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THE CUIVA HUNTER-GATHERERS OF WESTERN VENEZUELA

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The study of modern hunter-gatherers is an area of considerable interest in anthropology for several reasons. First, the determinates of many human behaviors can be more easily studied in these societies because the set of constraints and

behavioral options in foraging groups is relatively non-complex and because many behaviors take place in context where they can be easily monitored. Groups are relatively small

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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.

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PRESIDENT'S MESSAGE

Dear Fellows and Members of the Leakey Foundation:

1986 marks a banner year for the Leakey Foundation. Matched by our generous trustees, fellows and members, Bob Beck's gift of one million dollars in 1970 gave us the security of an endowment. A trustees' matching grant and the Baldwin Fellowships for the study of African archeology followed, and now we have been given the extraordinary challenge of matching a five million dollar grant from our chairman, Gordon Getty.

When we succeed in meeting this challenge, the Leakey Foundation will be the largest funding resource for the study of human origins, whether private or governmental.

Board members Ed Harrison and Bill Richards have assumed lead roles in the development effort, but many others are also involved.

Bill Kieschnick's energies, so valued in the Los Angeles community, are now going to be focused on the Leakey Foundation. Fleur Cowles was honored at a fund raising event in Los Angeles chaired by Fran Muir and Joan Wrede. In addition to her personal generosity, Fleur will spearhead an international effort to raise monies.

Several events took place this year in northern California, including an extremely successful symposium on "Diet and Human Evolution" chaired by Kay Woods and Gay Bradley. Trustees George Lindsay and Danielle Walker centered several events around a Richard Leakey visit to San Francisco in November.

Philae Dominick and Joan Donner in Denver, Bill Wirthlin in Salt Lake City, Jeff Short in Chicago and Ned Munger (worldwide as always) will be hard at work to match this extraordinary challenge.

During our annual meeting at the Grand Canyon, the Leakey Foundation Science and Grants Committee presented a list of priority funding needs. New efforts are needed in the education of Third World nationals and new study sites must be established for great ape and hunter-gatherer research before their habitats are gone forever. New technologies must be encouraged to interpret field data. Requests have come for important study projects in Israel, India and South America. The list is long, but the work will be exciting and rewarding.

You, our fellows and members, are our greatest friends and our true resource. Your continuing interest inspires us and your generosity is greatly appreciated. We hope that by working very hard to meet our challenge goal, we will encourage still greater generosity on your part. We need your help.



'TIS THE SEASON TO BE JOLLY,

... 'TIS THE YEAR TO GIVE.

Your willingness to help us meet the challenge can be especially rewarding in your 1986 year-end tax planning. Please see page 23.

SNAILS

Martin Pickford

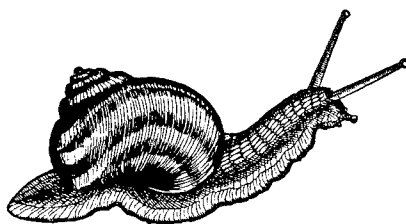
Institute of Paleontology, Paris

Why on earth should someone who is interested in human origins study snails? And fossil snails at that? The answer is that we wish to know more about the living conditions of our precursors; we want to know what the environment was like when our extinct relatives were still inhabitants of this globe. So how can the study of snails, of all things, help us to fulfil this wish?

Snails are of use to us for reconstructing past environments for several reasons. First and foremost, fossil snails from Lower Miocene times are similar to living ones, at least at the generic level of identification. In other words, snail shell shapes from Miocene sites in Kenya, for example, are the same as shells that we can collect today. This suggests that shell shapes have changed little, if at all, and since shell shape in land snails is often a function of environment, then similarity of shapes and sizes between Miocene and modern snails is suggestive of similarity in environments.

Secondly, most snail shells don't travel well. Land snails that don't float in water are soon destroyed by abrasion, breakage and other damage, which is why we almost never find fossil land snail assemblages mixed up with freshwater snail samples. In western Kenya, where fossil land snails are abundant, there is good evidence that in most assemblages, post-mortem transportation was negligible. For example we often find fossil shells with eggs inside the body cavity indicating that the individual died in a gravid condition. In recent shells which I have found with eggs inside, I have found it very difficult to transport the shell, even with suitable packing material, without dislodging the eggs. Thus the Miocene examples with eggs almost certainly lay undisturbed in the strata from the time they died until they recently eroded out of the sediment. We also find fossil land snails with the epiphragm in position. In land snails, some species will secrete an epiphragm over the aperture during the dry season, or in some species even on a daily basis. When a snail dies with its

epiphragm in position, the latter is very easily dislodged or even destroyed, because they are usually rather fragile or even soluble in water. Thus, fossils with their epiphragms in position indicate with a high degree of probability that the shell was not disturbed between the time that the individual died and the time that it became fossilized. There are several other observations that have been made which indicate that most of the fossil snail samples in Western Kenya have not been greatly disturbed



since they died. This means that we can reconstruct the environment of a site on the basis of the snails found there without having to worry about contamination from other sources.

The third important point about snails is that counting the sample is a doddle. So often in paleontology there is difficulty in determining the number of animals which contributed to the sample. For example, if you find a tooth, a finger bone and a toe bone from a single species in a deposit, do you count it as one, two or three individuals? With fossil snails, this difficulty does not usually arise, each shell representing a single individual.

Fourthly, many of the fossil land snails that I have worked with have been found in precisely the same strata as the fossil hominoids and other mammals. We thus avoid one of the most common problems encountered by scientists who work with fossil plant remains. Their samples usually come from different strata from the mammals' except in a few deposits such as lignites. When we

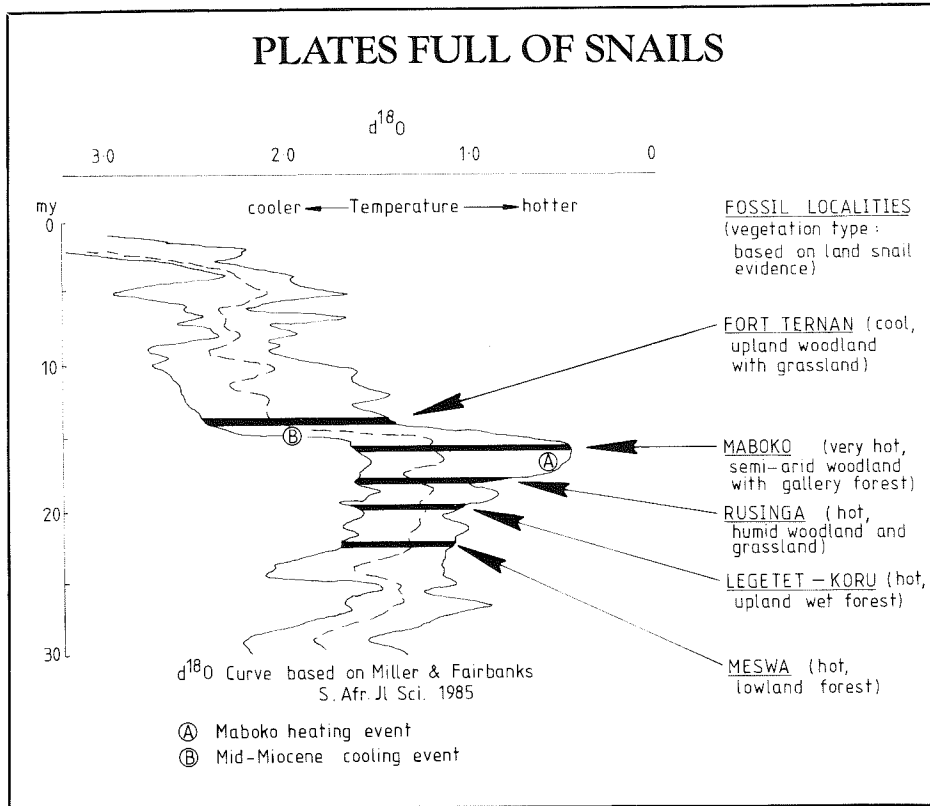
reconstruct the paleoenvironment on the basis of the land snails, we are at the same time doing it for the mammals found associated with them.

The fifth important thing about fossil land snails is that in some strata they are abundant and diverse. In some of the sites in Western Kenya we have found as many as 24 genera together, which compares favorably with the most diverse modern snail fauna of Kenya which comprises 26 genera. In fact, so good is the sample now available, that we have identified at least 50 percent of the known variety of fossilizable land snails that live in Kenya today. I know of no other group of fossils, animal or plant, which is better represented in the fossil record.

Sixth, but in many ways the most important of all, is that the modern environmental preferences of East African snails are reasonably well documented and understood. As was pointed out in 1963 by Bernard Verdcourt, who is a botanist whose full time "pastime" is snails, there is often a close correlation between environment and snail distribution. There are numerous taxa which are found only in forests, there are others that live in deserts, and yet others that prefer savannas. There are of course some taxa which are widespread, but even these have circumscribed distribution limits. All the fossil snails found in East Africa belong to taxa which occur there today. None of them belongs to genera endemic to other zoogeographic regions, either within Africa or outside. For example we find none of the endemic genera which occur in West Africa (including Zaire), Southern Africa or North Africa. From the point of view of the snails therefore, the East African Zoogeographic Province has been stable for at least 23 million years.

This does not mean that conditions within East Africa have remained stable for that length of time — quite the contrary. The snail faunas so far discovered suggest that there have been major changes in climate and vegetation patterns, but that whatever the changes, they took place within the bounds of

PLATES FULL OF SNAILS



the East African Zoogeographic Province. East Africa today is a land of contrasting environments. It has everything from coastal forests to sand dunes. It has vast areas of woodland, savanna and steppe as well as montane forest. Each of these major vegetation categories has its constituent land snail assemblage and several of them have now been identified in the fossil record of western Kenya.

I have sampled modern snails from all the major vegetation types in Kenya and there is no doubt that snail assemblages found in forest differ fundamentally from those found in savanna or steppe. However, forest assemblages collected in different parts of Kenya all look rather similar, although snails from lowland forests (less than 1200 meters altitude) can readily be distinguished from snail assemblages collected from upland and montane forests (above 1200 meters altitude). It is also possible to distinguish snail assemblages collected in dry forest from those collected in wet forest. Similarly, land snails which inhabit woodlands differ slightly from one another, making it possible to distinguish upland woodlands from lowland ones, or humid woodlands from semi-arid woodlands.

In western Kenya today, there are several types of vegetation, ranging from

humid woodland to montane forest. There are no semi-arid woodland, steppe or desert, even in the highly disturbed state that now exists due to human activity. Thus, in western Kenya it is possible in a few relatively undisturbed areas to collect snail assemblages representing lowland tropical forest, humid woodland, upland woodland, grassland (or savanna), upland and montane forest. Yet, on sampling the fossil sites in the same region, we find snails indicative of semi-arid vegetation bordering on steppic conditions, as well as the expected assemblages denoting forest and woodland.

How can we explain the former existence of lowland forest, upland forest, humid and semi-arid woodlands and upland woodlands in an area little more than 100 km long and 30 km wide? Could they all have existed at the same time in an area of comparable size and topographic conditions? In some areas in Kenya, one can indeed find such a variety of vegetation types within rather small areas, such as between the Suguta Valley with desert at its bottom, to Mt. Nyiro with montane forest at its summit only 30 km away. Yet, in such situations the topographic relief is extreme, the Suguta Valley being in the rain shadow of the Rift Valley and the summit of Mt. Nyiro high above the valley swathed almost permanently in mist. In western

Kenya, in contrast, all the fossil sites occur within 300 meters altitude of each other, in a region where topographic relief, although marked, is not extreme enough to result in vegetation changes as abrupt as we find between Suguta and Nyiro. How, then, can we explain the former existence of semi-arid conditions at Maboko 16 m.y. ago when the nearest that these conditions approach Maboko today is some 300 km away?

In contrast to the semi-arid conditions that the fossil snails indicate for Maboko, the snails from Koru indicate the former existence of wet upland forest, at Songhor they suggest dry lowland forest, and at Rusinga they indicate humid woodland with grassland patches. At Fort Ternan, the fossil snails suggest the former existence there of upland humid woodland with grass patches.

It is unlikely that all these vegetation types existed at the same time, and the most likely explanation to account for their unexpected juxtaposition is that the regional climate changed over time; bringing with it concomitant changes in vegetation.

If we arrange the fossil sites in their chronological order, with Meswa as the oldest and Fort Ternan as the youngest, with Koru, Songhor, Rusinga and Maboko in between in that order, we find that the sequence of snail assemblages suggests that the vegetation changed from upland forest at Koru, to lowland forest at Songhor to woodland with grass patches at Rusinga to semi-arid woodland, bordering on steppe at Maboko and back to upland woodland with grass patches at Fort Ternan.

I visualize that climatic conditions in western Kenya changed from cool and wet 20 m.y. ago to hot and dry by 16 m.y. ago and back to cool but not too wet at 13 m.y. ago. As the climate changed so did the vegetation, and as the vegetation changed so did the snail faunas. The handiest aid to visualizing how things happened is the "habitat plate" concept. This idea is analogous to the "plate tectonic" concept of continental drift. In plate tectonics chunks of continental crust move about on the surface of the globe, whereas habitat plates are habitats which shift about. In western Kenya, the Lower Miocene forest habitat plate was nudged aside as the climate changed, and the woodland habitat plate moved in, only to be replaced in its turn (16 m.y. ago) by a semi-arid habitat plate.

The semi-arid habitat plate in its turn

moved out and was replaced by an upland woodland plate. As each habitat plate moved, much of its constituent fauna moved with it, with the result that the fossil sites record comparable changes in faunas over time. Indeed, it is the changes in the fossil faunas that provide the evidence by which we can reconstruct the sequence of habitat plate events. Land snails are particularly useful in this respect.

If we compare the succession in which the habitat plates moved into and out of western Kenya with other climatic evidence from different regions of the globe, we may perhaps be able to discern whether the changes in East Africa were only of local significance, or whether they might have been related to global climatic changes.

In Japan there was a marked heating event during the Middle Miocene, known as the Kurosedani event, which was preceded and followed by cooler conditions. During the Kurosedani event, mangrove swamps grew in central Japan over 1000 km north of their present day distribution. The Kurosedani event, dated at about 16 m.y., correlates well with a similar heating event in the Paratethys region of Central Europe, during which palm trees grew 500-600 km north of their current range, and at the same time as the Langhian event in the Mediterranean.

Comparison of these events with the $\delta^{18}O$ (delta 18 oxygen) curve for the Atlantic and Pacific oceans reveals that there was a similar heating event at the same time in the surface waters of the oceans. The oceanic heating event is followed by an abrupt cooling event known as the mid-Miocene event, which coincides closely in time (14 m.y. ago) with the dramatic change in snail faunas from Maboko (semi-arid and hot) to Fort Ternan (humid and cool). It would appear, then, that continental conditions, as reconstructed from snails and other evidence, were changing in phase with oceanic surface water conditions. In western Kenya, I estimate that regional annual mean temperatures were about 10°C higher during the Maboko event than they were during Koru or Fort Ternan times.

So far, I have hardly mentioned human origins. Nevertheless, while habitat plates were shifting about with their faunal "passengers," early hominoids were not excluded. There is a remarkable concordance between land snail distribution patterns and fossil primate distribution patterns in the western

Kenya fossil record. With the snail faunas which suggest forested conditions are found a great diversity of primates, including *Proconsul africanus*, *Proconsul major*, *Micropithecus clarki*, *Limnopithecus legetet*, *Dendropithecus songhorensis*, *Rangwapithecus gordonii* and *Limnopithecus evansi*. No monkeys are known from any of the Kenyan sites which have yielded these hominoids.

With snail faunas from Rusinga and allied sites, for which woodland with grassland patches are indicated, a much less diverse primate fauna occurs, with *Proconsul nyanzae*, *Dendropithecus macinnesi* and *Rangwapithecus vancouveringi*. No fossil monkeys are found with these hominoids either.

In contrast at Maboko, for which semi-arid conditions are suggested on the basis of the fossil snails, fossil monkeys (*Victoriapithecus*) abound. They are found in association with the hominoids *Kenyapithecus africanus*, an oreopithecid, a species of *Micropithecus* and possibly *Limnopithecus*, but no *Proconsul* specimens have ever reliably been recorded from this habitat plate.

When conditions changed rather abruptly during the mid-Miocene cooling event, so did the mammal faunas. Monkeys once more disappeared from western Kenya, but some of the hominoids apparently survived to give rise to *Kenyapithecus wickeri*, an oreopithecid, and a species of *Micropithecus* at Fort Ternan. There is also the possibility that *Proconsul* once more returned to western Kenya.

Two things of importance to human origins and primate paleontology stand out in this sequence of events. Firstly, *Kenyapithecus*, which is the most man-like of the Lower and Middle Miocene apes, was adapted to a semi-arid habitat, and presumably evolved there. Secondly, monkeys were perhaps even more restricted in their habitat preferences during the Early Miocene, and the family probably evolved in semi-arid conditions. The present day abundance of monkeys in African forests is very possibly a recent phenomenon. They were entirely absent from Lower and Middle Miocene sites for which humid woodland or forest habitats are indicated on the basis of the snail evidence.

Thus, even though one might at first question the sanity of someone who set out to learn about human origins by studying land snails, in the final analysis it seems that they yield evidence which is crucial to understanding the conditions under which very early human

precursors might have evolved. That the study of snails can do this and a lot more besides suggests that we shouldn't turn up our noses at "plates full of snails." ■



BOOKS

THE COLBY MAMMOTH SITE, by George G. Frison and Lawrence C. Todd. University of New Mexico Press, Albuquerque, 1986. 248 pp. Illustrated. \$25.

This study interprets the evidence of eight mammoths found in association with human artifacts at an important Paleo-Indian site. The data lead to the conclusion that meat was probably cached here during Clovis times, and have far-reaching implications for the study of Late Pleistocene environments and human adaptations to them. (See article by Frison, *AnthroQuest*, Spring, 1986.)

THE CHIMPANZEES OF GOMBE, by Jane Goodall. The Belknap Press/Harvard University Press, Cambridge, Mass., 1986. 673 pp. Illustrated. \$30.

In her new book, Dr. Goodall gives an account of the history of her chimpanzee research center at Gombe in Tanzania and the 26 years of her work with these African primates who are taxonomically closer to humans than any other animal. As such, "The Chimpanzees of Gombe" is a prime source for the study of our evolution, bringing together detailed information on chimpanzee biology, ecology and culture. *The New York Times* said the "book may well emerge as the most significant ethological monograph based on field study in this half century." ■

PALEOPATHOLOGY AT RANCHO LA BREA

Fred P. Heald, M.D.

The Rancho La Brea tar pits, from which the bones referred to in this article were recovered, occupy an area now on prestigious Wilshire Boulevard in Los Angeles. The George C. Page Museum, which adjoins the bubbling pit area, houses the reconstructed skeletons from the asphalt basins, including that of a young Indian woman, and a laboratory for fossil analysis. The scientific digs here are in operation today, with rare finds still being uncovered.

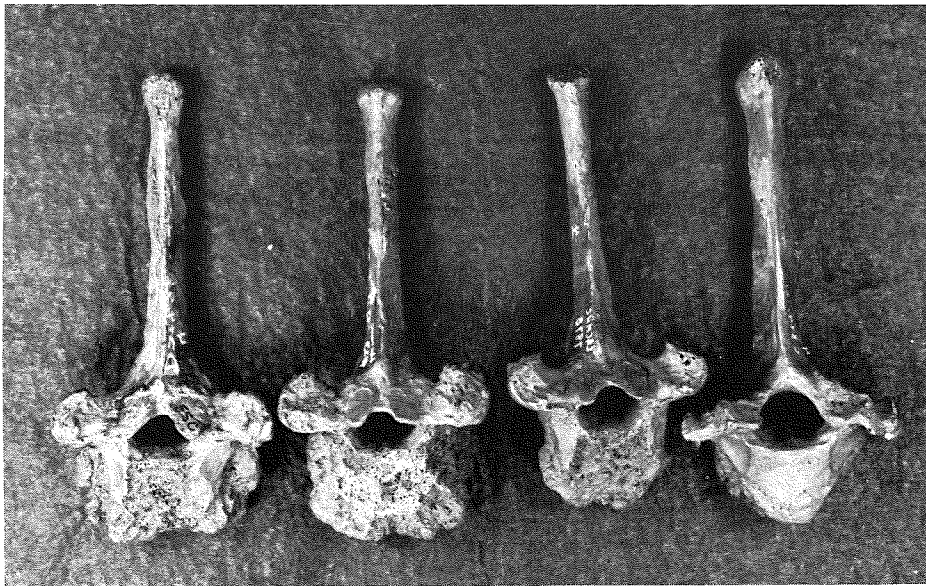
collection. In 1980, with the final housing of all Rancho La Brea material in the George C. Page Museum, an extensive re-inspection of the material was made with "paleopathology" one of the many curatorial projects undertaken. This effort has almost tripled the original sample of pathologic specimens.

Paleopathology is the study of diseases and injuries present in fossil specimens. Here at Rancho La Brea, soft tissues are, of course, not preserved and

our studies are limited to osteologic elements. Paleopathology has its most popular appeal when it concerns itself with human mummies. These often have soft tissues that add to the completeness and accuracy of diagnostic opinions. It must be pointed out that Rancho La Brea specimens are, of course, many times older than most archeological finds. Preservation of the Rancho La Brea material by the asphalt is remarkable in that the bone is not altered mineralogically and can be studied microscopically and by x-ray as if it were of contemporary age.

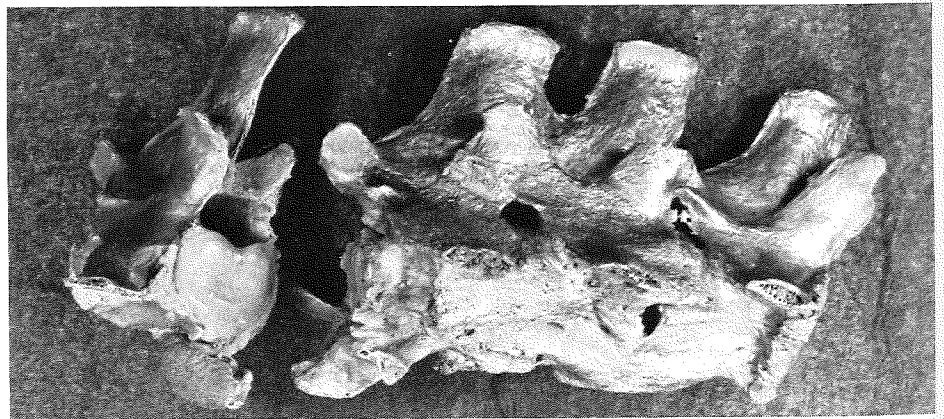
I would stress that living bone is not a hard, unyielding material that holds animals together. Bone is dynamic, it responds to use and especially to misuse. It has quite set ways of growing and of healing itself after injury which are common to all animals. I'm constantly delighted to observe that the similarity of response to injury in these fossils from Rancho La Brea is no different from those in man. With considerable ease, it is quite possible to cross over from a modern book on human pathology to these specimens!

The bony remains of carnivores make up the vast majority of the Rancho La Brea collection. This also holds true for the pathologic sample, plus an additional bias in the percentages due to a factor that I term "survivability." This reflects the fact that *Canis dirus* and *Smilodon californicus* were, without a

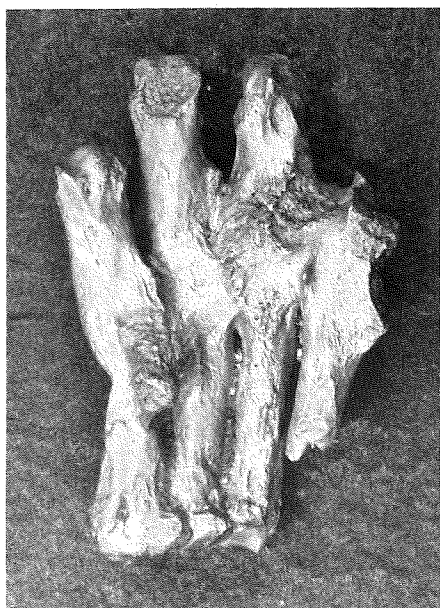


Canis dirus (dire wolf), cranial and caudal views of four associated thoracic vertebrae demonstrating discogenic disease with typical subchondral cystic changes in the end-plates. This is an osteoarthritis considered to have had its onset secondary to impact or compression damage.

The Rancho La Brea Collection at the George C. Page Museum (Los Angeles County Museum of Natural History) has undergone three curatorial phases since the fossils were recovered in 1913-1915. Originally, in the late 1920s and early 1930s, R. L. Moodie, University of Southern California, chose and published articles on selected osteologic or bony specimens. During the same period H. Wild, Los Angeles County Natural History Museum, organized and set aside a modest number of pathological elements apart from the hundreds of thousands of specimens collected. In the mid 1960s G. Sibley, Los Angeles County Natural History Museum, reorganized and expanded this



Canis dirus, lateral view of 3rd., 4th., 5th. & 6th. lumbar vertebrae. A typical example of spondylosis, fusing the central vertebral bodies about their margins, but sparing the central articulations. This is considered to be a degenerative process of aging. Note the advancing bony "hook" between vertebrae #3 & #4, with fusion still incomplete.



Canis dirus, ventral view of 2nd., 3rd., 4th. & 5th. metacarpals. Fractures and fusion of all four elements. A crush injury.

doubt, social animals. For example, an injured wolf or cat, remaining with its familiars, would be allowed to feed on the fringes of the pack, to survive and heal its wounds, only to go on and later succumb to entrapment, depositing its bones in the asphalt as proof of its original survival. A great many of the fractures and dislocations documented would have been fatal to animals with solitary hunting habits.

It is not speculation to assume that immediately fatal injuries are poorly represented in the asphalt sample. With this in mind, any attempt to make a broad statistical statement about death rates will be flawed. With very rare exception, the pathologies found in this study were not the primary causes of death. It must be considered, however, that morbidity statistics of non-lethal injuries in the original living animal population might very well approximate that found in our paleopathologic sample.

From careful observation it is quite possible to reach some conclusions about predation and feeding habits. "Tendon-pulls" and muscle traction injuries are reflected in damage to their respective bony attachments. These damages are used as clues as to the animal's functional behavior.

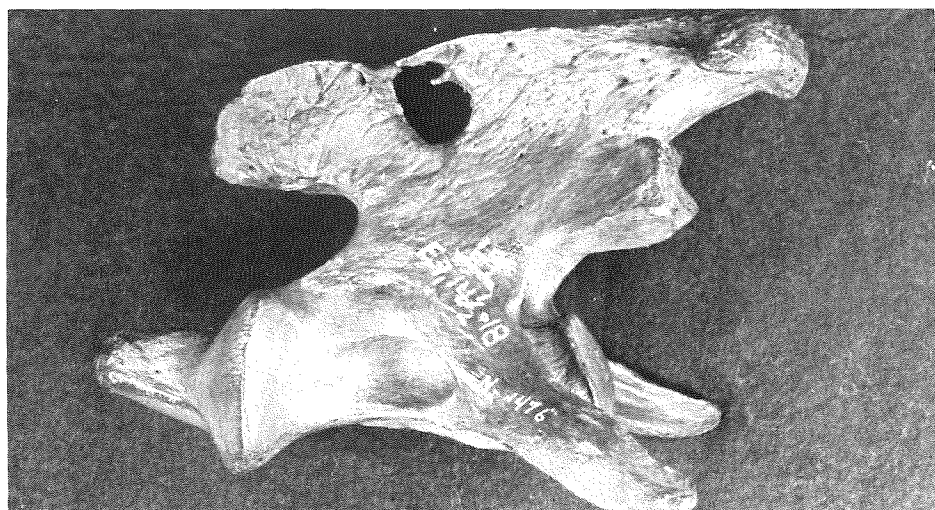
Smilodon californicus, attacking in a powerful forward lunge, sustained severe compressive, hyperextension, hyperflexion and twisting injuries to the neck.

The feet, legs and skulls of *Canis dirus* were particularly vulnerable to injury when tackling large, powerful prey. Crushing injuries and penetrating wounds with resultant sepsis were common. Skull fractures in *Canis dirus*, with healing, generally involve the frontal bones and not the parietals which cover the brain (the more vulnerable area).

Evidence of bite wounds are frequently found in the Rancho La Brea paleopathologic sample. Life was not easy then, nor is it still, 30,000 years later, on the Serengeti Plain of Africa, where A. Pusey, University of Minnesota, reports that many lions bear suppurating wounds on backs and shoulders secondary to bites.

all stages, are very common findings.

In summary, the composition of the Rancho La Brea paleopathologic sample consists of bony elements mainly from carnivores. Specific injuries related to predation behavior are common. These animals and humans exhibit a similarity of responses to injury and the degenerative diseases. The tolerance to injury demonstrated by *Canis dirus* and *Smilodon californicus* in enduring, healing and surviving wounds was remarkable. It has been stressed that the morbidity percentages in the pathological sample probably would have matched that of the living species present at Rancho La Brea during this particular span of the Pleistocene. ■



Smilodon californicus, (saber-toothed tiger) 2nd. cervical vertebra. Illustrates a healed bite wound of the dorsal spine.

The spinal columns of both *Canis dirus* and *Smilodon californicus* bear osteologic evidence of heavy, direct trauma and severe twisting accidents. Disruption of the diarthroidal joints and damage to central articulating joint faces proper have resulted in bizarre fusions which must have been disabling, but not fatal. Compressive forces, created by impact in attack, caused discogenic (end-plate) damage to vertebral centra with cartilagenous and subchondral disruption resulting in the development of a common type of osteoarthritis. The focal point of stress was not limited to the cervical region and is noted variously in the thoracic and lumbar areas as well. The area affected probably depended on the precise positioning of the spine at the moment of impact.

Degenerative diseases related to aging, such as ankylosing spondylosis in

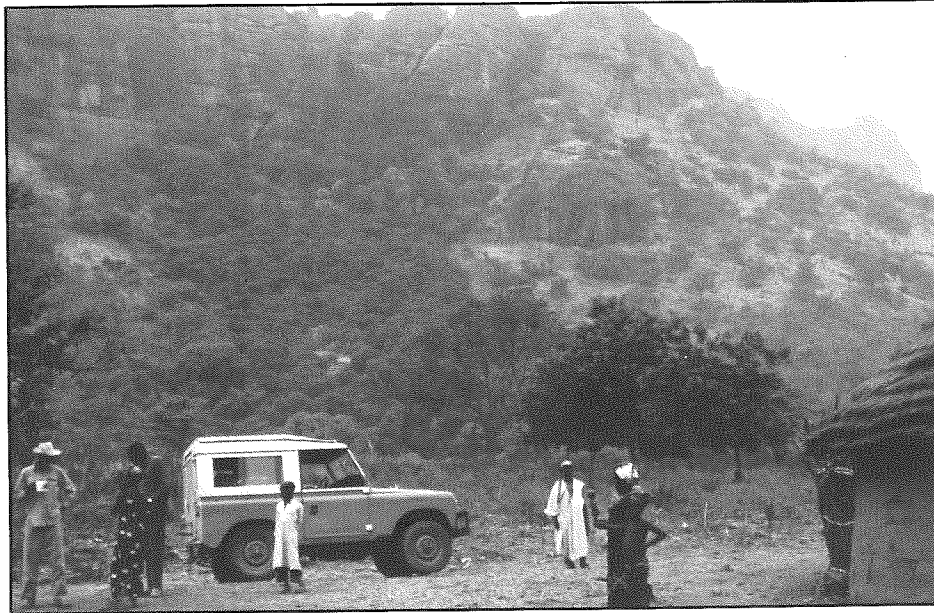


Canis dirus dorsal view of skull — large, depressed, right frontal fracture. The hoof of a juvenile *Bison antiquus* exactly fits into this depression.

ARID COUNTRY CHIMPANZEES

Jim Moore

Department of Anthropology, Harvard University



Dabiya, Mali. This patch of cliffside forest is similar to a nearby one in which we found numerous chimp nests, and villagers told us this patch is also used. Groups of chimps apparently move into such an area for up to several weeks and then move on.

While on vacation in Tanzania, I spent five days camping in the miombo woodland south of Uvinza. My main objective was to get a firsthand feeling for the habitat for comparison with the area near the Bafing River in Mali which I surveyed in 1984 (*AnthroQuest* No. 33; Winter, 1985). I was greatly aided by an unpublished account of Dr. Toshisada Nishida's 1975 survey of the area; I thank him for his encouragement, advice and comments on a draft of my report.

On November 1, 1985, I arrived at Uvinza by the morning train and checked in with the town chairman, Ivory Kayumba, who was very helpful but puzzled; he said he had not heard of chimps in the nearby woods. I caught a ride on the Mpanda road to about 45 km south of Uvinza and began hiking back through the woods at mid-afternoon. The ride was a mixed blessing; without it I would have spent a leisurely time nearer Uvinza rather than walking steadily all day, every day, in order to return to Uvinza for the train on the 5th. I believe this rush accounts for my only seeing 16 chimp nests, as most of them were directly overhead when I saw them; going slower, I

would have been able to scan the sides more effectively. I also heard chimps screaming during one night. I observed a variety of animals, including baboons, redbtail monkeys, zebras, roans and numerous duikers; elephant and



Ugalla, Tanzania. *Cynometra* gallery along a seasonal stream, with open "mbuga" in the foreground. This belt of evergreen forest is only about 20 meters wide, but is continuous along the stream bed for miles. I found three nests here.

buffalo signs were common. I met two honey collectors and saw several abandoned shambas, but there was little sign of regular human use of the area.

I was only able to visit a small part of a large region; the following comments apply only to the area I have seen.

Topography: The area is surprisingly similar to southwest Mali, with flat-topped tablelands cut by wide, fairly shallow valleys. There is more soil on the tablelands, though, and the woodland is basically uninterrupted by the hills. There are cliffs around some of the hills, but there are few boulders and it was much easier to get around than Mali.

Vegetation: Ugalla's miombo woodland has been described by several researchers. The area I traveled through (and as far as I could see from hilltops) was a nearly continuous woodland broken by occasional small open areas of marshy grass and scrub (*mbuga*) that were saturated with tsetse flies. Watercourses were marked by ribbons of *Cynometra* forest, some only 10 m across; though the rains had started the week before, most of these were dry and water was hard to find.

The woodland typically has very little undergrowth and affords easy walking and observing. The crowns of the trees (primarily *Julbernardia globiflora*) just barely touch, so that although there is continuous lacy shade and a squirrel could probably travel for miles through the trees, chimps might have trouble getting from one tree to the next.

Animals: The area seems to support a rich variety of animal life. In addition to those I encountered, Itani (1979) lists galago, blue monkey, eland, hartebeest, sitatunga, lion, leopard, wild dog and others. I think the most relevant long term field studies in the area might be the tsetse flies; they are locally very bad and I had 15 to 20 escorting me at all times — relaxation was being bitten at least once in five minutes (repellent had little effect). The flies were densest around the valley mbugas (clearly preferred buffalo habitat), and were not too bad on the hillsides and inside the *Cynometra* galleries (sometimes only tens of meters from infested mbuga). Chimp nests observed by Itani, Nishida and myself tended to be on hillsides and escarpments, and it might be interesting to study the relationship between tsetse and chimp distributions within the region.

As to Ugalla as a study site: There are rail lines to both Uvinza and Mpanda, with service several times per week; there are missionary planes on a semi-regular basis to Mpanda from Tabora; the Uvinza-Mpanda road is reasonably good and is being maintained. Furthermore, the Mpanda train stops at the town of Ugalla where the line crosses the river; this is near a major concentration of chimp nests found by Nishida in 1975. I think a suitable study site with water could be found with some searching. The only signs of human activity in the area were a few beehives and a pair of honey collectors; I saw none of five roadside villages marked on a 1964 map of the area and I was told that the Ujamaa program had successfully moved all farmers out of the woodland area, with the thought of forming a game reserve. The apparent absence of agriculture or serious hunting makes the Ugalla region a safe bet for relatively undisturbed research.

This Tanzanian survey brought home to me the need to precisely define what is interesting about dry country chimps. Although both Bafing and Ugalla are arid sites, the habitats are strikingly different. At the Bafing, scrub *Combretum* and stunted *Terminalia* alternate with stands of bamboo; baobabs cluster around escarpment edges and the plateaus are topped by short grass and shallow rooted trees. The general aspect is of very patchy vegetation, with the commonest types unsuitable for chimp climbing, let alone travel. The "standard tree" is no more than five meters tall and only about three inches in diameter.



Bafing, Mali. This is dense *Combretum* scrub near an annual stream bed.

In comparison, the miombo woodland of Ugalla is remarkably uniform; trees are larger and, while travel through the canopies might not be possible, they are large enough to provide refuge from predator attacks.

At both sites, chimp foods are concentrated along watercourses and escarpments, where drainage conditions permit the growth of evergreen *Ficus*, etc. and groves of larger trees and lianas. The difference is that in Mali these patches are separated by scrub that offers little refuge to a chimp, whereas in Ugalla there are climbable trees everywhere and the understory is open, with good visibility.

Most of the nests I saw in Mali were conspicuously clustered near specific resources (e.g. near baobab trees), and it was clear in several cases that a few chimps had nested in the same area repeatedly. My Ugalla sample is far too small to be more than casually interesting, but the largest group seen was four nests, and they were contemporaries; I saw no sign of repeat nestings. In Mali about 35 percent of contemporary groups had three or more nests versus 60 percent in Ugalla.

Chimpanzees (or hominids) in a dry habitat are presumably faced with at least three problems: finding water, finding patches of food and shelter, and avoiding being eaten during travel between those patches. Ugalla and the



Ugalla, Tanzania. Miombo woodland. There was very little undergrowth in most areas. The habitat appears to be more homogeneous.

Bafing appear roughly similar in terms of water and resource patchiness but at Ugalla the risk of travel seems to have been decoupled from the patchiness of the food; climbable trees are everywhere. My first reaction was that this made Ugalla less suitable for "hominid model" research on chimps. My second was to begin thinking about what is really meant by "open savanna" as a hominid niche. Ugalla has been described as a "dry, sparsely wooded environment" that informs us about the "adaptation of pongids to an open land" (Itani, 1979). This is true in that miombo woods are open and parklike compared with the tangles of riverine forest, and Ugalla certainly is dry. The animals recorded include lion, wild dog, zebra, hyena and others that conjure images of grasslands. From a foraging standpoint, the Ugalla chimps may very well be dealing with isolated patches in a "desert" such as would be riverine acacia clumps or kopjes in the Serengeti. However, the habitat is more like a New England maple forest than a grassland.

The first idea that comes to my mind is that a quantification of the patchiness of the two sites, followed by comparison of chimp ranging patterns and group size stability, would yield valuable information regarding the importance of food patchiness in antipredator

strategies. Unfortunately, the issue of human disturbance comes up; hunting has eliminated most predators from the Bafing site, and it is even conceivable to me that chimps are able to survive in the northern Bafing area only because predators have been greatly reduced.

The Bafing site is logistically easier and research there would help the general cause of conservation in West Africa. The flooding caused by the Manantali dam can be seen as a unique "natural" experiment as it compresses the ranges of animals in the area. The habitat appears harsher and patchier than Ugalla, and I suspect it is the "extreme" chimp habitat. The area of Ugalla that I visited appears much more congenial to chimps, and the difference between sites emphasizes that millimeters of rainfall are only a part of the story. Research at either site would be valuable, *if* the habitat is described in a way that permits analysis of the problems facing chimps. Direct application of Bafing data to models of hominids is difficult because predators have been shot out; direct application of Ugalla data may require redefinition — or just definition — of the "open habitat" we think our ancestors utilized. ■

BOOKS

FEMALES OF THE SPECIES, by Bettyann Kevles. Harvard University Press, Cambridge, MA, 1986. pp 251, illustrated. \$20.

Subtitled "Sex and Survival in the Animal Kingdom," this book explores the many ways in which female animals, other than humans, achieve their primary goal — perpetuation of the species. Kevles, who writes a science column for the *Los Angeles Times*, has incorporated important new research in her wide-ranging study. It is now recognized that the female plays a much larger and more active role in sexual behavior and ultimately in the evolutionary direction of the species than used to be thought. The book is divided into four major sections: courtship, mating, motherhood and sisterhood. It is recommended to anyone interested in sex roles and animal behavior. ■

GRANT SPOTLIGHT

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

H. S. Green \$1,500 funded

THE EARLIEST HUMAN SETTLEMENT OF WALES

Dr. Green will continue his fieldwork at the Pontnewydd Cave, Elwy Valley, and Carmarthen Bay sites. In the past six years, work here has uncovered a Late Acheulian industry and fragmentary hominid remains, providing important new evidence for the distribution of human settlement and of hominids themselves.

Joseph Gysels \$3,500 funded

PALEOANTHROPOLOGICAL STUDY OF OLDOWAN INDUSTRIES AT KAPTHURIN, KENYA

Mr. Gysels plans to finish the analysis of sites excavated at Kapthurin since 1981. He will do a comparative study in the National Museums in Nairobi of materials stored from Chesowanja, Koobi Fora and Olduvai.

Lewis R. Binford \$1,700 funded

EXPERIMENT IN BONE DISTRIBUTION BY HYENAS

The South African government has given Dr. Binford permission to collect natural "death bones" to place in special positions in Kruger National Park as they were mapped on the Zinj floor at Olduvai Gorge. He will observe hyenas chewing on them to see how the bones get distributed.

Nicola Stern \$4,000 funded

THE RANGING BEHAVIOR OF EARLY HOMINIDS

The aim of this project is to ascertain whether early hominids had a ranging pattern that differed significantly from that of modern humans by extracting information about past land use patterns from archeological debris. The fieldwork will be undertaken at Koobi Fora.

Diane M. Doran \$5,100 funded

THE COMPARATIVE POSITIONAL BEHAVIOR OF PYGMY (PAN PANICUS) AND COMMON (PAN TROGLODYTES) CHIMPANZEES

This study will compare the positional behavior of pygmy and common chimpanzees in Zaire and on the Ivory Coast.

B. Arensburg, et al \$10,000 funded

THE ORIGINS OF MODERN HUMANS IN THE MEDITERRANEAN LEVANT

These researchers from Hebrew University and Tel Aviv University will continue excavation and analysis of materials from the key Mousterian Upper Paleolithic site of Kebara Cave, Mt. Carmel, Israel. The research has potential significance to our understanding of human origins. Kebara has already yielded two well-preserved Neanderthal skeletons.

K. Bae \$4,825 funded

THE LOWER PALEOLITHIC CHONGOKNI STONE INDUSTRY

Mr. Bae will make a comparison study of the cultural tradition of the Paleolithic industries in eastern Asia in order to construct a potential model of hominid adaptation to this temperate zone. The project will also involve synthesizing current archeological evidence and environmental data from northeastern Asia. ■

FRANKLIN MOSHER BALDWIN FELLOWSHIPS AWARDED

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

The following Baldwin Fellowships were recently awarded:

Joseph Mworia Maitima,

who has been accepted at Duke University in a Ph.D. graduate program, will specialize in the study of paleoenvironmental aspects of human evolution. He will analyze pollen, diatoms and grass cuticles for information to that end, and work on core materials from Nkunga and Lari Swamp. He will sample a series of hominid find localities and archeological sites in Kenya for micro-fossils to interpret the paleoenvironmental settings. His Baldwin Fellowship will provide \$4,500 per year for three years.

Berhane Asfaw,

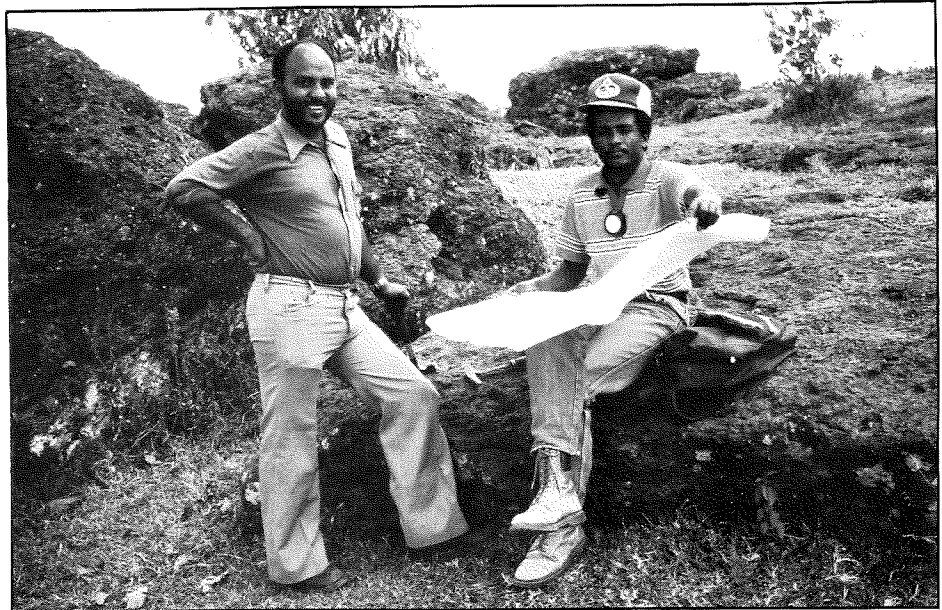
a graduate student at the University of California at Berkeley, will receive a Baldwin Fellowship of \$5,500 for one year while he completes his doctoral dissertation on the evolution of hominid frontal bones as demonstrated by fossils from the Middle Awash and Hadar in Ethiopia.

Onesphor Kyara,

a Tanzanian graduate student currently studying at Brown University under the supervision of Dr. Peter Schmidt, has been awarded a \$1,900 Baldwin Fellowship for studies under Dr. J.W.K. Harris at the University of Wisconsin, Milwaukee. Kyara will be working on his master's thesis on the Earlier Stone Age of Tanzania. ■

FIELD REPORTS

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



Giday W. Gabriel, at right, with Michael Tesfay of the Ethiopian Ministry of Mines and Energy, at an ignimbrite (volcanic) outcrop in the central sector of the Main Ethiopian Rift. Mr. Gabriel

was awarded a Franklin Mosher Baldwin grant for field work in his native Ethiopia and for graduate study at Case Western Reserve University in Cleveland, Ohio.

RESEARCH TRAINING AT THE UNIVERSITY OF CALIFORNIA BERKELEY

*C. A. Poggenpoel
Department of Archeology
University of Cape Town,
South Africa*

I would like to thank the Leakey Foundation for the financial assistance I received while attending a faunal course at the University of California at Berkeley during October, 1985, to March, 1986.

Because I arrived in the middle of the fall semester, Professor Clark Howell suggested that I should participate in a practical course that teaches graduate students laboratory techniques in casting prehistoric specimens in plaster of paris. This was a fantastic stroke of luck because since my return to Cape Town I have learned from Professor Nick van der Merwe that all archeological specimens analyzed in the Department of

Archeometry will have to be cast before subjected to any test in his laboratory, and someone with this kind of experience is needed to set up a casting program.

During the short vacation between the fall and spring semesters, I spent some time in the human osteology laboratory working with Professor Tim White, learning the techniques of aging human skeletal remains. A number of skeletons were excavated at a pueblo in New Mexico some years ago and the evidence suggested that the people who occupied the pueblo practiced cannibalism. The study of dissecting, cut marks and eating practices is of particular interest to compare with australopithecine site research in Africa.

In the spring I started the faunal course in paleontology. Since there is very little difference between zooarcheology and ecological paleontology, it was suggested by Professor Glynn Isaac some ten years ago to put a package together which trains paleontologists and archeologists how to recognize the

different skeletal elements and taxa normally found in archeological excavations. Since then the Department of Paleontology at Berkeley has offered this course every second year. Now taught by Professors Bill Clements and Don Savage, the course entails the study of Late Pleistocene and Holocene fauna.

During the first weeks of the spring semester we were trained to identify bones frequently found in archeological contexts, to measure the abundance of each taxon within a faunal assemblage, to count the number of different skeletal elements by which each taxon is represented, to estimate the proportional representation of individual size and the variability in size within each taxon and so forth. By learning the principles and procedures of faunal analysis and the different preservation techniques in the field and laboratory conditions, I have enhanced my understanding of faunal remains tremendously.

I also had the opportunity to attend other courses in archeology including a series of lectures given by Professor Desmond Clark on Old World prehistory. A number of seminars were presented by Professors Ruth Tringham and Meg Conkey on European and Near Eastern prehistory and Professor Clark Howell gave a weekly seminar on primate evolution.

The lack of qualitative data representing information on faunal analysis in field projects and theses in our department at Cape Town was the main reason for my attending the faunal course at Berkeley. The experience I have gained will help to establish a series of seminars for undergraduate students at Cape Town.

WILD CHIMPANZEE VOCALIZATION

*R.W. Byrne and J.M. Byrne
University of St. Andrews, Scotland*

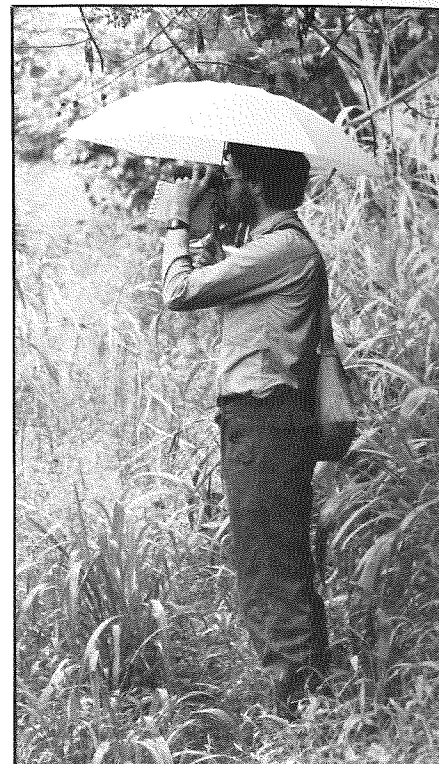
*H. Takasaki
University of Kyoto, Japan*

Vocalizations which carry long distances in tropical forests are probably more important for chimpanzees than for most primates because of their unusual fission-fusion groupings, in which subgroups of variable size and composition split off and coalesce flexibly. In

particular, the very far-carrying "pant-hoot" call is thought to be important both for long distance coordination of parties in the same chimpanzee community, and for threat and deterrence of animals from neighboring communities. In order to test these guesses about the functions of pant-hoot calls it is necessary to perform field playback experiments to see what the calls really "mean" to the chimpanzees; this had never been carried out, and it is what we set out to do in 1984.

We had been given permission to work at the Japanese study site in the Mahale Mountains National Park in Tanzania and we arrived in August, 1984. The first month was spent learning the identities of the chimpanzees by facial and other features, a not inconsiderable task as there are over 100 animals in the study community. At the same time we recorded vocalizations in order to select a set to use in playback experiments. The experiments themselves can only be carried out in a single cleared area. This is because in the dense forest it would not be possible to see the reaction of most animals, nor (more importantly) would it be possible to run an experiment without danger of some chimpanzees realizing that they were being "tricked." We designed a series of 18 trials which would examine two interesting hypotheses about the functions of pant-hoot calls, and made all the measurement of sound levels and distances which are necessary preliminaries to a successful playback trial.

At that time of year, mid-September, the study community of chimpanzees



R. W. Byrne

normally shifts its range northward, to be present very reliably in the area around the clearing for the next few months. In 1984 this did not occur, and in fact the chimpanzees spent half of September, most of October and the whole of November very far to the south of their normal range, outside the

J. M. Byrne



area of cut trails which the Japanese scientists use to facilitate access to the animals. It was thus quite impossible to complete the series of playbacks by the time we had to leave in late November — a little earlier than planned because of the activity of violent Zairois terrorists within the Mahale National Park and across Lake Tanganyika in Zaire. Fortunately, Hiroyuki Takasaki, who was working at Mahale until March, 1985, agreed to join us in extending our project into a collaborative study. Because of the chimpanzees' unusual ranging behavior that year, he too was in fact unable to continue the series of playbacks by the time he had to return to Japan in March, 1985.

Now Takasaki has obtained a two year research fellowship to work at Mahale from January, 1987, to December, 1988. He intends to intersperse occasional playback experiments with the normal course of his research work at Mahale. This is in some respects the best way to carry out the experiments, because it reduces the chances of the animals habituating to the recorded sounds or realizing that the sounds are "artificial." All of us are now looking forward to completing the project begun in 1984.

We made a number of incidental observations while with Japanese colleagues at Mahale. As well as some unusual feeding behaviors (we have collected samples of rotting wood and minerals for analysis), and a unique case of a lactating female who began estrous cycling (in the way that is normal in pygmy chimpanzees), our most exciting observations were of interactions with large carnivores. A party of female chimpanzees with young infants enthusiastically mobbed two lionesses with calls and branch-shaking (but no aimed throwing); the lionesses were unmoved by the displays and eventually strolled off.

An encounter with a female leopard and her young cub was very different, and may be of particular interest to *AnthroQuest* readers. A party of chimpanzees, with a small group of males in the van, drove the leopard into what was apparently the breeding den and after surrounding and mobbing her for over an hour one of the males was able to grab the two to three month old cub. They then tossed it around and killed it, while the mother made no attempt to retrieve or protect her cub. The abandoned body was carried by young chimpanzees, especially adolescent females,

for several hours; it was played with, groomed, tickled and cuddled in the manner of a mother with a baby chimpanzee. If chimpanzees can rob a leopard of her cub, it seems likely that they would be able to steal meat from carnivores of at least leopard size with virtual impunity.

COMPARATIVE STUDIES OF HUNTER-GATHERER CULTURES IN THE UNITED STATES AND POLAND

John Bower
Department of Sociology
and Anthropology
Iowa State University, Ames

The agreement for the scientific study reported here was formalized by the participating organizations, the Institute for the History of Material Culture, Polish Academy of Sciences, and Iowa State University, in 1984. It established a long term, cooperative archeological research program focused on comparative studies of Late Pleistocene and Early Holocene hunter-gatherer cultures in Poland and the United States. In addition, the agreement stipulated that fieldwork should be performed on opposite sides of the Atlantic in alternate years, beginning with a field season in the United States during the summer of 1985. Thus in June and July of that year Dr. John Bower of ISU and Dr. Michael Kobusiewicz of the IHMC spent about six weeks at various locations in Iowa and Illinois conducting reconnaissance and test excavations aimed at identifying sites for intensive data collection; they also carried out analytical studies of previously collected lithic assemblages from various Archaic sites. This report summarizes the results of those investigations.

The research team felt that it should devote a substantial amount of effort to typological studies of lithic assemblages representing the cultural stages embraced by the project, namely Paleoindian and Early-Middle Archaic. We were convinced that such work would not only yield relevant data but would also help sharpen our perception of the basic research issues with which our venture is engaged. (The lack of clear

definition was in part a consequence of the fact that comparative archeological research of the type envisioned for this project is essentially unprecedented.) With these goals in mind, especially the latter, we decided to schedule the typological studies ahead of the fieldwork. While artifacts from sites in central Iowa, western Iowa and northeastern Illinois were examined, by far the most intensive study was devoted to Middle Archaic assemblages from horizons 8 and 10 at the Koster site in central Illinois. The reason for concentrating on the Koster assemblages was that they constituted the best samples available to us, in terms of quantity and variety of specimens, as well as integrity of the collections. The major accomplishment of the laboratory research on the Koster assemblages was the production of a "Dynamic Technological Classification System," along the lines pioneered by Dr. Romauld Schild, that will accommodate Late Pleistocene and Early Holocene lithic materials from both Poland and the United States, thus providing a framework for direct comparison. A paper describing these studies is currently in preparation.

The program of reconnaissance and test excavations was aimed at identifying sites of high potential for intensive research. The criteria for evaluating the sites included (in descending order of importance) good preservation of ecofacts, evidence of a varied round of activities and waterfront location. The concern with ecofact preservation is related to the project's overarching emphasis on the question of adaptation. This question, together with logistical considerations, shaped our interest in habitation sites, as opposed to kill (or other specialized) sites. The waterfront criterion arose from two considerations: the fact that the sites likely to be excavated in Poland are located along erstwhile bodies of water, and the desirability of controlling as many variables as possible in the projected comparative analyses. Of course, the typological characteristics of cultural material were also considered.

Seven sites were carefully examined, two in central Iowa and five in northeastern Illinois. One of the sites in central Iowa, located on the northeastern margin of the city of Ames, appears to meet most, if not all, of the criteria for "high potential;" the other, located about 20 km southeast of Ames, is apparently a bison kill site with excellent bone preservation but otherwise

less promising characteristics. Both of the sites in Iowa probably represent the Middle Archaic stage.

Of the five sites examined in Illinois, three were deemed worthy of test excavation. One is located on the property of Pat and Ronald Hartmann of Elgin, another is in the middle of Hoffman Estates (and was imminently threatened by construction) and the third is on property owned by Dorothy and Floyd Watpler of Alden and farmed by Dwight Sphar. The tests generally involved probing with a posthole "auger" to depths up to 70 cm below surface at regular intervals along a series of transects laid out across the surface of each site. (In one case, presently to be discussed, small test trenches were also dug.)

Briefly, what the tests revealed was that the site on the Watplers' land may have the highest potential for intensive work. It is a "waterfront" site along the edge of a 5 x .5 km basin (now a peat bog) with excellent bone preservation; however, site function is unclear, and the probes (which included three small test trenches) did not expose substantial concentrations of cultural material or food debris. Moreover, judging from the typological characteristics of surface artifacts and a radiocarbon date from an elk bone retrieved from the upper layer of the peat, the site may be of Late Archaic affinity.

The results of reconnaissance and test excavations can be summarized as follows: Several — at least three — sites have been identified that might be suitable for extensive excavations which are scheduled for 1987; however, additional information is needed before a final selection can be made. At present, we are inclined to believe that the best prospect may be the site on the Watplers' land or another, more concentrated occurrence in the same basin. ■

NEW SCHOLARSHIP

The International Primatological Society has announced a Conservation Scholarship, reflecting its view that one of the best ways to promote the conservation of primates is to promote the training of habitat country conservationists.

A small number of scholarships will be awarded each year to assist citizens of countries with non-human primate populations to acquire further training. The chief criteria in application evaluation will be the ability to make a significant contribution to primate conservation and evidence that further training will aid significantly toward making this contribution.

There are two annual deadlines for applications: April 1 and October 1. For further information, contact Dr. John F. Oates, IPS Vice-President for Conservation, Dept. of Anthropology, Hunter College, 695 Park Ave., New York, N.Y. 10021. ■

JOHN ROBERTS AWARDED HIGHEST CHEMISTRY HONOR

John D. Roberts, Institute Professor of Chemistry at the California Institute of Technology and a trustee of the Leakey Foundation, has been named the recipient of the 1987 Priestley Medal, the nation's highest honor in chemistry. Named for Joseph Priestley, who discovered oxygen in the 18th century, the award is made annually by the American Chemical Society for distinguished service in chemistry.

Dr. Roberts is internationally recognized for his pioneering work in both chemical reactivity and Nuclear Magnetic Resonance spectroscopy. NMR is a technique of studying the structure of molecules by subjecting them to high magnetic fields and pulses of radio waves.

Dr. Roberts' NMR studies in organic chemistry, beginning in the 1950s, have resulted in new discoveries about numerous chemical substances, including many that are important in making plastics, medicines, detergents, pesticides and other products. ■

THE CUIVA

continued from page 1.

without elaborate political systems and economic opportunities are few (e.g., hunting/fishing versus gathering). Foragers build dwellings that frequently lack walls and carry out most of their subsistence activities in open areas. This allows ethnographers to observe such behaviors as food production consumption and processing, resting and child-care from a distance without drastically affecting the time allocation of the individuals under observation.

Second, band level foraging societies are typical of all but the last 10,000 years of human history. The archeological record of such societies is still difficult to interpret with confidence.

Early hominid foragers almost certainly had different behavioral capabilities. Consequently, we cannot take modern hunter-gatherers as typical foragers, nor can we reconstruct the behavior of past hunter-gatherers by direct extrapolation from the present.

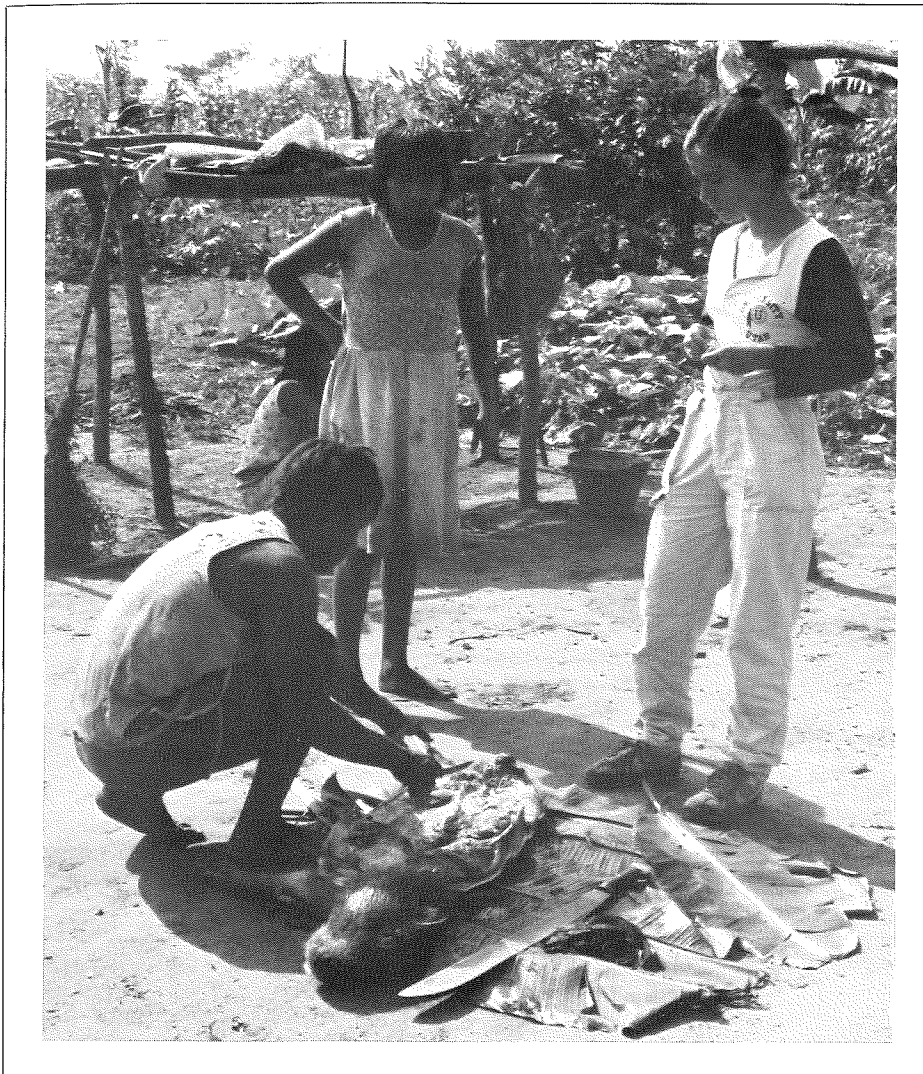
However, if the determinants of behavioral variation in modern hunting societies can be identified, they should improve our ability to reconstruct past human behaviors as seen through archeological remains.

Lastly, the opportunity to study hunter-gatherers is disappearing at a rapid rate due to the increasing economic exploitation of previously isolated areas of the world. Consequently, more detailed studies and behavioral analyses of modern hunter-gatherers should be undertaken as soon as possible before this opportunity disappears forever.

Even though numerous detailed studies of hunter-gatherers have been completed in recent years, several problems remain. In most cases, foragers are

ON THE COVER:

Group of Cuiva women at contact in 1960. Photo, courtesy of Roberto Lizarralde.



mental variation and the behaviors of different individuals grouped according to age, sex, or other attributes. With a large enough data set concerning the relationships between ecological and behavioral variables we will be able to test hypotheses about those relationships. It should be possible to generate and test hypotheses sufficiently general to predict the behavior likely to occur under ecological circumstances different from the modern world. This can be accomplished in two ways: 1) by using internal variation generated across time and space within an ethnographic case; and 2) by examining the variation between independent ethnographic cases over a broad range of ecological circumstances. Although the first of these two approaches has been adopted with increasing frequency and in an increasingly sophisticated manner by recent ethnographers, the comparative approach, using data from a variety of foraging societies, is still in its infancy. This is primarily due to the lack of large samples of quantitative and comparable behavioral and ecological data on more than a few foraging societies. The study of Cuiva hunter-gatherers of western Venezuela was motivated by a desire to change that situation.

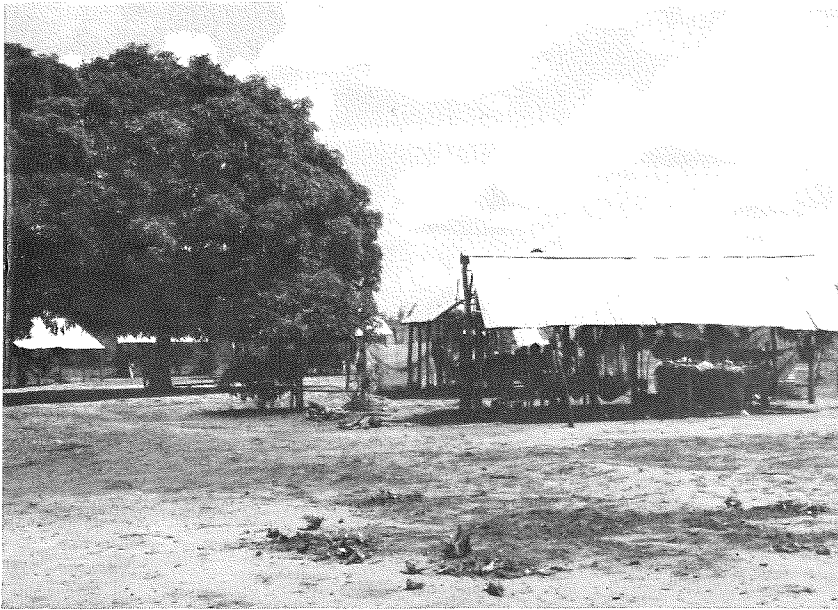
The current size of the Colombian and the Venezuelan Cuiva population is approximately 800 individuals. This group of hunter-gatherers inhabits the

Anthropologists at work. Hurtado, above, right; Hill, below, center.

confined to environments which are marginal for agriculture. Moreover, all modern hunter-gatherers have been exposed to state level economic systems which have changed, to varying degrees, the economic options available to them. Modern humans also represent a subspecies which has probably been in existence no more than 100,000 years. Earlier hominid foragers almost certainly had different behavioral capabilities. Consequently, we cannot take modern hunter-gatherers as typical foragers, nor can we reconstruct the behavior of past hunter-gatherers by direct extrapolation from the present.

One possible solution to this problem is to focus on the pattern of variation between sets of ecological variables and behavioral responses offered by each ethnographic case. Rather than seeking examples to represent a type, we can test for associations between environ-





The settlement at San Esteban.

savannas of western Venezuela and eastern Columbia. The contemporary Cuiva foraging range includes parts of the Capanaparo, Ariporo, Agua Clara and Meta River drainage near the borders of these two countries (between 69 and 70 degrees W and 6 and 7 degrees N). This represents a small area of the vast South American plain commonly referred to as the "llanos."

One of the most important ecological features of this area is high seasonality in rainfall patterns. The wet season lasts from April to October or November and the dry season from December to May. Almost 90 percent of the annual precipitation falls during the wet season. The rivers may rise as much as 10 meters and the grassland plains are almost entirely covered by standing water a few centimeters to several meters deep. The relatively few dry patches of land are then densely occupied by those mammals which are forced to take refuge. During the dry season mammals are also forced to concentrate in small areas but for different reasons. Because water sources become scarce, many species of animals move to the banks of rivers and streams.

The predominant vegetation types in the llanos are grasses in the savannas (90 percent of the vegetation) and gallery forests along river banks. The soils of the savanna tend to be infertile and poorly drained and vary in productivity depending on flooding frequency. While the more deeply flooded savannas have

dense patches of vegetation (primarily grasses and, less frequently, tubers), the sandhills and nonflooded ridges are almost bare of plants. These fluctuations in the availability of plant resources affect the distribution of grazers such as capybaras which consume large quantities of grass.

In contrast to the grassland soils, the alluvial soils found along rivers tend to be rich in nutrients. Many different types of vegetation grow in these forests including fruiting trees and plants with tuberous growths which serve as food to both human and nonhuman foragers. As a consequence, gallery forests have the highest densities of animal biomass in the llanos and, not surprisingly, human foragers frequently hunt in this microhabitat. Within the gallery forests, herbivores comprise the bulk of mammalian biomass. It has recently been demonstrated that the annual productivity of capybaras and deer is much higher than that of any other non-volant mammal in this ecozone.

According to informant reports, the Venezuelan Cuiva have had occasional and often hostile contact with Colombian and Venezuelan cattle ranchers since the early 1950s. However, these contacts were sporadic until 1960 when a Venezuelan cattle rancher, Marcelo Tapia, convinced the Cuiva leader at the time, Chere, to bring all the Cuiva to his land. Over a period of several years Chere gathered several local but scattered bands together on Tapia's ranch.

Initially the Cuiva lived and worked close to the Colombian border on the left bank of the Capanaparo River but later they moved further east and south to Carabali on the right bank. At this time some Cuiva also resettled a site

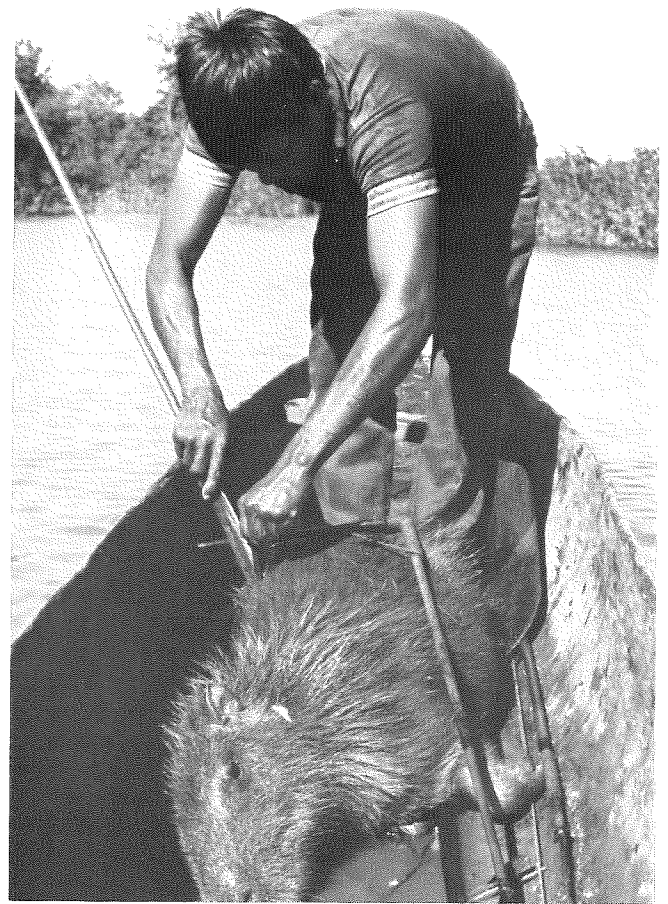
In 1967, 20 members of the Cuiva community were killed The crime was orchestrated by a local rancher and was typical of several other massacres . . . in the preceding few decades.

that they had occupied before contact, now called San Esteban. These two sites have been essentially permanently occupied since the late 1960s.

In 1967, 20 members of the Cuiva community at San Esteban were killed at a ranch called La Rubiera in Colombia. The crime was orchestrated by a local rancher and was typical of several other massacres that had taken place in the preceding few decades. Since 1967



Hunting in the savanna.



Man hunting in canoe with capybara.

sporadic killings have been reported by both sides and current Cuiva-criollo (Venezuelan nationals) relations range from tense to openly hostile.

In the early 1970s the Catholic priest Father Gonzalo Gonzales became involved in medical and agricultural programs among the Cuiva. He convinced the Venezuelan government to set aside 21,000 hectares for these hunter-gatherers and had some temporary success introducing subsistence agriculture to the groups.

A few years later Father Gonzales was ousted by the Dirección de Asuntos Indígenas (the Venezuelan Indian affairs bureau) and a permanent office was set up at Carabali. Since then assistance from government programs has been minor and infrequent, and seems to have had less of an impact on the Cuiva traditional economy than the earlier efforts of Marcelo Tapia and Father Gonzales.

All ethnographers that have studied the Cuiva in the past three decades found them to be essentially full time foragers, except for Coppens (1975).

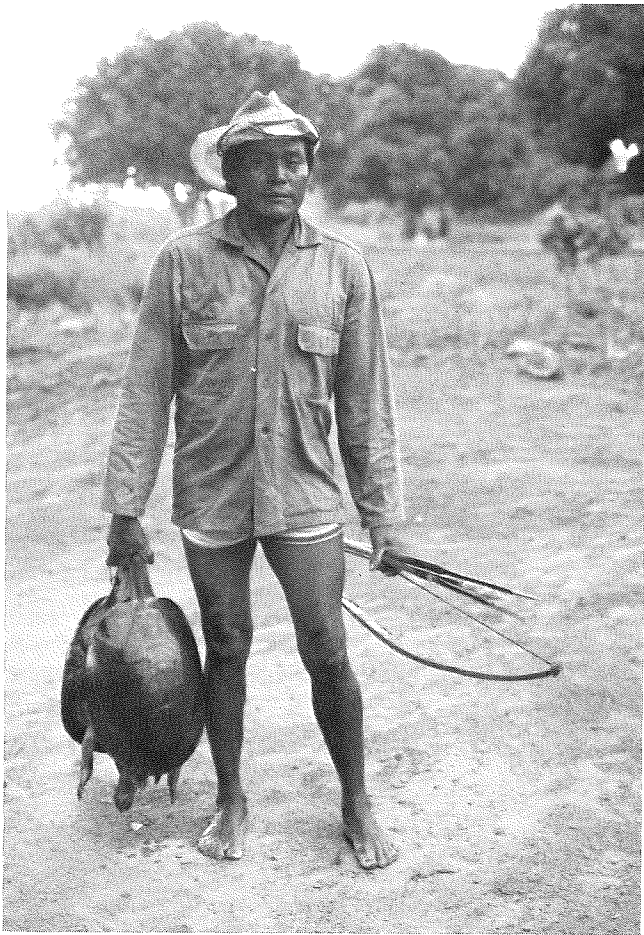
This seems to be due to the timing of his work. During this time, the Cuiva were under the strong influence of Father Gonzales who had been bringing tools, seeds, and fruit trees to Coppens' study site over a period of two years. After the Dirección de Asuntos Indígenas took over in 1972, the priest abruptly stopped his economic development program and since that time the Cuiva have been unable to farm successfully. The question of why these hunter-gatherers have not become part time or full time horticulturalists in spite of considerable exposure to planting techniques deserves careful examination in the future.

In view of the scant information that is currently available on the Cuiva and of the conflicting reports on their main subsistence strategies, a research project was designed to study the Cuiva population currently residing in southwestern Venezuela over a period of two months. The aims of this preliminary study were 1) to determine if the Cuiva are currently subsisting primarily by hunting and gathering as has been recently re-

ported, 2) to determine precisely where they are located and the size of the population, 3) to complete a brief but detailed quantitative study of food acquisition, time allocation and demographic patterns in the event that they were found to be foraging substantial amounts, and 4) to assess the potential for useful long term research among the Cuiva.

The Venezuelan Cuiva currently have two permanent settlements on the right margin of the Capanaparo River approximately 30 kms south of the town of Elorza in the state of Apure. During the wet season these villages can only be reached by boat or plane. In the dry season, on the other hand, jeeps are the preferred form of travel. The walking distance between Carabali and San Esteban is about 45 minutes. Until 1983 there was a third community, El Paso, about one hour from both Carabali and San Esteban. The members of this settlement were incorporated into Carabali during a short period of intervillage warfare.

There are several important differ-



Game brought into camp: iguana, cayman and turtles.

ences between Carabali and San Esteban. Carabali is located in a rather hot and dry area of savanna without shade or water nearby. It is also quite distant from some of the best root patches and hunting grounds of the area. The location seems to be determined in part by the presence of the Dirección de Asuntos Indígenas office some 200 meters from the village. This office houses government functionaries who provide goods and services (e.g., tools, seeds, cattle, clothing, medicine, teach classes) on an irregular basis but with a high enough frequency to encourage the Cuiva not to move elsewhere. A man-made well at this site serves as the primary source of drinking and bath water for Cuiva and non-Cuiva residents.

The village of Carabali consists of sixteen huts that form two rows running parallel to one another. It has a large clear area in the center where children play and most socializing and dancing take place. The huts have roofs and walls made of aluminum sheets and no windows. The closed huts, in combina-

tion with strong feelings of distrust towards the government functionaries and outsiders, made behavioral observations and interactions with members of the Carabali community difficult.

The second permanent settlement, San Esteban, is located on a high ridge in the gallery forest at the edge of the Capanaparo River. Water, shade and food resources are found at short distances from the village. Members of this village pride themselves on their independence from government functionaries. Although the Cuiva of San Esteban have few interactions with these officials, they have nevertheless been given a few seeds, tools and some cattle as well as some training in agriculture and livestock raising over the past decade. These handouts, however, are currently of minimal economic importance. Other government benefits such as wages, clothes, medicine and food very rarely reach the Cuiva of San Esteban.

San Esteban consists of 10 huts which form a semi-circle around a large, clear area about 20 meters from the

edge of the ridge. A communal field is located at the southern end of the village. A number of mango trees are found in the periphery of the settlement which produce large amounts of fruit at the height of the dry season and are excellent shading trees throughout the year. The huts are made of wooden posts with roofs of aluminum sheets but are without walls. This type of hut construction made the collection of observational data feasible from any central location in the community.

The current Cuiva population size is 268 individuals with 166 living at Carabali and 102 at San Esteban. Some of the Venezuelan Cuiva have used San Esteban as their main permanent camp for as long as 20 years. However, they frequently pack up their belongings to set up temporary camps closer to food resources that may be in season at that point in time. For example, during our stay several families moved upstream to a spot where an important tuber is found in abundant quantities. At other times moves might be motivated by warfare. In 1984 after members of San

Esteban were accused of killing a Carabali adult male and their community was raided by Carabali Cuiva, the San Esteban community moved to Colombia for several months. The Carabali community spends much more time in small band-size foraging camps than they do in their permanent large settlements. Temporary camps that we observed varied greatly in their composition and size. The smallest camps were formed by couples without children, and the largest were formed by more than half the permanent residents of San Esteban (10 nuclear families).

Cuiva and women generally exploit resources in different microhabitats and use different means of transport and tools when they forage. Men generally hunt along the banks of rivers, streams and swamps with canoes or on foot after traveling by canoe to an area that will be searched. Canoes are also used on most fishing trips. Hunters are usually accompanied by a second person who helps paddle while they are actively involved in the hunt. Sometimes wives and/or older children will accompany their husbands to do this work. At other times adult men might hunt together taking turns with the paddling and the hunting. Less frequently men will walk through the savanna in search of animals such as deer and armadillos or vegetable resources such as honey and palm fruits.

Regardless of where they hunt, the Cuiva men usually either start at sunrise and stop in the middle of the day or hunt in the late afternoon. Men use bows and arrows, spears, harpoons, fishlines and hooks. The puncturing ends of these weapons are made out of metal which the Cuiva have obtained through trading since the colonial period or before.

The current Cuiva population is 268 individuals with 166 living at Carabali and 102 at San Esteban. Some have used San Esteban as their main permanent camp for as long as 20 years. However, they frequently pack up their belongings to set up temporary camps closer to food resources that may be in season.

In contrast, men almost never collect tubers. Although they sometimes accompany the women on gathering trips, they ignore the roots. Their main purpose for joining women seems to be to

hunt near the root patch, to collect seeds (yopo, *Anadenanthera peregrina*) used to make drugs, to help the women carry the load back to camp, and/or to care for the children while the mother forages.

Women's foraging takes place primarily in the savannas found along the right margin of the Capanaparo. Many tubers are found either at the transitional edge of the savanna and the gallery forests or in the deeply flooded areas of the savanna. Consequently, the women generally travel on foot to the food patches. They use metal or wooden digging sticks, woven baskets and sometimes nylon bags to collect these vegetable resources. They usually forage in groups of adult females and adolescent girls who leave camp at sunrise and return shortly after noon.

During the study in November and December, 1985, the Cuiva of San Esteban depended primarily on game and roots for their subsistence. Wild animal resources account for more than half the meat acquired by the Cuiva. Capybaras, fish and caymans are the most important within this group.

Roots are the second most important staple among the Cuiva. They provide almost as much food as animal resources when measured in kilograms but less than one third of the calories that game provides.



Women digging and processing roots and tubers.

In contrast, only very small amounts of fruit, honey and eggs were taken during the study period. Plantains were harvested from fields that did not belong to the Cuiva and are therefore considered to be a "foraged" food. Agricultural products and store-bought foods are of minor importance in the Cuiva diet.

Data analyses show that most of the calories consumed by the Cuiva come from foraging and that animal rather than vegetable resources account for a greater portion of the caloric value food acquired.

The sexual division of labor among the Cuiva follows the usual pattern of male specialization in hunting and female specialization in gathering.

The sexual division of labor among the Cuiva follows the usual pattern of male specialization in hunting and female specialization in gathering. Men's subsistence efforts then provided 51 percent of the food by weight brought into camp and 69 percent of the calories. Women, on the other hand, acquired primarily roots and a few palm fruit. One land turtle, encountered by a woman while digging for roots, was captured. Women's foraging efforts then provided 56 percent of the food by weight but only 28 percent of the calories. When a couple's food resources are pooled, parents generally provide for themselves plus two children.

Although men produce more food than women, they do not allocate more time for food acquisition than females. Cuiva men between the ages of 20 and 60 years spend an average of 91 minutes per day foraging, but hunt only two days out of the week. This means that on days when men forage they stay out for a mean of five hours and 18 minutes. Males over 70 years of age allocate less time to foraging than younger men.

Similarly, women spend little effort in the pursuit of food resources although slightly more than men. Adult females between the ages of 20 and 60 years spend an average of 112 minutes per day collecting roots, or 21 minutes more time in food acquisition than men



in the same age group. Adult females only forage on slightly over two days out of the week. This suggests that on days when women forage they spend a mean of six hours and 32 minutes out of camp. Interestingly, the two women over 60 years of age foraged for longer periods and more frequently than younger women.

Sex differences in time allocation when adults stay in camp are of interest here. On days when men do not hunt, they seem to spend most of their time lying in their hammocks, visiting other men, consuming drugs, making tools and canoes. By contrast, they allocate few minutes per day to food processing (mainly butchering). Another important male activity is childcare. When mothers leave on foraging trips, the husbands are usually left in charge of the youngsters.

Women, on the other hand, spend a great deal of time food processing, weaving hammocks and carrying baskets while simultaneously taking care of youngsters when they stay in camp. In fact, when time spent in food processing by females is added to food acquisition we will probably find that Cuiva women allocate a great deal more energy to food-related activities than men. Unlike males, females very rarely consume drugs. Although women seem to spend less time visiting and resting in their hammocks than men, there are nevertheless important female in-camp activities.

Some of the parameters we chose to

examine in this preliminary analysis were completed family size, child mortality rate and sex ratio. The average completed family size among the Cuiva, that is, the mean number of live births for postreproductive women, is 5.13 births. Of the offspring born, 52 percent die before reaching maturity (i.e., before the age of 15). Females may be at a higher risk of death (55 percent) during the early years than males (49 percent). The data suggest that the Cuiva population has been declining in size recently (i.e., the data show a negative growth rate). This is because only 1.18 females born per woman are expected to survive

Males are not only less likely to die of natural causes at an early age than females, but they are also less likely to be killed by their mothers at birth . . .

to 15 years of age. In addition, only a fraction of the surviving females reproduce in turn. Among the Cuiva there is a relatively high rate of sterility (12 percent).

Males are not only less likely to die of natural causes at an early age than females, but they are also less likely to be killed by their mothers at birth than are females. Female infants were the victims in 10 out of 11 cases of infanticide reported. The mother of the single male infant killed had been left without a husband during the pregnancy. In contrast, in almost all the cases of female infanticide the mother stated that she did not want to have a daughter.

Males are not only given preference after birth but there is also a greater probability that a woman will give birth to a male than to a female. The sex ratio at birth tallied from all reproductive histories is 117 males to 100 females. The sex ratio in the current population is also high (151 males to 117 females) and quite pronounced in the subadult group (71 males to 43 females).

The most important finding of our research for future investigation is that the Venezuelan Cuiva are still essentially full time foragers and continue to hunt and gather in an area that is part of their traditional home range. Although they have permanent settlements with a few agricultural fields and some domestic



Moving camp.



animals, they nevertheless spend most of their time hunting and gathering out from permanent villages and temporary camps.

Another important finding is that, during November and December of 1985, animal resources were the main source of calories among the Cuiva. Among the wild animals taken, capybaras are the most important resource both in total kilograms and total calories acquired. Fish also made a substantial contribution, while other large animals (e.g., caymans) and small game (iguanas, turtles) accounted for the remaining meat component of the diet.

Roots are the second most important component of the Cuiva diet at this time of the year. They were taken in very large quantities throughout the study period. In fact, whenever families left the main settlement on overnight foraging trips they appeared to do so in order to move closer to abundant patches of tubers. Interestingly, the distribution of vegetable resources rather than game seemed to be the most important criterion for camp location. This may also be true during the late dry season when the Cuiva set up camp near abundant fruit groves.

Low male work effort seems puzzling in view of the Cuiva demographic pattern which shows relatively high levels of infant mortality and few live births per woman. This raises the question of

why Cuiva men do not spend more hours per day foraging in order to improve the nutritional status of their wives and children. A possible explanation is that these hunter-gatherers are adjusting their dry season behaviors according to the constraints during the wet (lean) season. Informants reported that during the wettest part of the year the Cuiva eat much less than during the dry season. If the Cuiva were to drastically increase their food consumption during the best months, individuals might actually suffer more harm than good. Furthermore, if women were to become more fertile during the dry season as a result of increases in fat reserves, they might end up losing their infants anyway during the lean season because only a few mouths can be adequately fed in the wettest months. The extra effort in subsistence work during the seasonal resource abundance would therefore not be worth the short term benefits.

Another interesting finding is that there is a very high sex ratio in favor of males among the Cuiva. The reasons why males should be the preferred sex are somewhat complex but may be associated with high male-female differences in economic value and, therefore, in the costs of raising offspring. Males may actually be less costly to raise because when they begin to produce food they provide much more than

females. Modern sex allocation theory suggests that the less costly sex will be produced in greater numbers.

The Cuiva pattern contrasts with and resembles the foraging behaviors of other hunter-gatherers in interesting ways. Ache men spend much more time in food acquisition than Cuiva males and Ache women spend slightly more time in this activity than Cuiva females. On the other hand, the !Kung and the Hadza are characterized by time allocation patterns more similar to the Cuiva. In these two groups sex differences in time allocation to food acquisition are slight. Interestingly, while the Ache are found in a tropical forest, the Cuiva, the !Kung and the Hadza are all found in savanna environments. What ecological factors might be responsible for the differences?

There are also some interesting demographic similarities and differences between the Cuiva, the Ache and the !Kung. Of these three groups, the !Kung show the lowest number of live births per woman. Cuiva women have a somewhat higher mean while the Ache show the highest average. At the same time we find differences in the sex ratio at birth across these three groups. The Cuiva and the Ache show almost identical sex ratios at birth, while the !Kung sex ratio is lower. Moreover, as among the Cuiva, Ache male children survive at a higher rate than female children. But

the pattern is reversed in the !Kung case. !Kung male children show lower survivorship than female children.

We also found interesting differences in the relative robustness of adults in these three foraging populations. While the Ache are the most robust, the !Kung are the smallest individuals in the sample and the Cuiva are found in between these two extremes. Differences in per capita consumption (at first glance) do not seem to be producing these differences. In fact, the !Kung seem to be eating slightly more than the Cuiva although it is possible that per capita consumption data on a full annual cycle for both groups will show otherwise. The Ache as foragers eat much more than either the Cuiva or the !Kung and are also more robust.

Opportunities to carry out productive research among the Cuiva in the future are excellent. We were able to establish good working relationships with the Cuiva and with local governments which will allow us to visit the area without difficulties. Hurtado became affiliated with a national research institute, the Instituto Venezolano de Investigaciones Cientificas (IVIC), which has offered to give logistical and institutional support to the Cuiva research project in the future. Both ecology and anthropology students at IVIC may become involved in our fieldwork during seasons of the year when we are absent.

Second, it is extremely unlikely that the Cuiva traditional economy will change drastically in the near future. Conversations with local ranchers led us to conclude that the potential for agriculture is low in this area. The fact that the Cuiva have been exposed to farming for so long and yet continue to depend on foraging supports this hypothesis as well. Analyses of soil samples we collected in several Cuiva slash-burn fields should give us a better measure of the productivity of the soils in the area.

Third, the Cuiva provide an excellent opportunity to study the demography of a foraging group. Because they have had contact with outsiders since the 1950s, events can be accurately dated and matched to the births of individuals 30 years old and younger. Moreover, Venezuelan nationals who have had considerable interactions with the Cuiva since contact, have offered us access to the many photographs they have taken.

Fourth, the fact that there are several fluent Spanish speakers in the Cuiva population who are still integrated in

the community and continue to live as foragers will allow us to collect detailed interview data on settlement patterns.

And lastly, the Cuiva offer an excellent opportunity to complete observational studies on men's and women's work effort, childcare and alloparenting, infant mortality and other measurements of fitness across highly dissimilar seasons of the year and across individuals in different age and sex classes and in other categories. This internal variation may allow us to isolate some of the factors responsible for the main behavioral patterns. These analyses in combination with future comparative studies using data on the Cuiva and other modern foraging groups will help us better understand the ecological determinants of hunter-gatherer behavior across time and space.

SOME READINGS ON THE CUIVA AND OTHER FORAGING PEOPLES

Bailey, R. and N. Peacock

1984 Efe Pygmies of Northeast Zaire: Subsistence Strategies in the Ituri Forest. In D. du Garinne and G. A. Harnson eds. *UNCERTAINTY IN THE FOOD SUPPLY*, New York: Cambridge University Press.

Binford, L. R.

1978 *NINAMUIT ETHNOARCHAEOLOGY*. New York: Academic Press.

Binford, L. R.

1981 *BONES: ANCIENT MEN AND MODERN MYTHS*. New York: Academic Press.

Butland, G. J.

1966 *LATIN AMERICA: A REGIONAL GEOGRAPHY*. Second Edition. New York: John Wiley and Sons.

Charnov, E. L.

1985 *THE THEORY OF SEX ALLOCATION*. Princeton: Princeton University Press.

Duffy, K.

1984 *CHILDREN OF THE FOREST*. New York: Dodd Mead.

Eisenberg, J. F.

1979 *VERTEBRATE ECOLOGY IN THE NORTHERN NEOTROPICS*. Washington: Smithsonian Institution Press.

Fisher, R. A.

1958 *THE GENETICAL THEORY OF NATURAL SELECTION*. Second Edition. New York: Dover.

Gould, R. A.

1980 *LIVING ARCHEOLOGY*. Cambridge: Cambridge University Press.

Griffin, P. B.

1985 The Agta of Northeastern Luzon, Philippines. In C. Schrire ed. *PAST AND PRESENT IN HUNTER-GATHERER STUDIES*. New York: Academic Press.

Hames, R. B. and W. T. Vickers

1983 *ADAPTIVE RESPONSES OF NATIVE AMAZONIANS*. New York: Academic Press.

Harako, R.

1981 The Mbuti Pygmies in the Ituri Forest, Zaire. In R. S. O. Harding and G. Teleki eds. *OMNIVOROUS PRIMATES*. New York: Columbia University Press.

Jones, R.

1980 Hunters in the Australian Coastal Savanna. In D. Harris ed. *HUMAN ECOLOGY IN SAVANNA ENVIRONMENTS*. London: Academic Press.

Lee, R. B.

1979 *THE !KUNG SAN*. Cambridge: Cambridge University Press.

Lee, R. B. and I. DeVore

1968 *MAN THE HUNTER*. Chicago: Aldine.

1976 *KALAHARI HUNTER-GATHERERS*. Cambridge: Harvard University Press.

Leacock, E. and R. B. Lee (eds.)

1982 *POLITICS IN BAND SOCIETIES*. Cambridge: Cambridge University Press.

O'Connell, J. and K. Hawkes

1981 Alwara plant use and optimal foraging theory. In B. Winterhalder and E. A. Smith eds. *HUNTER-GATHERER FORAGING STRATEGIES*. Chicago: University of Chicago Press.

Sarmiento, G.

1984 *THE ECOLOGY OF NEOTROPICAL SAVANNAS*. Cambridge: Harvard University Press.

Schrire, C. (ed)

1985 *PAST AND PRESENT IN HUNTER-GATHERER STUDIES*. New York: Academic Press.

Shostak, M.
1981 NISA: THE LIFE AND
WORDS OF A !KUNG WOMAN.
Cambridge: Harvard University Press.

Tanaka, J.
1980 THE SAN HUNTER-
GATHERERS OF THE KALAHARI.
Tokyo: University of Tokyo Press.

Winterhalder, B. and E. A. Smith (eds.)
1981 HUNTER-GATHERER FOR-
AGING STRATEGIES. Chicago:
University of Chicago Press.

Yellen, J.
1977 ARCHEOLOGICAL AP-
PROACHES TO THE PRESENT:
MODELS FOR RECONSTRUCTING
THE PAST. New York: Academic
Press. ■

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CALENDAR

DR. BIRUTÉ GALDIKAS

February 2, 1987	Lecture	8:00 p.m.	University of California, San Diego
March 5	Lecture	Evening	Greater Los Angeles Zoo Association and Department of Anthropology, University of Southern California
March 14 or 15	Lecture	Evening	Zoological Society of Florida (Metrozoo), Miami
March 26	Lecture	8:00 p.m.	University of Calgary
March 27	Seminar	3:30 p.m.	University of Calgary
April 2	Lecture	8:00 p.m.	Whitman College, Walla Walla, Washington
April 3	Seminar	Morning	Whitman College, Walla Walla, Washington

MR. RICHARD E. LEAKEY

February 25	Lecture	7:00 p.m.	Co-sponsored by Virginia Museum of Natural History at University Hall, University of Virginia, Charlottesville. For information: 818-449-0507.
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DR. SHIRLEY STRUM

April 10	Lecture	Evening	San Francisco Zoo
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