MEETING PHYSICAL ANTHROPOLOGY

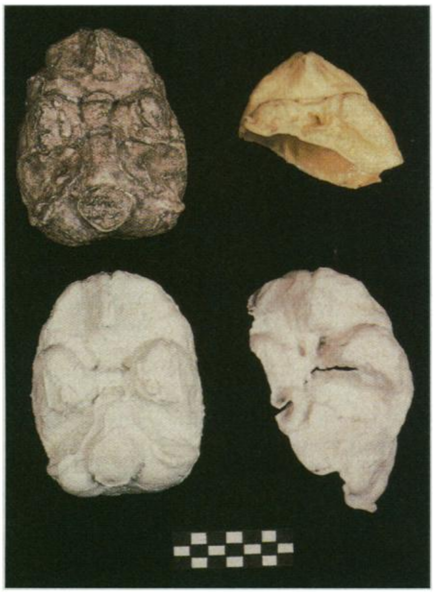
Anthropologists Probe Bones, Stones, and Molecules

COLUMBUS, OHIO—More than 500 presentations at the annual meeting of the American Association for Physical Anthropology here covered all aspects of human nature, from genetics to stone tools. Two highlights explored brain shape in hominids and the original Asian homeland of the first Americans.

Early Changes in Brain Shape

Around 2.5 million to 3 million years ago, the genus *Homo* had yet to appear, and the small hominids believed to be our close relatives had brains hardly bigger than a chimpanzee's. But controversial reconstructions presented at the meeting suggest that by then, the brains of some of these creatures were already reorganizing toward the human configuration.

By inferring brain shape from the contours of fossil skulls, paleoanthropologist Dean Falk of the University at Albany, New York, and her colleagues conclude that in the hominid *Australopithecus africanus*, brain regions thought to be used in abstract thinking and language were beginning to show some resemblances to those of modern humans. "Brain reorganization started to happen early," says Falk. The work also showed that the robust australopithecines, heavy-jawed creatures that lie off the main line to humans, lacked these more modern features and had smaller brains than had been thought.



The shape of things to come? Unlike robust forms *(top), A. africanus* brain casts *(bottom)* show expanded temporal and frontal lobes more like those of modern humans.

These bold conclusions sparked much interest at the meeting, but many of those who attended Falk's packed presentation aren't ready to accept all her interpretations. "Something like this is always exciting," says paleoanthropologist Leslie Aiello of University College, London. "But I'm not completely convinced that we can take the incipient *Homo* traits back that far."

Falk and her colleagues examined more than a dozen australopithecine brain endocasts—internal casts of skulls that preserve brain shape. They found several key differences between the three robust species and *A. africanus*. For example, in the lower part of the frontal lobe behind and above the eyes, *africanus* brains were gently rounded and expanded in size, somewhat like those of modern humans—albeit overall much smaller—but robust brains were pointy and beak-shaped, like those of apes. In modern humans, says Falk, this area contains a small region called Brodmann's area 10, thought to be involved in abstract thinking and planning. And the front part of *africanus* temporal lobes was expanded; that's the same brain region active in modern humans when they recognize and name a face, says Falk. She speculates that "the robusts were apelike in their cognitive abilities," while "for *africanus*, I wonder if there's something going on with planning and the first glimmers of naming?"

Falk says her finding about brain shape could strengthen the case for *A. africanus* as an ancestor of modern humans. Other researchers note, however, that candidate ancestors such as *A. afarensis* and the newly discovered *A. garhi* may also have these features, which would mean there is no special link between *A. africanus* and *Homo*. However, Falk's analysis does take the root-chewing robust forms down another peg, by shrinking their brain sizes.

Using their new findings about brain shape as guides, Falk and graduate student John Guyer, who is also a sculptor, reconstructed half a dozen australopithecine skulls. The *A. africanus* size estimates, including that of a specimen called Sts 71, which Falk had suggested was wrongly estimated (*Science*, 12 June 1998, p. 1714), all matched published numbers. But for four robust skulls, cranial capacity dropped by 30 to 68 cubic centimeters (cc). Falk concludes that the average size of all known robust crania is not close to 500 cc, as previously reported, but 450 cc—the same as that of *A. africanus*. (A modern human brain is about 1350 cc.) If, as some researchers suspect, the robusts were a bit larger than *A. africanus*, that gives *africanus* a proportionately larger brain.

But not everyone is willing to buy these new numbers. Ralph Holloway of Columbia University, who did many of the previous reconstructions, sticks by his earlier estimates, in which he used both *A. africanus* and living apes as models for robust brains.

Holloway is also not prepared to accept Falk's "*Homo*-like" features in *A. africanus*. He notes that only one or two *africanus* endocasts are complete enough to show the temporal and frontal lobe features, which could simply be natural variations. "I do not accept their conclusions. … These areas are quite variable in chimpanzee and gorilla, and particularly so in modern humans, and I am distrustful that somehow australopithecine variability was any less," he says.

Even if the distinctions are real, adds paleoanthropologist Bill Kimbel of the Institute of Human Origins at Arizona State University in Tempe, structural differences in the robust skull could force the brain to take a different shape from that of *africanus*—in which case the differences might have no bearing on the hominids' thinking ability.

Still, researchers say, Falk has pointed out brain features to search for in new hominid finds. "Qualitative differences between *africanus* and robusts are important," says Aiello. "What remains to be seen is … if they are truly cognitive differences."

The New World's Founding Fathers

The adventures of the first Americans took them 10,000 kilometers, from the Bering Strait to Alaska, British Columbia, and eventually all the way to the tip of Tierra del Fuego. But where did their journey begin? At a special symposium on the peopling of the New World, two independent presentations of genetic data pointed to roughly the same region of Southern Siberia as the original homeland of the men, if not the women, who eventually colonized the New World.

Multiple genetic trails left in the Y chromosomes of living men all lead to a region near Lake Baikal, according to talks by ge-

CREDIT: J. GUYER

neticist Mike Hammer of the University of Arizona, Tucson, and molecular anthropologist Theodore Schurr of the Southwest Foundation for Biomedical Research in San Antonio. Markers from the mitochondrial DNA (mtDNA), which is passed down through the mother and so reveals women's movements, paint a more complicated picture. But even so, "we've got a place we can point to on a map now," says Hammer, "a place for archaeologists to start thinking about connections." And indeed, archaeologists report that about 20,000 years ago the Baikal region was home to a mysterious people called the Mal'ta, who have been suggested as ancestral stock for New World peoples.

Hammer's team tracked the ancient Asian homeland of Native American founding fathers by sampling the Y chromosome—which is found only in males—from 2198 men from 60 populations worldwide, including 19 Native American and 15 indigenous North Asian groups. They sought sites where the Y chromosomes from different populations tend to have different DNA bases. Earlier work had noted that many Native Americans have one particular set of such mutations, called a haplotype (*Science*, 5 March, p. 1439). Hammer also found this major haplotype, which he calls 1G, in half of all Native Americans. But his large sample yielded five additional New World haplotypes. For example, 25% of all Native Americans carry the set of mutations Hammer calls 1C, and 5% carry 1F; three other haplotypes are found at lower frequencies.

To trace these genetic variations back to their source, Hammer sampled more than 1000 men from across Asia. He found that all six New World haplotypes are now concentrated in two centers, northwestern and northeastern Siberia, but the indigenous peoples now in those regions are thought to have migrated from around Lake Baikal. "If you step back and look at the big picture, you're seeing a big generalized region around Lake Baikal," Hammer says.

Those findings fit with independent data presented by Schurr. In a sample of more than 300 ethnic Siberians and 280 Native Americans, he and his colleagues see two primary ancestral Native American patrilineages, which may include one or more haplotypes. One lineage turns up commonly in peoples west of Baikal, like Hammer's 1C. Schurr also sees a sublineage that apparently arose further east in Asia, perhaps near the Amur River, and then spread both west into Siberia and further north toward the Bering Strait and eventually the New World.

Schurr says that mtDNA markers hint at several Asian source areas, including one in Mongolia, perhaps indicating different Asian roots for the men and women who first populated the New World. And all this complexity suggests multiple migrations from Asia, say Schurr and Hammer. Other geneticists have suggested a single migration, but the diversity of markers in Native Americans makes that unlikely, argues Stephen Zegura of the University of Arizona, Tucson, a coauthor on Hammer's talk. "A single population that includes all the Y chromosome and mtDNA variants we're seeing would have to be very, very large. It's hard to explain it all with a single migration."

But no matter how many trips, many of the males in the party apparently started with the same peripatetic population in Siberia. Archaeologists have previously noted a potential source culture around Lake Baikal, dated 25,000 to 20,000 years ago: the Mal'ta, a mammoth-hunting people known for blade and biface tools that researchers have speculated might be the precursors of the Clovis points early Americans made 12,000 years ago. Some archaeologists had been skeptical of the link; as Ted Goebel of the University of Nevada, Las Vegas, notes, "there's a huge gap" between those dates, and later Siberian technologies don't look like anything in the New World.

That puzzle remains, says Goebel, but he is quick to add that the new genetic data will spur archaeologists like himself to focus even more intently on the Baikal region. Says Goebel: "For sure the answers, yea or nay, lie somewhere up there on the mammoth steppe."

–ELIZABETH CULOTTA

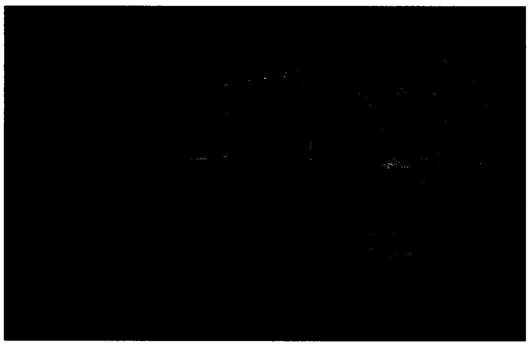
SCIENTIFIC COMMUNITY

Mathematics Gets Institutionalized—Again

The NSF is expanding its program of mathematics institutes to bring visiting researchers from second-tier universities into the mainstream

Mathematics is often a solitary pursuit, but it's showing signs of becoming markedly more social. Since 1982 the National Science Foundation (NSF) has funded two mathematics research institutes, where mathematicians from different institutions work in collaboration, often with scientists from other disciplines. Now NSF is set to expand the effort.

This month, the NSF announced plans to fund three institutes, the winners of a competition that drew between 10 and 20 entries. Two of the winners are the existing institutes at the University of California, Berkeley, and the University of Minnesota. The third is a new institute at the University of California, Los Angeles (UCLA). The proposed grants total approximately $8 million per year for 5 years, roughly 8% of the NSF budget for the mathematical sciences and a $2.5 million annual increase in spending.



Gathering place. The future home of the Institute for Pure and Applied Mathematics at UCLA.

CREDIT: YASI BEHPOUR/UCLA

NSF sees the institutes as a way to help research mathematicians at "second-tier" universities stay in touch with the mainstream, says Donald Lewis, program director for the Division of Mathematical Sciences at NSF. He points out that few of these mathematicians receive any NSF support: "Institutes and conference centers, if sufficient in number, would give nonfunded researchers an opportunity to keep abreast of the latest developments," he says. NSF also wants to create links between mathematics and other disciplines, a primary goal of the new UCLA institute.

Mathematicians applaud the move. "I think the institutes are an excellent idea," says William Jaco, a mathematician at Oklahoma State University in Stillwater and former executive director of the American Mathematical Society. "Having venues for this type of long-term collaboration is as valuable for mathematicians as a laboratory is for laboratory scientists."

The two existing institutes, the Berkeley-based Mathematical Sciences Research Institute (MSRI) and the Institute for Mathematics and Its Applications (IMA) at the University of Minnesota, opened shop in 1982. Each hosts upward of 100 visitors at any given time, including students and postdocs as well as scientists from other fields. The institutes run semester- or yearlong programs for collaborative research and teaching on broad topics, with shorter sessions on specific subjects. Slated for 1999–2000 at MSRI, for example, is a yearlong program on noncommutative algebra (a branch of mathematics that is especially important, for example, in quantum mechanics) and semester-