PALEONTOLOGY

Ancient DNA Pulled From Soil

Paleontologists working in the Siberian tundra can trudge for kilometers without finding a bone from the mammoths or bison that once roamed the permafrost. Now, two labs have shown that ancient DNA from these creatures and other ancient animal and plant life may be quite common underfoot, preserved in sediments bearing no signs of fossils. Much of the plant DNA probably derives from roots, which would have been well protected under ground; the animal DNA likely comes from cells excreted in urine and feces. "This technique truly will revolutionize our ability to reconstruct past flora and fauna," says paleoecologist Glen MacDonald of the University of California, Los Angeles. It could shed light on questions such as what kinds of plants lived during the ice ages or when the first humans crossed to North America.

Deep freezer. Apparently barren permafrost can contain DNA from ancient plants and animals.

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Ancient DNA is typically extracted from fossilized bones, tissue, or dung. But a team led by Eske Willerslev and Anders Hansen, graduate students in molecular biology at the University of Copenhagen, has now pulled DNA from Siberian permafrost sediments and the soil of caves in New Zealand. Another group matched the samples to those of known fossil bones, the collaborators report online in *Science* this week (www.sciencemag.org/cgi/content/abstract/1084114). The Siberian sediments yielded what the authors say is the oldest reliable ancient DNA so far, from plants up to 400,000 years old.

Permafrost is a good haven for preserving DNA because it is constantly cold. The Danish team started out looking for bacterial DNA, but the researchers were surprised to find that they could recover fragments of chloroplast DNA in soil samples. They identified 19 taxa of angiosperms, gymnosperms, and mosses. Soon they found DNA from eight kinds of animals, including modern denizens such as lemmings and extinct ones such as mammoths and steppe bison, which matched fossil DNA analyzed by co-author Alan Cooper of Oxford University, U.K. The animal DNA was at most 30,000 years old, according to radiocarbon dating of the sediment.

Perennially dry temperate caves in New Zealand, meanwhile, yielded ancient DNA from the extinct moa and a plant community much like that present before human colonization in A.D. 1000. "Importantly, this demonstrates that DNA can be preserved in soil for long periods, even in unfrozen conditions," Cooper says.

The permafrost plant DNA indicates that an area called Beringia, which spanned eastern Siberia and western Alaska, was once a vegetation-rich steppe—the kind that some researchers have argued would have been necessary to support mammoths and other megafauna—rather than a sparse polar tundra. But grasses declined from 36% to 3% of the DNA samples after about 11,000 years ago—which fits the idea that climate change played a big role in the mass extinction of mammoths, ground sloths, and other large North American mammals, the authors say.

Figuring out what glacial vegetation was like in Beringia can help test computer models of climate change, says Stephen Jackson, a botanist the University of Wyoming in Laramie. But he and others want to see more samples of ancient DNA and a more thorough demonstration of the technique on modern vegetation before being convinced that it can accurately reveal the patterns of past climates. "It's pretty exciting, but there's a lot of work that needs to be done," adds Elizabeth Hadly, a specialist in ancient DNA at Stanford University.

One drawback of the animal DNA is that it's difficult to know exactly what layer of soil it was deposited in. The samples "could be from much younger sediments due to leaching of urine," notes Hendrik Poinar of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Caves, too, have their limitations. Animals can churn soil, and a fluctuating water table can transport DNA.

But if these obstacles can be overcome, finding DNA in sediment "frees ancient DNA researchers from the shackles of needing fossils to be able to look into the past," says Cooper.

–ERIK STOKSTAD

ScienceScope

Green Light for Germany's Idled Neutron Source

BERLIN—More than 20 months after its construction, neutron researchers in Germany at last have permission to turn on their newest reactor. The federal environment ministry this week gave its long-awaited approval to the FRM-II neutron source in Garching, outside Munich. The controversial reactor is designed to burn highly enriched uranium fuel, which some worry could be diverted for weapons use (*Science*, 30 March 2001, p. 2527).

Workers finished construction in August 2001, and the Bavarian and federal governments later agreed to start the facility if it switched to low-enriched fuel within 10 years. But early hopes for a prompt start faded as the environment ministry asked for revised plans on reactor safety and waste disposal. This week's approval requires conversion to medium-enriched uranium fuel by 2010.

That will be a challenge, says scientific director Winfried Petry of the Technical University Munich, because scientists have lost 18 months of research and testing. Final approval for start-up is expected soon from Bavaria's environment minister, and Petry predicts experiments will be running within a year.

–GRETCHEN VOGEL

France Softens Budget Cuts

PARIS—Responding to protests, the French government has softened proposed cuts in science funding. But research groups say the financial outlook remains grim.

Last month, French researchers took to the streets after Research Minister Claudie Haigneré announced plans to freeze or reduce budget credits used to finance an array of public and quasi-public research institutions (*Science*, 21 March, p. 1823). CNRS, France's main basic research funder, and other institutions claimed they could lose up to 30% of their operating funds. Last week, the government softened the blow by lifting a freeze on some credits and pledging to impose no more cuts this year. Officials also said funds carried over from last year would allow institutes to keep spending stable.

Many scientists are skeptical. "It is a victory, [but] the cuts still mean a 30% drop for CNRS," says microbial ecologist Patrick Monfort of researchers' union SNCS. And other researchers note that the government has warned that mounting deficits may require across-the-board cuts in the future.

–BARBARA CASASSUS