MEETING BRIEFS

Anthropologists Take the Measure of Humanity

DENVER, CO—Physical anthropologists are best known for their work using ancient bones and tools to follow human evolution. But at last week's 63rd Annual Meeting of the American Association of Physical Anthropologists here, the scope of papers indicated increasingly prominent roles for genetics, primatology, and reproductive biology in the field. Among the papers were presentations on locomotion among human ancestors, using nuclear DNA to trace human origins, and child-care in marmoset monkeys.

Walkers and Swingers

Lucy, the petite human forebear who lived in Africa some 3 million years ago, finally has a head, but anthropologists continue to argue over whether she kept her feet on the ground.

In a paper presented here last week, anthropologists reported on the first skull assigned to Lucy's species, *Australopithecus afarensis* (*Science*, 1 April, p. 34), as well as a series of limb, foot, and inner ear bones from *A. afarensis* and other human ancestors. The shapes of those bones have become part of a long-standing dispute in which some scientists claim *afarensis*—our oldest known nonape ancestor—spent much of its time in the trees, like its ape forebears. Other researchers, however, say it walked on the ground in an upright posture much like modern humans.

"They were fully bipedal, doing something completely different from apes," insists Lucy's co-discoverer, Institute of Human Origins anthropologist Donald C. Johanson. Not so, says State University of New York at Stony Brook anatomist Randall Susman: *Afarensis* "walked funny—not like modern humans," he says, arguing the odd gait implies the species slept, ate, and lived primarily in the trees.

The first to take a stand at the meeting was Susman. Extrapolating from the Johanson team's measurements of *afarensis* fossil foot bones, Susman concluded that *afarensis* had toes averaging 30% longer than modern humans' toes relative to body size. But Susman wasn't content with measurements. He shod himself and three colleagues in long shoes designed to match the augmented digits. After loping around the lab and using computers to analyze their stride, Susman concluded *afarensis* needed a high-stepping gait to avoid dragging its long toes on the ground—much like a person walking in scuba fins. Says Susman: "We know they were walking on two legs part of the time, but they weren't walking around like modern humans."

Susman's attempt to get a toehold on the question was bolstered by a new study of the inner ear bones of apes, modern humans, and the human ancestors that came in between. University of Liverpool anatomist Fred Spoor used high-resolution computed tomography (CT) to scan the skulls of modern humans, apes, and several species of human forerunners. The images focused on the bony labyrinth, fluid-filled canals of the inner ear that are responsible for balance. Spoor found that modern humans and their close ancestors—*Homo erectus*—had canals oriented vertically. This pattern is different from that found in chimps and other apes, whose canals tend to be aligned more horizontally. Spoor assumes that the canal alignments are related to posture. The labyrinths of *afarensis*' two nearest descendants—*A. africanus* and *A. robustus*—most closely resembled the chimp/ape pattern and, Spoor says, it follows that *afarensis* would too. "It suggests," he says, "that australopithecines were basically similar to chimpanzees."

IHO/JOHANSON

Tree limbs? The forearm bone of our earliest nonape ancestor *(right)* is longer than the modern version—possibly an adaption for tree-swinging.

A final fossil bolstering this view was presented, ironically, by Johanson. He showed a recently discovered *afarensis* forearm bone from Ethiopia that was far longer than an *afarensis* upper arm—an ape-like pattern, well suited to tree-swinging. Susman, naturally, was pleased to see this long-limbed evidence. "The physical evidence is there that these animals spent a lot of time climbing trees," he says.

But Johanson says looking like a chimp doesn't mean acting like a chimp. In *afarensis*, he argues, "there's still a lot of evolutionary baggage...carried over from their ape ancestry. But I think there's been a major behavioral shift." He points out that a famous series of two-footed prints at Laetoli, Tanzania—contemporary with *afarensis*—as well as a reconstruction of Lucy's pelvis and hips, indicate that the creatures walked like modern humans. And Bruce Latimer, a fossil foot specialist at the Cleveland Museum of Natural History, criticized Susman's foot study as "abysmal," because shoes change the way people walk—irrespective of the length of their feet. "All that proves was that if you dress people up in clown shoes they walk funny," says Latimer.

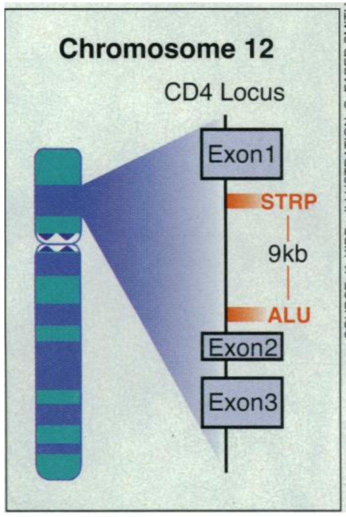
Spoor's argument that the *afarensis* labyrinth resembles that of a chimp also fell on deaf ears. Kent State University anatomist Owen Lovejoy, chief architect of a model of *afarensis* as fully bipedal, thinks that the changes in the labyrinth canals seen in modern humans may be the result of brain expansion—and don't have much to do with a shift from four-leggedness to an upright stance. But clearly this argument has legs to carry it on for years to come.

African Origins Theory Goes Nuclear

"Mitochondrial Eve" has been a woman of questionable repute in recent years. Scientists have picked holes in the once popular theory that genetic lineages, traced with DNA from a cell's mitochondria, show that all modern humans descended from a woman who lived in Africa some 200,000 years ago. Now, evidence from another part of the genome—the DNA in the nucleus—supports the notion that Africa was indeed the recent birthplace of modern humans.

Using a method that traces the inheritance of a chunk of a chromosome in populations around the world, Yale University researchers presented data at the meeting showing that there are many versions of this DNA in most of Africa, but much of the diversity has been lost elsewhere in the world. According to the scientists, the loss of diversity is best explained by a population "bottleneck": When a small group of settlers set off from their African home, they carried only a fraction of their parent population's genetic variability with them. "This work does support the 'Out of Africa' hypothesis," says University of Pittsburgh School of Medicine geneticist Robert Ferrell, who also uses DNA to trace ancient human migrations. "It's important because questions were raised about the mitochondrial data."

Nuclear DNA provides a more complete picture of a population than does mitochondrial DNA, which is only inherited from the mother, scientists say. Because women and men don't always move together—a group of men might become separated after leaving on a hunting trip, for instance—nuclear DNA, which is inherited by both sexes, reflects population movements more accurately.



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Traveling DNA. Inheritance patterns of two nuclear genetic markers *(red)* support the idea that modern humans evolved in Africa.

The research, carried out by Yale University grad student Sarah Tishkoff, working in the lab of her adviser, geneticist Ken Kidd, traces the evolution of two neighboring non-coding DNA segments on chromosome 12 that are inherited together as a single unit. One was a 300-base pair-long repetitive element called Alu. It exists in two basic forms in humans: the complete form, and a truncated version that's missing 250 base pairs. Both forms show up in populations from around the world, so this Alu by itself is not very useful for distinguishing ancestral migrations. But not far down the DNA road from this Alu is another landmark—a marker made up of many tiny repeating segments of DNA, known as a short tandem repeat polymorphism (STRP). Unlike this Alu, which has apparently undergone only one major change in humans, this repeat shows up at many different lengths.

The combination turned out to be very useful. After looking for the segments in 1000 people from 31 different populations, Tishkoff and Kidd found different patterns of inheritance for the two markers in different parts of the world. "The world divides into three—Sub-Saharan Africans, Northeastern Africans, and non-Africans," says Kidd. In Africans living south of the Sahara, Tishkoff found tremendous variation—both forms of Alu, each teamed with a wide range of different length repeats. But when she looked at Ethiopian Jews, Somalians, and Egyptians living in Northeast Africa, she found less diversity. In fact, whenever Tishkoff saw the truncated Alu in these populations, it usually showed up in one particular pairing—with a form of the STRP that spanned 90 bases. In populations in the rest of the world, there were even fewer exceptions to this pairing.

The best explanation for this data, say Tishkoff and Kidd, is that the truncated Alu arose early in Africa. Over the course of thousands of generations, it became paired with many different lengths of the STRP in most of Africa. But in folks on the northeastern edge of Africa—the people who migrated out of the continent—random genetic drift linked the Alu deletion most often to the 90-base pair STRP. Then, some of these people left Africa in the recent past, expanding over the planet. The small émigré population size reduced their genetic variability even more, says Tishkoff, leaving little but the truncated Alu coupled with the 90-base pair STRP. The migration was recent enough so that mutations and recombination haven't yet reintroduced variability to the pattern. "It's very consistent with a recent spread of modern humans out of Africa—it's hard to imagine anything else that could explain the data," says Kidd.

University of Utah geneticist Ryk Ward, who studies genes to decipher the peopling of the Americas, thinks that Tishkoff's study is a "lightning bolt for a lot of new ideas" about tracking ancient populations. One important idea is to link other Alu elements with a dozen more STRPs from other parts of the genome—just to make sure that the same picture of an exodus from Africa holds up. "This is a great start," says Ward. "But since we don't know how these short tandem repeats change, we have to be careful using them."

Mothering Marmosets

It's tough finding good child-care these days —even for monkeys in the Brazilian forest. If you're the dominant female in a marmoset troop, the solution is to prevent lower-ranking females from reproducing, so your own little darlings will be the center of collective attention. This scheme makes perfect sense, of course, from the point of view of the dominant female. But what surprises primatologists is that the subordinate females seem to go along with it so readily—since this raw deal deprives the lower ranks of the chance to pass along their DNA to the next generation.

This puzzling pattern was presented at the meeting by University of California, Davis, biological anthropologist Leslie Digby in a paper on marmoset mating. She and her collaborators at the Federal University of Rio Grande do Norte, who observed three troops of common marmosets (*Callithrix jacchus*) in the forests of northeastern Brazil, also propose a solution. The marmoset social system, they contend, gives an infant born to a subordinate female little chance of survival, and so the energy invested in giving birth would be wasted.

Anthropologists have known for some time that marmosets band together to care for the offspring of the dominant female, who usually bears twins. The grouping is a big help, because marmosets are small and if the entire troop isn't there to protect them, the young are likely to get picked off by birds or snakes. In addition to protecting them, the other troop members also help the dominant female feed and carry her twins.

But why, researchers have wondered, don't other mothers try and give birth? Apparently, the subordinates don't even ovulate, according to studies of marmosets by University of Wisconsin Primate Center zoologist David Abbott.

Digby formed a possible answer after she watched three marmoset troops in which a rare event occurred: A subordinate female was breeding at about the same time as the dominant female. And the subordinate female learned that it doesn't pay to buck the system. While the dominant mother had lots of help caring for her young, the subordinate mothers cared for their offspring mostly on their own.

In fact, the subordinate females had good reason for staying away, particularly from the ranking female. In one case Digby saw, a dominant female got between a subordinate

L. DIGBY

No monkey business. The social system of marmosets *(above)* permits only the dominant female in a troop to bear young.

mother and her infant and repeatedly kept them apart with threatening behavior. In another case, apparently, the threats were backed up. The 24-day-old infant of a subordinate female was killed in a fight—and Digby strongly suspects that the killer was the dominant female, who was part of the fight and who had been antagonistic toward the mother (although she could not see the actual killer in the flying fur). The dominant female gave birth to twins two days later, and the subordinate mother helped suckle the offspring.

"Everybody wins as long as everyone plays the game—you cooperate and you don't antagonize the dominant, breeding female," says Abbott. Apparent altruism in a subordinate female, it seems, is really a response to a tough system of social enforcement.

–Ann Gibbons