ANTHROPOLOGY

A New Look Into Neandertals' Noses

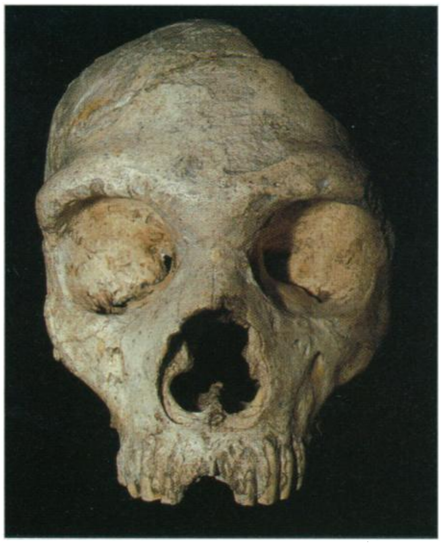
Noses hold clues to how these ice age humans lived and breathed. To read those clues, researchers have to rely on models and extrapolation

Neandertals, that unique breed of hominids who frequented the forests and caves of Europe for perhaps 200,000 years, have been an object of intense interest since the first one was discovered in Germany's Neander Valley in 1856. They have also been a focus of controversy. Whether or not Neandertals and early modern humans ever clashed in war, as some researchers have suspected, anthropologists have been engaging in their own "Neandertal wars" over whether these heavyset bipeds were basically like us or built differently enough to qualify as a separate species.

All sides agree that Neandertals tended to have prominent brow ridges, heavily muscled bodies—and big noses. Most of the external part of the nose is made from cartilage, which doesn't last. But from the shape of the nose hole, researchers conclude that the typical Neandertal schnoz was high, wide, and projecting. Crucial internal structures called turbinates, paper-thin, scroll-like bones that lie along the insides of mammalian noses, have not survived in fossils. But because these humans evolved in northern climes—actual glacial conditions in the case of later European Neandertals—some scientists say their turbinates would likely have been large to increase the mucous membrane–covered internal surface area available to warm and humidify cold, arid air.

Scientists are now engaged in a flurry of research, measuring and modeling noses to try to push beyond these generalizations and see just how Neandertal noses differed from those of *Homo sapiens* both modern and archaic. And lately, as a half-dozen presentations at the meetings of the Paleoanthropology Society and the American Association of Physical Anthropology this spring in Columbus, Ohio, showed, studies of the Neandertal nose and face are allowing researchers to look beyond the species controversy. Led by the Neandertal nose, anthropologists hope to learn more about Neandertal breathing and energy use, and thus about the hard-driving Neandertal lifestyle, says anthropologist Jeffrey Laitman of Mount Sinai Medical Center in New York. Although some scientists continue to probe the species question, he says, others are "trying to get at the real issues and look beyond whether it's *Homo lumpus* or *Homo bumpus*."

The flurry of interest was kicked off in 1996 in the *Proceedings of the National Academy of Sciences*, where evolutionary biologist Jeffrey H. Schwartz of the University of Pittsburgh and anthropologist Ian Tattersall of the American Museum of Natural History in New York claimed to have discovered several nasal features unique to Neandertals. The most important finding, gained from examinations of skull bones of five European Neandertal specimens, was that they, unlike modern or ancient *Homo sapiens*, had distinctive bumps of bone—separate from their turbinates—on each side of their nasal apertures. The authors called these "medial projections" and suggested they might have served to increase surface area within the nose, helping to warm and moisturize inhaled air.



Bumps of contention. Projections on sides of nose hole are clearly visible in skull from Gibraltar.

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Schwartz and Tattersall's paper set off a flurry of work on those bumps, and the results have been contradictory. Some anthropologists have failed to find the bumps on other Neandertal specimens, while others claim to have found them on modern human skulls as well. At the meeting, anthropologist Robert Franciscus of the University of Iowa, Iowa City, reported that he tried to settle the issue by making more than 40 measurements from each of 523 modern skulls as well as those of 200 fossil hominids, including all available Neandertals. Neither Neandertals nor moderns had the kind of bumps Schwartz and Tattersall had described, he says. Rather, every population had some sort of simple bump that probably represents the "roots" of long-gone turbinates.

Schwartz and Tattersall, however, say their own analysis of additional specimens bears out that Neandertal nose bumps are clearly different from anything found in other fossil humans. But even though the battle of the bumps is unresolved, it has sent specialists flying back to their specimens for more study, says anthropologist Steven Churchill of Duke University, looking for new insights into how Neandertals breathed.

Churchill himself recently decided that one way to find out more about the Neandertal nose was to model noses in action. He says airflow turbulence makes the nose more efficient at heating and humidifying the air stream, so Neandertal noses would be expected to promote turbulence. But, Churchill says, "unlike modern humans living in cold and dry environments, Neandertals also had wide nasal passageways," more like Africans—which facilitates smooth, or laminar, airflow with minimal heating.

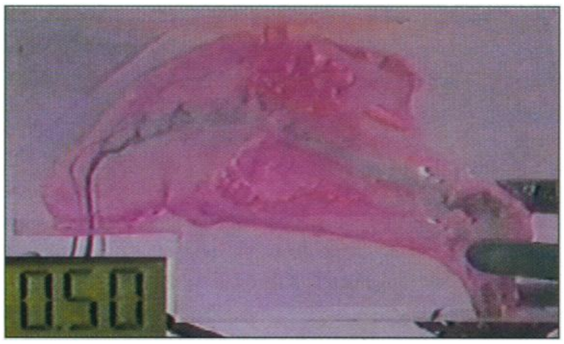
To understand such an unusual combination of traits, Churchill made clear acrylic casts of human noses, from molds taken from 10 medical school cadavers. He then put tubes up the casts, which represented a range of European nose types, and siphoned dyed water through them to study the flow dynamics. "We tested the argument that a number of nasal features [including the large aperture and protruding turbinates] that are accentuated in Neandertal noses function to induce turbulence," he says. What he found, however, was that only one feature—downward-directed nostrils, found in modern Europeans and, he believes, Neandertals—increased turbulence. Large turbinates actually seemed to reduce it, says Churchill.

He suggests that the wide noses and, to an extent, the large turbinates were a trade-off. Stocky Neandertals, like heavy-duty trucks, were very heavy energy users, and simply breathing in enough oxygen would have required as much as 1000 calories a day—double the amount a modern male needs. The Neandertal nose shape may have made it less efficient at heating, but it also reduced the drag that limits airflow in a narrow nose, he speculates.

Other researchers praise Churchill for rolling up his shirt-sleeves and designing an experiment to address these issues. But some say he is making unwarranted assumptions. Anthropologist Patrick Gannon, who directs the Sinus Research Laboratory at Mount Sinai School of Medicine in New York City, says there is no way of knowing the size of Neandertal turbinates or whether their nostrils were downward-directed. Gannon also says that no matter what the shape of the nose, the airflow is normally laminar when humans inhale, and he thinks it unlikely that Neandertal breathing would be any different. Franciscus, too, says Churchill makes too many assumptions about the size of Neandertal noses. "They're no different from cold-adapted early modern humans," he says. Churchill responds that turbinate remains on two Neandertal specimens indicate they were large, and the large base of the Neandertal septum indicates a downward turning nose.

As the nose exchanges continue, the research is also spilling over into other areas of the Neandertal head. For example, Franciscus says his measurements do confirm one "completely unique" Neandertal feature: the shallow depth of the throat. The vertical distance between the back of the roof of the mouth (the hard palate, which is also the floor of the nose) and the hole where the spinal cord exits the skull is much shorter in Neandertals than in either living or early modern humans, a characteristic first noted by Laitman more than 20 years ago.

At the time, Laitman thought this trait might have limited Neandertal speech, but scientists are now trying to focus on less speculative issues. Franciscus says he sees the short throat as a by-product of other Neandertal traits. He notes that they, like modern humans, had big brains. But they were more like the earlier *Homo erectus* in their patterns of facial growth. To fit this big brain on top of their primitive face, they had to alter their braincase—and ended up with an unusually short throat, he theorizes.



Nose in action. Acrylic model of human nose submerged in water. Dye shows how air would flow.

Laitman's group thinks that Neandertal uniqueness also extends to respiratory tracts, inner ears, eustachian tubes, and sinuses. "I say when you take the upper respiratory tract together with [these other features] we may be looking at a very distinctive *bauplan*," he says. The bottom line, he contends, is that all these features support the notion that Neandertals relied more heavily on nose breathing than do modern humans. Franciscus, who thinks Neandertal noses were nothing special, isn't persuaded, insisting that "from everything we can measure about their internal nasal morphology, they breathed the same as we do."

With plenty of disagreement left, it's probably going to be a long time before scientists reach consensus on how Neandertals breathed—let alone what that might say about their relation to ourselves. But paleontologist Fred Spoor of University College London believes the field is taking a promising direction. There's less "storytelling" going on, as research shifts from the species question to how Neandertal physiology worked. "There's a bit of a new school of people saying ... let's try to make a testable hypothesis," he says, and that's "ultimately a more scientific approach."

—CONSTANCE HOLDEN

CANCER RESEARCH

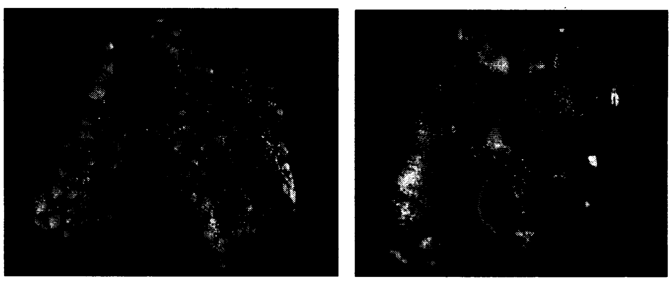
Potential Target Found for Antimetastasis Drugs

Researchers have finally cloned the gene for the enzyme heparanase, which helps cancer cells escape to new sites in the body

Cancer cells are dangerous not so much because they've lost the brakes on their growth. Rather, it's their ability to metastasize—escape from the original tumors and spread through the circulation to new sites in the body—that makes cancer so tenacious and deadly. Now, researchers have gotten their hands on a key enzyme that helps cancer cells roam the body and may thus be a good target for anticancer drugs.

Like the patrolling cells of the immune system, spreading cancer cells have to be able to breach such barriers as the extracellular matrix (ECM), the glue that holds cells together in tissues, and the basement membranes that surround the blood vessels. These consist of proteins embedded in a fiber meshwork consisting mostly of a complex carbohydrate called heparan sulfate. In previous work, researchers had cloned several genes for the enzymes, called proteases, that cancer cells use to break down the protein portion of the ECM and basement membranes.

But even though researchers suspected for nearly 15 years that the cells also produce an enzyme that snips the heparan sulfate meshwork, that enzyme had eluded them—until now. Two groups, one led by Christopher Parish of the John Curtin School of Medical Research (JCSMR) in Canberra, Australia, in partnership with Progen Industries in Brisbane, and the other by Israel Vlodavsky at Hadassah-Hebrew University in Jerusalem and Iris Pecker of the biotech firm InSight Ltd. in Rehovot, Israel, report in the July issue of *Nature Medicine* that they've finally cloned the long-sought heparanase gene.


Metastasis blocker. The lungs of rats injected with breast cancer cells and treated with a heparanase inhibitor *(right)* have far fewer metastases than controls *(left)*.

The wait was apparently worth it. Although metastasizing cancer cells may produce as many as 15 different matrix-digesting proteases, the new work suggests that there is only one heparanase. Thus, if its activity can be inhibited—and indications are that it can be—other heparanases shouldn't be around to cover for it. "This is very exciting and surprising," says Lance Liotta, a metastasis expert at the National Cancer Institute in Bethesda, Maryland, whose own work has focused on the proteases.

What's more, a blow to heparanase apparently packs a double punch. Besides inhibiting cancer cells' ability to roam, blocking heparanase also hinders the formation of the new blood vessels that feed tumors, perhaps because the enzyme helps the vessels' grow-

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