ground and find walking somewhat cumbersome. The gibbon and siamang have extremely long fingers and toes for grasping, which interfere with walking on level surfaces. On the ground, they must walk bipedally with short, high steps. The orangutan foot is specialized for suspension. Grasping in hanging postures is performed entirely with the lateral four toes, as the first toe is greatly reduced. Since muscles and ligaments absorb most of the tension, the bones themselves are surprisingly lightly built for so large an animal. Consequently ground travel is very awkward. The chimp and gorilla share fewer specializations of the foot, except strengthening of the bones to bear their large body masses.

The Miocene hominoids have long been known to resemble both the monkeys and apes in different skeletal features, although what this signifies has not been certain. Interpretations in the past were prejudiced by a perception of monkeys as "primitive," when in fact they are highly specialized. As far as the postcranial skeleton is concerned, hominoids never did pass through a "monkey stage" of evolution. The best interpretation now emerging is that the fossils possessed a less specialized locomotor pattern combining both walking and climbing adaptations.

The Miocene feet were strongly built, with a powerful grasping first toe. The intrinsic joints were very mobile. The posterior foot was built to receive the diagonally directed stresses of grasping and climbing. The anterior foot showed the opposite arrangement. The bones were somewhat lighter and constructed to receive the longitudinal stresses of walking and running. The ankle was also tightly fitted to produce only one type of motion, thus stabilizing it for running. The Miocene apes could both walk and climb efficiently, but probably did neither quite so well as their specialized living relatives. We might describe this behavior as generalized arboreal quadrupedalism.

Significantly, we can derive the dif-

ferent contemporary locomotor patterns quite easily from this unspecialized form. As monkeys and apes diverged at the beginning of the Miocene, the former emphasized the walking and running aspects. This gives them great speed but probably limits the body size for arboreal species. Some anthropologists believe Old World monkeys originally arose in a more terrestrial habitat.

The hominoids retained and improved upon climbing abilities. As the arms became longer, efficient monkey-like locomotion became impossible, and different lineages committed themselves to more specialized alternatives. A slower climbing pattern can maintain a larger body mass in the trees, and this encouraged the development of different strategies and lifestyles from those of monkeys. Some species have apparently reached their limits of body size. Only extreme suspensory specialization enables the orangutan to maneuver safely, while adult gorillas rarely enter trees.

One further specialization has arisen from this ancestral pattern. Human bipedalism has much in common with monkeys in the mechanics of a running foot and the consequent immobilization of many of its joints. But the upright body posture, the robust first toe, and the ability to shift weight by movements within the foot are an inheritance from our long climbing heritage without which our efficient bipedal locomotion would not be possible. ■

#### Correction

*The pictures in the last issue of AnthroQuest showing Dr. Nadine Peacock in Africa were miscaptioned. The natives are Efe pygmies, not !Kung San.* ■

## 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.*

Michael K. Diamond      \$2,250 funded

### HOMOLOGY, HETEROCHRONY AND EVOLUTION IN THE LESSER DURAL SINUSES OF PRIMATES

Mr. Diamond will conduct osteological, soft tissue and embryological studies of the cranial anatomy of fossil primates (specifically the sinus cavities). The results should be important in interpreting cerebral vascular evolution in primates and very helpful in investigating the functional cranial anatomy of fossil primates.

C. Loring Brace      \$5,375 funded

### CHANGES IN THE FACE OF ASIA: RESPONSE TO FOOD PREPARATION PRACTICES

Dr. Brace plans to study and measure five Japanese and Chinese collections of 100 dental specimens each. He believes that the key factor influencing jaw and teeth evolution is not so much diet itself but what is done to food before its consumption. Where food processing substitutes for a certain amount of chewing, a decrease in tooth size can be predicted. He believes the best independent test can be made in Asia where the world's most sophisticated cuisine has antecedents that suggest an antiquity for food preparation practices.

Christopher Boehm \$5,400 funded

**LONG DISTANCE  
VOCALIZATION  
OF  
PAN TROGLODYTES**

These funds are to videotape and sound record the vocalization of chimpanzees at Gombe, working with Jane Goodall and her assistants. Experimental studies will be made to determine what the vocalizations mean.

Kathleen D. Gordon \$5,875 funded

**A TEST OF  
DENTAL MICROWEAR  
ANALYSIS IN  
RECONSTRUCTING DIETS  
OF PREHISTORIC  
HUMAN POPULATIONS**

Dr. Gordon will analyze microscopic surface damage on worn fossil teeth on a microcomputer. Samples from several prehistoric and historic New World aboriginal populations, representing dietary specializations, will be used. Dental microwear analysis is a promising method of reconstructing diet and feeding behavior of extinct species or populations.

Signa L. Larralde \$975 funded

**LITHIC ASSEMBLAGES  
IN CONTEXT:  
RAW MATERIAL  
DISTRIBUTION  
VERSUS ARTIFACT  
DISTRIBUTION  
IN THE CENTRAL  
GREEN RIVER BASIN,  
WYOMING**

Ms. Larralde will analyze data from an archeological survey of stone artifacts in Wyoming to test three assumptions: 1) Prehistoric people selected specific raw materials for certain tasks; 2) materials were selected by shape and size for certain tasks; and 3) the availability of raw material in an area influenced the development of tool kits.

Peter Andrews \$8,265 funded

**MIOCENE EXCAVATION  
AT PASALAR, TURKEY**

Dr. Andrews will continue excavations of the Middle Miocene deposits at Pasalar, a site that has yielded abundant fossil hominoids relating to great ape and human evolution. He expects to recover additional faunal and geological evidence. Pasalar is one of the earliest sites outside Africa where hominoids are found.

Michael D. Petraglia \$1,500 funded

**SITE FORMATION PROCESSES  
AT ABRI DUFAURE:  
AN UPPER PALEOLITHIC  
ROCKSHELTER  
IN SOUTHWEST FRANCE**

Mr. Petraglia will conduct an in-depth computer analysis of Abri Dufaure. He wishes to define how natural processes acted to reorganize the material record and will address three issues: 1) what deposits mean in terms of occupation sequences; 2) how the vagaries of deposition and post-deposition processes affect archeological interpretations; and 3) the development of analytical guidelines to decipher site patterns.

Diana Margaret Avery \$2,500 funded

**MICROMAMMALIAN EVIDENCE  
FOR PALEOENVIRONMENTAL  
CHANGE**

Dr. Avery will travel to a conference in Senegal and then examine the micro-mammal collection and Olduvai Gorge material in Nairobi, Kenya. She wishes to examine pan-African patterns by analyzing small mammal remains from paleontological and archeological sites to interpret change in vegetation and climate during the past in Africa. Small mammal data can provide information about the introduction of agriculture and its effects on the natural vegetation.

Kevin Hunt \$4,095 funded

**POSITIONAL BEHAVIOR  
IN PAN TROGLODYTES**

Mr. Hunt will conduct a quantitative study of chimpanzee locomotion and posture in the field. The frequency and context of climbing in chimps and baboons will be compared. The importance of arm swinging and vertical climbing in hominoid evolution is a fundamental issue with implications for understanding the origin of bipedalism in hominids.

Richard Charles Preece \$5,000 funded

**PALEOECOLOGY OF THE  
PALEOLITHIC SITE  
AT AMBRONA  
AND NEIGHBORING SITES  
IN CENTRAL SPAIN**

Dr. Preece will visit seven museums and will process and analyze 150 invertebrate samples from Ambrona and other Quaternary sites in Spain. He hopes to elucidate the exact nature of the environment at these sites. The study should enable Ambrona to be placed in paleoenvironmental and stratigraphic context and provide insight into Spain's biogeographic and paleoclimatic history.

Glenn C. Conroy \$5,458 funded

**THREE-DIMENSIONAL  
COMPUTER IMAGING  
OF MATRIX-FILLED  
AUSTRALOPITHECINE  
SKULLS FROM  
SOUTH AFRICA**

Dr. Conroy and a colleague will examine South African hominid skulls with an exciting and innovative computer imaging technique which will provide 3-D images from 2-D tomographic data. Electronic "dissection" of a skull in any plane desired in a totally safe and non-invasive way is now possible. Previously there has been no way to accurately examine intercranial volume and shape without damaging the fossil in question.

David M. Helgren \$4,950 funded

**GEOARCHEOLOGICAL  
INVESTIGATIONS IN THE  
WESTERN RIFT VALLEY  
OF ZAIRE**

Dr. Helgren proposes to determine whether there are Early Pleistocene fossils and artifacts in the Western Rift. The overall Semliki research project may significantly increase our understanding of human evolution.

William J. Hamilton \$5,000 funded

**DEMOGRAPHY AND KINSHIP  
IN A NATURAL  
BABOON POPULATION**

Dr. Hamilton will continue an ongoing study of baboon behavior in Botswana. The project emphasizes analysis of the genetic relationships among baboon troop members as well as their individual responses to other troop members and those of different troops. This is the only long term study of chacma baboons still underway and is one of the few studies of primates in Africa not subject to substantial human interference efforts.

Linnea Doris Pyne \$1,650 funded

**AN ANATOMICAL AND  
BEHAVIORAL INVESTIGATION  
INTO THE ORIGINS AND  
EVOLUTION OF  
HUMAN LANGUAGE  
AND ITS RELATIONSHIP  
TO HANDEDNESS**

Ms. Pyne will investigate handedness in rhesus monkeys at the Caribbean Research Center in Puerto Rico. A significant correlation between right-handedness and left brain dominance for language processes has been shown in humans; if the pattern is consistent for non-human primates, rhesus monkeys should show the same.

Pia Nystrom \$1,500 funded

**SOCIAL AND  
FEEDING ECOLOGY  
OF ADULT MALES IN A  
HYBRID GROUP OF BABOONS  
IN THE  
AWASH NATIONAL PARK,  
ETHIOPIA**

Ms. Nystrom will study male hybrid baboon habitat utilization, feeding ecology and individual interactions in Awash National Park.

Thomas W. Stafford, Jr. \$2,500 funded

**GEOCHRONOLOGY OF THE  
TEPEXPAN EARLY MAN SITE,  
MEXICO**

Dr. Stafford will undertake fieldwork and the analysis of vertebrate fossils and plant remains from Tepexpan. The site is of great interest to the question of human antiquity in the New World, human relationship with the extinct mammoth, and the time of the mammoth's extinction.

Hill/Hurtado/Kaplan \$6,200 funded

**COMPARATIVE RESEARCH  
ON FORAGERS  
IN LOWLAND  
SOUTH AMERICA**

Drs. Hill, Hurtado and Kaplan are beginning the first phase of long term comparative research on foraging populations in lowland South America. Their objectives are to 1) produce a detailed data base of several newly discovered or not well described hunter-gatherer populations; 2) collect data to test ideas regarding several important human traits; and 3) identify as many populations as possible within this area wholly or largely dependent on foraging. The investigators hope to produce a map with preliminary information on all known foraging populations in South America.

Jonathan Haas \$3,100 funded

**THE ORIGINS OF MODERN  
HUMAN ADAPTATION**

Dr. Haas and overseas participants are funded to attend a week long seminar on the cultural and biological transition from the Middle to the Upper Paleolithic. Paleoanthropologists are far from a consensus on the exact nature of the transitions as well as patterns of interaction between culture and human biology during this period; participants will address these critical issues. (See page 7: Trinkaus report.)

Martha Joan Tappen \$2,520 funded

**TAPHONOMIC STUDIES  
OF A PLIOCENE  
ARCHEOLOGICAL  
OCCURRENCE IN THE  
WESTERN RIFT VALLEY  
OF ZAIRE**

Ms. Tappen's research is also related to the Semliki project. She wishes to study bone weathering to understand the nature of archeological accumulations and the underlying hominid behaviors. She will be seeking much-needed taphonomic information from a new area, Senga Five site.

John Olsen \$7,521 funded

**ARCHEOLOGICAL AND  
PALEOANTHROPOLOGICAL  
RESEARCH IN THE  
SOCIALIST REPUBLIC  
OF VIETNAM**

Dr. Olsen and his coinvestigator, Dr. Russell Ciochon, will undertake field research in Vietnam with Vietnamese scientists from the Institute of Archeology in Hanoi. Their goals are to investigate Early to Middle Pleistocene assemblages and newly recovered hominid and hominoid fossils as well as to visit several field localities which have yielded such remains.

Jean Hudson

\$7,880 funded

**ADVANCING METHODS  
IN ZOOARCHEOLOGICAL  
ANALYSIS:  
AN ETHNOARCHEOLOGICAL  
APPROACH AMONG THE  
AKA PYGMIES**

Ms. Hudson plans a year long study of Aka pygmy camps, observing a series of them from their first day of occupation to their abandonment. When a camp is abandoned, it will be treated as an archeological site.

William Kimbel

Larry Marshall

\$1,500 funded

**PALEOANTHROPOLOGICAL  
RECONNAISSANCE OF  
LATER NEOGENE  
FOSSIL-BEARING LOCALITIES  
IN TUNISIA**

Published data on North African mammalian paleontology suggest that a number of fossil-bearing localities in Tunisia merit exploration for remains of early hominids and artifacts. The potential for contribution to our understanding of the biogeography and evolutionary relationships of our earlier hominid ancestors will be assessed.

Dennis Rasmussen

\$2,812 funded

**PAIR BONDS OF  
PANAMANIAN TAMARINS:  
REPRODUCTIVE AND  
SOCIAL-ECOLOGICAL  
CORRELATES**

Dr. Rasmussen plans a long term study of the social behavior and ecology of the endangered Panamanian tamarin. He will collect data on factors influencing patterns of primate pair bonding and paternal care of offspring as well as group leadership, intergroup interactions and reactions to introduced strangers.

Gregory T. Laden

\$4,500 funded

**FORAGERS AND  
FOOD GROWERS  
IN THE RAINFOREST:  
ARCHEOLOGY IN THE  
ITURI FOREST, ZAIRE**

Mr. Laden will study the Efe pygmy foragers and Lese villagers in the Ituri Forest. The results of his research could be invaluable in understanding the settling of the area and the origin of the Efe pygmies.

Kenneth W. Russell

\$6,000 funded

**ENERGETICS OF  
WILD AND CULTIVATED  
GRAIN PROCUREMENT  
AND FORAGER/FOOD  
PRODUCTION TRANSITION**

Mr. Russell will study the Zuweida Howetat of southern Jordan. Camel pastoralists, they seasonally cultivate wheat and barley yet continue to forage for wild grains. Their food procurement activities provide a unique opportunity to document energetic subsistence data among a traditional society in the Near East before it disappears.

Nicola Stern

\$4,000 funded

**RECONSTRUCTING  
THE RANGING BEHAVIOR  
OF EARLY HOMINIDS**

Ms. Stern wishes to ascertain whether early hominids had a ranging pattern that differed significantly from that of modern humans. Her immediate goal is to demonstrate that patterned distributions of archeological debris can be recovered, and that significant information about past land use patterns can be extracted from this debris. The field-work will be undertaken at Koobi Fora. This is the first project geared solely to the issue of distinguishing hominid from other primate patterns of land use.

**GRANT GUIDELINES**

The L.S.B. Leakey Foundation was formed to further research into human origins, behavior and survival. Its sphere of interest lies in the support of research related to human evolution. In recent years this has meant that priority has been given to research into the ecology, archeology and human paleontology of the Miocene, Pliocene and Pleistocene; into the behavior of the Great Apes and other Old World primate species; and into the ecology and adaptations of living hunter-gatherer peoples. The Foundation recognizes that not all research related to human evolution falls into these categories; other areas of study have been funded occasionally.

Grants are normally made to scientists with professional qualifications and demonstrated capability. Applications from graduate students working for an advanced degree will be considered if supported by their faculty advisor. Undergraduates are not eligible to apply to the Foundation directly. However, they may be supported as part of a principal investigator's project.

The majority of the Foundation's grants have been between \$3,000-\$5,000. Priority is normally given to the exploratory phase of promising new projects as well as enabling researchers to exploit novel opportunities in establishing programs. If grants are likely to be required in future years for long term projects, some estimate of future requirements should be made in the initial application. In addition, applicants should be aware that publication subvention is generally given low priority.

Where research is to be undertaken abroad, evidence must be submitted that permission from the appropriate government agencies has been secured or sought. If the applicant is not the principal investigator, but is participating in a project under someone else's direction, evidence for permission to participate from the principal investigator must be submitted as well.

Applications are accepted according to the following deadlines: February 1, April 1, August 1, October 1 and December 1. The Science and Grants Committee reviews applications which have been received by a specific deadline within three months after that deadline. Please keep this in mind when planning the commencement date of your project. ■

## CHINESE PALEOLITHIC

continued from page 1

deputy director of the Beijing Natural History Museum. Two hominid teeth were recovered during earlier research, and an initial paleomagnetic estimate of elapsed time suggested the teeth could be 1,700,000 years old. This date would suggest contemporaneity with the Middle Bed I deposits at Olduvai Gorge, in the era prior to the appearance of the Acheulian in Africa. Recent restudy of the paleomagnetic sequence has resulted in a different estimate, placing the hominid teeth somewhat more recent than 700,000 years ago. Although neither of us is a physical anthropologist, the teeth seemed much more similar to *Homo erectus*-grade hominids than to earlier forms. Three stone tools were recovered from geological strata comparable to those that yielded the teeth, and at least one of them was convincing to the senior author. Since no comparable-sized gravels are reported in the deposit, it is important to note that the only pieces that appear to be geologically out of place also look like tools.

We had the opportunity to examine the fauna excavated from Yuanmou in some detail. The fauna appears to represent complete carcasses of animals, not a jumble of bones, and has yielded rather complete anatomical units, such as complete heads. We observed no cut marks on the bone but did note considerable rodent gnawing, particularly on the ribs of a large bovid. (This latter observation is extremely important since some consider this deposit to have accumulated on the floor of a perennial ancient lake.) Little evidence of carnivores was observed (there was only one possible tooth-inflicted mark, and this was ambiguous — it could have been caused by excavation damage). We did see provocative evidence of modification on one large bovid rib, which appeared to exhibit a heavy-handed hack mark. We were convinced of the hominid involvement at the site as evidenced by the tools and the tooth mark taken in conjunction with the hack mark. The lack of carnivore involvement makes this site less complicated for assessing the role of hominid involvement than many other sites we visited. Nevertheless, it is quite clear that Yuanmou is primarily a paleontological location

where natural death and natural taphonomic processes were the primary agents responsible for the site. Hominids seem to have visited the site, and perhaps exploited some carcasses, but thus far their role appears to have been very minimal indeed. In spite of this, the classic romantic interpretation has been applied to the site — namely, that these early hominids were hunters.

### Xihoudu

A second location for which great antiquity has been claimed is in Shanxi Province, central China (Site 4 on Map). This site is known as Xihoudu and was excavated by Professor Jia in 1985. As at Yuanmou, a paleomagnetic date has been interpreted to indicate an age of 1,800,000 years ago. A large faunal assemblage was recovered from this location, and the fact that all the species are said to be extinct clearly suggests antiquity. The selected examples of fauna we were shown were not heavily rolled and do not appear to have suffered heavy fluvial alteration. We saw no cut marks or other evidence for hominid modification, nor any convincing evidence of carnivore activity. It should be pointed out, however, that we saw only samples selected for their completeness.

The unmodified state of the fauna contrasts markedly with the (relatively few) recovered tools, the majority of which are heavily rolled and abraded and have clearly suffered severe hydrological modifications. Of the sample of tools shown to us about half were highly problematic and could be easily seen as having been naturally fractured. Unfortunately, the stony matrix was not sampled and we have no way of knowing what the naturally occurring stream cobbles might have looked like. A few of the tools were convincing, but once again we have no way of knowing from what type of raw material population these might have been selected. Judging by the contrast between the condition of the fauna and that of the tools, we believe that this site had a complex formation history. To this point, however, investigations have not been oriented toward clarifying this complexity.

Claims have been made for the use of fire at this site, but from a Western perspective we should approach such claims with skepticism. While we did not see the alleged burned pieces from Xihoudu, we did see many other bones claimed by the Chinese to have been

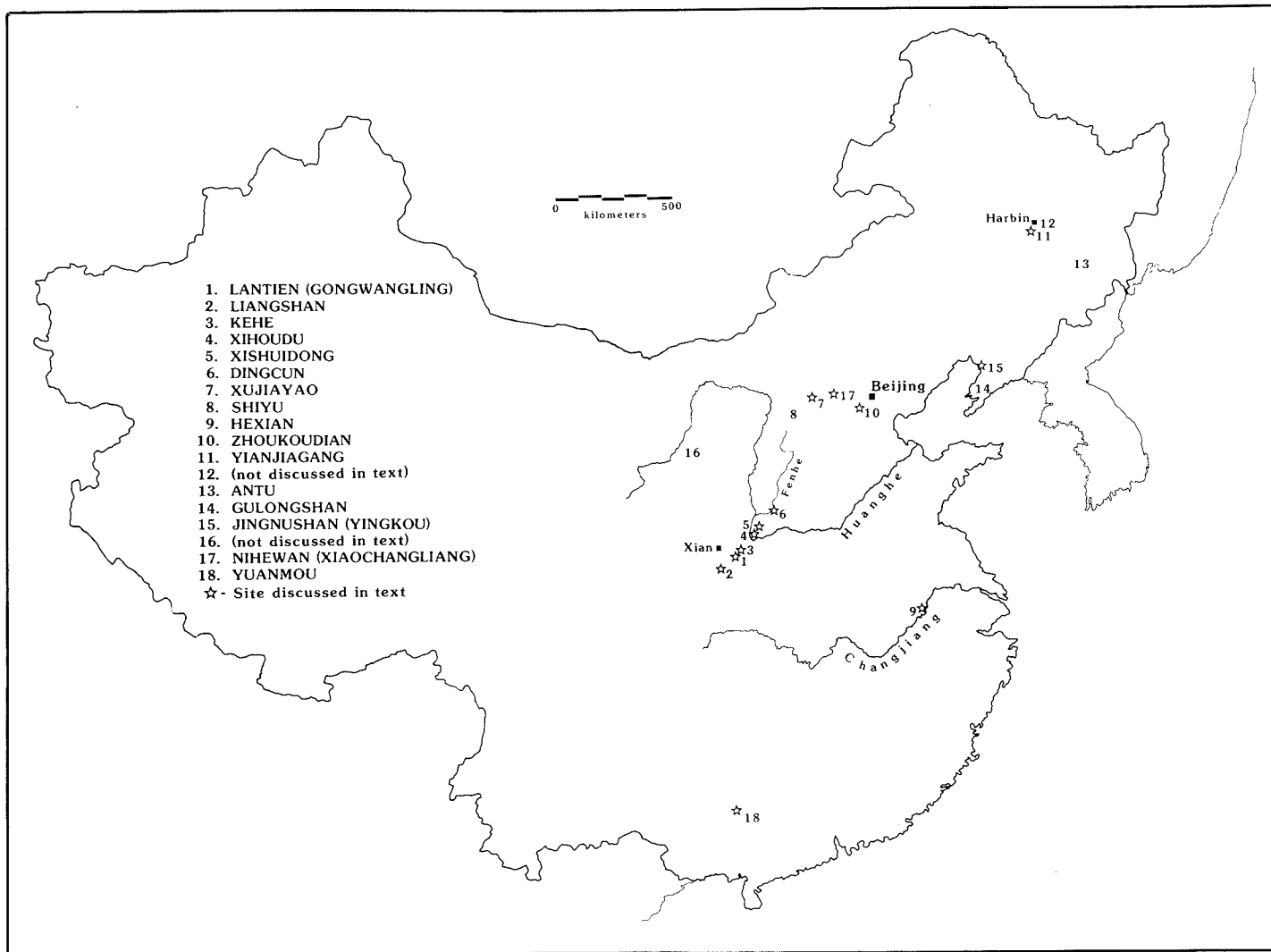
burned that were, in our opinion, simply mineral stained. We are skeptical of the age claimed for this site, and we are convinced that it is not a "site" in the sense considered by the Chinese investigators — namely, that hominids were the agents responsible for its accumulation and contents. Hominids may have been present, but other agents, in this case natural processes, seem to have shaped the character of the deposit. We look forward to further, more sophisticated work at this location.

### Xiaochangliang

The final location for which great antiquity has been claimed is from the Nihewan Basin of Hebei Province, not far from Beijing. There are a number of artifact-yielding sites in the deeply stratified deposits of this basin. We had the opportunity to examine tools from one such location (Site 17 on Map) said to be geologically dated to around one million years ago. The lithic material we saw was all convincing and showed very little evidence of postdepositional modification; edges were sharp, surfaces were not abraded. This assemblage of tools was very different from that seen at Xihoudu, where the tools were very large and made of massive flakes. At least one tool from Xihoudu, when seen from above, looks like a crude handaxe retouched only on one side. On the other hand, the tools from Xiaochangliang are small, and there is good evidence for bipolar flaking. We saw a well-made endscraper and numerous small sidescrapers as well as diminutive choppers. Some of the latter, while made of flint, were reminiscent of at least one specimen from the Yuanmou Man location in south China.

### Summary

Although the dating of these sites is far from secure, and although at least the Xihoudu site is a taphonomically complex location that is not well understood at present, the geology and the paleontology of these three sites suggest considerable antiquity. Even more interesting is the suggestion that at this early era considerable variability in the technology and typology of stone tools was clearly present. At Yuanmou the three provocative tools are not associated with lithic debris and appear to come from a lake or "pan" deposit that has not experienced significant hydrological



Map of Paleolithic and Paleontological Sites in the People's Republic of China.

sorting, at least judging from the condition of the bones. These tools suggest the occurrence of a transported component to the technology. By way of contrast, the small tools associated with lithic debris at Xiaochangliang in the Nihewan Basin document an expedient, on-the-spot manufacture and use of tools that, in our opinion, bear many formal analogies to the small tools of the Developed Oldowan of Africa. The tools from Xihoudu are quite distinct from those mentioned above because they are very large and were manufactured from massive flakes. Professor Jia told us that flakes and lithic debris were generally lacking from the artifact-bearing deposits at Xihoudu. This situation is confused by the obvious role of hydrological action in the formation of the deposits; however, this suite of tools may further document the presence of a transported aspect of large tools in the earliest technologies thus far known in China.

It should be noted that many Chinese scholars are still wedded to the idea that man evolved in Asia. This view contributes to the willingness of many to uncritically accept very early dates for Chinese sites and to explore the possibility of stone tools being found in Pliocene deposits.

#### Sites Between 700,000 and 100,000 Years Old

We were privileged to see materials from several of the Chinese sites dating to this period: Gongwangling (the site of the Lantien skull); Kehe (in the Fen Ho Valley of Shanxi Province); Zhoukoudian Localities 1 and 15; Dingcun, in the Fen Ho Valley; Xujiayao (near Datong, Shanxi Province); a little-known site called Xishuidong, in Shaanxi Province (not far from the Lantien site); as well as the fauna associated with a *Homo erectus* fossil from the Hexian locality, Anhui Province. We

also had an informative interview with the excavator of a recently discovered *Homo* skeleton from the site of Jingnushan, located on the Liaodong Peninsula near the northeastern Chinese port of Dalian. Many of these locations have been previously reported so we will only comment on observations that may not have been made previously or, to our knowledge, are not reflected in the literature.

We were shown the extensive collections from Kehe in the Institute of Archeology, Shanxi Province (Site 3 on Map), where the tools and fauna had graciously been laid out for us. The site is geologically dated to approximately one million years ago; however, as with many of the dates for Chinese material, we were skeptical of this early assignment. The materials we saw were recovered from a deposit said to be approximately one meter thick in classic fluvial sand and gravel deposits of the Fen River. The fauna is uniformly en-



View of Hanshui Valley from Lantien (Gongwangling).

crusted with what appear to be iron deposits and shows little evidence of heavy rolling or abrasion. The assemblage is dominated by large species, including rhino, elephant, large bovid, and some *Megaloceros* remains. We saw no evidence of butchering marks or other hominid-inflicted marks or forms of breakage on the fauna. Two possible exceptions were a *Megaloceros* jaw and a rhino jaw with what appear to be impact holes similar to those reported by Hill on the jaws of hippopotamus butchered by modern Dassenatch tribesmen. These are also analogous to remains from the TK site at Olduvai Gorge. We noted no evidence of carnivore involvement. Except for the provocative holes in the above-mentioned mandibles the fauna appeared to be exclusively paleontological.

The stone tools were rolled and abraded to varying degrees and represented a wide variety of forms. Cores similar to those Binford and O'Connell have reported from modern Australia were noted, along with a wide variety of choppers and large flake tools with scraper edges as well as spheroids. Little if any lithic debris was present, but the evidence of rolling and abrasion makes it difficult to know whether this is a function of hydrological sorting. The only tool that showed evidence of extended use or reuse was a small quartzite "point." By African or European standards the assemblage had many of the characteristics of a transported assemblage, although there was a greater emphasis on large flakes than is com-

mon in the West. No evidence of prepared core techniques was noted.

#### Lantien

We had a pleasant visit to the site of Gongwangling, where the famous skull of Lantien Man was found (Site 1 on Map). We were not able to make any new observations at this location to add to what has already been reviewed in the literature.

#### Xishuidong

Xishuidong is being investigated by Mr. Huang of Northwestern University, Xian City, Shaanxi Province (Site 5 on Map). It was described as a cave in marble (?) containing ash layers; however, most of the bones shown to us were unequivocally mineral-stained rather than burned. Most of the stone tools from this site are unconvincing in that they resemble roof spalls. There are a very few unambiguous tools, however, including a bifacial disc and a backed chopper similar to those known from Locality 15 at Zhoukoudian. Three spheroids appear to have been worked, but there are several other naturally rounded stones in the assemblage.

Although the stone tools were not very exciting, the fauna was most interesting. A few (perhaps one percent) of the long bones appear to have been impacted by humans. Much of the fauna is heavily rodent-gnawed, but there is little evidence of large carnivore-in-

flicted marks on the bones. Essentially the entire faunal assemblage was characterized by few teeth and head parts and by a preponderance of upper limb parts, including pelvis and cervical vertebra fragments. The dominant species are rhino, horse, and a large bovid (presumably *bubalus*), and cervids are represented almost exclusively by shed antler. A very few specimens exhibited some hack marks and what might be tool-inflicted cut marks. This assemblage is certainly not from a hyena or canid den, and the bias in anatomical parts seen in the assemblage is unlike any cave assemblage Binford has worked with. While a few specimens appear modified by hominids, there is little to suggest that hominids actually lived in the cave; only five tools appear to be good examples of hominid products. The high frequency of rodent gnawing may be cited to suggest accumulation by porcupines or other similar creatures, although some of the specimens were much too large for porcupines to transport. The conflicting signals this assemblage gave to Binford suggest that the taphonomic processes represented here are complicated but unique in his experience.

#### Zhoukoudian

We were given the opportunity to study some of the fauna from the important deposits at Locality 1 (Site 10 on Map), and our report is currently in press. For this reason we will not dwell on the details of the fauna. We might mention, however, that the greatest proportion of the fauna we observed was unequivocally referable to the actions of denning animals, particularly hyena.

While in China we received a copy of Zhang Senshui's major report on the stone tools from Zhoukoudian and we had the opportunity to discuss his work with him at some length. Since returning from China we have had some of Zhang's data translated and have performed a number of multivariate studies to quantify the variability noted among the Zhoukoudian levels for both typological and raw material characteristics. Tools manufactured from non-local raw materials are mainly choppers, chopping tools, and large flake tools, which universally lack associated debris. This is the same pattern identified as the transported component in early African and Western technologies. In marked contrast, another aspect of the technology is largely represented by the frequently cited bipolar core reduction strategy.





Professor Jia Lanpo.

Associated with the remains of this aspect are most of the small tools, lithic debris, and heavily retouched tools. This is analogous to what is known both from the Oldowan and the Acheulian in the West, although slightly different techniques are commonly employed. The basic organization of the technology into a transported component and a locally produced, expedient tool component, which occur independently of one another, is organizationally identical to what is thus far known in the West; only the forms of the tools are (slightly) different.

Since we do not know the provenience of the fauna we are unable to determine if there are any faunal correlates to this fascinating pattern in the lithic assemblage. Because the sample of hominid remains from the site of Zhoukoudian is large, however, we sought to determine if there is any differential association of hominids by age or sex with the different aspects of the tools assemblage. We hoped to discover if there was any bias in the sex of adult *Homo erectus* remains found with the two aspects of the assemblage. Since there is great uncertainty about the sexing of the specimens, at present this analysis cannot be done. Our preliminary results do show that adult *Homo erectus* remains may occur with either aspect of the technology, but that children and juveniles occur only with the expedient tool assemblage. This provocative observation may have significant implications for our understanding of the social organization of *Homo erectus* groups who used the Zhoukoudian cave site. It is hard to imagine the conditions under which this type of association might be produced, but when our

studies are complete we will certainly have more to say on this issue.

### Hexian

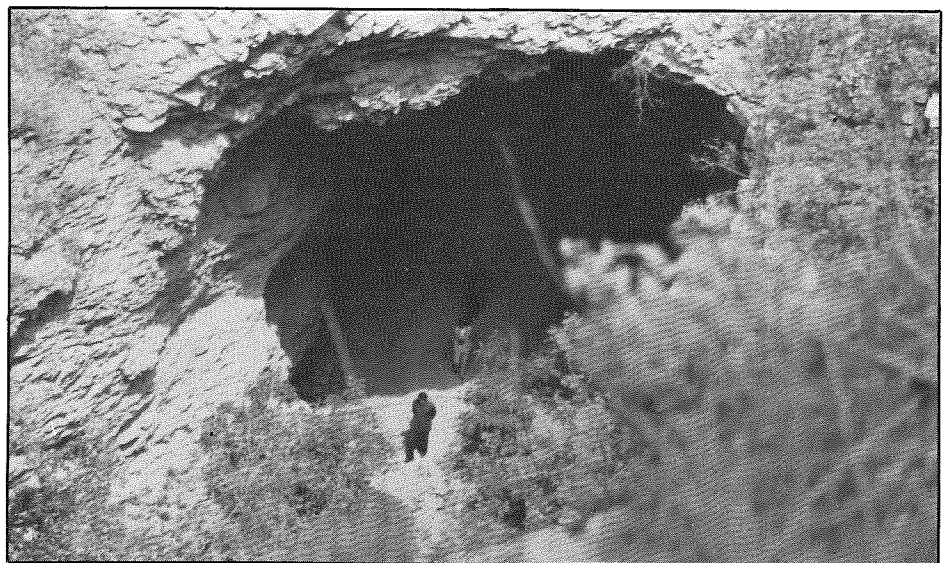
We were privileged to spend many hours viewing the fauna recovered from Hexian (Site 9 on Map), which has yielded important *Homo erectus* remains. This site was described as a carstic sinkhole with the "entrance" from the top. The first things that struck us about the fauna were the large numbers of shed *Megalocerus* antlers and the very large numbers of head parts of other cervids, which included antlers still attached to many of the skulls. In the latter category were numerous examples of carnivore gnawing, as was the case with the cervid limb bones. Many bone splinters were demonstrated, and as is common in hyena assemblages, gnawing occurs on the wide end of the bone flake but not on the pointed end. The animal gnawing always preceded the breakage of the bones. Metatarsals and metacarpals were common, and many were unbroken, but we saw very few tarsals or carpals (which could be a function of recovery techniques).

We were shown a number of provocative bones, some with a kind of erosional pitting with which Binford was unfamiliar. Four examples of bones seem to have been old and weathered before they were impacted by a sharp object. These impact marks could be the product of roof fall. In at least one additional case the impacting was repeated several times in one general area

and was recognized as nearly identical to that found on a bone from Zhoukoudian. The marks on this specimen did not appear to have been caused by roof fall and were much more consistent with those produced by hominid use of a bone as a hammer. No tool-inflicted cut marks were noted on any of the bones we examined.

While this assemblage exhibited the unmistakable tooth-inflicted modification expected to occur in an animal den assemblage, the number of tooth-modified bones was low for animal den remains that Binford has previously examined. Similarly, the very large number of cervid heads was also abnormal relative to most animal dens' known to Binford. It is possible that this was a natural animal trap similar to the South African site of Kromdraai, where agile carnivores and perhaps hominids could enter and exploit trapped animals. Much more time needs to be spent on this assemblage with detailed attention paid to the frequencies of animal-inflicted marks carefully tabulated by anatomical part before the formation contexts can be inferred.

The numbers of cervid heads and the seemingly high frequency of long bone splinters, some of which have clear impact rosettes, resemble properties of the Zhoukoudian fauna; however, the lack of convincing stone tools is in marked contrast to the presence of tools at Zhoukoudian. In addition, the impression of a low frequency of animal-gnawed bone further suggests that there is more to this assemblage than can be assimilated to our limited knowledge of



Mouth of Pigeon Hall, Zhoukoudian. The important deposits called "Quartz Levels 1 and 2" were found on the right side of this entrance.

cave taphonomy. This is a most important fauna and one that deserves detailed study.

The impressions summarized above leave one with the clear implication that there is much to be learned about the formation contexts of cave faunas and with a feeling that perhaps hominids were more involved at this site than the numbers of hominid-modified bones and the few very doubtful stone tools would indicate. This site is currently being equated temporally with the upper part of the Zhoukoudian Locality 1 sequence, perhaps dating around 300,000 years ago. The discussion of the fauna from this site leads nicely to a discussion of the site of Jingnushan where Professor Lu of Beijing University has recently unearthed a nearly complete hominid skeleton.

### Jingnushan (also called Yingkou)

We were not able to visit Jingnushan (Site 15 on Map) or to examine any of the remains thus far unearthed. We spent a very pleasant afternoon with Professor Lu Zune, however, and he told us some interesting things about his recent finds. Near Dalian in northeast China, this site has been known for many years and was actually excavated in part by Japanese investigators during the 1930s. Local museums sponsored research during the 1970s just inside the cave entrance in deposits that are reported to be largely destroyed as a result of the earlier Japanese work. The excavators removed four levels, some of them containing quartzite tools, and Mr. Lu began his work in the lower deposits after the local museum crews had abandoned their work. At the time of our visit only a small area (4 by 7 m) had been opened up by Mr. Lu, but a nearly complete skeleton of a late *Homo* was discovered. Uranium series dating has been used to obtain a date of 310,000 years ago for the level that contained the hominid remains. Although stone tools had been recovered in the earlier excavations, at the time of our visit no stone tools had been recovered from the layer that yielded the hominid skeleton. Mr. Lu reported that there were many *Megalocerus*, bovids, and rhino bones. The upper limb bones were said to be missing their articular ends, which suggests the actions of carnivores. Many rodent bones were noted, and in Mr. Lu's judgment these were frequently burned. He also reported the presence of a hearth. As in many cases in China

we were skeptical of the reports of fire since most of the bones did not seem to have been burned but were instead simply mineral-stained.

Mr. Lu is quite interested in taphonomy and is currently researching carnivore modifications of bones. According to Lu there were no carnivore-inflicted marks on the *Homo* skeletal remains. Mr. Lu's description sounds like a burial to Binford, and if so, we strongly doubt that the widely circulated opinion that this skeleton is *Homo erectus* will turn out to be accurate. In addition, if this find represents an intrusive burial originating in the upper artifact-bearing levels, then the uranium series date obtained on material found at the same elevation as the skeleton will certainly be far too early for dating the skeleton itself. A preliminary report on these important finds is scheduled for publication in 1986, and we can anticipate a paper with more attention to taphonomic detail than is common in most Chinese reports. This very important find could provide us with an updated picture of the hominids who lived in north China during the period contemporary to the emergence of Neanderthals in the West.

### Dingcun

Along the Fen Ho near the old Chinese village of Dingcun are many localities that are referred to collectively as the Dingcun site (Site 6 on Map). We were privileged to visit the area and see the location of Pei and Jia's excavations. More recent work had been done at Locality 100, however, and our attention was focused on this site. It is quite clear that the artifact content of the various locations is in fact very different. In the original excavations many of the commonly illustrated large tools were found, along with bola stones or spheroids, although it was reported that few cores or flakes were also found. This situation contrasts with that at Locality 100 where few large tools were found but flakes dominated the assemblage. The curator of the local museum, Mr. Zhou, noted that when spheroids (bola stones) were common there was a tendency for higher frequencies of natural stones seemingly out of geological context (manuports?) and there was some increase in the frequency of lithic debris as well.

The locations yielding the Dingcun materials are on the third terrace of the Fen Ho in fluvial sand and gravel deposits. These fluvial deposits underlie a

thick loess accumulation. Within the crossbedded sand and gravel deposits the artifacts tend to occur as diffuse occurrences both horizontally and vertically. The density of tools is estimated to be about one per cubic meter of deposit. The local archeologists expressed the opinion that all the "typical" Dingcun locations had been water-sorted and in no way represent living floors. One striking feature of the artifacts is that they are all made of the same raw material, which is widely available in the local area.

While we were in Dingcun we asked about the possible presence of "small tool" occurrences in the area, and it was reported that some had been recently discovered — that is, tool assemblages more like those from Zhoukoudian. Such locations were considered to be earlier than the typical Dingcun materials, but this estimate seems to rest on typological considerations rather than stratigraphic ones. When the local archeologist was questioned about the fauna he noted that the large bones tend to come from deposits of coarse sand while the smaller bones are generally found in fine sand. He also noted that complete bones were common, a situation most likely to occur if water rather than hominids had removed the bones from animal carcasses. Many bones are recovered from non-artifact bearing deposits, and the local archeologist noted that he could see little difference between bones found with artifacts and those found in non-artifact bearing deposits. None of the bones we were shown exhibited tool-inflicted cut marks or any evidence of having been impact fractured. These facts fit with the archeologist's observations that few long bone splinters were noted in the deposits. On the other hand, he did comment that some bones exhibiting heavy hack marks had been recovered, and we were shown a complete bovid tibia that did in fact have a tool-inflicted hack mark.

We came away from the Dingcun location convinced that the locations investigated since the 1950s were low integrity deposits sorted and formed primarily by fluvial action. The artifacts, the animal bones, and in one case hominid remains were associated only as a function of fluvial action. No behavioral relationships between the bones and the stone tools could be implied from this association. The situation at the original excavation spot, Locality 98, is unclear since horizontal concen-



*View of excavated area at Xujiayao. The loess deposits seen on the right had to be removed to expose the artifact-bearing levels.*

trations of tools, perhaps manuports and spheroids, occasionally contained scattered faunal remains. It is possible that the original location represents the fluvially restructured remnant of a site, or more likely sites, since localizations were judged to have been vertically diffuse. The contents of this location could have been originally structured by hominid actions, but it is impossible to evaluate this possibility at present. It is provocative that there may be some systematic relationship, although a poorly documented one, between transported tools and the exploitation of carcasses at or near the locations where they were found. If the assemblage from the original excavation at Locality 98 represents largely transported tools, which seems likely since lithic debris and cores were both rare, then the absence of bone splinters from marrow processing activities and the exclusive recognition of tool-inflicted hack marks on the bones would be consistent with what appears to characterize the differences between transported versus expedient tools in

contemporary assemblages in the West. Dingcun is believed to date from between 200,000 and 100,000 years ago.

### **Xujiayao**

As at Dingcun, we were privileged to visit the Xujiayao site and spend time with the excavators (Site 7 on Map). Unlike the sites discussed thus far, Xujiayao is a Paleolithic location in lacustrine deposits at the edge of a now-extinct Pleistocene lake. Jia's excavations at this location represent a tremendous manual effort; extensive loess overburden (9 m thick) had to be removed in order to expose the levels yielding artifacts. A large lateral exposure (approximately 250 sq m) was made in the artifact-bearing deposits.

The artifacts from this location are a classic small tool assemblage. Evidence of the bipolar technique is common, and the raw materials reduced were primarily small quartzite and jasper pebbles. Small flakes are commonly retouched, and a variety of formal types

(e.g., scrapers, points, and graters) have been recognized by the excavators. Many so-called scrapers actually appear to be backed knives. In addition, many naturally backed knives were identified only as utilized flakes by the Chinese. In the main, however, the assemblage appears to contain few formal types and is typologically interesting primarily with regard to edge morphology. Nevertheless, emphasis by the Chinese investigators is on formal tool types. Our impression of these types is not as sanguine as those of our Chinese hosts, who are trying very hard to see "progress" in this assemblage relative to analogous materials known from Zhoukoudian and elsewhere. To us, Xujiayao appears to be an assemblage very similar both technically and morphologically to that seen from the upper levels at Zhoukoudian, differing primarily only in the quality of the raw materials used and perhaps in the occurrence of a higher frequency of backed knives.

When questioned on the problem of stone tool localizations, the excavators

recalled that the tools were scattered both vertically and horizontally throughout a deposit about one meter thick. At other times, particularly when on the site, excavators spoke of what might be called "hot spots" where there may have been localizations of tools. Before visiting the site we were already convinced that the site had a complex formation history since we had seen some stone tools that were considerably rolled, while the majority were in absolutely mint condition.

Prior to our site visit we had been shown a selected assortment of fauna from Xujiayao. It was quite clear that Professor Jia had selected this sample for us because he considered them to be bone tools. The assortment consisted primarily of long bone splinters from horses, which were some of the most beautifully preserved bones from a Paleolithic site the senior author has ever seen. As was the case with the stone tools, some bones from larger species were heavily rolled. There was also a sizable collection of small bovid horn cores that showed no evidence of hominid modification but were nevertheless considered by Professor Jia to be tools.

Many of the horse long bone splinters were unambiguously marked by stone tools. The marks included longitudinal scrape marks as well as short chevron filleting marks. Many of these bones bore the unmistakable marks of percussion impact, resulting presumably from marrow processing activities. In one case a horse long bone splinter had been percussion impacted after carnivore gnaw marks had been inflicted at one end. In this case at least, carnivores had had access to the bone before the hominids broke it open for marrow. On the whole, however, little evidence of carnivores was evident in the assortment of bones we examined.

While on the site we had the opportunity to make further observations on fauna and importantly on what are likely to have been manuports. We were interested to learn more about the occurrence of the artifacts and bones in the deposits and were told again that there were "hot spots" both vertically and horizontally. A demonstration excavation was performed, and it was certainly true that in one place low in the artifact-bearing deposits considerable bones and few tools were found while in another place about 12 m away there were frequent tools but few bones. It was interesting that the bone

unearthed while we were on the site was broken up into small cancellous chunks and small pieces of long bone. This contrasted sharply with the large pieces shown to us in the museum.

#### Summary of Early and Middle Paleolithic Materials

We think the reader must by now clearly appreciate the considerable variability currently demonstrable among the assemblages thus far documented in China. Among assemblages considered "early," great differences distinguish the small tool materials of the Nihewan Basin from the massive flake tools recovered at Xihoudu and Kehe. We saw other assemblages collected from ancient terraces in southern China and also from central China (Liangshan; Site 2 on Map) that clearly demonstrate a consistent pattern of large tools and large flake tools with occasionally shaped pieces that might be considered proto-handaxes, although they are almost always unifacially shaped. Choppers and chopping tools are present in these assemblages; nevertheless, very large modified flake tools seem to be very common. These latter tools do not characterize such early African assemblages as the Developed Oldowan, although the core tools might be considered at home in such assemblages.

These large tool complexes, thus far known exclusively from fluvial deposits and ancient terraces, contrast in almost every way with the small tools recovered from the Nihewan Basin and considered to be roughly contemporary. The latter are made on small flint and quartzite pebbles; many small derived flakes are worked and retouched considerably, and evidence of the bipolar technique is common. These materials are reminiscent of the majority of the assemblage from Zhoukoudian, and a similar technical approach is clearly seen at the later site of Xujiayao. Within the span of time represented by the above-mentioned sites are others that have yielded primarily large tools — Dincun and Locality 15 at Zhoukoudian, for instance. This demonstrable dichotomous pattern spanning hundreds of thousands of years is clearly recognized by the Chinese. Unfortunately, rather than seeing the pattern as being something in need of explanation, like most Western archeologists of an earlier generation, they assume an explanation and simply arrange their variability into tree

diagrams believed to trace historically distinct cultural traditions. The assumption is simply that recognizable differences and similarities are a direct measure of cultural "distance" between the makers of the tools. No attempt is made to view technology as something responsive to the environment or as being representative of the behavioral adaptations of the hominids. Variability simply reflects socio-ethnic distinctiveness, with some "lines" being progressive and others conservative. The archeological record in China is simply accommodated to the beliefs of the archeologists regarding the cause of variability; variability itself is not investigated. This ensures that detailed study of the sites, their structure, formation processes, and taphonomy will be emphasized regardless of their context. Fauna is primarily treated paleontologically as a clue to the age of the assemblage, and lithic debris, manuports, and other materials are rarely recorded.

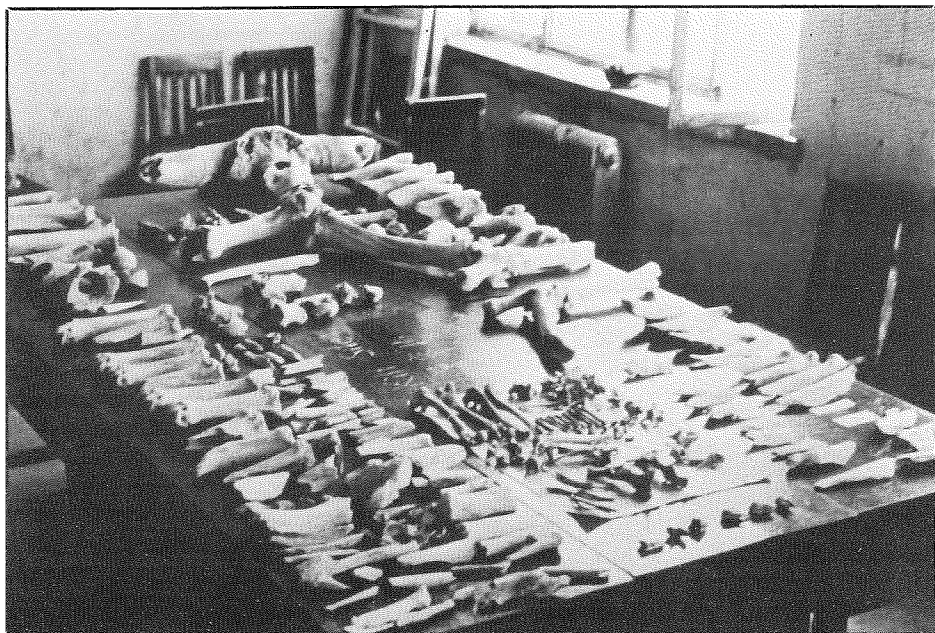
Another source of bias affecting the investigation of Chinese Paleolithic data is a strong nationalism, so that the Chinese Paleolithic is basically viewed as being Chinese history. There is little attempt to see the Chinese material in a broader context of hominid evolution and radiation. A common response by the older Chinese archeologists to any suggestions of comparative similarity to materials from outside China is that such extra-Chinese relationships are irrelevant. The Chinese sequence is seen as a self-contained historical tradition from the very beginning, one that leads through indigenous processes to the modern Chinese culture. This approach is particularly evident in the recent treatment of the site of Shuidonggou. Materials from this site, housed in the Musée de l'Homme in Paris, were studied by François Bordes and found to be essentially within the range of Western Mousterian assemblages. Recent studies by Chinese archeologists have emphasized the Asiatic uniqueness of the assemblage from Shuidonggou, and the site has been placed in a key position representing a blending of the earlier Chinese traditions. This may be correct, but the similarities to Western materials should be evaluated, not dismissed.

Throughout our discussion of the materials we were able to see while in China, we have emphasized properties that we considered to be relevant for gaining an understanding of the Chinese

sequence relative to what we know or suspect about hominid materials from outside China. We were concerned with formation processes, taphonomy, and clues to an understanding of the inter-assemblage variability demonstrable within China. We noted some provocative things, which have been summarized here. The case for a dichotomy between locally manufactured and used tools and tools that were transported can certainly be supported, at least to the extent that this dichotomy demands further investigation. The hint that at Zhoukoudian there is a biased association between children and the expedient component of the assemblage is most provocative. Similarly, the lack of much hominid modification of bones or even of much broken bone debris at Dingcun, where large transported tools are found, contrasts with the situation at Xijiayao, where expedient tool manufacture and use is clearly indicated; at least some bones are heavily tool modified, and the bones seen on the site are very broken.

These observations all fit a pattern that may stand behind some of the assemblage variability beginning in the Oldowan and continuing through the Mousterian of Western Europe. Our observations should be seen as provocative rather than definitive because we rarely saw complete assemblages and, in most cases, were shown highly selected examples of both fauna and stone tools. Nevertheless, the justification is clearly present for asking a new set of questions of the Chinese material.

Finally, we can report that change is in fact beginning in China. We visited an excavation in northeastern China (Manchuria) where the research team, composed of local archeologists and You Yuzhu of the IVPP in Beijing, were carrying out excavations using modern methods at the site of Yianjiangang near Harbin. This team is drawing maps of their finds as uncovered in situ and is seeking to recover all the materials contained in the deposits (Site 11 on Map). Mr. You is particularly interested in taphonomy and is clearly giving much analytical attention to the impressive faunal collection being recovered. We had the opportunity to view a vast faunal assemblage from Yianjiangang, and although most of it is clearly referable to hyena behavior, Mr. You's careful work will supply the Chinese scholars with a wonderful control collection of hyena-accumulated fauna. The excavators hope that hominid-related materials will be forthcoming. At the time of



*Fauna from Yianjiangang.*

our visit, one possible stone tool had been recovered as well as some fragments of hominid bones. Since our return to the U.S., Mr. You has written us that more artifacts have been found. This site, and the skills that the Harbin team are developing, when linked to their broad comparative curiosity, could

go a long way toward changing Chinese Paleolithic archeology and placing the very important Chinese material in a context more relevant to broader concerns of hominid evolution and the radiation of the species than has been the case until now. ■

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## MEMBERS' EVENT

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The Associates of the L.S.B. Leakey Foundation are pleased to present their third Members' Symposium titled, "Extinctions! Who's Next?" This October 25 event will be held at the Los Angeles County Museum of Natural History and will be cosponsored by the museum. A dinner honoring the scientists will be held at the Page Museum on October 24. Details and invitations will follow. The symposium will deal with different interpretations and explanations of major extinctions in the fossil record and attempt to predict future events. We have been fortunate enough to assemble the country's experts on this subject: Dr. Ernest Lundelius, Jr., of the University of Texas in Austin; Dr. Paul Martin of the University of Arizona in Tucson; Dr. Jack Sepkoski of the University of Chicago; Dr. Steven M. Stanley of Johns Hopkins University; and Dr. Adrienne Zihlman of the University of California, Santa Cruz. Dr. Irvan DeVore of Harvard University will serve as moderator. Plan now to attend this outstanding event! ■

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### TO THE EDITOR:

Please tell Dr. Duffy that the "rat" pictured on page 21 of the Spring issue is actually an elephant shrew (Family Macroscelididae, *Rhynchocyon cirnei stuhlmanni*). Score one Colin Turnbull! Personally I am glad that Turnbull did not characterize or study the "typical" pygmy group. I find his comparative (our culture and theirs) approach more interesting and useful (see especially *The Human Cycle* (1983) Simon and Schuster). In any case it is good that you have aired a diversity of opinions.

Keep it up. Many thanks.

H. David Dean  
Dept. Anthropology  
Graduate Sch., S.U.N.Y.

*We would also like to acknowledge Bob Truett of the Birmingham Zoo for his letter regarding this error.*

*We appreciate your vigilance.*

The Editors ■

## Shaman

On my way to the university and a morning class in Keats,  
bringing an armload of succulent weeds for the calf at Ag  
(who doesn't study poetry but is my friend)  
I pass an open door: on the concrete floor lies  
a dead goat, legs splayed, split up the middle,  
head thrown back, tongue stuck out, face frozen in grimace,  
a professor of veterinary medicine and his students squat  
around the carcass, scrutinizing guts.  
  
Innards gleam in their skeins of wet tissue.  
  
A suddenly harsh sun glints on a flint knife,  
from under a high and heavy brown brow,  
above cheeks daubed and streaked with ochre paint,  
sharp eyes glance up and calculate my presence,  
sweat beads the backs of the apprentices  
who murmur and shift on their heels  
while flies by hundreds buzz around the corpse,  
and the gold savanna seems to stretch away forever.

Fil Lewitt  
Faculty of Education  
Tottori University,  
Japan

## CALENDAR

- October 25:** Symposium  
*"Extinctions! Who's Next?"*  
Los Angeles County Museum of  
Natural History  
Details to follow.
- November 6-10:** Symposium  
*"Understanding Chimpanzees:  
Chimpanzee Behavior and Ecology  
in the Wild and Captivity"*  
Chicago Academy of Sciences,  
Chicago, Illinois  
For information, call (312) 549-0606
- November 10:** Lecture  
1986 Allen O'Brien  
Memorial Lecture:  
Richard Leakey, *"The Origins of  
Mankind"*  
8 p.m., Beckman Auditorium,  
California Institute of Technology,  
Pasadena, California  
For tickets, call (818) 356-4652
- November 12:** Lecture  
Richard Leakey, *"The Origins of  
Mankind"*  
8 p.m., Palace of Fine Arts,  
San Francisco, California  
For tickets, call (415) 775-2021 ■

## AN ALTERNATIVE WAY OF GIVING

*There are advantages to gifts of securities. The following guidelines are offered to benefactors interested in supporting the Foundation in this way.*

The tax system in the United States has long given favored treatment to charitable gifts (including gifts for scientific and educational purposes) providing for public support of charities without direct intervention by the government. The L.S.B. Leakey Foundation is a public charity and, as such, qualifies for the 30 percent (rather than the 20 percent) limitation on deductions for charitable contributions of securities. Stated another way, a donor can deduct up to 30 percent of his or her contribution base for gifts of securities to the Leakey Foundation. (Speaking generally, the contribution base is gross income less business expenses.) It is very advantageous to make charitable gifts of appreciated securities which have been held more than six

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## BOOKS

**THE EVOLUTION AND ECOLOGY OF MAMMAL-LIKE REPTILES**, edited by Nicholas Hotton III, Paul D. MacLean, and Jan J. and E. Carol Roth. Smithsonian Institution Press, Washington, D.C., 1986. pp 352, illustrated. \$35 cloth; \$19.95 paper.

The contributors to this book examine the development of mammal-like reptiles from the most primitive reptile stage through the transition to mammals. Paul MacLean, M.D., wrote the introduction. (See his related article in *AnthroQuest* No. 33, Winter 1985.)

**MIND FROM MATTER**, by Max Delbrück. Basil Blackwell, Inc., New York, 1985. pp 316, illustrated. \$29.95 cloth; \$9.95 paper.

The subtitle of this book by the late Nobel Laureate Max Delbrück is "An Essay on Evolutionary Epistemology." Focusing on the evolution of the human brain, he shows how it delivered so much more than was ordered in the process of natural selection — how it transcended mundane tasks and went on to conceive and manipulate theoretical and philosophical concepts such as number theory and quantum mechanics.

**ORIGINS OF MATERIALS AND PROCESSES**, by John Delmonte. Technomic Publishing, Inc., Lancaster, PA, 1985. pp 388, illustrated. \$30.

Delmonte brings to his most recent book a lifetime of research, writing and business activity in the area of material technology. This study is an extensive presentation of the sources of materials and technology including the development of metals, ceramics, fibers, lithics and glass, and the methods used to produce them. The book is stocked at both bookstores and museums. ■

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