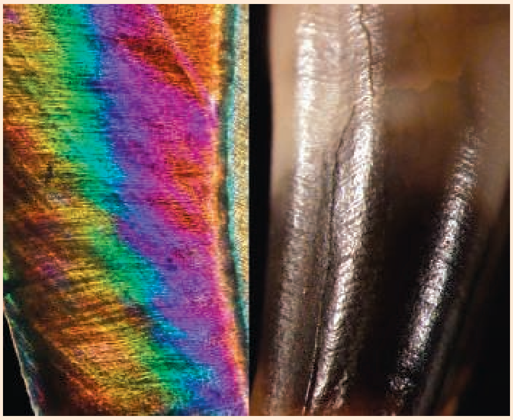
Dental Evidence Suggests Neandertals Matured Faster Than We Do

Paleoanthropologists eager to compare the development of Neandertals and modern humans waited for years to be allowed to take a slice out of a Neandertal's tooth to see the minute daily growth lines inside. "We await a brave curator somewhere who will allow a single Neanderthal tooth to be sectioned; much depends on it," paleoanthropologist B. Holly Smith of the University of Michigan, Ann Arbor, wrote in an article in *Evolutionary Anthropology* in 2004.

Smith has gotten her wish recently, but with mixed results. A study in *Nature* last year of two sliced Neandertal teeth found that the teeth formed slowly, like those of modern humans. But this week in the *Proceedings of the National Academy of Sciences* (*PNAS*), researchers analyzed growth lines in a sliced Neandertal molar plus other uncut teeth from the same specimen. They conclude that this 8-year-old Neandertal from Belgium grew up more rapidly than modern human children, according to lead author Tanya Smith (no relation) of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. "I think it's pretty convincing," says paleoanthropologist Jay Kelley of the University of Illinois, Chicago. But he notes all the same that the paper provides "data for [only] one individual." Data on more Neandertals may be able to resolve the problem this year, thanks to a new method for seeing growth lines without damaging specimens (see main text).



Lifelines. A Neandertal's tooth has both internal (*left*, diagonal lines) and external (*right*, horizontal lines) striations that record its growth.

Researchers have known for some time that humans are the only animals to have extended their childhoods long enough to have a teenage phase. *Homo sapiens* grew up twice as slowly as apes and our australopithecine ancestors that lived 4 million to 2 million years ago, says Holly Smith. Our ancestors may have lengthened childhood and delayed reproduction to allow more time to develop their brains, perhaps improving social learning, language, and other behaviors.

But researchers do not know when this dramatic change in life history strategy took place in the human family. Were *H. erectus* parents 1.8 million years ago the first to experience the joys of teenagers, or did adolescence appear 500,000 years ago in a common ancestor of Neandertals and modern humans? A previous report in *PNAS* by Tanya Smith suggested that it was even later.

The best way to find out is to look inside the teeth of Neandertals, modern humans, and their ancestors. Like rings in a tree, teeth grow incrementally, preserving a record of their development in microscopic lines in their enamel. These lines are deposited daily, along with less frequent lines that reveal stresses such as birth. And longer-period lines can be seen on the surfaces of teeth. In the new study, Tanya Smith took a thin section of an upper molar and counted the number of daily lines laid down before and after birth and between long-period lines. This told her how many days passed between the longer-period lines. She could then use the external lines on the uncut teeth to calculate how much time passed before their roots and cusps formed completely, as well as to determine the timing of key developmental benchmarks. She found, for example, that the second molar erupted a few years earlier in this 8-year-old Neandertal than in *H. sapiens*, suggesting that Neandertals grew up faster than we did.

That conclusion contradicts the earlier study of a Neandertal, done by Christopher Dean of University College London and colleagues. Given the conflicting reports, the next step is to analyze more specimens. "Dental evidence from a larger number of individuals … would go a long way toward clinching the claim that they were distinct in the way they grew up," says Dean. That is precisely what Tanya Smith and her colleagues are trying to do with their new x-ray vision in Grenoble. **–A.G.**

hominid skulls, at a 45-micrometer resolution (the width of a hair). By taking radiographs of a sample that rotates 180° or 360° during a 2-hour run on the beamline, the team can use software to produce a stack of cross sections that generate a precise 3D image. The cost for the 8-day run on hominid teeth: $120,000, in this case underwritten by ESRF.

So far, Tafforeau and colleagues have used the synchrotron to expose the internal structures of fossil green algae and an unerupted premolar in an extinct primate, among other fossils featured in *Applied Physics* in 2006 to demonstrate the method. Detailed new images of dinosaur embryo bones are "truly spectacular and cause a stir every time they are shown at a scientific meeting," says paleontologist Eric Buffetaut of the Centre National de la Recherche Scientifique in Paris.

Tafforeau was recently hired full-time at the synchrotron to focus its x-rays on more fossils. Specimens that recently vied for precious time on the beamline include Cretaceous mammals encased in rock, dinosaur and bird embryos, snails, rodent skulls, Mesozoic crocodile coprolites, and the skull of the earliest proposed hominid, *Sahelanthropus tchadensis*. Such large fossils present new challenges compared with the tiny rodent teeth or insects in amber. And then there are the unexpected surprises. "Le Moustier has crashed," announced Tafforeau as imaging of Hoffmann's specimen began. The fossil shifted just 5 micrometers on its pedestal of wax, and the plaster used to restore the fossil absorbed too much of the beam, making phase-contrast imaging difficult.

As the week progressed, Tafforeau, Smith, and colleagues worked around the clock to use every minute of beam time. They had better luck with a jawbone of a Neandertal from Krapina, Croatia, which produced sharp images that can be contrasted with those of an early modern human from Qafzeh Cave in Israel. But the answer to their question—how fast these Neandertals grew up—won't be known until after the team has analyzed many terabytes of data.

Paleoanthropologist Jean-Jacques Hublin of the Max Planck Institute for Evolutionary Anthropology watched the images flashing up on a bank of computer screens in the control room and reflected on the march of technology during his lifetime. "When I started my career in paleoanthropology, we used only calipers and a camera," he said. "I never imagined then that we shall time the development of a Neandertal with an accelerator."

–ANN GIBBONS

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