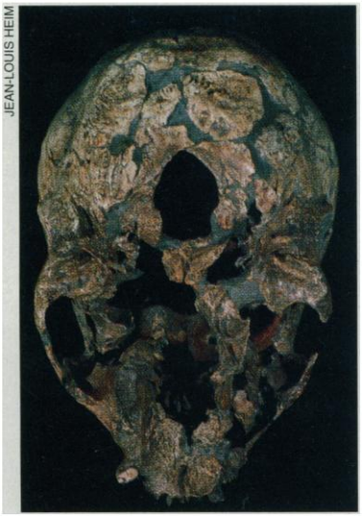
PALEOANTHROPOLOGY

Neandertal Language Debate: Tongues Wag Anew

"What did one Neandertal say to the other?" If you think that's the beginning of an old joke, you're wrong. It is an old question, but to the little band of anthropologists looking for the answer, it's no joke. Indeed, the answer bears closely on a central question in early human evolution: Were the Neandertals, who died out 35,000 years ago, part of the same species as early modern human beings? Until recently, a small but influential group of anthropologists had thought that Neandertals were physiologically incapable of complex speech—and if Neandertals couldn't converse rapidly, it seems unlikely that they would have interbred with our smooth-talking ancestors, the Cro-Magnons. But others believe, just as strongly, that Neandertals were capable of rapid, complex speech—and that they may be at least part of our ancestral stock.



JEAN-LOUIS HEIM

Talking head? New reconstruction of the La Chapelle Neandertal skull. Seen in basal view, the skull is central to the question of whether Neandertals could speak.

Vocal debate. Although this subject has been vocally debated since the first Neandertal bones were found in a cave in Germany's Neander Valley in 1856, it reached a higher pitch during the 1970s, after Brown University linguist Philip Lieberman and Yale University anatomist Edmund Crelin posited that Neandertals had a tongue and larynx badly placed for producing the range of sounds necessary for complex modern language. But that controversial view ran into trouble a couple of years ago, when paleoanthropologists discovered a Neandertal skeleton in the Middle East with a throat bone that was virtually identical to a modern human's. In February, at the annual meeting of the American Association for the Advancement of Science, University of Kansas paleoanthropologist David Frayer presented a survey of accumulating data, including the discovery of the hyoid bone and a new reconstruction of an old Neandertal skull, in launching a new attack on the idea that Neandertals couldn't speak. "It is now time to reject the notion," Frayer said boldly, "that Neandertals lacked the capacity for modern speech."

Not everyone is ready to accept this invocation—and some are already talking back. As *Science* went to press, anatomist Jeffrey Laitman of the Mt. Sinai School of Medicine—who has worked on hominid vocal tract anatomy since he was a graduate student of Crelin's—was putting finishing touches on plans to present his very different case at a 2 April meeting of the American Association of Physical Anthropologists. Laitman plans to argue that comparative studies of various hominids show that Neandertals had a larynx positioned higher in the throat than humans, and, as a result, they probably lacked the vocal tract anatomy to produce the range of sounds necessary for modern human speech. Says Laitman: "I've spent my entire academic career trying to understand the upper respiratory tract, and it is clear that these folks [the Neandertals] are different from us."

The line of work done by Laitman, Lieberman, and Crelin was initiated back in 1966 by Lieberman, who was sitting in a bathtub listening to a radio program when he heard the announcer say that chimpanzees cannot talk. "I said, 'Gee, why can't they talk?' " recalls Lieberman, who then spent the next 20 years trying to answer that question. By the mid-1970s, Lieberman, Crelin, and Laitman had compared the skulls of fossil hominids with those of present-day human adults and newborns, apes, and chimpanzees. Early on, the trio found that they could use the shape of the base of the skull to predict the structure of the vocal tract—a flat cranial base, for example, is associated with a combination of a high larynx and a tongue shape that seems to preclude modern speech because it leaves too little room in the oral cavity for pronouncing sounds necessary for rapid, easily recognizable speech.

One important Neandertal fossil used in their analysis was the La Chapelle-aux-Saints skull from southern France, discovered in 1908. It had a relatively flat cranial base, and when they reconstructed its vocal tract with the aid of a computer model, the Neandertal emerged with a high larynx. Further computer simulations showed that this model Neandertal was unable to pronounce certain vowels. And to Laitman and Lieberman, lacking those vowels meant that Neandertals could not speak the way we do today.

That theory was controversial from the start. But according to Frayer and others, such as University of New Mexico paleoanthropologist Erik Trinkaus, Laitman and Lieberman's hypothesis really was questioned anew a few years ago. Laitman and Lieberman relied on measurements of the cranial base because, while Neandertal skulls are relatively common, there were no specimens of the delicate throat bones—and, of course, none of the soft tissues of the vocal tract itself. But in 1989 a Neandertal hyoid (throat) bone was found in Kebara cave near Mount Carmel in Israel in an excavation directed by Baruch Arensburg of Tel Aviv University. When the Arensburg group published their results in *Nature* in 1990, they argued that the hyoid was virtually indistinguishable from those of modern humans in size and shape. Neandertals "appear to be as anatomically capable of speech as modern humans," the authors wrote.

That wasn't the end of the new evidence. At about the time the hyoid was found, French paleoanthropologist Jean-Louis Heim of the National Museum of Natural History in Paris was reconstructing the La Chapelle skull, which was falling apart after decades of handling. In the *Bulletin et Memoires de la Société d'Anthropologie de Paris*, Heim wrote that his reconstruction had some significant implications for the Neandertal speech question—largely because the new configuration had a more angled cranial base. In fact, Frayer says, the angles measured by Heim on the "new" La Chapelle skull are within the range of those he found in a survey of the skulls of Europeans from the Upper Paleolithic to the Middle Ages, including that of a medieval Hungarian. "Nobody argues the medieval Hungarians weren't able to talk," says Frayer, who thinks the evidence backs his view that Neandertals were ancestral to modern humans. While Heim thinks Neandertals were a separate species, he agrees that his reconstruction should "put an end to the controversies about the existence of articulated language among Neandertals."

Mincing no words. Heim's notion that the controversy is about to go away is almost certainly wrong. The controversy will no doubt continue, partly because Laitman and Lieberman are skeptical of the value of just one new reconstruction . "I don't agree that newer is better," says Laitman, who has studied both reconstructions. In spite of that skepticism, Laitman put the new measurements into his computer model, and it came out as having the larynx of a human child—still too young to have a larynx low enough to produce rapid speech that is easily understood. And as far as the Kebara hyoid bone

goes, Laitman minces no words: "A single bone tells us absolutely nothing about any ancestor's vocal tract." He adds: "Using the exact same measurements, I can show you that pigs' hyoids in many ways are more similar to modern humans."

Where does this leave the field? "To be quite honest, I don't see how a dispassionate observer can make a choice" between the pro-Neandertal-speech and anti-Neandertal-speech camps, says University of Pennsylvania Neandertal expert Alan Mann. "I think a lot of people are in bystander mode," agrees Ian Tattersall of the American Museum of Natural History. In the end, this controversy underscores a central problem in paleoanthropology: how difficult it is to reconstruct behavior (including linguistic behavior) from the remains in the fossil record. Unless there are some remarkable, unforeseen technological breakthroughs in interpreting fossils, the punchline of the old nonjoke about what one Neandertal said to the other may just be lost forever. –Ann Gibbons

EVOLUTIONARY BIOLOGY

Is "Flying Primate" Hypothesis Headed for a Crash Landing?

He heralded it as the "flying primate" hypothesis—the idea that a certain suborder of bats was more closely related to primates than to other bats—but lately Australian neuroscientist John Pettigrew has been feeling somewhat batted about. "I know that when five studies in a row show molecular data against the hypothesis, I can't claim I'm in a strong position," he says. Then again, the University of Queensland neuroscientist isn't quite ready to cave in.

Six years ago, Pettigrew proposed in *Science* that the so-called megabats, or flying foxes, were descended from primates, whereas the microbats were not. That flew in the face of the classical view that the two types of bats were in the same order—or "monophyletic." Since then, the issue has been up in the air, but now it looks like Pettigrew's "diphyletic" hypothesis may have come crashing to earth. In this issue of *Science*, Morris Goodman and his colleagues of Wayne State University publish the latest in a string of molecular results showing that systematists haven't really been blind as bats all this time: Microbats and megabats are closely related in evolutionary terms, they conclude, and megabats aren't really flying primates at all.

Combined with classic morphological work comparing the wings, ears, hind limbs, and other features of both types of bats, the growing body of molecular evidence "blows apart the hypothesis that megabats really are primates," Goodman argues. That hypothesis came to Pettigrew, an expert on the brain's system for processing visual information, when he looked at megabat brain tissue under a microscope for the first time. In the microscope, Pettigrew found visual pathway traits in the megabat cortex that were thought to be unique to primates (*Science*, 14 March 1986, p. 1304). The similarity was so remarkable that he proposed that megabats (*Megachiroptera*) were descended from an ancestor they shared with the primates. Microbats (*Microchiroptera*) didn't show those same neural pathways—and Pettigrew proposed that the two suborders of bats evolved from two different ancestors. The theory had the stunning implication that all the striking features of bats would have to have evolved twice.

The idea that flight evolved twice in mammals in exactly the same way was labeled as, well, batty by specialists in evolution. Classical morphologists found it hard to discount the vast number of physical similarities between megabats and microbats. The debate also created a rare opportunity for molecular evolutionists to wield their new molecular and computing tools to help settle the question. In the past couple of years, molecular evolutionists have set about sequencing the nuclear and mitochondrial DNA and amino acids from bat tissue. The first molecular studies were inconclusive, but new work on both mitochondrial and nuclear genes is much stronger, and it all reaches the same conclusion: Megabats and microbats hang from the same branch of the family tree.

ARCHIVE PHOTOS

Flight of fancy? Much recent evidence suggests that the hypothesis that megabats are closely related to primates may be as fanciful as this creature from the "Wizard of Oz."

In the study published in this issue, Goodman and graduate student Wendy Bailey used a 1.2-kilobase region of nuclear DNA that includes a large part of the epsilon-globin gene that codes for embryonic hemoglobin (although most of the sequence is noncoding). By examining this DNA sequence in 17 species, Goodman's group built a phylogenetic tree that puts the two suborders of bats squarely in the same order. Unpublished work on the sequence of a gene that codes for the interphotoreceptor retinoid binding protein (part of the visual system) by Michael Stanhope, a research associate in Goodman's lab, reaches the same conclusion. Both studies put the bats at some distance from primates. This work follows two other studies published recently in the *Proceedings of the National Academy of Sciences* that found similarity in the bats' mitochondrial genes—one by Ronald Adkins and Rodney Honeycutt of Texas A&M, who sequenced the mitochondrial gene for the enzyme cytochrome oxidase II, and another by David Mindell of the University of Cincinnatti, who sequenced the mitochondrial genes that code for the 12S ribosomal RNA and for the enzyme cytochrome oxidase I.

Pettigrew, however, says he has yet to be convinced that the molecular methods are infallible. "At the moment there is tremendous hubris about molecular data," says Pettigrew. "These groups think they have the answer, but we have to be cautious." There is a possibility, albeit a remote one, he argues, that the similarities in the genomes of megabats and microbats could be the result of convergent evolution—that, by chance, the different species ended up with random mutations in the same sites of the genome. An interesting idea, no doubt, but most experts in the field are betting that it won't fly.

– Ann Gibbons