ARCHAEOLOGY

Did *Homo erectus* Tame Fire First?

PARIS—At some point during human evolution, our early ancestors realized that a hunk of rhinoceros or antelope would go down a whole lot easier if it were first roasted over an open fire. Yet exactly when the culinary arts truly began has been the subject of much debate. Some scientists have argued that our hominid ancestor *Homo erectus* began using fire for cooking and other domestic purposes more than a million years ago, but most experts still maintain that there is no clear evidence for controlled use of fire earlier than about 200,000 years ago, when *Homo sapiens*—the species to which modern humans belong—was already well established. Now new, as yet unpublished, data from a collapsed sea cave called Menez-Dregan on the southern coast of Brittany in France may provide support for the pre–*H. sapiens* camp.

A team led by Jean-Laurent Monnier of the University of Rennes has tentatively dated material from what appears to be an ancient fireplace back to 465,000 years, with an estimated error of ±65,000 years. Such an early date would fall well within the domain of *H. erectus*. If the results can be confirmed, says archaeologist Clive Gamble of the University of Southampton in the United Kingdom, "that would be very exciting."

Last year, Monnier and his colleagues published results from another apparent fireplace at Menez-Dregan in the proceedings of the French Academy of Sciences. Working with Michel Laurent and Christophe Falguères at the Institute of Human Paleontology in Paris, the team used electron spin resonance (ESR)—a technique that allows dating of quartz that has been heated to high temperatures—to date pebbles and burned sediment from the hearth at roughly 380,000 years. The latest results, taken from a layer deeper in the same archaeological site, push these dates back even further. But to make their case for such an early use of fire, the French team will have to prove two things: that their dating is correct, and that the material they are working with really came from a tended hearth rather than a natural fire.

According to Michael Tite, of Oxford University's Research Laboratory for Archaeology and the History of Art, the "absolute limit" for accurate ESR dating is about 500,000 years back—dangerously close to the period in which the French researchers are working. Thus Monnier's team has submitted its samples to experts at the Center for Weak Radioactivity in the Paris suburb of Gif-sur-Yvette, who will use thermoluminescence to verify the ESR results.

But was it a real fireplace? In recent years, similar claims from other *H. erectus* habitats—such as at Zhoukoudian in China and Terra Amata near the French city of Nice—have come under increasingly skeptical scrutiny. "We've been disappointed before," says Gamble, because it is often very difficult to distinguish a controlled fire from a natural one. The skepticism is fueled by the fact that more recent fires show clear-cut evidence. "It's like going to a Boy Scout camp. You get hearths, and you get these wonderful kind of doughnut rings of material radiating out," says Gamble.

But Monnier says that even the older fireplace at Menez-Dregan, which he admits was in poor condition, contained a strong concentration of burned pebbles and charcoal, which he says are "the two essential elements" of a purposeful fire. And paleoanthropologist Richard Klein of Stanford University agrees that if the French team can demonstrate "quartz pebbles that have been burned to [high] temperature, they may have the best evidence yet."

If *H. erectus* did indeed use fire in a tended hearth for cooking, the finding may have important ramifications for understanding human social evolution. "If they're just burning meat to stuff in their mouths," Gamble says, "they're a different kind of animal than if they're sitting around the fire and talking while they do it."

–Michael Balter

CHEMISTRY

Two Steps for Light-Altering Polymers

To information-age visionaries hungry for speed, electrical connections are starting to look as outdated as speaking tubes. These visionaries long to combine microelectronics with optics, which could shuttle information between computer chips much faster than electric wires can. Completing this marriage, however, will take more efficient and durable materials for transforming electrical signals into optical ones than are available today. But with the improvements in these nonlinear optical (NLO) materials announced in this issue of *Science* and at the American Chemical Society (ACS) meeting in Anaheim, California, in April, the prospects for integrating optics and electronics got a little brighter.

NLO materials manipulate light by changing their refractive index and other properties under the influence of an applied voltage or another light beam. And one of the most promising places to find these unusual properties is among the tailor-made organic materials called polymers. Existing NLO polymers have not found their way into commercial devices, in part because they haven't been efficient enough at manipulating light or stable enough to survive at the high temperatures of device fabrication and use. The new results, from groups at Caltech and at IBM's Almaden Research Center in California, mark headway on both fronts—albeit in separate materials.

To make an NLO polymer, chemists graft molecular components called NLO chromophores to a backbone molecule, such as a polyimide. The chromophores give the polymer its ability to manipulate light because their electric charges separate under the influence of light or an electric field, forming an asymmetric charge distribution that affects the material's optical properties. The backbone provides support and keeps the chromophores properly oriented.

Until now, researchers have been unable to graft chromophores to polymer backbones that can withstand more than a few minutes at temperatures around 250°C, says Don Burland of IBM Almaden. But by coming up with new synthetic chemistry techniques to link chromophores to a more stable polyimide, he and his colleagues report on page 1604 of this issue, they have created an NLO polymer that is stable at up to 325°C and lasts more than 1000 hours at 225°C. "That's very impressive," says Seth Marder of Caltech.

Burland and Marder agree, however, that a heat-resistant backbone won't be enough to make NLO polymers into a commercial proposition. The chromophores need attention, too, to make them more efficient at altering refractive index in response to an applied voltage, an effect measured by a material's R value. The current IBM polymer only musters an R value one-sixth that of lithium niobate, an inorganic NLO crystal used in most current devices. "They've really got to kick it up," says Larry Dalton of the University of Southern California.

At the ACS meeting, Marder said he and his colleagues had managed to create a polymer that does just that. The polymer, made with a new chromophore that has an unmatched ability to separate charges, sports an R value roughly 10 times that of the IBM material. Dalton calls this achievement "extremely important," because it beats conventional lithium niobate all hollow. Marder admits that the new materials "are not very thermally robust." But he notes, "If you could combine our R value with their thermal stability, it would be amazing."

–Robert F. Service