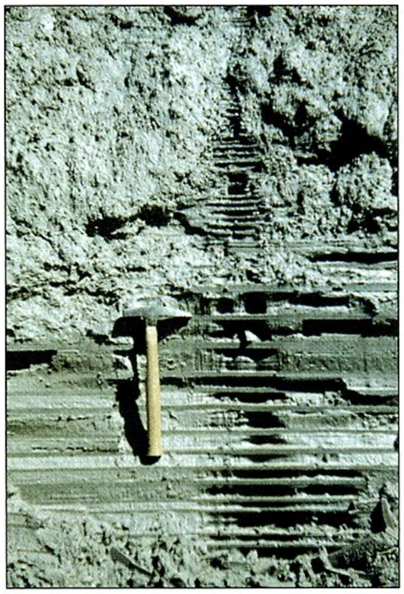
PALEOCLIMATOLOGY

Viable But Variable Ancient El Niño Spied

A climate record preserved in the bottoms of now-vanished lakes in New England shows traces of El Niño as far back as 17,500 years ago. The findings, reported on page 1039 of this issue, indicate that the tempo of tropical Pacific warmings remained roughly constant, but the beat strengthened and weakened for thousands of years at a time.

"It's nifty stuff," says paleoclimatologist David Rea of the University of Michigan, Ann Arbor. "This is new information—how long does a climate mode last, and when does it switch to the next mode?" The results fit well with new climate models that suggest that periods of weakened El Niños rhythmically alternate with the current mode of strong El Niños. Driving these swings, at least in the models, are periodic variations of solar heating as Earth wobbles on its spin axis. The record of these orbitally induced climate shifts over past millennia may help researchers understand how climate oscillations like El Niño will respond to future greenhouse warming.



Muddy message. Varying thickness of lake sediment layers tells of a variable El Niño.

The latest record of ancient El Niño is a byproduct of century-old geologic work. Early in the 20th century, Swedish geologist Ernst Antevs came to New England to sort out the history of the great ice sheets' retreat northward beginning 20,000 years ago. He could map the sequence of sediments washed out from the ice sheet and deposited in a lake at the ice's edge, such as Glacial Lake Hitchcock, which filled the Connecticut River valley. But to trace the ice front's position in New York, Vermont, and New Hampshire at a given time, Antevs needed a time marker that would tell him that sediments in widely separated lakes were laid down at the same time.

Antevs found such a marker in the seasonal layering of glacial sediments. Each summer, glacial meltwater would carry a heavy load of coarse sediment into the lakes, and each winter, meltwater would slow to a trickle, laying down a thinner, finer-grained layer. Antevs could tell which year, out of thousands, one of these layers or varves was laid down, because climate changes from year to year and decade to decade influenced the amount of melting across New England, creating unique patterns of varve thickness.

Geologists Tammy M. Rittenour and Julie Brigham-Grette of the University of Massachusetts, Amherst, which sits on Glacial Lake Hitchcock deposits, shared Antevs's interest in glacial history. They took a digitized version of his thickness records of more than 4000 summer-winter varve pairs published in the 1920s, filled a few gaps by adding some new thickness measurements (including some from a core they drilled on campus), and verified a 4000-year varve chronology spanning the glacial retreat from 17,500 to 13,500 years ago.

But the varve record offered tantalizing hints about climate as well. Rittenour (who is now at the University of Nebraska, Lincoln) and Brigham-Grette teamed with statistical climatologist Michael Mann of the University of Virginia in Charlottesville to extract a history of climate variability over that same 4000-year period. The thicker a varve, the warmer the weather in New England that year. They found that New England climate varied with the same 2.5- to 5-year beat that El Niño currently follows in the Pacific. Apparently, then as now, El Niño's influence reached into New England.

That came as a bit of a surprise, because a 12,000-year climate record retrieved from an Ecuadorian lake, close by the tropical Pacific, shows no sign of El Niño's torrential rains in that period (*Science*, 22 January 1999, p. 467). But the New England varves hold a clue to reconciling the two records. The Ecuadorian record may contain only the strongest El Niños, the ones whose heavy rains could wash sediment into the lake, while the New England record may contain both large and small El Niños. In New England, the apparently larger El Niños steadily faded until they were more or less gone 13,500 years ago. If those were indeed the larger ones, their absence left the Ecuadorian record with nothing big enough to record from the end of the ice age until strong El Niños returned in the past 5000 years.

Climate modelers using two very different paleoclimate models think they see how El Niños might have waxed and waned this way over the millennia. Amy Clement and her colleagues at the Lamont-Doherty Earth Observatory in Palisades, New York, used a simple model of the tropical Pacific, and Zhengyu Liu of the University of Wisconsin, Madison, and his colleagues used a complex global model. Both groups find that Earth's wobbling could be responsible. Today, Earth's spin axis is tilted so that the planet is closest to the sun in January, during Northern Hemisphere winter, giving the planet a little extra solar heating then. But Earth wobbles like a top, taking 21,000 years for one wobble, so that 11,000 years ago its spin axis pointed in the opposite direction, putting Earth closest to the sun in Northern Hemisphere summer. In the models, that extra summer heat is enough to strengthen winds over the tropical Pacific at a time of the year critical to initiating a new El Niño, discouraging it from forming, says Clement.

That Earth's orbital variations may be fiddling with El Niño's vigor has climate researchers excited. "This is a real opportunity to look at El Niño under other climatic base states," says paleoclimate modeler John Kutzbach, a collaborator of Liu's at Wisconsin. By seeing how El Niño reacts when prodded by changes in the rest of the climate system, he notes, researchers should get a better idea of how El Niño will behave in the future. The recent results "say, yes, if we have a different base state, we get a different El Niño," he says. "And the greenhouse will obviously be a different base state." –**RICHARD A. KERR**

CREDIT: T. M. RITTENOUR/UNIV. OF NEBRASKA, LINCOLN

HUMAN GENOME

Mapping a Subtext in Our Genetic Book

PARIS—As scientists race to finish a rough draft of the human genome, a European consortium is about to launch an effort to pinpoint every key spot in our genetic code where cells turn genes on and off by adding a methyl group to cytosine, one of the four nucleotides that make up DNA. Variations in methylation between healthy and ailing tissues "might give us a better understanding of what goes wrong" in some diseases, says Alexander Olek of Epigenomics, a biotech start-up in Berlin. The consortium announced at the Genomes 2000 meeting here last month that they have won initial funding for the project, which aims to grind out methylation maps for every kind of tissue.

Since the 1960s, researchers have accumulated more and more evidence suggesting that methylation plays many roles, including silencing the extra X chromosome in females. And methylation gone awry is linked to cancer and rare inherited diseases such as ICF syndrome, an immune disorder distinguished