ANTHROQUEST

news of human origins, behavior and survival

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THE WAY WE WERE

SPECULATING AND ACCUMULATING: new approaches to the study of early human living

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UNIVERSITY OF CALIFORNIA, BERKELEY

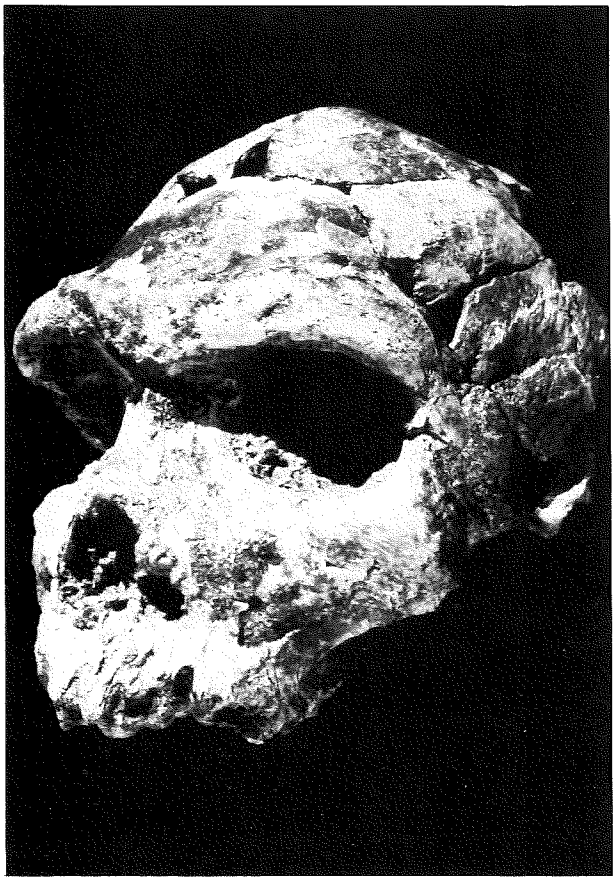
We are concerned lately with trying to understand more about what early hominids were doing by studying the evidence of their activities that has survived the millennia of burial in the African bush. As a prehistorian, my concern is to investigate how human beings in the past were able to get by on sparse resources. What better place to start than in the Middle Awash area?

Hominid bones from there are three to four million years old but we have only the bones themselves and there are no known living places that would be direct indicators of human activity at this early time. The anatomical evidence suggests that these early ancestors — "Lucy" and the "First Family" — were primarily vegetarian. Being efficient bipedal walkers, as we know from that remarkable series of 74 feet of footprints found by Dr. Mary Leakey at Laetoli, they probably used their hands to manipulate simple tools — digging sticks or natural carrying trays — to exploit the resources of the savanna and the forest ecotones that were their home. This is indirect but informed speculation based on the anatomy of the fossils and analogy with the behavior of the great apes.

Then, about two million years ago, stone tools appear suddenly and we find the first evidence of places where hominids were carrying out their activities. On these home bases have been found bones, broken by hominids, in association with stone tools, from which it can be inferred that some tools, at any rate, were being used for the processing of meat and the obtaining of marrow. So begins the accumulation of direct evidence from the stones and bones themselves of some of the things that these ancestral hominids were doing. The problem is, of course, to understand when and how these tools were used and about the individuals who made and used them.

This is where the detective in all of us comes to the fore. Empirical studies in excavated activity areas, experimental reproduction of artifact assemblages and analogs now available from the excellent studies of the behavior of great apes — in particular the chimpanzees and some savanna monkeys — together with what can be inferred from the knowledge of hunting and gathering peoples make it possible to form hypotheses and so build models of early hominid behavior. This can be expected to lie somewhere between that of apes and hunter-gatherers, closer to the apes, of course, in

continued on page 18



The Bodo cranium of Middle Pleistocene age from the Middle Awash, Ethiopia. Several cut marks made with a stone knife are present below the left eye socket and on the frontal bone and are consistent with the intentional removal of the skin from the face and head of this individual. photo: Tim White

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.

The L.S.B. Leakey Foundation is a public foundation. All contributions are tax-deductible as provided by law.

THE L.S.B. LEAKEY FOUNDATION NEWS

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PRESIDENT'S MESSAGE

For the last 14 years, Ned Munger has served as president of the L.S.B. Leakey Foundation. During his presidency and with his direction, the Foundation became an international research source for the study of humankind. Outstanding scientists were attracted as trustees of the Foundation and as members of the Science and Grants Committee. Endowment and other funds in support of grant requests multiplied. Educational programs in the form of lectures, seminars and symposia attracted and stimulated participants in increasing numbers. These many years have been the best of times for the L.S.B. Leakey Foundation.

At the beginning of each year of Dr. Munger's long term as president, he stood for election and was enthusiastically supported. In later years the trustees were concerned that, because of his wide range of interests and responsibilities, he would leave to focus his considerable talents elsewhere. This summer, in Nairobi at the annual meeting, he resigned to our regret, after long consideration.

It has become my task and my challenge to follow Ned Munger as president. Fortunately for the Foundation and for me and all of us, he has agreed to continue as an active trustee with his efforts directed to the Franklin Mosher Baldwin Fund and African grants in general. The Foundation must share him with others, but with his continued support and that of so many others attracted to the Foundation during his years, we can be confident that the best of times will extend into the future.

GREAT APE RESEARCH FELLOWSHIP

Early in 1984 the Leakey Foundation invited applications for a new fellowship in great ape field research, with emphasis on its significance for understanding human origins and the exploration of ape behavior in different habitats. (See *AnthroQuest* No. 28.)

The committee reviewing applications has unanimously recommended Dr. Caroline Tutin's proposal, "The Behavior and Ecology of Sympatric Gorillas and Chimpanzees in Gabon," for the 1984-85 period. Dr. Tutin is co-director of Station d'Etudes des Gorilles et Chimpanzés, Reserve de la Lopé, Gabon.

Thanks to the generosity of Trustee Mrs. Anne Earhart and Fellow Mrs. Margot Marsh, $55,000 is now available for three annual fellowships, with $20,000 being awarded to Dr. Tutin. The grant need not be spent within one year's time; it is hoped each recipient will extend the use of the funds for as long as possible. The Foundation is requesting additional monies for the fellowship and hopes that it may become endowed.

Again, for the 1985-86 season, the fellowship will be awarded to an individual to facilitate the establishment of a long term research project on a wild population of great apes. Worth up to $20,000, the grant is for field expenses only. Applicants should submit a curriculum vitae and one page statement of research goals by February 1, 1985, to the L.S.B. Leakey Foundation, attention Kathleen F. Galvin, Grants Officer, Foundation Center 1-7, Pasadena, CA 91125. Eligible candidates will be asked to provide further details by April 15, 1985. The recipient will be announced in October.

NEW FELLOWS

The L.S.B. Leakey Foundation is pleased and honored to welcome as new Fellows: Judy Smith, Los Angeles, California, Marianne Bertino, San Gabriel, California, and Ruth Schaffner, Santa Barbara, California.

IF YOU PLEASE

That unused Kodak carousel slide projector gathering dust in your closet can embark upon a new, meaningful career with the Leakey Foundation. Your donation will be greatly appreciated! Please call the office at (818) 449-0507.

DIET AND HUNTER-GATHERERS

IRVEN DEVORE
DEPARTMENT OF ANTHROPOLOGY, HARVARD UNIVERSITY

Both biological and cultural anthropologists have long studied the dietary, ecological, and economic adaptations of human societies, but they have been slow to appreciate how fundamental a society's subsistence strategy is to understanding human behavior, gender roles, and social organization.

Yet it is not too much to say that nutritional demands determine the majority of the daily activities of most people in the world today, and that the complexity of a society is directly related to its means of subsistence.

There are several anthropological perspectives that bear importantly on the general topic of "human nutrition, behavior and adaptation." In the broadest perspective of evolution, anthropologists and paleontologists have sought to understand the diet and socioecology of the nonhuman primates. For example, although the frugivorous apes flourished in Miocene times, the evolving ability of monkeys to digest the toxins in unripe fruits, nuts, and leaves led to a competitive radiation in which the monkeys flourished in the forests of the Old World and the numbers and kinds of apes were consequently reduced. We know that by some four million years ago our hominid ancestors were living on African savannas and eating an omnivorous diet. The relative importance of scavenging, hunting, gathering, and seed-eating during hominid evolution is still a matter of debate and active investigation. By about 100,000 years ago fully modern humans had emerged; the hunting and gathering economy they had evolved is still practiced by remnants of hunter-gatherers in remote parts of the globe today. Agriculture and pastoralism became established only some 10,000 years ago and began to spread rapidly. Yet, as recently as the time of Christ, about one half of the world's peoples still lived by hunting and gathering.

Looking back on this thumbnail sketch of the evolution of human subsistence, it is clear that the development and persistence of hunting and gathering has been the most critical stage in the emergence of our species. The recent florescence and world-wide expansion of agriculture and industry has occurred far too rapidly for our biology to adjust; physically we appear to be identical to our hunter-gatherer ancestors of 100,000 years ago. It is startling to realize that we now live in industrial cities with the mind, the body, and the complement of emotions that evolved in the small, face-to-face camps of hunter-gatherers.

It is not difficult to find evidence that many behaviors that were adaptive in the hunter-gatherer context may no longer be so. Our food preferences are one example. Our perception of what

Ingo Riepl: Anthro-Photo

Bedouin woman cooking mid-day meal.

tastes "sweet" or "bitter" is based on the fact that we evolved to prefer the taste of ripe fruits, but to find "bitter" the toxins in green fruits and tubers and to avoid them. Salt, necessary in small amounts for our metabolism, occurs only as a trace element in nature, and we evolved to enjoy and seek out foods with this salty taste. Wild animals carry little fat, and under the energetic demands of hunter-gatherer life it was an advantage for our ancestors to enjoy as much of this precious commodity as they could secure. One need hardly add that many of the health problems of civilization can now be traced to our present overindulgence in foods rich in salt, sugar and fat. Throughout our evolutionary history we found pleasure in those tastes that were adaptive in a hunter-gatherer context; now those same tastes may lead to an unhealthy diet.

Sophisticated means of food production and distribution have meant that, at least in the affluent West, we need no longer suffer the periodic peaks and valleys of food availability that were the heritage of all humankind until this century. We are only beginning to understand how this dependable food supply may be affecting our physical well-being, but increasing numbers of anthropologists believe that chronic obesity and adult-onset diabetes may be one important consequence. Periodic food abundance followed by food shortage has been a reality for hunter-gatherers and primitive agriculturalists alike. James Neel, the eminent human geneticist at the University of Michigan, has suggested that mammals, including ourselves, have evolved a "thrifty gene" to cope adaptively with boom and bust food cycles. Many animal experiments and clinical tests on human populations indeed suggest that many individuals are able to store fat during a season of plenty when, by the insulin cycle in their bodies, excess blood sugar is converted into fat storage. If a person with such a "thrifty morphotype" then fails to encounter lean seasons, the result can be obesity, an overworked pancreas, and adult-onset diabetes.

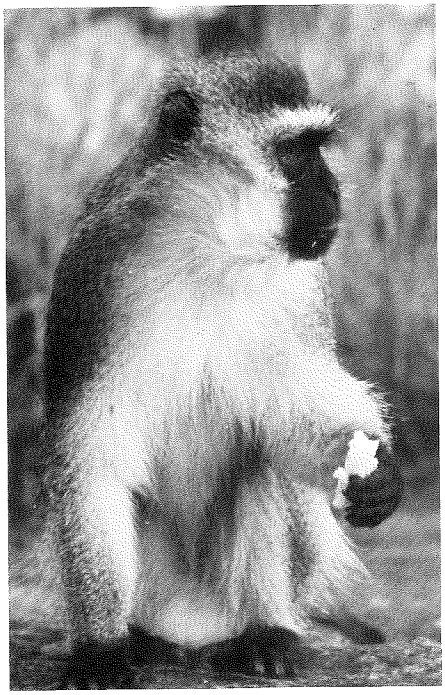
Historically, recent changes in diet and lifestyle may have profound social consequences. Between 1880 and 1940 the average age of menarche in girls in Europe and the U.S.A. declined from 17½ to 13 years of age. Rapid physical growth and, according to Dr. Rose Frisch of Harvard, the ability to reach a "critical weight" (a level of fat storage sufficient to carry a fetus and nurse a child), are primarily responsible for this

dramatic downward trend in the age of first menses. Our social, legal, and religious institutions have scarcely begun to cope with this new capacity for reproduction by the very young.

Humans who continue to live largely or entirely by hunting and gathering still occupy refuge habitats in deserts and savannas in the Old and New World tropics — areas that pastoralists and agriculturalists have historically found to be only marginally productive. One of the largest such populations, the !Kung San (or "Bushmen") of the Kalahari Desert of Botswana, Africa, has been the subject of intensive investigation since the 1950s. Richard Lee and I began a long term study of the !Kung San in 1963. In its first decade the San study included 12 long-term and again as many short-term investigations of a wide spectrum of topics: archeology, ecology, demography, social organization, acculturation, infant and child development, belief systems, nutrition, and health status. Well over a hundred articles and eight books on the San have now been published by members of our research group.

Among our findings was the fact that these hunter-gatherers, in a desert-fringe savanna, are surprisingly well-nourished (although still subject to strong seasonal differences in food availability and occasional drought years). This remarkably stable subsistence base is due to the daily gathering of fruits, nuts and tubers by the women; in fact, women regularly provide 60% of the San diet and up to 80% of the diet in some seasons. Archeologists and anthropologists have subsequently modified their views of "man, the hunter" to include "woman, the gatherer," and many of us now believe that the first human tools were not hunting weapons, but the digging stick and carrying bag of the gatherer. No doubt in part as a consequence of their importance in the San economy, women hold a more equal place to men in the San society than in any other culture yet reported by anthropologists.

Efe Pygmy men eating honey. Irven DeVore: Anthro-Photo



Vervet eating. Irven DeVore: Anthro-Photo

Since January, 1980, we have been engaged in research on the demography and ecology of two adjacent populations in the Ituri Forest region of Zaire: the Mbuti (Efe) Pygmies and their horticultural neighbors, the Lese. The earliest inhabitants of the Congo basin and traditionally classified as hunter-gatherers, the Efe exchange forest products and labor for the produce of Lese gardens. To date we have investigated the demography and social structure, physical growth, diet and activity patterns, health and nutrition, and child development of both populations. The project has grown to include 20 affiliated research workers from seven institutions in four countries.

Comparable studies of hunter-gatherers in Africa, Southeast Asia, and South America are being carried out by other investigators. What we are beginning to realize is that the role of fats, starches, meat proteins, and sugars in hunter-gatherer diets is very poorly understood. Efe women, in a forest with very few starchy vegetables available, go

Marjorie Shostak: Anthro-Photo

"Ice Cream, 1974".

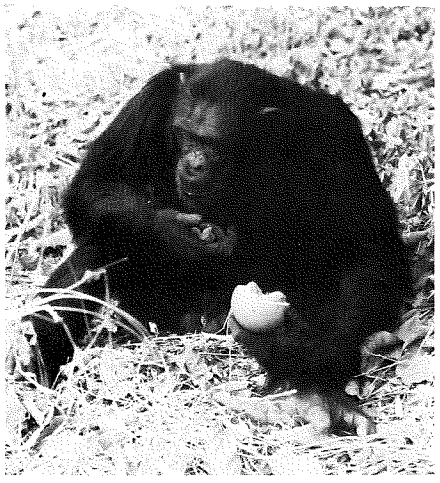
to great lengths to obtain starches such as manioc and rice from the Lese villagers. Indeed, some of us have come to doubt whether there are forest hunter-gatherers anywhere in the world who can live entirely independently of cultivated starches. Other hunter-gatherers have gone to considerable trouble to trade meat and meat fat for cultivated crops, and we are only now beginning to understand that the nutritional synergy achieved when amino acids from both vegetables and meat products are combined in a diet may be the driving force behind many human activities.

It may be fairly said that the study of human nutrition is presently in complete turmoil. A remarkable report by Gina Kolata, "Dietary Dogma Disproved," in *Science* magazine, outlines one group of problems that have recently come to light. It had long been assumed that there are two major classes of carbohydrates: sugars such as glucose and fructose were classified as "simple carbohydrates" and were believed to be immediately absorbed in the digestive system, with a consonant rapid rise in blood sugar and blood insulin. Diabetics, for example, were advised to avoid these "simple carbohydrates" in favor of the "complex carbohydrates" (starches such as corn, rice, and potatoes), because the slower absorption rate of the latter presumably led to a more moderate and manageable rise in blood sugar and insulin.

Research scientists at the National Institute of Health, the Universities of Colorado, Toronto, Oxford, and elsewhere have recently shown this "dietary dogma" to be utterly misleading. Says one, "potatoes are like candy as far as a diabetic is concerned;" ice cream, on the other hand, "is fine as far as blood glucose is concerned." There have been other, similar surprises. The effects of foods eaten in combination, for example, are unpredictable. Cheese and bread eaten together yield the rapid glucose rise characteristic of bread, and not the slow rise associated with dairy products; a bread and bean combination, on the other hand, yields a slow rise characteristic of beans. Suffice to say that long-standing assumptions about basic constituents of the human diet are not only in question, but that there is at present no theory to account for the new findings, and that our knowledge of the effect on humans of every food and food combination is now proceeding with tests on volunteers on a case-by-case basis. Concludes nutritionist Phyllis Crapo, "I think at last we will pull nutrition out of the dark ages." □

Chris Walter: Anthro-Photo

Wedding feast, Konya, Turkey.



Richard Wrangham: Anthro-Photo

Male chimp eating stychnos fruit.

Baboon eating Thompson's gazelle. Irven DeVore: Anthro-Photo

DIET AND HOMINID EVOLUTION

STANLEY AMBROSE

Most theories of hominid evolution identify a single factor that set in motion a chain of events which resulted in the evolution of features characteristic of humans. The first coherent scenario, offered by Charles Darwin, suggested that our defenseless ancestors adopted tool use, leading to selective pressures for greater intelligence and upright posture to free the hands for more effective tool use. Reliance on technology allowed reduction in tooth size and an increase in brain size, etc. This model suggested that brain size increases and tool use had preceded upright posture. This was a very durable scenario of hominid evolution and is fairly sophisticated considering the fact that it was constructed in the absence of any fossil evidence. The scenario was in fact impervious to evidence to the contrary and contributed to the success of the Piltdown forgery.

Fossil and archeological evidence now shows that upright posture preceded brain expansion, dental reduction and tool use by at least two million years. Hence, bipedalism, for carrying food to mates rather than to use tools, has been elected the prime mover in hominid evolution. However, while bipedalism may have been one of the greatest steps on the road to humanity, our extinct cousin, robust *Australopithecus*, dramatically demonstrates that it takes more than bipedalism to make a man. Our anthropocentric bias inexorably draws us to the conclusion that robust *Australopithecus* was the aberrant, and *Homo* the inevitable result of bipedalism, though patterns in the evolution of other groups of animals suggest otherwise.

Large brains and small teeth are the hallmarks of the earliest *Homo*. Man appears abruptly on the African savanna two million years ago, in the words of F. Clark Howell, like the Scarlet Pimpernel, and is usually accused of making the earliest stone tools, eating the meat of large animals, living in groups, sharing food, and littering the landscape with unsightly patches of broken bones and stones. *Australopithecus robustus* also rumbled onto the savanna unannounced and uninvited. He is seated by the kitchen door in Ye Olde Savanna Bar and Grille, handed the vegetarian menu, but no cutlery to eat with and ignored by most of the flock of paleoanthropological waiters and the maitre d' who consider him to be incapable of engaging in stimulating conversation and a lousy tipper anyway.

The simultaneous appearance of *Homo* and archeological sites with cut marks on bones and meat polishes on stone tools is tangible, albeit imprecise, evidence for a change in diet towards more meat and possibly other soft, nutritious foods. A persuasive scenario, with meat eating as the prime mover, can be constructed along the following lines. The need or desire to eat meat, for whatever reason it arose, would select for tool use in the absence of effective carnivore teeth and also for cooperative hunting and/or scavenging of carcasses and thus for foresight, planning, sociality, sexual division of labor and food sharing at 'home bases.' The relatively small teeth of *Homo habilis* tell us that soft foods such as meat were eaten but the possibility that plant foods prepared with tools rather than with teeth also contributed to dental reduction should not be overlooked. Plant foods are not preserved on the earliest archeological sites but their potential contribution to hominid diets should not be underestimated and may have been large. How can the proportions of meat and plants in the diets of early hominids be estimated?

The answer is elementary, my dear Watson — in the elements comprising animal tissues. The old saying "you are what you eat" is true at the atomic level, as has been demonstrated by Nick Van Der Merwe, Michael DeNiro and others. Different diets leave subtle, yet distinctive atomic-level signatures in tissues such as hair, bones and flesh. Foods are composed mostly of four basic elements: carbon, nitrogen, hydrogen and oxygen but all atoms of an element are not created equal. Lighter and heavier atoms that are chemically identical are called isotopes. Most are stable, such as ^{12}C, ^{13}C, ^{14}N and ^{15}N and some are radioactive, such as ^{14}C, which decays with time and is thus not a good dietary tracer. Some environments, such as marine and terrestrial ones, have different proportions of stable isotopes. Animals feeding exclusively in marine environments can be readily recognized by the distinctive carbon and nitrogen isotope ratios in their tissues. Within an environment different foods may have different isotope ratios. For example, most kinds of plants, including trees, shrubs, leafy herbs and temperate zone grasses, such as wheat and rice, discriminate against fixing heavy carbon (^{13}C) in photosynthesis. Other plants, particularly tropical grasses, such as sorghum, maize, millet and sugar cane, adapted to growth under conditions of high heat, strong sunlight and water stress, do not discriminate against heavy carbon isotopes. The process of discrimination is called isotopic fractionation and leads to a two percent difference in the isotope ratios of tropical and temperate-adapted

grasses.

A diet of wheat, rice, potatoes and lamb would give a piper on the Scottish moor a body composition with two percent less 13_C than a Maasai on the equator eating a diet of sorghum, amaranthus leaves and zebra. Similarly, a grazer in the tropics such as the wildebeest or zebra has two percent more 13_C than a browser such as a bushbuck. Hence the forest dwelling leopard should have less 13_C than the savanna dwelling lion. Nitrogen isotope ratios shift as one goes up the food chain from plants to carnivores. An herbivore differentially retains heavier nitrogen (15_N) from the plant proteins it consumes and the carnivores do the same with the herbivore meat protein. Stable nitrogen isotope ratios can therefore be used to distinguish the position of an animal on the food chain.

And so, when used in combination, stable carbon and nitrogen isotopes can tell us whether an animal in the tropics was a grazer or a browser, a carnivore or a herbivore and if a carnivore, whether it ate the meat of grazers or of browsers. Omnivory is detected by intermediate isotope ratios.

A long list of the diets attributed to various hominid species could be compiled and it would show that there is little agreement about who ate what. For a single species the suggested diet ranges from bloodthirsty or cowardly carnivory, eclectic or super-omnivory, monotonous, strenous herbivory, grass seed eating, nut cracking and so forth. Stable carbon isotope analyses of fossil bones could narrow down the potential dietary regimes considerably and it might then be possible to be more precise about who ate what during which period in the Pliocene and Pleistocene. Maybe.

Science proceeds in small steps and it would be foolish to assume that this area of research will be an exception. So before even the smallest pieces of the precious relics and icons of the religious order of paleoanthropology are ground into a fine powder and subjected to an incredible host of other indignities on the altar of the new prime mover, Dietary Change, it would be wise to explore the potentials of the technique with more expendable fossils and in recent and modern tropical environments where diets and environmental variables are better understood. Several major questions should be resolved before the technique is applied to our precious ancestors. Are proteins preserved in fossils from hominid-bearing localities? Can reliable dietary information be obtained from preserved proteins? Can reliable dietary information be obtained from bone minerals? What are the effects of different environments on the isotope ratios of animals with fixed diets? Can modern recent human populations in Africa, for which there are data for dietary specializations, be correctly differentiated by stable carbon and nitrogen isotopes? These questions can be answered by the careful analysis of fossil and recent bones and associated sediments of a variety of African mammals with known dietary preferences: browsers such as giraffe, bushbuck and duiker; grazers such as zebra, wildebeest and hippo; and carnivores such as felids, canids and nyenids. A variety of skeletons from recent and modern hunting, fishing, farming and herding populations from eastern and southern Africa are available to determine how well diverse, complex human diets can be differentiated.

Once these questions are answered to our satisfaction, the potentials for applying the technique to fossil hominids will be known with greater certainty. On the one hand, unnecessary destruction of valuable fossil hominids may be avoided; on the other, new valuable information about the role of dietary changes in hominid evolution may be obtained.

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

Dr. Ambrose of the University of California, Berkeley, was awarded a FROM fellowship in 1983. □

The San (Bushmen), Botswana, at Christmas feast. Irven DeVore: Anthro-Photo

DATING

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Department of Geology and Geophysics
University of Utah

There are basically three lines of investigation that are involved in geochronology — the dating of rocks and other earth materials. First, there are the physical and chemical dating methods which give us numerical estimates of age. Second, there is the reconstruction of the order of events in sections of sedimentary rocks — those laid down by water and wind. What is done is to find rocks which can be dated within a sequence of strata in order to establish the ages of fossils found within it, since the fossils themselves are not directly datable. The third line of investigation is called geologic correlation, in which one establishes that two or more events happened at the same time, or very nearly so.

Here I will discuss briefly three dating methods that are useful in dating what are called Cenozoic rocks, those of the last great division of geologic time during which the mammals became dominant. This encompasses about the last 60 million years. The methods I will discuss are sometimes called primary dating methods because they allow us to arrive at numbers for the age of things. The first method is radiocarbon dating, useful only for about the last 50,000 years of geologic time, although recently the method has been extended to about 100,000 years.

How does radiocarbon dating work? High in the atmosphere, radioactive atoms of carbon are formed and then oxidized to carbon dioxide by various reactions. This mixes into the rest of the atmosphere so some carbon dioxide in the atmosphere is radioactive, and plants become radioactive by using the carbon dioxide to make their tissues. Animals, too, become radioactive because they eat the plants. As long as the plant or animal is living, the carbon in it continues to be exchanged with the atmosphere. The carbon 14 is continually replaced as time goes on. When the organism dies, that exchange ceases. So a radiocarbon age determination dates the time of death of the organism. Even in rather recent archeology we sometimes have to worry about how the organic material itself relates to the archeological record. Those who have worked in Southwest archeology are very familiar with this problem. People who built pueblos would sometimes use beams out of older pueblos, made from trees, the inner tissues of which were dead and ceased exchanging carbon perhaps some hundreds of years before the building of a pueblo.

Some carbon dioxide is always dissolved in the oceans and the rest of the waters of the earth, so that carbonate minerals which are precipitated by organic or inorganic means from the lakes and the ocean are also radioactive. When shells stop forming and are deposited in sediments, they become material for dating as well. In radiocarbon dating we measure the amount of carbon 14 which still remains in a sample. This is one of the few cases in geochronology where we measure the amount of parent remaining, and this leads to an assumption. We assume that the amount of parent being produced over geologic time is the same as today. We now know that this assumption is invalid. It is a good first approximation, but refinements are necessary to arrive at a precise age.

A second dating method is potassium-argon, developed by John Reynolds, Garniss Curtis and Jack Evernden at the University of California at Berkeley in the mid-1950s. Shortly after the method was developed, it was used to provide an age for the hominids at Olduvai Gorge of about 1.75 million years. That date, produced that long ago, is still an exceptionally good determination.

The problem with this method is that fossils cannot be dated directly by it. Instead we have to find a volcanic rock, a piece of obsidian, or some mineral which can be used. Not all potassium is radioactive — only one isotope is, and this makes up only a small fraction of the total potassium in a sample. As potassium decays within mineral crystals, argon gas accumulates. What we measure is the ratio of argon produced from the decay of potassium in a crystal to the amount of potassium.

A third method, fission track dating, again is mainly applicable to volcanic rocks. It works in quite a different way from potassium-argon dating. One of the isotopes of the element uranium (not the one we fission to make bombs, but the other one) fissions spontaneously, naturally, very slowly. Fission is a very violent process, and when each of the single uranium atoms decays within a crystal, it damages the crystal, and leaves a trail through it which can be viewed by various means. If we measure the amount of uranium in the crystal, and count up the number of tracks, we have a measure of age. Again, this works only for volcanic minerals insofar as we are concerned here.

In both of these latter two cases there is an event we are dating, just as in the radiocarbon method where we are dating the death of an organism. In the potassium-argon and fission track methods we are dating the time of cooling of volcanic minerals.

Some of the error sources that are encountered are common to all techniques. One of the most common problems is contamination of samples by older or younger materials. In the case of potassium-argon dating, for example, we are trying to date materials in East Africa that are about one to two million years old. The basement rocks of East Africa are one to two *billion* years old. A single grain of billion year old material in a low potassium sample that is only a million years old will make it appear much older than it is. We cannot allow even a single sand-sized grain of material to contaminate our samples. This is one of the largest problems in potassium-argon dating of young rocks where old rocks are also exposed.

A single grain of billion year old material in a low potassium sample that is only a million years old will make it appear much older than it is.

Radiocarbon dating has similar problems. Contamination by modern carbon is the worst, sometimes brought about by the collection containers such as paper bags which are made of modern cellulose. Less serious is contamination by "dead" carbon, such as that in plastic bags made from petroleum products. It is called "dead" carbon because it is so old that all the radiocarbon has decayed away long ago.

Another problem, peculiar to the radiocarbon method, is that the amount of carbon available has changed with time. We have learned that even over short times the radiocarbon can become diluted. As we burn up stacks and stacks of dead carbon from the petroleum we pump out of the ground, we dilute the amount of carbon 14 in the atmosphere, so that its activity is now less than it is in tree material that is 100 years old. That is, it was less until atomic bombs were tested in the atmosphere; now it is higher again.

The problems that arise in potassium-argon dating are several. Aside from contamination, which is extremely

important, it is possible in some materials for argon to leak out, even at low temperatures. By low temperatures, we mean those commonly encountered on the surface of the earth, about 0 degrees to about 20 degrees centigrade. Age in the potassium-argon dating method is

Another problem, peculiar to the radiocarbon method, is that the amount of carbon available has changed with time.

proportional to the ratio of argon over potassium. If some argon leaks away, it makes the number in the numerator smaller, and it means that the age that one computes is too young. There are other ways in which argon leaks out, for example by secondary heating from later volcanic events.

If some argon is present that shouldn't be when the material forms, the ratio is also changed. We call that sort of argon "extraneous" argon. It is not a very common phenomenon, but it is an important one for understanding what is going on. The source of this extraneous argon is the depths of the earth. Volcanic rocks come from extremely deep within the earth (as much as 120 km below the surface). Potassium exists down there, and that potassium, like potassium everywhere, is decaying to argon all the time. If any of this argon is captured in a rock as it cools, it leads to ages which are too old.

A third problem shows up mainly in dating volcanic glasses. These materials tend to lose or gain potassium rather easily, upsetting the ratio of argon to potassium and therefore the age, making it either too old or too young.

In fission track dating, the biggest problem is track fading. The best way to get around it is to avoid materials that we know are susceptible to track fading at low temperatures. If track fading has occurred, the ages are younger than they should be.

In all of these methods there are two ways of speaking about errors. First, there is a parameter that we call precision. If we have an extremely precise determination of the age of some material we can, for example, state that it is one million years old, plus or minus one percent. That would be an extremely precise age. The second thing that we talk about is accuracy – more difficult to assess. Accuracy means the nearness to the true result. It involves the philosophical idea that there is a real number that should be gotten out of the sample. One may have a very precise age, and it may be dead wrong; it is a very inaccurate one.

I have spoken of only three of the dozens of methods of dating which are currently available. Another kind of dating method, often termed "secondary," is often important at sites where the materials cannot be dated by primary means. The traditional way of correlating between sites is by looking at the associated animal fossils. If we can calibrate these animal fossils at one locality, we can look at those at a different place and find out how old the deposits at that second place are.

Paleomagnetic polarity changes can also be calibrated. These are changes in the magnetic polarity of the earth itself. At various times in the past – the first change being about 700,000 years ago – if you had a compass in your hand and you stood in one place for 5000 years, you could watch the north arrow of the compass turn around and point south instead of north. That would be called a time of reversed polarity. There is now a very fine structure worked out for the paleomagnetic polarity record and dates have been assigned to all the transitions. So if you start from a single potassium-argon age or fission track age, and have a paleomagnetic polarity stratigraphy, you can make further guesses about where you are in time. Archeomagnetic variations occur over a much smaller

Accuracy . . . involves the philosophical idea that there is a real number that should be gotten out of a sample. One may have a very precise age, and it may be dead wrong. . .

time span; they are mainly useful to the later periods of archeology where we can calibrate a curve of the direction to the north pole in a particular region as a function of time.

Relating some datable material to a hominid fossil brings up the problem of stratigraphy. There is a very ancient law, laid down by Steno in the late 1600s, that says that rocks that lie on top of others must be younger than those on which they lie. However, it is difficult to apply the law of superposition in some cases. In any case not all fossils are found in strata which can be easily related. Because of the scarcity of hominid fossils, paleoanthropologists try to take collections from everywhere and put them all together. They would like to know what order to put them in and this must be done by correlating from one locality to another. The correlation can be done using fauna or paleomagnetic polarity. It can be done directly by dating materials, or it can be done by correlation of volcanic ashes. If we want to correlate between localities as widely separated as Olduvai Gorge and Hadar, or between Lake Turkana and Hadar, we have to find something in common between them. At some geographic separation every one of the correlation methods fails except primary radiometric dating and the paleomagnetic

Because of the scarcity of hominid fossils, paleoanthropologists try to take collections from everywhere and put them all together.

reversal records.

I want to make one final comment. Very often in anthropology something like this happens. There is a tuff dated at, say, 2.0 ± 0.0 M.Y. Below it in the section is a tuff dated at 2.4 ± 0.1 M.Y. We find a hominid fossil between these two tuffs. How old is the hominid? In general, people would say this hominid is 2.2 million years old. But that attaches an element of certainty to the determination which is really not there. It would be better to say that it falls between 2 and 2.4 million years; or, if you take the analytical errors into account, between 1.9 and 2.5 million years. We really have no other information about it.

This article is adapted from Dr. Brown's presentation at the Leakey Foundation symposium in Salt Lake City earlier this year. □

OPPORTUNITY

We have been funded by the National Science Foundation to conduct research on the phenomenon of quartz hydration which may lead to a dating technique useful for paleolithic quartz artifacts. We are now seeking dated quartz artifacts from the Old World in the range from 8,000 - 20,000 years. Please contact Professor J.E. Ericson, Division of Geochemistry, MS 170-25 Caltech, Pasadena, CA 91125. □

NEW *HOMO ERECTUS* DISCOVERY

The most complete skeleton of *Homo erectus* found to date was discovered in August in northern Kenya by Richard Leakey, director of the National Museums of Kenya, and Alan Walker, professor of anatomy at Johns Hopkins University.

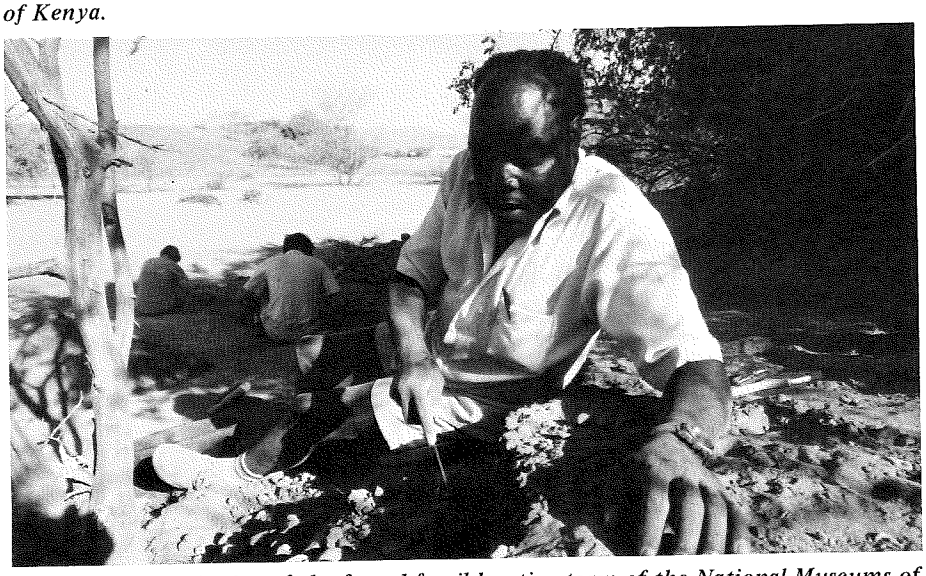
The bones of a boy about 12 years of age, estimated to be about 1.6 million years old, were uncovered between two layers of volcanic ash near the Nariokotome River, not far from the western shore of Lake Turkana.

The age of the boy at death was determined by a study of his teeth. It is estimated that he was about five feet, four inches to six inches tall and weighed about 143 pounds and would probably have reached six feet in height as an adult. "This is quite surprising," Richard Leakey said, "because we used to think of our ancestors, particularly in this early period, as rather puny, rather fragile. Perhaps they were much stronger and better built than we had ever imagined."

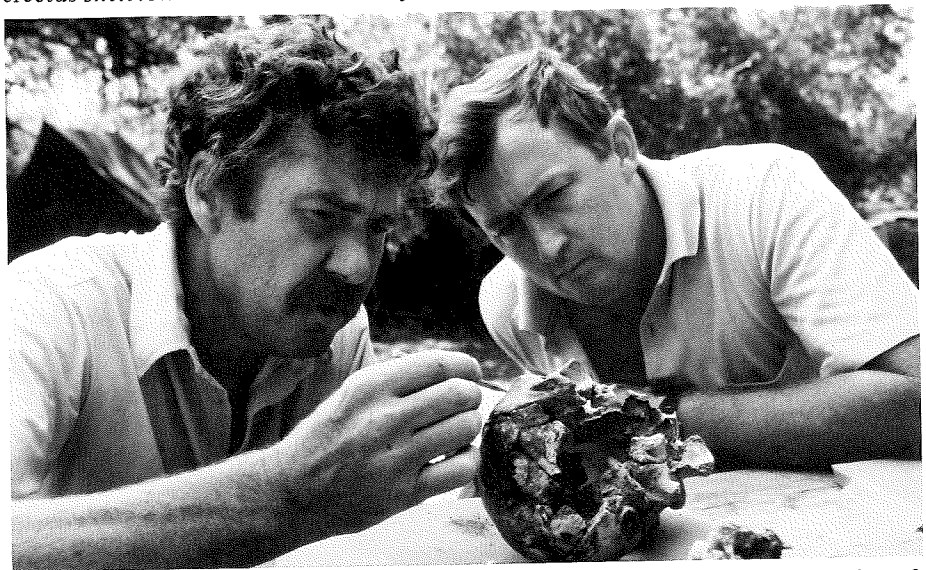
Earlier discoveries of *Homo erectus* fossils have been much more fragmentary. The only major missing portions of the new skeleton are the left arm and hand, the right arm from the elbow down and most of both feet. There are no visible signs of illness or trauma, adding to the value of the discovery. The only other example of *Homo erectus* found with bones below the neck had suffered from a bone disease.

Pieced together like a three-dimensional jigsaw puzzle, this is the reconstructed skull of a young male Homo erectus *found on the western shores of Kenya's Lake Turkana, and dated as being about 1.6 million years old.*

Stretching the bounds of man's knowledge of his ancestors, Richard Leakey, director of the National Museums of Kenya, digs out a bone of a Homo erectus *who lived 1.6 million years ago. Leakey and Alan Walker of Johns Hopkins University Medical School, veterans of paleoanthropological fieldwork in Africa, headed the expedition, which was financed by the National Geographic Society and the National Museums of Kenya.*



Kamoya Kimeu, leader of the famed fossil-hunting team of the National Museums of Kenya, digs for more pieces of bone on the west side of Lake Turkana in Kenya. It was Kimeu's find of a small skull fragment that began the discovery of a Homo erectus *skeleton that is the most complete early human ancestor skeleton ever found.*



Alan Walker (left), a professor at Johns Hopkins University Medical School, and Richard Leakey, director of the National Museums of Kenya, study the skull of a Homo erectus *found on the west side of Kenya's Lake Turkana.* □

FIELD REPORTS

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

THE ETHNOARCHEOLOGY OF FARM SHELTERS AT HANI, GHANA

Merrick Posnansky
Departments of History and Anthropology
University of California, Los Angeles

There has been a dramatic shift in West African archeology, as elsewhere in Africa, from casual excavations to produce sequences of pottery and work out inter-regional cultural relationships to more extensive examinations of single sites, often over a period of many seasons, in order to learn about past patterns of human behavior.

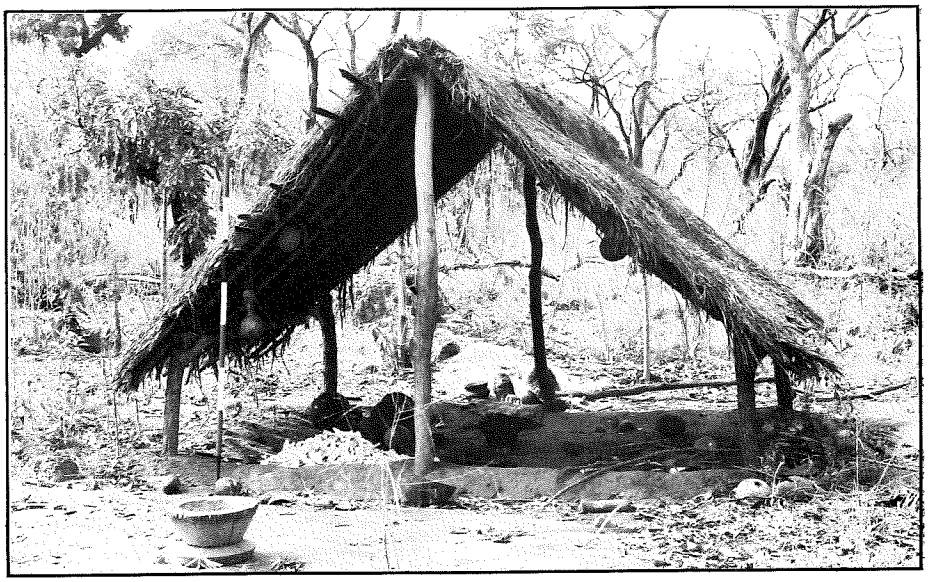
In recent years, insights into past behavior have often been obtained through the use of ethnoarcheology in those areas where elements of continuity can be clearly demonstrated from the prehistoric communities to their present lineal descendants – those living in physical environments little changed and with technologies at a similar stage of development. Partly as a result of such new approaches, archeologists have learned to appreciate the importance of intra-site relationships as they demonstrated that the bulk of recognizable activities took place outside the walls of the houses they were investigating. Site catchment analyses demonstrated the need to view settlements within their natural resource areas. Studies of agricultural and other procurement activities in modern settlements, such as the ones that I undertook with my colleagues at Begho in Ghana, were stimulated by such approaches. It was in the course of studying the seasonal farming, collecting and hunting activities of the villagers of Hani in 1975, 1979 and 1980 that I became aware of the fundamental importance of farm shelters within the food procurement cycle. Work elsewhere in Ghana and Togo convinced me that I was not dealing with an isolated phenomenon but one with widespread implications.

Archeologists have in the past focused their attentions on surface concentrations of artifacts. Discrete clusters within a broad scatter have been presumed to indicate houses or rubbish dumps within a village or town. The distinction about the latter is based on the distribution area of the scatter and the nature of the identified structures and artifacts. Isolated dispersed finds away from such settlements have been ignored or discounted as accidental finds and their significance has rarely been integrated into the detailed information obtained from the settlement sites which have been major foci of archeological attention. It is the contention of my research that these dispersed scatters around large concentrations probably indicate former farm shelters of the community contained within the larger concentration and should not be ignored. They will ultimately provide information on the resource strategies of the past communities.

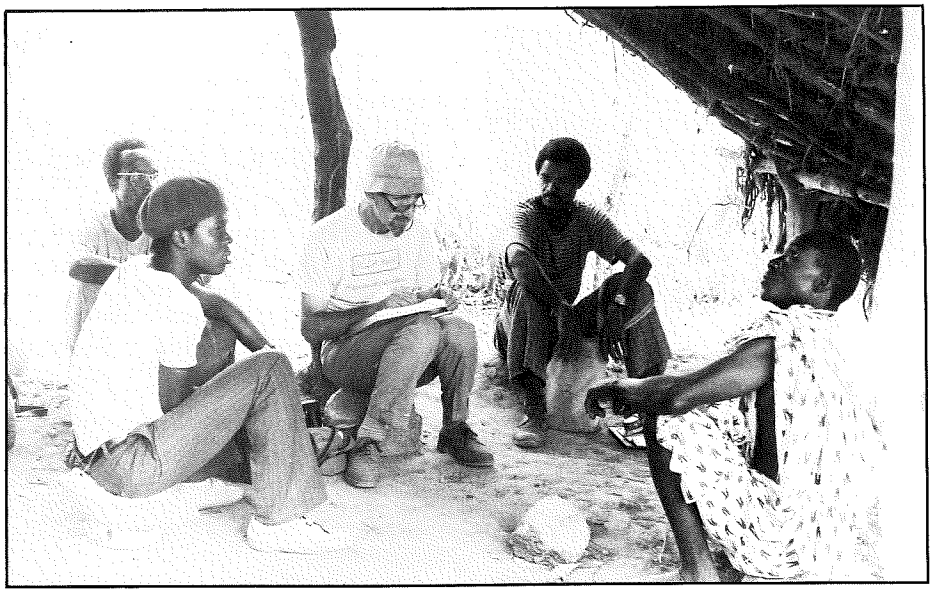
To understand their nature at the present time I returned to Ghana in 1983 where, with the help of my former colleagues from the Department of Archeology of the University of Ghana, we conducted further research at the village of Hani. The work was supported by grants from the L.S.B. Leakey Foundation and the University of California, Los Angeles, Senate Research Committee. Hani is located just north of the forest some 350 km northwest of Accra, the capital of Ghana. Our research involved working during the day with the individual farmers, visiting shelters and making detailed plans of their contents and physical setting. We conducted questionnaires on general aspects of rural economy in the village during the relaxed time of the early evening.

The village of Hani is the lineal descendant of the medieval and early modern trade town of Begho (ca. A.D. 1100-1800). The chief and elders of Hani preserve a rich heritage of oral tradition. Its population is presently around 1100 to 1200 living in some 110 houses. All the householders to a greater or lesser degree engage in farming. Yams are the dominant crop followed by maize, beans, cassava, groundnuts and rice. Tobacco is one of the few non-food crops. Nine out of every ten farmers actively hunt, trap and collect upwards of 170 wild plants as foods, relishes, medicines and for making into soaps. In times of stress, as during the last few years of drought and acute economic depression in Ghana, the number of collected and hunted species and the quantities involved have drastically increased. A slash and burn agricultural cycle allows for yam cultivation in the first year, followed by two years of other crops. Then the land is left fallow for between five and 20 years. Seventy percent of all the farms lie between two and four hectares under cultivation at any one time. The smallest farms, generally worked by the women on the shortest fallow rotation, are the ones nearest the village and tend to include the greatest variety of minor crops such as peppers, okra and tomatoes.

A sample of 25 shelters in different locations was studied. A surprising uniformity of design, size and use was observed. Most shelters (*pata* in Brong) are used for three years, are rectangular in shape, oriented north to south and have a mean size of 4.7m in length, 3.5m in width and 2.4m in height with the greatest variation being in the length. Roofed with either grass or borassus palm fronds, which are viewed as being more durable but also more prone to snake and wasp infestation, they are normally erected by the farmer himself in about a week. Occasionally the northern end is closed with a rough grass wall. They are used for sheltering



Farm shelter at Hani, Ghana, 1983.



Merrick Posnansky interviewing farmer in shelter at Hani, Ghana, with colleagues from University of Ghana.

from the heat of the midday sun and the rain, for storing tools and foodstuffs, as a base for minor food processing such as corn hulling and cassava drying, for preparing meals on the farm and as a place to relax away from the village. Often several shelters are built relatively close to one another providing a sense of community on the farm. Though paid laborers, largely Dagarti from the north, sleep there during the busy yam mound building or weeding season, the farmer rarely does. He keeps a special set of pots and a pestle and mortar there but other items like stools are made at the shelter. Several tools which are never seen in the village, such as the wooden yam planting implement called the *paga*, are kept permanently in the shelter. The most often given reasons for the origin of the shelters are that farmers began them to maximize their time on the farm and that the shelter provided a place to keep a permanent fire. All the shelters have at least one hearth consisting of three stones, many have an internal bed or bench, and a little under half the farmers keep chickens and may have special nesting baskets.

The farmers keep the areas of their shelters remarkably clean, regularly sweeping up rubbish. Seventy six percent place the rubbish in a single pile, rarely more than 70 to 80cm high, while half also place a heap of cassava peelings some 10 meters from the shelter to provide a fertile environment for mushrooms to grow during the rains. Several have traps set close to the shelter to catch grasscutters, rats and birds, both for food and as a way to deter them from eating stored foodstuffs. One farmer had 95 tension traps, 150 wire snare traps and five spring traps set within a kilometer of his shelter and could occasionally catch up to six creatures in a day. Considering that today a smoked grasscutter is worth 20 times the urban daily wage, this can be quite a profitable pursuit. Some farmers use their rest hours for communicating skills and farming lore to the young. In former times it was quite common to keep a musical instrument like a xylophone at the shelters.

Most farmers can readily recognize where shelters existed up to 20 to 30 years ago; 65 percent recognize the sites from hearth stones, and 47 percent can readily identify former shelters from sherd scatters and rubbish heaps. It is of interest that nearly one in three farmers is able to pick out sites from the vegetational changes that the shelters cause. Most shelters have such trees as palms and mangoes nearby which are the result of the farmer throwing away seeds. The tree pattern persists long after the rubbish dump, never very high, has merged with the broken terrain or the hearth stones have perhaps been separated.

When the farmer shifts to a new area he leaves behind a cleared area, a rubbish heap and the hut. Occasionally he may take a few of the poles to build his new structure. He never takes his hearth stones or the stones he has dragged in to sit upon or to use as an anvil for straightening the odd tool. The fringe of vegetation, the result of his eating and defecating habits, remains. Some of the young trees like mangoes or papaya are planned to provide fruit for him when he is next in the area but others are purely accidental. In course of time a network of little sites is built up around the major settlement. They are ephemeral, rarely lasting more than four years, but are sites where a whole range of activities has been undertaken, where possibly a half dozen pots have been broken and where worn out fragments of knives, cutlasses, and hoes are also left behind, as well as minor fragments of wire snares and metal traps. It would be a Herculean task to identify and plot all such past sites but at least I feel that this study indicates that the scatters of pottery, the occasional bones or metal fragments away from major Late Iron Age or historic settlements fit into a pattern. Their density should indicate the length of occupation of the site they surround while their distance from the site suggests the size of the settlement on the premise that the larger the site, the greater the area of the catchment and the further the distance of many of the farming activities. In the same way that we have had to move away from studying just the area within the few walls of a house, so we need to examine a past settlement within its wider agricultural procurement zone. Go into any West African village in the day and it is deserted; the same was true in the past. We need as archeologists to appreciate where the action was taking place, down on the farm and often around the shelter.

CORD ROULETTED POTTERY IN KENYA

Simiyu Wandibba
National Museums of Kenya
Franklin Mosher Baldwin Fellow

In many parts of western Kenya potmaking is still an important craft. Pottery is still regarded as a necessary utensil. Many families continue to use pots to collect and store water, to cook in, to make beer in, to drink from and to store various types of food. In addition to these domestic uses, pots have a commercial value in that they are still sold in large numbers.

Most of the pottery in western Kenya today is made by Luyia and Luo potters. Luo pottery, especially, has become very popular in Kenya and can be found in markets throughout the country. It is worthwhile noting, however, that some of the so-called Luo pottery found outside western Kenya is, in fact, not Luo but Luyia. The Luo and Luyia pots have similarities that might make it difficult for a casual observer to distinguish one from the other, and so all pottery from western Kenya has been labelled Luo on the outside markets.

It has become an accepted fact that the way pots are made is conditioned by the cultural norms of the people making and using them. This means that in

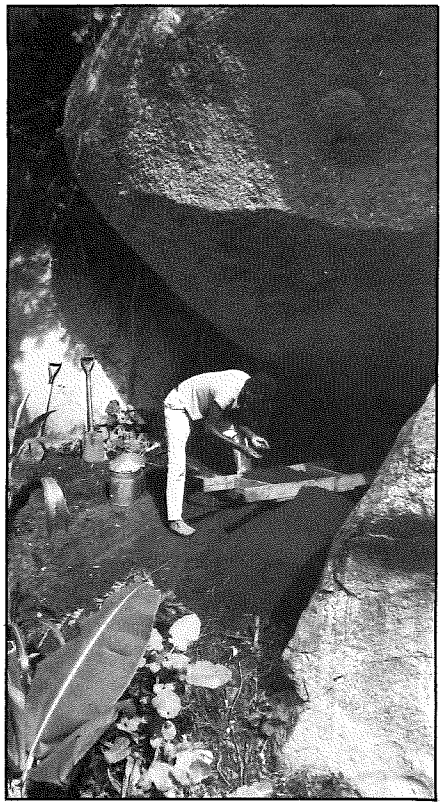
general it should be possible to distinguish the pots made and used in western Kenya on the basis of the ethnic group that made them. Thus, a pot made by a Luo potter should differ from that made by the Luyia or Kalenjin potter, for example. This is generally true, but in areas of contact between the different ethnic groups one expects a certain amount of overlap. However, there appears to be one common element in the pottery that is made in the area today. It exists in the decorative technique, namely, cord roulette impressions. Motifs, however, differ from one ethnic group to another and, in some cases, from one locality to another.

Cord rouletted pottery was first reported in Kenya from the central Rift Valley by Louis Leakey (1931), who described a very small and fragmentary assemblage of pottery from a Nakuru burial site, about five or so kilometers outside Nakuru on the main road to Nairobi. A more elaborate description appeared in Mary Leakey's report on her excavations at Hyrax Hill (1945) with reference to pottery recovered from a locality she described as the "northeast village." The characteristic features of this pottery are the presence of spouts and vertically applied handles, together with impressed rouletted cord decoration. The basic vessel shape seems to have been the "globular" form with round bases and straight or slightly everted rims.

There was another locality at Hyrax Hill that also yielded cord rouletted pottery, referred to by Mary Leakey as the "Iron Age settlement." The main features of this pottery are impressed cord decoration, round bases and vertically placed handles. The so-called "globular" forms appear to be lacking and instead the basic vessel form seems to be a pot with convex walls and either straight or slightly everted rims. Whereas the impressions of the majority of specimens were made with a twisted cord roulette, the ones on eleven specimens were executed with a knotted cord roulette.

Both Louis and Mary Leakey ascribed this pottery to the "Gumban B variant of the stone bowl culture," on the basis of the apparent association with stone bowls at the Nakuru burial site, the name being taken from an earlier people known in the historical tradition as the Gumba. According to Louis Leakey, this variant of the stone bowl culture was of Neolithic age and it was still regarded as such as late as 1959. Later it was found that this type of pottery was not and is, in fact, dated to the Late Iron Age period.

In 1962, Merrick Posnansky coined a new name for this "Gumban B," labeling it the "Lanet culture." Lanet is the name of a Late Iron Age site excavated by Posnansky in 1957 which lies about



S. Wandibba – work in progress.

7km to the east-southeast of Nakuru town and not very far from Louis Leakey's Nakuru burial site. The site has been radiocarbon dated to 1585 ± 100 A.D. The chief characteristics of the pottery from this site were given as: simple forms based on elongated gourd prototypes; vertical handles placed near the rim, normally on opposite sides of the pot; straight rim forms with squared lip and cord rouletted (or knotted grass) decoration around the rim, often on the lip edge and, in the case of many of the more elongated forms, also running vertically down the pot between and often down the handles themselves. This is in general very similar to Mary Leakey's description of the specimens from the northeast village. It should be pointed out, however, that none of the Lanet specimens that I have examined recently has a knotted roulette decoration. The decoration was executed with a twisted cord roulette.

In the light of the preceding descriptions of the Hyrax Hill and Lanet specimens, a redefinition of Lanet ware appears necessary. The main characteristics could now be said to include: pots with convex walls and straight or slightly everted rims; twisted cord rouletted decoration and vertically placed handles. Spouts and lugs may also be present. In general, the rims are square-shaped and decorated with a twisted cord roulette. The decoration occurs in either single or double horizontal bands.

Most of the pottery that is made in Western and Nyanza provinces today does not have all the same features as Lanet ware. For example, spouts and handles are, in general, lacking. Some of the pots, however, have lugs and the dominant decorative technique is that of cord roulette impressions. Since decoration appears to be one of the most useful means of defining typological relationships between different groups of pottery, one could assume a certain amount of similarity between modern western Kenya pottery and Lanet ware. After all, the presence or absence of features such as spouts and handles depends mainly on the use to which the vessels are put. Most of the pots made in western Kenya today, however, differ in vessel form from those of Lanet ware. Furthermore, most of this modern pottery is decorated with a knotted rather than a twisted cord roulette. Among the Luo, the twisted roulette appears to be limited in its use to decorating small vessels that are made in imitation of metal and plastic bowls in vogue today.

On the other hand, modern Okiek pottery is characterized by paired handles, two or more lugs, and various rouletted designs. Both the twisted roulette and the knotted roulette appear. The decorative motifs on this pottery are very similar to those on Lanet ware pots. A continuity in the pottery tradition in the Rift Valley is thus implied.

Marakwet pottery constitutes another manifestation of continuity in the Lanet ware tradition in the Rift Valley. None of the other Kalenjin collections examined had as many attributes in common with Lanet ware as either the Okiek or Marakwet pottery.

Outside of the central Rift Valley area, twisted cord rouletted pottery has been observed as far east as Lukenya Hill, near Athi River, at Karura Forest, near Nairobi and as far west as Bungoma and Busia.

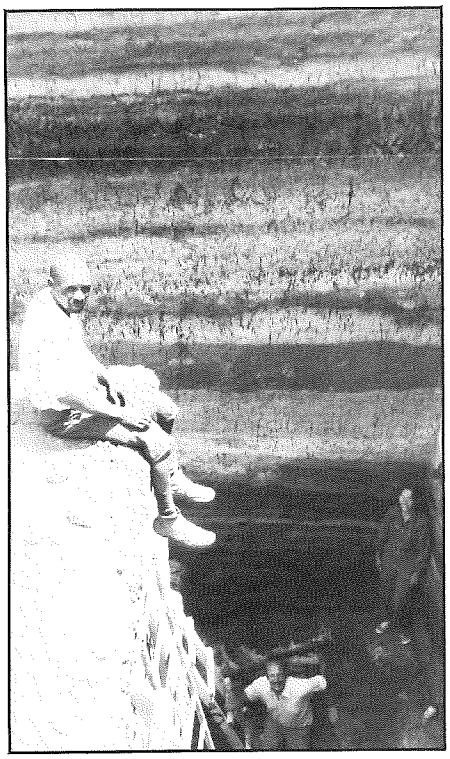
Unfortunately, there are very few sites with Lanet ware that have been dated by radiometric means. Work undertaken in the Rift Valley by a University of Massachusetts team has revealed that most of the dates for this pottery lie between the fifteenth and eighteenth centuries. Lanet ware was probably in general use within the central Rift Valley at least from the start of the sixteenth century.

Most of the pottery ascribed to Lanet ware has been recovered from the "Sirikwa holes." This suggests that it was made by the creators of these "holes," who are assumed to have been people known as the Sirikwa. These people feature quite widely in the oral traditions of the Kalenjin, Maasai and Baluyia. The oral traditions suggest that the Sirikwa, whoever they were, originated east of Mt. Elgon and that they

ultimately occupied the area now referred to as the Uasin Gishu Plateau.

As already stated, nearly all the pottery made in Nyanza and Western Provinces today is decorated with a *knotted* cord roulette. When and where this method came into existence is still uncertain. What is clear, however, is that the adoption of this particular technique is more recent than the use of the *twisted* cord roulette.

Contrary to the excavation reports, no knotted rouletted pottery is present at the type site of Lanet or at Kabyoyon on Mt. Elgon. Furthermore, there is continuity in the Lanet tradition within the Rift Valley. We have seen that both the Okiek and the Marakwet made pots quite similar to the pottery excavated from Lanet sites. Lastly, the pottery made in western Kenya today is not similar to Lanet ware. My recent excavations in Bungoma district have resulted in the recovery of much pottery that is in many respects similar to that made in the area today. This pottery was found associated with tobacco smoking pipes. Thus the adoption of the knotted cord roulette is unlikely to be much older than two centuries at most.



John Thebe, Kathleen Kuman and Ron Clarke positioned at various levels in a trench at Florisbad which exposed eight meters of stratified deposits.

MIDDLE STONE AGE HUMANS IN SOUTHERN AFRICA: OPEN AIR SITES AT FLORISBAD AND GI

Kathleen Kuman
Franklin Mosher Baldwin Fellow
University of the Witwatersrand
Johannesburg, South Africa

Some half-million years after man began living in caves, archeologists discovered their value as places that preserved traces of the prehistoric past. Caves were natural shelters that concentrated much human activity in one place and protected cultural material and bone from the elements. In much of southern Africa, however, the human past has also been investigated at open air locations such as pans, ancient lake shores or springs. Such venues can provide a stratified record of the past because they may have been used repeatedly over thousands of years. The study of both types of sites gives the prehistorian a more complete picture of the past. During 1982-1983, travel grants from the L.S.B. Leakey Foundation, the Boise Fund, and the University of Pennsylvania enabled me to work at two fascinating open air sites, Gi and Florisbad and to undertake the artifact and archeological analysis for a doctoral thesis.

Gi is a site located on the edge of a seasonal pan, or natural basin, in the northwest Kalahari Desert of Botswana, less than one kilometer from the border with South West Africa/Namibia, in the Dobe Valley north of the Aha Hills. The site was discovered in 1969 by John Yellen with the aid of the local !Kung Bushmen. Since the initial work in 1969-1970, Gi has been excavated over four field seasons by Dr. Alison Brooks of George Washington University. In 1976, a student on the Brooks-Yellen expedition, Aron Crowell, discovered that the !Kung San were carrying on their traditional practice of ambush hunting at pans. Crowell's ethnographic study of these hunts thus provided a likely analogy for use of Gi pan in prehistory and a fitting glimpse through time for a region where Bushmen peoples are thought to have lived for millennia.

San hunts are held on moonlit nights during the dry season when game is restricted to a few remaining water holes in this semi-arid environment. The practice today is for a small party of men to rest concealed behind a blind built of a circle of stones. At other pans where no stone is available, brush alone is used for the blind. With bows and poisoned metal arrows the men shoot as many animals as possible during the night and follow the spoor of their wounded prey in the morning, locating the dead or dying quarry. We have no evidence that any prehistoric hunters at the pan used poison, and metal arrows are a recent acquisition, but Late Stone Age peoples did have the bow and arrow. They may also have employed pitfalls or killed game directly with spears. Back beyond 30,000 or 40,000 years, Middle Stone Age hunters at Gi may have used spears and ambush tactics or even game drives.

Historically, the Bushmen have also been known to make pitfalls for game near water or along game trails. In the early 1900s, their construction came under European prohibitions or controls. During the 1982 excavation, we were witnesses one morning to a kudu hunt that actually made use of one of our archeological pits. We arrived at Gi to find a large male kudu being chased by a pack of hunting dogs led by one hunter's well-trained animals. They managed to drive the exhausted kudu into the pit, where the hunter easily killed it with a metal spear.

In the Late Stone Age units at Gi, five pit features have been located which Dr. Brooks interprets as ambush structures and pitfalls. They contain bone fragments and artifacts, as well as scattered charcoal, probably from fires used for warmth during the wait for game or for cooking prey too large to remove completely from the pit. The historical analogy for these pits is plausible as the most recent date for Gi is only 110 ± 50 years, well within the period of recorded Bushman settlement in the area. A lacustrine limestone underlying the Late Stone Age levels has been carbon 14 dated to $23{,}980 \pm 590$ years. Altogether, the Late Stone Age units are 80 cm thick and contain a microlithic culture known as the Wilton, which includes small crescents, scrapers and bone points.

Below is a layer of calcrete or lacustrine limestone of up to 50 cm thickness, which has sealed in over one meter of Middle Stone Age deposits. Ostrich egg shell fragments from these levels have all produced carbon 14 dates beyond the range of the method. The fauna contains three extinct species typical of the Middle Stone Age, while the style of the tools seems consistent with the later Middle Stone Age. Most significantly for dating, Dr. David Helgren's sedimentological studies of the site suggest an Upper Pleistocene age for the main Middle Stone Age unit somewhere in the range of 50,000-100,000 years B.P. The work done so far suggests that the Gi environment in Middle Stone Age times was somewhat more arid than the region is today. We get a picture of Gi as a fresh water pan with its own localized vegeta-

tion, surrounded by a dry, almost treeless grassland, where extinct giant zebra, buffalo and hartebeest were hunted along with the extant warthog and zebra. Fauna is not well preserved, probably due to trampling by game using the pan to drink and to the periodic water-logging of the deposits by water without the mineral properties to harden bone.

Among the artifacts, both formal tools and waste are abundant. Of more than 1400 retouched pieces studied prior to the 1982 excavation, 25 percent are unifacial and bifacial points typical of the Bambata Complex of the Middle Stone Age. The most comparable tool industry to Gi is found in Zimbabwe, but equivalent types elsewhere have been referred to as the "Stillbay" culture.

The Gi tools also show that raw materials for their manufacture were used to the extreme. Most cores are small and skillfully reduced, and retouched tools were often kept in service by several resharpenings of the working edges.

Another focus of the work at Gi concerns problems of stratigraphic disturbance that can originate in a number of ways. Firstly, smaller sized material at a site can shift from its original horizon downwards if the deposit is relatively loose or if cracks in a drying land surface develop. Secondly, human activity at a site can have a serious effect. Material can be brought both up and down as people dig pits for water, game or cooking. Thirdly, burrowing animals can bring material up or down from its original horizon. Both people and animals also trample objects into the ground, particularly if the deposit is muddy from seasonal rains.

Over 1100 km from Gi to the south of the Kalahari basin, the site of Florisbad is located in the flatland of the Orange Free State of South Africa. It is the locus of warm springs that have been active possibly since the late mid-Pleistocene. In 1912, important fossil finds later described by Dr. Robert Broom came to light when the owners of the original farm began digging a swimming pool at the springs. The abundance of well-preserved bones eventually elevated Florisbad to the status of a type site for Middle Stone Age fauna, and together with the nearby site of Vlakkraal, the "Florisbad-Vlakkraal faunal span" was described. In 1932, an even more exciting find came to Profesor T. F. Dreyer – the partial cranium of an archaic *Homo sapiens*. All these fossils seem to have come from the spring eye deposits, which had cut through a number of layers laid down over millennia. Although these spring eruptions were local and very limited, the early investigators left us none but the vaguest records on the precise provenance of their finds.

Since 1981, Dr. R. J. Clarke, a specialist in fossil hominids and African prehistory, has been conducting new excavations through the National Museum in Bloemfontein. He has also undertaken a new reconstruction of the hominid cranium and has found the original one in error on a number of points. Improper conjoining and orientation of the facial bones had given an incorrect anatomy to the face.

Many of the dates published for Florisbad over the years can no longer be considered accurate. The deposits were penetrated by modern roots which make precise radiocarbon dating difficult, while dates for the lower levels based on amino acid racemization are not reliable. A new dating program is now under way. Dr. J. C. Vogel has provided a carbon 14 date on charcoal of >43,700 years for an important occupation level midway through the depth of the site.

The excavated areas consist of up to eight meters of well-stratified deposits sandwiched within four major peats. The top cultural unit, a silty clay, contains a Late Stone Age industry of Holocene age, a type of Smithfield. A Middle Stone Age occupation floor of indefinite radiocarbon date was found between two peat layers. Here prehistoric people must have hunted game at a lake or swamp created by the springs. The occupation floor is well-preserved and around a hearth found at the western limit of the excavated area are the remains of numerous animals, largely grassland bovids and hippopotamus. Many bones were smashed and fragmented in butchering or marrow extraction. The remains of a single hippo were also found.

Artifacts, as well as concentrations of chipping debris, were discovered throughout the occupation floor. One of the very exciting finds for this layer is a number of artifacts which can be fitted together as conjoining pieces. Such "retrofitted" tools show the extent of a single occupation.

Trampling on this level must have been minimal as the artifacts are sharp edged. Bones here differ from the fossils found in the early excavations of the spring eyes. They are poorly mineralized and although a variety of body parts was found, the fauna is fragile and poorly preserved. This differs from the well-mineralized bones found by the original investigators, apparently in the spring eyes. To date we have dug five areas down to bedrock to find the fossil-rich deposits. Important stratigraphic information has emerged, but the fossils remain elusive. The fauna from the old collections shows a variety of extinct types: the giant long-horned buffalo (*Perlorovis*), the giant short-necked giraffe (*Sivatherium*), the giant hartebeest (*Megalotragus*), the giant zebra (*Equis capensis*), extinct forms of lechwe (*Kobus venteri*), blesbok (*Damaliscus niro*) and springbok (*Antidorcas bondi*), and an extinct subspecies of wildebeest (*Connochaetes gnou antiquus*). Modern hippopotamus were also very common. Also present were modern hyena, jackal, wild hunting dog, otter, mongoose, warthog, eland, black rhino, various rodents and the quagga and zebra.

A further interesting difference has emerged in a comparison of the old artifact collections with the assemblage from the occupation floor. Rounded stone balls which we think were used as throwing stones in hunting are found only in the spring areas. One way of hunting larger game must have been to mob the animal, attacking with these heavy projectiles once it had become surrounded or mired in the swamp. The old collections also contain numerous retouched artifacts, including many unifacial points and what Dr. A. J. Meiring in 1956 described as a "Macrolithic Culture" from the base of the site, which we have found nowhere else to date. Although some natural stones were described as artifacts, a number of crude flakes and core-like tools, mostly in dolerite, do occur. Whether this assemblage represents an earlier tool industry or merely has this appearance as a result of the crude rock used is still unknown.

Aside from its valuable fauna and tool assemblages, Florisbad is a unique site in its long record of paleoenvironmental information preserved in a complex stratigraphy of over 12 meters. A more complete picture of the succession of environmental change at Florisbad will emerge. As to fauna, Dr. Clarke has made certain observations on bones from the original excavations. Before fossilization, bones weathered and suncracked on the surface and many horn cores became riddled with grooves from horn moth larvae. Large numbers of the bones, including the hominid cranium, also show signs of having been broken and gnawed by hyenas. This observation shows that the bones from the spring deposits, unlike those from the newly excavated occupation floor, were probably concentrated, if not also accumulated, by hyenas rather than man. Only then were the bones fossilized, probably with minerals in the spring water.

Another stage in their history occurred when the bones became eroded: deep pits, grooves and gouges occur along with polished surfaces. Bone canals that were filled with calcium carbonate from the fossilization process were left standing from the surface as surrounding bone was eroded away. What this pitting and polishing may mean is a complicated issue and all possible influences must be considered.

Thames terraces excavation.

THE THAMES TERRACES

As a result of five years' work by P.L. Gibbard of Cambridge University, studying boreholes and geological exposures produced for motorways and new industrial developments, the chronology of the Pleistocene terraces of the River Thames west of London has been entirely reformulated. This classic area for early man living sites has been little studied in the last 50 years. This spring (1984) with the aid of a Leakey Foundation grant, Dr. Gibbard was able to do the final field work and produce the drawings that tied the early man sites into the picture. At the same time he has been able to move down river to the other side of London, where the river terraces can be tied up with his new chronology, and he is planning further studies at the site of the discovery of Swanscombe Man, and other early man sites in the area.

Swanscombe itself was the site of an important excavation by Louis Leakey just before World War II, whose results were never published because all the records were destroyed in London during the war. Many of the finds from this excavation are in the British Museum and Phil Gibbard hopes to place these in their proper position.

Meanwhile his completed research west of London has defined the areas to search for new early man sites, and will be consulted continuously as these become available because of further industrial development. The completed research project has been handed in to the printers and will be published in 1985 as a geological monograph by the Cambridge University Press. □

HUNTER-GATHERERS ON THE ROAD TO EXTINCTION

All of us who live today are descendants of hunter-gatherers. In our earlier history, before the advent of agriculture and pastoralism, all humanity lived by hunting and gathering. Today, the few remaining practitioners of this way of life are diminishing at an increasingly rapid rate and will, quite surely, disappear before long under the impact of modern civilization. Very soon any living model of our early ancestral societies will be beyond redemption.

A special issue of the *Cultural Survival Quarterly* (Vol. 8, Fall 1984) describes the struggles of modern hunter-gatherer groups to adapt to today's society, including the Negrites of the Philippines, the Mbuti Pygmies of Zaire, the Insuit of Canada and the Bushmen of Namibia. Cultural Survival is an anthropological association in Cambridge whose central interest is protective action. This issue of its *Quarterly* is of much interest to anyone who wishes to know more about tribal peoples. The address of Cultural Survival is 11 Divinity Ave., Cambridge, Massachusetts 02138.

Dr. Irven DeVore of Harvard University, an officer of Cultural Survival and a member of the L.S.B. Leakey Foundation's Science and Grants Committee, says that as recently as 2,000 years ago about half the human race still lived by hunting and gathering. (See Dr. DeVore's article on page 3.) Today, probably no group depends entirely on such activity for its livelihood. "The rapid cultural change of the last 10,000 years is in a sense a cultural veneer on an older biological pattern," DeVore said. "Our deepest emotional makeup — what makes us happy, sad or loving — evolved around the campfires of hunter-gatherer bands." The study of present-day peoples retaining remnants of these campfire traditions can reveal much about the range of human and environmental possibilities and improve our understanding of human evolution. □

The Grant program 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. Members and donors are invited to designate their gifts in support of specific research projects.

Won't you take this opportunity to direct your contribution to the grant project of your choice?

GRANT SPOTLIGHT

Brigitte Senut *$1,500 needed*

STUDY OF EVOLUTIONARY PATTERNS IN HOMINOID ELBOW JOINTS

Professor Senut of Paris' Musee de l'Homme will study the fossil remains of Miocene primates and some Kenyan specimens in Vienna and Nairobi. She will ask key questions concerning the evolution of the upper limb, especially the humerous and its joints. Comparisons with modern primates will be made.

Eitan Tchernov *$4,250 needed*

LATE PLIOCENE– EARLY PLEISTOCENE FOSSILIFEROUS SITES IN THE JORDAN VALLEY

During these time periods, the Levant served as a corridor between Africa and Eurasia and there is every reason to believe that the spread of early hominids took place via this area. The Era-el-ahmar Formation is likely to hold evidence of this migration. Professor Tchernov of the Hebrew University of Jerusalem proposes to obtain a better understanding of the formation and to excavate in the 'Ubeidiya Formation in which Oldowan artifacts have been found.

Katherine Ann Manley-Buser *$1,500 needed*

A METEROCHRONIC STUDY OF THE HOMINOID FOOT

This study will look at the growth and evolution of the foot in large bodied hominoids and will distinguish those differences in ontogeny which are due to an increase in size from those that may reflect other adaptations. Of special interest are the changes that lead to the evolution of the human foot.

Andrew Sillen *$4,140 needed*

STRONTIUM AND DIET OF EAST AFRICAN EARLY HOMINIDS

The goal of this research is to determine the role of meat in the diet of early East African hominids. A bone chemistry technique has been developed in the last year that can determine this ratio in bone remains as early as two or three million years ago.

Paul Sondaar *$1,800 needed*

PLEISTOCENE ISLAND MAN OF SARDINIA

Human remains of about 13,500 B.P. have been discovered on Sardinia in association with fauna and bone tools. Professor Sondaar of Belgium wants to begin the first season of fullscale excavation in cave deposits there. This project could help in the understanding of a paleolithic culture in an island environment and the response of hunter-gatherers to the arrival of agriculture.

David Watts *$10,000 needed*

ECOLOGY OF THE MOUNTAIN GORILLA SOCIAL SYSTEM, KARISOKE RESEARCH CENTER

Funding is needed for the continuing operation of the Karisoke Research Center in Rwanda, the location of much important primate research by Dr. Dian Fossey, where Dr. Watts is now conducting further study of the behavioral ecology of the mountain gorillas.

Erik Trinkaus *$2,895 needed*

DIAPHYSEAL BIOMECHANICS OF LATER PLEISTOCENE HOMINID FEMUR AND TIBIAE

The purpose of this research is to increase our understanding of patterns of hominid locomotor skeletal anatomy, the evolution of the human lower limb in the genus *Homo* and finally the habitual levels and patterns of locomotion associated with later Pleistocene human adaptive evolution.

Kim Hill and Hillard Kaplan *$6,860 needed*

STONE AGE FORAGERS OF MANU NATIONAL PARK, PERU

This project will continue the work begun in 1982 under a Leakey Foundation grant, about which the scientists wrote in the last issue of *AnthroQuest*. The Mashco-Piro Indians are believed to be still living as hunter-gatherers.

Ralph L. Holloway *$5,000 needed*

COMPARATIVE AND PALEONEUROLOGICAL APPROACHES TO HUMAN CEREBRAL ASYMMETRIES AND EVOLUTION

Dr. Holloway of Columbia University requests funds for equipment and travel related to the collection and preparation of specimens, and for data publication costs.

Louis de Bonis *$2,200 needed*

HIGHER PRIMATES AND FAUNAL TURNOVER DURING THE LATE MIOCENE OF NORTHERN GREECE

Professor de Bonis needs funds to excavate for hominoid primate specimens of the Late Miocene in northern Greece in order to make comparisons with similar material from India, Pakistan and China representing *Sivapithecus, Gigantopithecus* and *Orangopithecus*. This study will help to clarify the relationship between apes and hominids. □

continued from page 1

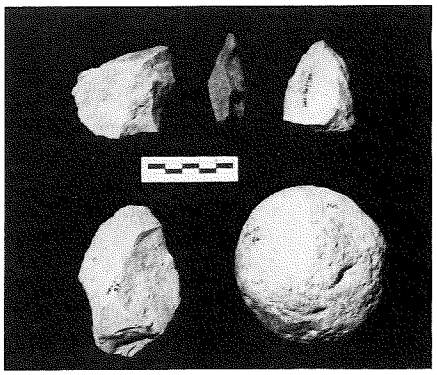
the earliest stages.

These are just our very first steps, as it were, in this kind of understanding. But as time goes by, the models will quite clearly become more tightly focused and have greater reliability as more and more data become available and as we develop better techniques of identification and interpretation such as identification of organic traces. Recent studies have shown that apparently it is possible to identify blood proteins on the edges of tools that have been used as far back as 6,000 years ago and furthermore to identify what species of animal it was that the bone and blood came from. If this method stands the test of further work and if it can be used as far back as the Plio-Pleistocene boundary, then indeed we are in business in a big way.

I must emphasize, though, that these hypotheses and models are only as good as the empirical data on which they are based. Appreciably more data occur on the hominid sites and activity places than we are able to recognize and use today. What we can extract depends on the intellectual approaches and techniques that are available to us at the present time. What we know today was undreamed of when I was a student at Cambridge 48 years ago. We spent a tremendous amount of time looking at river gravels because that is where we were told to look and that is where all the early paleoliths in Europe had been found. It took us quite a long time to realize that this wasn't going to tell us all that much about behavior.

It was not until the late 1940s and the early '50s that Louis and Mary Leakey's excavations at Olorgasailie and my own at Kalambo Falls showed that it was possible to uncover early hominid activity areas that had suffered no major disruption by geological or animal agencies before having been covered by more deposition and so sealed until we actually uncovered them ourselves. In 1959, the first early hominid was found by the Leakeys in an open site at Olduvai Gorge, a skull of the robust australopithecine. There followed a hitherto unprecedented number of hominid fossils from East Africa and the Ethiopian Rift regions.

Now the prehistorian was no longer alone in his ongoing investigations and scientists in many different disciplines became involved. These geologists and physicists developed various degrees of radiometric dating that for the first time gave us a reliable time scale and showed the length of time that each biological and cultural grade lasted. Botanists, paleontologists, ecologists, climatologists, animal behaviorists and many others are now involved. So was born



Stone artifacts of Middle Pleistocene age. Knife, scrapers and a spheroid used in the probable butchery of a hippo carcass at the site of Hargufia (HAR-A2), Middle Awash, Ethiopia.

the new discipline of paleoanthropology. Today, team study – interdisciplinary and international in composition – is greatly extending our knowledge of the chronology, paleoecology and behavioral aspects of early man research. Excavations are now aimed at exposing as large an area as possible of the surface horizon on which the evidence of hominid activity has been found. The possible relationship of everything to everything else is plotted and studied and analyzed.

Dramatic advances have been made during the past 10 to 15 years in understanding the archeological data. The initial naivete which we all had of assuming that all accumulations of stone artifacts and bones that were found together were quite clearly the result of hominid activity has now given place to a much more cautious approach that seeks to identify all possible agencies that have left evidence of their presence and so were responsible for influencing the relationships, the dispersal, disappearance or breakage patterns of bones and artifacts visible at a site. By a process of elimination, we are better able to arrive at an approximation of the extent of hominid involvement.

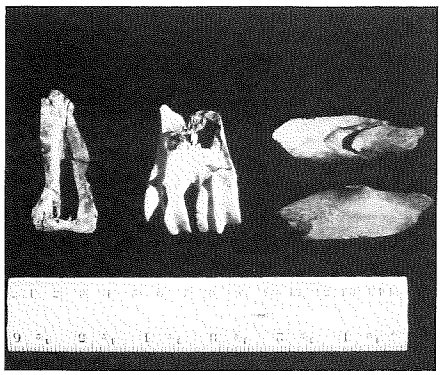
Basic to understanding behavior is to know what kind of habitat the hominids were living in. Almost all of these activity sites were situated close to water. Here stone for tools was usually readily available and the streams themselves gave access to water. The gallery forest provided shade and a place of escape from danger. Trees supplied sleeping places and there were plant foods in season of many kinds. And there was also the strategic situation for securing meat. A lot of game animals have to drink regularly and seek shade daily and most carcasses and natural deaths are found in that zone. Studies of the paleotopography and microsedimentology show that the preferred locations for sites were in a flood plain, on a stream bank, in a channel bed, on a levee, in a scored stream course, on a gravel bar or on an old soil horizon.

If you can locate the nearest sources of raw material used for tools, they will show you something about the territorial range of those particular tool-using hominids. It is reasonable to assume that all the tools were connected with processing food resources or usable materials or with the manufacture of simple artifacts and utensils. Except for stone, artifacts made out of other materials would in most cases not have survived. Stone tool-making and meat and bone processing seem to have appeared at the same time, around two or perhaps two and a half million years ago. Most prehistorians are now, I think, of the belief that these two activities are certainly related.

Large supplies of meat on a recently dead animal became available to hominids possessing a sharp flake that could cut through the thick hide. Even the large carnivores are not able to rip the tough hide of a large animal such as a hippopotamus or an elephant until the carcass has decayed sufficiently. High-power magnification and scanning-electron-microscope studies of the polishes and other evidence of use on the edges of artifacts can show what kinds of materials they were being used on: hide, meat, bone, plant remains. At the East Turkana sites in northern Kenya, flakes from activity areas a million and a half years old still show evidence of meat polish. They also show a soft plant polish and evidence of working wood. So, even at that early time, stone tools were being used for a series of different purposes. By using rejoining methods and edge polish studies, a very great deal of information concerning the activities of these sites can be reconstructed.

Bone wastes and artifacts give discrete association that suggests butchering. Studies in reassembling bone fragments and in the surface modification of bones on the activity sites can distinguish carnivore gnawing, chewing and breaking patterns from hominid activity. Fine cut marks, comminuted fractures and bone flaking are general indicators of human work. Remarkable cut marks made by a stone tool on the Bobo hominid skull were noted by my colleague, Professor Timothy White. Scanning-electron-microscope studies of these cut marks show quite clearly that they were made by a stone tool; this particular hominid was defleshed or, if you like, scalped. This discovery, of course, raises many questions.

Most of the bones of these activity areas represent incomplete remains of a number of different animal species, mostly medium to small mammals but also birds, reptiles and fish. It was at one time thought that hominids obtained most of their meat, if not all of



Longitudinally and horizontally split bone to extract marrow and two bone flakes such as result from percussion flaking of bone by hominids. From the site of Bodo (BOD-A1), Middle Awash, Ethiopia.

it, from hunting. And indeed, from the beginning, small animals very probably were foraged and hunted. Now, however, studies are suggesting that most of the meat used may have been obtained from scavenging, carnivore kills or naturally dead animals. These were and may still be important sources of meat for some village farmers in various parts of Africa. Until now, though, no one has attempted to quantify the availability of carcasses.

Such a study is being undertaken at the present time by one of our Berkeley students, Robert Blumenschine, in the Serengeti and northern Tanzania, in regions that are very comparable to the savanna habitats of the early hominids. Sufficient meat and, what is perhaps every bit as important, bone marrow was indeed likely to have been available and to have been used by groups of hominid scavengers. (Letters from Blumenschine in the field appeared in *AnthroQuest*, Spring, 1984.)

These are highly significant findings. They may show an additional reason why hominid activity areas with bone are associated with streams and lakes, near which most of the carcasses are found. A still further possible reason is that probably the best way that early hominids had for preserving a meat supply was to store meat under water, as hyenas not infrequently do.

What about plant foods? These are mostly perishable, of course, and so nothing usually survives. But we are all omnivorous and hunter-gatherers in the tropics obtain most of their food from plants and not from animal sources. It is likely that early hominids made extensive use of plant foods: berries, fruits, nuts, flowers, roots, tubers. All that they would have needed to obtain tubers and other buried foods would have been a digging stick. The only competitors for more deeply buried foods would probably have been pigs.

There is, however, quite a large problem in hominids using uncooked plant foods. The human gut cannot absorb many common plant foods if they are eaten raw — grains, legumes and tubers, for example — as these contain toxins which, if consumed raw for any length of time, will cause severe incapacity, malnutrition and death. The impact of all of these toxins is greatly reduced by cooling. It would seem, therefore, that the protein intake from raw plant foods alone would probably have been insufficient without some supplementing. Before fire-using, the important source would probably have been insects, caterpillars, grubs, termites, grasshoppers, and birds' eggs.

(I once asked a young acquaintance of mine in Africa who was eating caterpillars what they tasted like. And he said, "Oh, very good. They're rather like locusts.")

How far back in time is it possible to see evidence for fire-using and -making, one of the fundamental inventions of humankind? Our work in the Middle Awash and the Ethiopian Rift in 1981 suggests that fire could have been used almost as long ago as the time when hominids first became bipedal and had their forelimbs to manipulate tools. Regular fire-using is reasonably well established for sometime shortly after half a million years ago from sites in China, Europe and Africa. But how much further back in time does it go?

In open tropical savanna situations, all that survives as evidence of human fire are patches of reddened and burned earth, fire cracks and fractured stones, and significantly related burnt bone and artifacts. Evidence of this kind has been found at two sites in Kenya and two in Ethiopia, dating shortly after one and a half million years ago. The Middle Awash study added further intriguing evidence in the form of many more reddened clay patches in fine grained sediments. They had been fired to well over 250 degrees centigrade and they occur in sediments ranging from Late Pliocene to Middle Pleistocene, that is from ca. 2.5 M.Y. to about 500,000 years ago.

Sometimes there are stone artifacts and bone in association. These clay patches resemble burned termite earth around tree stumps. Very often, of course, dead trees and stumps are burned in forest fires. But they are also intentionally lighted by man, as they will burn for several days or weeks and in some instances months and so are a readily available source of fire and heat. This is a worldwide practice. With hands adapted to tool manufacture, early hominids could have made use of natural fires and have intentionally lighted others, but only, of course, if they had become aware of the trémendous advantages of doing so. They are unlikely to have been afraid of fire

The Boro River, Botswana. Typical of the riverine habitat favored by the early hominids. Shows gallery forest, levees, overbank swamp and open savanna.

unless there was a danger of being trapped; chimpanzees are not afraid and they have been seen to jump through gaps in a forest fire.

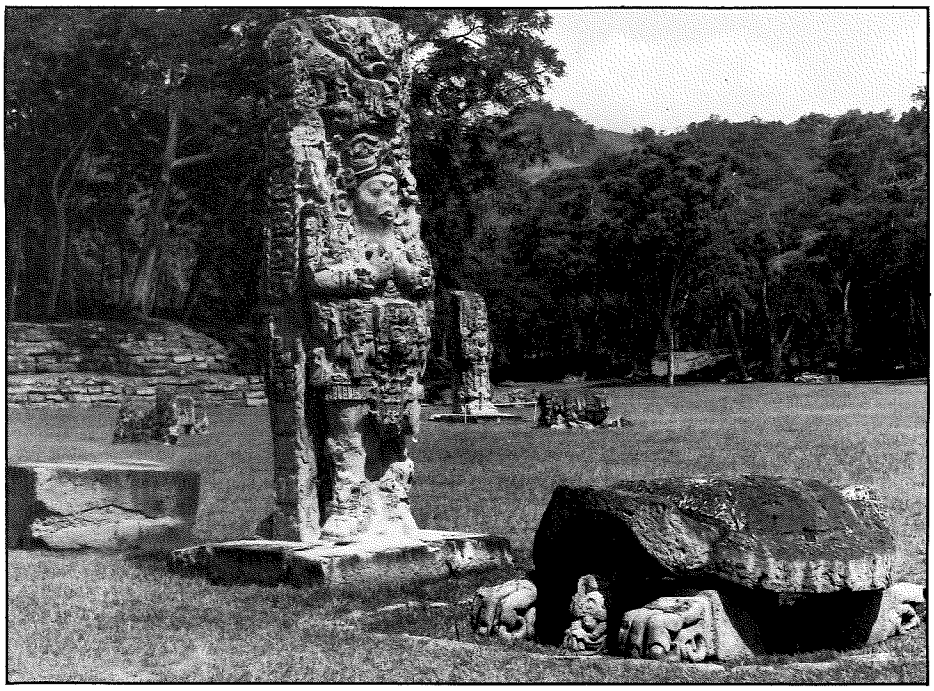
Some of the advantages to an early and relatively defenseless hominid of using fire were: securing food — insects, reptiles and small game animals; escaping from an advancing fire front; digging out suffocated rodents and termites; collecting honey and the carcasses of animals trapped — and incidentally cooked — by the fire. Protective fires would be a deterrent to predators. Burning branches could have been used to hurl at carnivores to drive them away from a carcass. And perhaps having greater significance for hominids, fire would enable meat and plant foods to be roasted or parched, thus making them more digestible.

The search for our ancestors is one of the most exciting and rewarding that I know. It concerns all of us. There is room for many more to join in and I commend it to you. By knowing where we came from and the extent of our genetic inheritance for sublimating our uncontrolled animal emotions by rational thought, symbolic behavior, tolerance, outward-reaching altruism and esthetic appreciation, we may stand a better chance of survival in an overcrowded and resource-depleted world. We can be sure that, year after year, the accumulated data from the ground and the greatly reduced ambiguity made possible by more precise and scientific rigor will provide an understanding in another 25 years' time out of all proportion to what we know today. These advances have been to a large extent made possible by organizations like the Leakey Foundation.

This article is adapted from Dr. Clark's presentation at the Leakey Foundation symposium in Salt Lake City last spring. □

COPAN

Honduran Institute of Anthropology and History
Tegucigalpa



Principal site.

Long known among archeologists as the "Athens of the New World," the Mayan ruins of Copán in western Honduras constitute one of the ancient world's premier cultural achievements. Located in a fertile river valley nestled between volcanic cliffs and sedimentary hills, the ruins have a long history of exploration, beginning in the 1840s and continuing to the present day. These attentions are well deserved when one considers not only the quality of the artistic remains at Copán but their quantity and sheer magnitude as well. Copán is the premier site in the Maya area in terms of the numbers of altars and stelae and also boasts the longest single written text of the Classic Period. In addition, the surface of the site is littered with thousands of fragments of tenoned architectural sculptures which originally formed elaborate friezes on the temples surmounting the pyramids.

The study of this sculpture and of the site in general has traditionally focused on the dating of the pieces, with an eye toward reconstructing at least some of the history of this important pre-Columbian city. This was done through the examination of the calendric portions of the site's numerous hieroglyphic inscriptions. However, this research was only able to tell a part of the story; archeologists had some idea of the temporal framework within which the important events took place but very little concrete knowledge of just what those events were. Within the last five years, the government of Honduras has set out to rectify this situation.

The first phase of the Copán Archeological Project has succeeded in providing a wealth of new information as well as discovering several important new monuments. Calling on prominent archeologists from all parts of the globe, the project has been interdisciplinary as well as international. Research was conducted on numerous fronts simultaneously, including renewed hieroglyphic and iconographic studies of the sculpture, intensive investigation of the architectural history of the Acropolis and Great Plaza area, and extensive mapping and probing of the thousands of smaller ruins found throughout the valley.

The hieroglyphic research, conducted by Dr. Berthold Riese of the Institute for Iberoamerican Research of Berlin, has perhaps been the most informative. In his view, the carved monuments of Copán have a long and detailed story to tell us about the rulers of the city. Indeed, it is now recognized that the personages depicted on the stelae represent portraits of those rulers, rather than manifestations of the Mayan gods as had been thought previously. This new interpretation is much more in tune with what we know of other pre-industrial civilizations, such as Egypt, where all state art was dedicated to the aggrandizement of the Pharoahs and their families. Riese has been able to show that the hieroglyphic texts, while firmly anchored by calendric and astronomical controls, are in fact dedicated mostly to recording the life and times of the Mayan rulers. Events such as births, accessions to the throne, conquests, anniversaries and deaths of kings can now be recognized on the stelae, altars and other sculptures of Copán. Some monuments detail long sections of historical commentary and one altar depicts all 16 kings in the royal dynastic sequence. Riese has been able to reconstruct not only many of the events in the lives of those kings, but even to obtain some glimpses into their personalities, based on the kinds of monuments which they erected and their distribution.

The history of the site as a whole, however, cannot be derived solely from the carved monuments. Copán also contains one of the largest superimposed series of buildings in the New World in its Acropolis-Great Plaza area. Literally hundreds of years of constructions lie buried beneath the surface of the final buildings and floors which the visitor sees. These earlier remains were thoroughly investigated by Dr. Charles D. Cheek, who has succeeded in interrelating and cross dating a long series of complex buildings in the Great Plaza, beginning around 400 A.D. and climaxing with the final phase structures, ca. 800 A.D. Included in these remains were a number of ritual caches and two ball courts. The Acropolis itself has been periodically cut away by the Copán River over the centuries since the abandonment of the city, resulting in the longest archeological section in the world – over 300 feet long and 100 feet high. Here the visitor is allowed a

El Escribano.

spectacular view of 400 years of superimposed constructions, with plaster floors, platforms and terraces, and innumerable wall lines exposed in the cut.

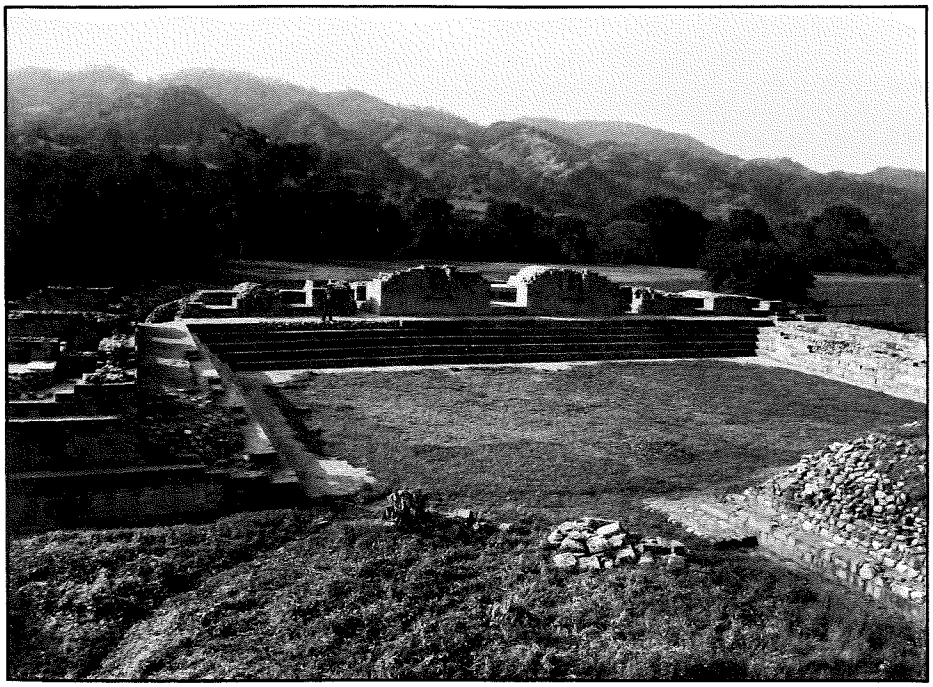
In order to better understand the collapse and abandonment of Copán and the demographic buildup which preceeded it, Dr. Claude F. Baudez of France set out to document not only the ecological capabilities and constraints of the small riverine valley in which Copán is located, but also the number and form of the other ancient settlement within its confines. He and his colleagues concluded that in the final decades of occupation, Copán was probably no longer self-sufficient agriculturally and probably had to rely on food imported from neighboring valleys.

Dr. Rene Viel, another French archeologist, has shown that the earliest pottery makers in Copán lived about 1000 B.C. with succeeding phases increasing in sophistication up to the end of the Classic Period. Particularly interesting was a deposit containing ceramics of a type previously not encountered in western Honduras which provided important information on the external connections and possible ethnic affiliations of the earliest *Copanecos.*

From all of this, the archeologists in the first phase of the project have succeeded in showing that the growth of Copán was a long process taking place over hundreds of years. Population growth and complexity of social institutions and art styles went hand in hand, with each succeeding generation being larger and with greater possibilities for individual expression. The coalescing of a number of diverse families into a unified society with a single ruling lineage appears to have coincided roughly with the introduction of carved hieroglyphic writing about 400 A.D. The lineage and its art style thrived and prospered over four centuries; kings were born, reigned and died, each one contributing historical relics which reflected his own particular values and tastes, and helping to shape what was to come. The city grew progressively larger and more diversified, culminating in a state which controlled a vast retaining area and had a population in the tens of thousands. Although the history of development and apogee of the city are now well understood, the makeup of its social classes and the actual causes of the collapse remain somewhat obscure.

Beginning in December, 1981, and still continuing, the second phase of the Copán Archeological Project set out on an ambitious program of excavation and restoration, unprecedented in the Maya area since the Tikal Project in Guatemala. Under the direction of Dr. William T. Sanders of Pennsylvania State University, the second stage was to answer many of the questions left unanswered and to leave literally dozens of ancient buildings restored and accessible to the visitor. Having the completed archeological map and a good idea of the occupation history of the city at his disposal, Sanders designed a research program which would simultaneously reveal a broad spectrum of ancient Copán society and attempt to define what the causes of that society's demise were. The residential quarters of over 100 people would be investigated with the idea of preserving and restoring them, touching on all levels of the socio-economic spectrum. The survey was to continue beyond the boundaries of the Copán Valley into neighboring regions to see how far Copán's influence was felt and what kind of friends and enemies were close at hand.

The results of investigation so far indicate that in the last decades of occupation, the city and valley of Copán were becoming increasingly dependent on the importation of foodstuffs. Judging from hieroglyphic evidence, it appears that the neighboring cities broke off from Copán's political-economic web at just the time when she needed the greatest influx of goods from the outside. Sites such as Rio Amarillo, Los Higos and Quirigua declared themselves independent in the latter half of the 9th century A.D. Without their tribute the city was no longer able to maintain itself and this doubtless, plus other complications, contributed to the Maya collapse. □



Restored monuments at burial site.

MEMBERS' SYMPOSIUM

On Saturday, January 26, 1985, the L.S.B. Leakey Foundation and the Southwest Museum in Los Angeles will co-sponsor a symposium for members. Titled "Hunters and Gatherers in the New World and Implications for Understanding Human Evolution," this one day meeting at the museum will explore human adaptations to diverse ecological zones. Outstanding scientists scheduled to speak are Robert Bettinger, University of California at Davis, Louis Binford, University of New Mexico, Kristen Hawkes, University of Utah, Richard S. MacNeish, Robert S. Peabody Foundation for Archeology, and Carmel Schrire, Rutgers University. Those who have heard some of these speakers at earlier Foundation programs know how exciting they can be.

Do plan to spend the day with us, learning about a fascinating subject in the spectacular setting of the Southwest Museum. Information and registration forms will be mailed to our members. If you are not now a Foundation member, we urge you to become one and join us on January 26. If you have questions, phone the Leakey Foundation office at (818) 449-0507. □

BOOKS FOR THE HOLIDAYS

THE ORIGINS OF MODERN HUMANS, Fred H. Smith and Frank Spencer, editors. Alan R. Liss, New York, 1984. 612 pp. $70.

A correlation of the hominid fossil record from a world-wide perspective, a major review which attempts to synthesize late additions to the Pleistocene record in the broad context.

ATLAS OF RADIOGRAPHS OF EARLY MAN by Mark F. Skinner and Geoffrey H. Sperber. Alan R. Liss, New York, 1982. 350 pp. $70. Illustrated.

This volume is a comprehensive collection of radiographs of fossil hominids, including a number of specimens of human morphology never illustrated before. It covers African hominids from two to three million years ago to European specimens from the last 50,000 years.

DISCLOSING THE PAST by Mary Leakey. Doubleday, Garden City, N.Y., 1984. 215 pp. Illustrated. $15.95. Ten percent discount to members, plus tax and postage, if ordered from the Foundation office.

This is Dr. Leakey's autobiography, the story of her remarkable life spent searching for the fossils of our ancestors in East Africa. While her husband, Louis S. B. Leakey, was alive, the two carried on their anthropological research in tandem, work that resulted in major discoveries. With his death, neither the work nor the discoveries ceased, as Mary Leakey carried on. She is a force in the international scientific arena.

AMAZON JOURNEY by Dennis Werner. Simon and Schuster, New York, 1984. 296 pp. $16.95.

This is the account of Werner's good, tough year of research, living with the Mekranoti Kayapo Indians of Brazil. Their villages of 250 to 350 people are the largest Indian communities in Amazonia today. Their culture, now so threatened, was still largely intact in 1976-77 when Werner was with them.

The book gives a general overview of Mekranoti culture and is a good enough adventure story to interest any lay reader. More importantly, it is a record of a people's culture before it inevitably and too rapidly disappears forever.

FROM HUNTERS TO FARMERS, edited by J. Desmond Clark and Steven A. Brandt. University of California Press, Berkeley, 1984. 444 pp. $44.

This study deals with the causes and consequences of food production in Africa. The twenty nine essays included investigate both how and why man first began producing food; they combine original fieldwork and analysis with scientific approaches and current theoretical thinking.

LIVING THE SKY by Ray A. Williamson. Houghton Mifflin, New York, 1984. 288 pp $19.95. Illustrated.

Ray Williamson's book contributes to the growing understanding of the importance of the sky in the early native American culture. He uses a combination of archeology and astronomy as well as sky charts to make his points. He manages to convey to us the deep involvement of the American Indian tribes with the movements of the sun, moon and stars and how their tribal activities were set to coincide with various celestial events. He gives us a sense of the wonder experienced by today's scientists when, after a routine survey with modern instruments, light or a cast shadow actually strikes where calculations indicated it should. Ray Williamson opens a door on past beliefs for us so that we become aware of the feeling of rhythm that underlay and connected all ancient life and beliefs.

ARCHAEOLOGICAL FIELDWORK OPPORTUNITIES BULLETIN and ARCHAEOLOGY ON FILM, published by the Archaeological Institute of America, Boston, Massachusetts, 1984.

The first of these two publications lists U.S. and foreign excavations and field schools with positions for volunteers, paid staff, student participants and technical specialists. It also lists study tours with an archeological focus. Paperback. $4 for A.I.A. members, $6 for nonmembers.

The second publication is a comprehensive and up to date guide to films and other audiovisual materials on archeology. Paperback. $7.50 for A.I.A. members, $10 for others.

The address of the Archaeological Institute of America is P.O. Box 1901, Kenmore Station, Boston, Massachusetts 02215.

HUMAN EVOLUTION by H. James Birx. Charles C. Thomas, publisher, Springfield, Illinois, 1984. Ca. 550 pp.

This is the second in Dr. Birx's projected four volume series exploring human evolution against the background of both the natural and social sciences. Special attention is focused on fossil man and the great apes.

CLASH OF CULTURES by Brian M. Fagan. W. H. Freeman, New York, 1984. 318 pp. Cloth, $28.95, paperback, $15.95. Illustrated.

Archeologist Brian Fagan of the University of California at Santa Barbara describes the discovery of non-Western societies and early encounters with American Indians. The book tells of ordinary people pursuing their day-to-day goals and making decisions that would have often tragic and unimagined consequences in later generations.

THEORIES OF EVOLUTION by H. James Birx. Charles C. Thomas, publisher, Springfield, Illinois, 1984. 357 pp. $39.50.

Dr. Birx, chairman of the anthropology-sociology department, Canisius College, Buffalo, New York, investigates the fact and implications of evolution from various perspectives: the natural sciences, social theory, dynamic philosophy, process theology and cosmic mysticism. He explores the history of evolutionary theory from Leonardo da Vinci to Stephen Jay Gould. In the chapter titled "The Emergence of Humankind," he refers to the outstanding research and discoveries by the Leakeys.

THE ORIGIN OF ANCIENT AMERICAN CULTURES by Paul Shao. Iowa State University Press, Ames, 1984. 430 pp. $42.75. Illustrated.

The author presents documented evidence in support of the theory of Chinese origin of ancient American cultures, citing Chinese historical records and archeological data. He follows the chain of events leading to the dislocation and subsequent emigrations of people from east Asia which resulted in sporadic and involuntary arrivals in the Americas. These Asians provided the initial cultural stimuli and the succeeding cultural reinforcement for the genesis and development of cultures in the Americas. □

CALENDAR

SATURDAY, JANUARY 26, 1985

Members' Symposium, "HUNTER-GATHERERS IN THE NEW WORLD: IMPLICATIONS FOR UNDERSTANDING HUMAN EVOLUTION"
Southwest Museum, Los Angeles. (See page 21.)

JANUARY 28 THROUGH FEBRUARY 4, 1985

TAUNG DIAMOND JUBILEE INTERNATIONAL COMMEMORATIVE SYMPOSIUM,
The University of the Witwatersrand, Johannesburg, South Africa (See back page.)

JANE GOODALL LECTURE SERIES

TUESDAY, APRIL 16, 1985
1985 Allen O'Brien Memorial Lecture
for the L.S.B. Leakey Foundation
Beckman Auditorium, Caltech, Pasadena, California, at 8 P.M.

WEDNESDAY, APRIL 17, 1985
Presented by the Los Angeles Zoo
at the Times Mirror Square Auditorium,
Los Angeles, California, at 7:30 P.M.

SUNDAY, APRIL 21, 1985
Gallagher Theater, University of Arizona,
Tucson, Arizona, at 2 P.M.

FRIDAY, APRIL 26, 1985
Popejoy Hall, University of New Mexico,
Albuquerque, New Mexico, at 8:00 P.M.

MONDAY, APRIL 29, 1985
Loretto-Hilton Center, Webster University,
St. Louis, Missouri, at 8:30 P.M.

TUESDAY, MAY 7, 1985
Gaines Auditorium, Agnes Scott College,
Decatur, Georgia, at 8:15 P.M.

ROGER FOUTS

MONDAY, APRIL 22, 1985 AT 7:30 P.M. & TUESDAY, APRIL 23, 1985 AT 11:00 A.M.
Coe College, Cedar Rapids, Iowa

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THE TAUNG CHILD TURNS SIXTY

One day in October, 1924, Professor Raymond Dart, an Australian anatomist at the Witwatersrand Medical School, received two carefully wrapped packages at his home in Johannesburg. He was dressing for a wedding to be held there but took time to open the boxes that had been mailed to him from the Taung Limeworks, a quarry on the dolomite plateau of South Africa. One contained a fossil brain cast with distinctly hominid features and also the back of the forehead and face bones into which the cast fitted. "Here, I was certain," Dart wrote later, "was one of the most significant finds ever made in the history of anthropology."

By mid-January of the following year, Dart had written a preliminary paper on the discovery and on his conclusions from working alone and with limited resources on the fossil. Because of the size and shape of the brain and teeth, he asserted that the Taung specimen had been a creature, perhaps six years old, which had walked upright and represented "our troglodytic forefathers," astoundingly intermediate between the apes and man in the chain of evolution. He named the Taung find *Australopithecus africanus*, "the southern ape of Africa," the first hominid fossil out of Africa.

After Dart's paper was printed in London's *Nature*, he was harshly attacked by the scientific establishment. It was generally felt that he had claimed far more for the Taung skull than was warranted by the evidence. At 32, Dart had become a celebrity but also something of a joke. Not a fighter, he did little further to persuade others of his theory.

Now, of course, sixty years after he first saw the Taung Child, we know that Dart had drawn the right conclusions from the fossil, albeit more from inspiration than evidence.

In 1936, Robert Broom, a Scottish doctor trained in midwifery, found an adult australopithecine skull at the South African limestone quarry at Sterkfontein, uncovered by blasting, as the Taung skull had been, imbedded in the rock. The discovery, as important as it was, did not persuade all the scientific world that Dart had been right. Broom found further remains at Sterkfontein and nearby Kromdraai which upheld Dart's claim that a small-brained, bipedal, man-like creature had lived in the area. In 1946, Broom published a monograph on the subject which won much support for Dart and *Australopithecus* as a forerunner of man.

During the following year, Broom discovered a very fine skull at Sterkfontein and a nearly complete pelvis and vertebral column and other fragments — definitive evidence of *Australopithecus'* human affinities. Raymond Dart was completely vindicated and the australopithecines, first recognized sixty years ago with the unearthing of the Taung Child, were firmly established in the chain of evolution.

Robert Broom, even more a Don Quixote than Dart, died in 1951 in South Africa. He had become quite famous. The renowned Raymond Dart, now 91, still lives there. The Taung Child traveled last spring to New York to visit the American Museum of Natural History and resides at the University of the Witwatersrand.

TAUNG DIAMOND JUBILEE

The Taung Diamond Jubilee International Commemorative Symposium, marking the 60th anniversary of the 1924 discovery of the Taung Child skull by Professor Raymond Dart, will be held at the University of the Witwatersrand, Johannesburg, South Africa, from January 28 through February 4, 1985. Dart will celebrate his 92nd birthday during this time. Professor Phillip V. Tobias, a member of the Leakey Foundation Science and Grants Committee, is chairman of the symposium.

Visits will be made to the Taung site in Botswana and the Krugersdorp Valley sites of Sterkfontein, Kromdraai and Swartkrans.

Patrons of the Jubilee include the Leakey Foundation, the Institute of Human Origins, the University of the Witwatersrand and the University of Botswana. □

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