

GENETICS

Ancient DNA Reveals Neandertals With Red Hair, Fair Complexions

What would it have been like to meet a Neandertal? Researchers have hypothesized answers for decades, seeking to put flesh on ancient bones. But fossils are silent on many traits, from hair and skin color to speech and personality.

Personality will have to wait, but in a paper published online in *Science* this week (www.sciencemag.org/cgi/content/abstract/1147417), an international team announces that it has extracted a pigmentation gene, *mcl1r*, from the bones of two Neandertals. The researchers conclude that at least some Neandertals had pale skin and red hair, similar to some of the *Homo sapiens* who today inhabit their European homeland. The paper comes on the heels of one that used similar techniques to show that Neandertals shared the modern human form of the only gene so far known to influence human speech, *FOXP2*. Although researchers are working to sequence the entire Neandertal genome (*Science*, 17 November 2006, p. 1068), these are the first specific nuclear genes to be retrieved.

"These are the two genes you'd most like to see from a Neandertal," explains Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, who led the *FOXP2* study.

The *mcl1r* paper is "logical, elegant, and convincing," says anthropologist Nina Jablonski of Pennsylvania State University in University Park. "It's a great paper," agrees molecular geneticist and pigmentation expert Rick Sturm of the University of Queensland in St. Lucia, Australia.

Many of the Neandertals cavorting in museum dioramas around the world already have pale skin or red hair, because anthropologists have long predicted this coloration on the basis of evolutionary theory. The dark skin beneficial in Africa offers no advantage at high latitudes, and in cloudy Europe,

pale skin facilitates vitamin D production, Jablonski says. But there was no proof of Neandertals' looks until a team led by Carles Lalueza-Fox of the University of Barcelona in Spain and Holger Römpler of the University of Leipzig in Germany set out to retrieve the *mcl1r* gene from a 43,000-year-old Neandertal from El Sidrón, Spain, and a 50,000-year-old specimen from Monti Lessini, Italy.

MC1R is a cell membrane receptor that helps regulate the balance between red-and-yellow-colored pheomelanin and black-and-brown-colored eumelanin. Living people with variations that make the receptor work poorly tend to have red hair and pale skin, although other pigmentation genes also have strong effects (*Science*, 2 March, p. 1215).

Using the polymerase chain reaction (PCR) to target and amplify the gene, the researchers found a point mutation not seen in living humans. They checked about 3700 people, including everyone involved in the project, to be sure that the variant was unique to



Ginger man. Some Neandertals had red hair and pale skin, as seen in this reconstruction of a French fossil.

Neandertals. Next, they explored the variant's function by expressing it in human cells and found that it impaired the receptor's activity. "If you have a variant with this low action in modern humans, you get classically Irish-looking red hair and pale skin" in homozygotes, people with two copies of the variant, says team member Michael Hofreiter of the Max Planck Institute in Leipzig. The researchers calculate that at least 1 in 100 Neandertals would have been homozygotes. Thus Neandertals and *Homo sapiens* in Europe followed independent evolutionary paths to a similar phenotype, Lalueza-Fox says.

"I'm convinced that what they're saying is real," says Sturm, who has used similar functional assays to check *mcl1r* variants in living people. Lalueza-Fox adds that Neandertals may have carried a variety of changes in *mcl1r*, as we do, and so may have had a spectrum of skin and hair colors.

Pääbo and colleagues also used targeted PCR to isolate the *FOXP2* gene. They chose *FOXP2* because people with mutations in the gene have impaired speech. Pääbo's team had previously traced the gene in living people and suggested that the unique human variant was selected relatively recently, less than 200,000 years ago—long after Neandertals and modern humans had diverged (*Science*, 16 August 2002, p. 1105). The implication was that Neandertals lacked the modern human form, Pääbo says.

But to their surprise, that's not what they found when they sequenced the gene from two bones from El Sidrón, where Lalueza-Fox runs a "clean" excavation for DNA analysis. Both bones carried the modern human version of *FOXP2*. That doesn't necessarily mean Neandertals spoke as we do, because many genes presumably influence speech. But "from the point of view of the one gene we know, there's nothing to say that Neandertals were different from us" in their language abilities, Pääbo says.

Because the Neandertal *FOXP2* gene matched that found in living people, Pääbo's team used extra controls to try to rule out contamination with modern human DNA. For example, they sequenced the Neandertal Y chromosome and found that it differed from that of living men at five key sites. No contamination of the Y chromosome strengthens the case that the *FOXP2* result is real, Pääbo says.

The Y chromosome finding also argues ▶



against interbreeding between Neandertals and the modern humans then entering Europe. “I find it paradoxical in some ways,” says Lalueza-Fox, who is an author of both studies. “The papers make Neandertals more like modern Europeans, with light skin and hair color and language abilities, and yet there are no signs of interbreeding with modern humans.”

But others aren’t yet ready to concede that

either contamination or mixing has been completely ruled out. “The additional controls give me one more confidence that contamination is not a problem, but we can’t be 100% sure,” says evolutionary geneticist Jeff Wall of the University of California, San Francisco, who in August reported what he saw as contamination in Pääbo’s group’s bulk Neandertal sequencing (*ScienceNOW*, 29 August, sciencenow.org).

Wall adds that if the *FOXP2* result is real, it’s possible that Neandertals acquired the human *FOXP2* variant by mixing. “If there was admixture, it wasn’t very much. But we can’t tell if there was a small amount.” Pääbo says he can’t rule out that scenario but considers it “unlikely,” given the genetic data so far.

—ELIZABETH CULOTTA

ENERGY POLICY

National Academies Make Case for Sustainable Growth

Use energy more efficiently. Put a price on carbon emissions. Develop green energy sources.

Those recommendations on sustainable development, from a report released this week by dozens of the world’s national science academies, may be familiar. But the scientists behind the 174-page effort believe that the urgency of the problem will make up for its lack of originality in grabbing the attention of policymakers around the globe, and they intend to launch a major effort to get the message out. “The goal is to work fairly deeply into governments,” says Hal Harvey of the Menlo Park, California-based William and Flora Hewlett Foundation, which helped fund the report, dubbed *Lighting the Way*.

The peer-reviewed report’s recommendations reflect the diverse perspective of the 15 experts, nominated from more than 90 national academies, working under the auspices of the 7-year-old InterAcademy Council (IAC) in Amsterdam, the Netherlands. “Meeting the basic energy needs of the poorest people on this planet is a moral and social imperative” that technology transfer and international efforts could address, the report begins. On energy efficiency, it recognizes that most building construction will occur in cities of the developing world, and it calls on local governments and scientists to develop sustainable practices. California and Brazil are held up as models for energy efficiency and the use of biofuels. Report co-chair and director of Lawrence Berkeley National Laboratory Steven Chu calls the “international flavor” of the 2-year effort unique, noting that its proposed doubling of applied energy research says that the money must be “internationally coordinated.”

Co-chair José Goldemberg, secretary for the environment in São Paulo, Brazil,



Burning issue. New report discusses how to reconcile China’s booming, coal-fueled economy with green development.

believes that governments are eager to hear those messages, and he notes that many national academies in the developing world already “have close ties to governments.” The report, requested by the science academies of Brazil and China, was rolled out this week with a workshop in Beijing and with plans for a follow-up symposium in Brazil. The Chinese Academy of Sciences brokered a meeting between Chu and Chinese Premier Wen Jiabao, and CAS President Lu Yongxiang announced plans, including the creation of a renewable energy R&D center, to help wean China from its heavy dependence on coal. A major element, Lu says, will be a rapid expansion of China’s nuclear industry, which currently generates just 1.6% of the nation’s power supply.

The report’s emphasis on the developing world should be popular in Washington, D.C., predicts Paul Bledsoe of the nonprofit National Commission on Energy Policy. Although Bledsoe believes that “speedy U.S.

action is a necessary precursor” to sustainable policies in the developing world, he notes that the willingness of developing nations to tackle the problem has been “the sticking point [in Washington] all along.” Roughly one-fourth of the \$550,000 the Hewlett Foundation spent on the report is devoted to an international media push that would bolster outreach by individual academies.

Chu hopes the new report will make a bigger splash than other academic efforts; previous IAC reports on women in science and African agriculture, for example, have caused barely a ripple. His model is the 2005 U.S. National Academies’ report on U.S. science priorities, *Rising Above the Gathering Storm*, that served as the basis for the America COMPETES Act, which became law this summer. “We didn’t make claims for originality,” says Chu, a member of that panel, too. “[But] that report was incredibly successful.”

—ELI KINTISCH

With reporting by Richard Stone in Beijing.