AnthroQuest

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LEAKEY LECTURE 1999

Language and Human Evolution

By Dr. Matt Cartmill

The ability to use language makes *Homo sapiens* a uniquely successful, powerful, and dangerous mammal. Other creatures' signals carry only a few limited kinds of information about what is happening at the moment, but language lets us tell each other in limitless detail about what used to be or will be or might be. How did such a marvelous adaptation get started? And if it is so marvelous, how come no other species has ever come up with anything similar? I think these may be the most important questions we face today in studying human evolution. Unfortunately, they are not very well understood, because the tools and techniques that evolutionary biologists use to answer such questions do not work very well when it comes to the origins of language. But in the past few years, linguists and anthropologists have been making some breakthroughs, and we are now beginning to have a glimmering of when and how language originated.

We know that language made its appearance in the human lineage by at least 30,000 years ago. By that time, people in various parts of the world were making representational paintings and sculpture, and ornaments for personal adornment—necklaces of teeth and shells and so on—and burying their dead ceremoniously with grave goods. These things imply the presence of art and religion, which are high-level kinds of symbolic behavior. It seems reasonable to think that the everyday symbol-handling machinery of human language must have been in place then as well.

Language surely goes back further than that, but archaeologists do not

Dr. Cartmill, Professor of Biological Anthropology and Anatomy, Duke University

agree on just how far. Some of them think that earlier, more basic human behaviors—such as hunting in groups, or tending fires, or making stone tools—also demanded language. But others insist that these activities are possible without speech. After all, chimpanzees hunt communally, and they can be trained to make fires and chip flint.

Paleontologists have pored over the fossil bones of our ancient relatives in search of evidence for speech abilities. Unfortunately, it is not clear just which parts of our anatomy are necessary for language skills. Some scientists have tried to find traces of the presence of language by looking at the fossilized braincases of our ancestors. Others have sought to find fossil evidence of language in the throat and tongue. Of course, these organs also do not fossilize, so the scientists have to reconstruct the tongues and throats of early hominids from their fossil skulls and jaws, and then use some educated guess work to figure out whether those imaginary tongues and throats could have produced human speech. The uncertainties involved in these long chains of reasoning have fueled a lot of scientific debates.

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Notes from the Field:

Cathemerality in Argentinian Owl Monkeys

By Carrie Sloan and Dr. Eduardo Fernandez-Duque

Most primates are active during the day, a few during the night, and even fewer during both; those active during the day as well as during the night are known as cathemeral. Contrary to other strictly nocturnal species of owl monkeys in tropical South America, Aotus azarai *of Northern Argentina is cathemeral.*

The research team headed by Dr. Eduardo Fernandez-Duque is investigating which ecological factors may lead owl monkeys to be cathemeral solely in the southern part of their range. The project focuses on examining the relationships between cathemerality in mirikinás (the local name for owl monkeys) and changes in climate, moonlight, and food availability in the forests of Formosa, Argentina. This research will offer insight into the effects of harsh, dry environments on the behavior of owl monkeys, and shed light on how our earliest ancestors may have behaved in similar climates. The Leakey Foundation is proud to support this project by providing matching funds for other awards made by The Douroucouli Foundation and Dumond Conservancy for Primates and Tropical Forests.

One can always expect the unexpected during field work: uncooperative subjects, faulty equipment, moody Mother Nature. Still, our project seems to be protected by some sort of impenetrable ring of positive aura. Perhaps this stroke of luck is a result of our staff diversity representing the United Kingdom, the United States, and four provinces of Argentina. Perhaps we are just not of interest to Pomberito, the faceless forest gnome locally believed to be the source of bad things. Our mon-

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President's Message: Challenges and Accomplishments

April 1999

Dear Members:

There is so much to communicate about all of our activities that it is hard to know where to begin! Suffice it to say that there is much going on in the exciting exploration of our human past. The Leakey Foundation is well into our spring granting session, and is quite pleased with the variety and scope of applications received from both students and established research scientists throughout the world. The Scientific Executive Committee and staff go to great lengths to obtain thoughtful, professional reviews on each application. Thus, we feel confident that we are granting funds for the most compelling research projects.

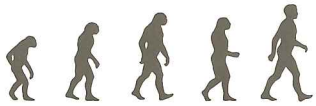
Those of you who attended this year's Leakey Lecture know how fascinating it was to consider the importance of the development of language in human evolution. Dr. Matt Cartmill provided us with an amazing look at the emergence of this integral part of what makes us human. While his talk furnished an in-depth view of the different approaches scientists have used to examine when our ancestors may have begun using language, I hope you will enjoy the abbreviated version of Dr. Cartmill's Leakey Lecture included in this issue of *AnthroQuest*. The Leakey Lecture is an especially important avenue for the Foundation to afford perspective to the public on the interdisciplinary nature of reconstructing our human origins. We are proud to be able to provide support and promote the work of eminent scientists such as Dr. Cartmill and other past speakers for this special annual event.

Many of us involved with the Leakey Foundation over the past three decades were fortunate to know Louis and Mary Leakey and their devotion to the National Museums of Kenya. The Leakey Foundation has long supported the Museum through our various grant programs, most recently through the Mary Leakey Award, which will provide funds for Museum employee Emma Mbua as she pursues her Ph. D. at the University of Hamburg. I'm sure that Louis and Mary would have supported wholeheartedly the recent appointments of Richard Leakey as Chairman of the Board of Trustees of the National Museum of Kenya, and George Abungu as Director of the Museum. The future of this great institution, which was so shaped by the work of Louis and Mary, will be vastly enhanced by the commitment and experience which these men bring to their jobs. We look forward to the opportunities these appointments will present to scientists in Kenya and, more broadly, to the future of human origins research.

The recent tragic events in Uganda remind us of the precarious nature that scientists and travelers face in many parts of the world. Having sponsored research projects in the Bwindi Impenetrable Forest, the Leakey Foundation is particularly concerned about the researchers working in that area and hope that the situation improves soon. Carrying out research in politically unstable locations is often an unfortunate fact of life for scientists working in the field of human origins. Although fossil hunting and work with primates can be romanticized, we should remember that it is challenging work frequently conducted under adverse, and even dangerous, conditions. The accomplishments of the many dedicated researchers, and their sacrifices, should not go without recognition.

Sincerely,

Kay Harrigan Woods
President



The Leakey Foundation

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A special note of thanks to many of you who responded to our recent solicitations. Funds from members and past grantees alike help us fulfill our goal to support this important research!

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But some recent research—funded in part by the Leakey Foundation—suggests that Neanderthal Man may have been "one of us" in this sense, even if *Homo neanderthalensis* was not one of our ancestors. Last year, my colleague Richard Kay, his student Michelle Balow, and I published some data on the hole through which the hypoglossal nerve leaves the braincase. This nerve's sole job is to control tongue movements. It also innervates all the muscles inside the tongue itself.

The hypoglossal nerve emerges from the brainstem and runs through a canal at the front edge of the foramen magnum. What we did was to squirt liquid rubber into this canal in humans, apes, and various fossils, pull out the rubber cast, and measure its cross-sectional area.

We found that the hypoglossal canal is relatively big in modern humans—on average, about twice as big in cross-section as that of a chimpanzee. We conjectured that the larger canal reflects a larger hypoglossal nerve, to give us more precise control over tongue movements in speaking. Among fossil hominids, we found a small, apelike canal in the gracile australopithecines from South Africa, about 2.5 million years ago.

We suggested that these early hominids, which had ape-sized brains, also had apelike tongues and could not talk. The early-*Homo* boy recovered piecemeal from 1.5-million-year-old deposits at Nariokotome in northern Kenya had a small hypoglossal canal, below the modern human range; but this may have been because he was young. All later hominids we have looked at so far have canal sizes in the human range. To us, all of this suggested that language dates back at least half a million years, long before the first appearance of modern humans in the hominid fossil record.

Unfortunately, our data do not add up—at least not yet—to a satisfactory test for the presence or absence of language in fossil hominids. We have no evidence that the hypoglossal nerve is larger in people than it is in chimpanzees. Until we have some data on comparative nerve size, all these arguments about what the size of the canal means will remain speculative.

So what little evidence we have suggests that human language abilities may date back at least half a million years, to the first members of the genus *Homo* that had brains as big as those of people today. The very earliest hominids, the australopithecines, could not talk. The scientific verdict is still out on the early, small-brained species of *Homo*. Although there is no consensus on the language abilities of Neanderthals, I tend to think that these early Europeans must have had some sort of language. After all, they had brains larger than those of most modern humans, made elegant stone tools, and knew how to use fire.

It seems reasonable to think that language dates back before the first

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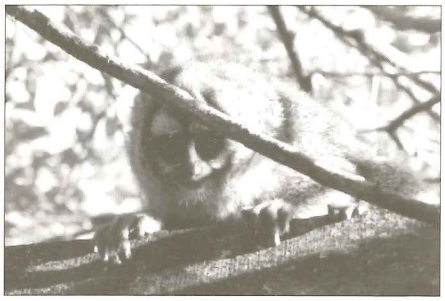
Monkeys *continued from page 1*

keys still toy with us, our equipment still has its weaknesses, and Mother Nature still has her fun, but each redeems itself with general agreement, loyalty, and encouragement. Having just completed the first half of our study, we are thrilled with the progress made and hope that the Leakey Foundation and its associates will share in our satisfaction.

Our study will allow a comparative analysis of the ecological factors leading owl monkeys to nocturnality in tropical forests, and cathemerality in relatively drier habitats. The environment of these mirikinás is drier, harsher, and more seasonal than tropical rain forests. This environment may resemble the environment that African hominoids faced during the Late Miocene when tropical areas became drier and woodlands expanded. Any attempt to reconstruct the evolution of hominoid behavior will benefit from an understanding of how a wide range of ecological variables affects the evolution of behavior in a particular species.



Mirikinás (owl monkey), Formosa, Argentina

For the last seven months, our research team has been collecting behavioral data on diurnal and nocturnal activity of five neighboring groups of mirikinás. Data collection is running smoothly with almost 800 hours of behavioral data collected. We follow each group of monkeys in 12-hour follows from dawn to dusk, dusk to dawn, and occasionally for twenty-four continuous hours. Although extremely demanding, 24-hour follows will provide invaluable data to compare day and night activity under similar environmental factors. Given that the presence of infants may also affect the activity of the group, we started collecting data on infant behavior during the recent birth season. Additionally, we have begun cast collection and follows of three spectacled owls to evaluate how the presence of a potential predator might affect the behavior of the monkeys.

The activity of the monkeys is also likely influenced by the availability of food resources. In order to estimate the abundance of insects and plants available to the monkeys, we are collecting insects and monitoring the presence of leaves, fruits, and flowers. Our insect light-traps are very temperamental and, with their various broken light bulbs, frayed cables, and dysfunctional batteries, have proved challenging in maintaining our personal sanity. However, we have successfully collected insect samples every ten days at two different heights in the canopy, and after seven months have nearly perfected the system. In addition, we are monitoring almost 1000 trees, all of which have been tagged and measured

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Language *continued from page 3*

appearance of modern *Homo sapiens*. But this does not tell us how language got started, or what the intermediate stages between animal calls and human language might have been like. The fossils are of no help in answering these questions.

Perhaps we have been asking the wrong question all these years. Because anthropologists are fixated on the question of what separates people from the other animals, we have been asking, "What is it that is unique about language?" rather than, "What is sufficient to get the job done?" These questions seem to have different answers. The answer to the first question is "syntax"; but the answer to the second appears to be "semantics"— referential meaning. And it seems clear that some other animals are quite capable of handling semantics.

Looking at things this way casts the question of language evolution in a new light. The acquisition of protolanguage—signaling systems that have semantics but lack syntax—by our remote ancestors would have been an enormous adaptive leap forward. And because of its adaptive value, protolanguage would have been enough to enforce the selection pressures that reshaped the human vocal tract to produce more intelligible and fluent vocal sounds, even before syntax came on the scene. I suspect that it did so, and that our ancestors evolved human vocal morphology many hundreds of thousands of years before the appearance of what linguists today recognize as true, fully human language.

The human difference is real and important, but it is rooted in aspects of human psychology and biology, including certain language abilities, that we share with our close animal relatives. If the growing consensus on the origins of language can join these disparate truths together, it will be a big step forward in the study of human evolution. ■

Excerpted from the 1999 L.S.B. Leakey Lecture jointly sponsored by the Leakey Foundation and the California Academy of Sciences in San Francisco, California.

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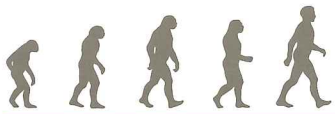
for diameter; half of these trees have also been identified to the species level.

As much as our field activities allow, we are entering data in the computer for preliminary analyses: all of these analyses underscore the highly seasonal character of the area. Based upon a quick look at the insect samples, we are under the impression that owl monkeys may find substantial changes in the availability of insects between seasons. The first months of plant data show the same pattern: almost no fruits when we began in July, and most trees fruiting between December and January. As we continue to collect and analyze data, we hope to determine which of the many ecological variables best explains cathemeral behavior.

Although the identification of individuals is unnecessary for our current work, future research will benefit from individualized animals. Male and female owl monkeys are similar in size, color, and external genitalia, and therefore are indistinguishable in the wild; however, with time and attention, we are discovering different physical characteristics of particular monkeys that are enabling us to identify individuals. Furthermore, after some back and forth parcel play of equipment, we now have radio collars and a radio transmitter ready to be used as soon as we feel confident in safely capturing (using a blow-pipe), tagging, and releasing the monkeys. Completing this step will aid us in locating the monkeys more quickly; facilitate night follows; and considerably benefit broader investigations of the natural history of these owl monkeys.

In 1996, the Foundation funded a preliminary study that allowed Dr. Fernandez-Duque to search for a suitable population of owl monkeys for a potential long-term study. A *potential* long-term study it is no more, and the Foundation's support this year is essential in making this the longest study ever on the behavioral ecology of owl monkeys. ■



The Leakey Foundation

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