Signs of unsteady climate appear in ice

Geoscientists have discovered evidence of a widespread cooling 8,200 years ago that raises questions about the stability of the modern climate.

Researchers have usually considered the current geologic time period, the Holocene epoch, immune to the wild temperature shifts of the last ice age, which ended 10,000 years ago. In theory, the giant glacial sheets on North America and Europe during the ice age destabilized the climate; once the ice melted, the climate calmed down.

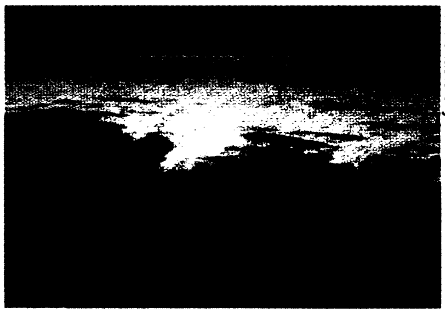
New findings culled from a borehole in central Greenland now challenge that idea. At a meeting of the American Geophysical Union in Baltimore this week, Richard B. Alley of Pennsylvania State University in University Park and his colleagues reported that the climate of the northern latitudes, and possibly much of the globe, cooled markedly 8,200 years ago, after the ice sheets had retreated. "What this means is we have an event here that we cannot blame on the ice sheets," says Alley.

The researchers discovered signs of the cooling preserved within Greenland's thick ice sheet, a remnant of the giant glacial blankets that existed during the ice age. A U.S. team known as the Greenland Ice Sheet Project 2 (GISP 2) drilled through the 3-kilometer-thick covering during the early 1990s. The ice cores from that hole have provided a climate record of the last 100,000 years.

Measurements of oxygen isotopes in the GISP 2 ice indicate that the temperature at the summit of Greenland dropped 4°C for a century—a relatively short, but intense, climate shift, says Alley. The cooling exceeds all other Holocene temperature changes recorded in GISP 2.

Such findings build on the results of earlier drilling projects in Greenland, which also turned up signs of a temperature drop 8,200 years ago. From the previous studies, however, scientists could not tell whether the cooling was limited to Greenland. The records from GISP 2 and from a nearby European hole suggest that the cool snap affected other regions as well.

Greenland's glacial cover, a leftover from the last ice age.



R. Monastersky

By sampling the contents of bubbles trapped in the ice, scientists have determined that concentrations of methane in the atmosphere dropped 20 percent during the cold span. Because methane comes predominantly from wetlands, fluctuations in its concentration reflect changes going on outside ice-covered Greenland. Wetlands in the high latitudes or perhaps in the tropics may have played some role in the climate change 8,200 years ago, says Alley.

The ice record also shows a jump in the concentration of tiny soot particles at that time. The soot peak could have come from increased forest fire activity in eastern Canada during the cooling, suggests Ken C. Taylor of the Desert Research Institute in Reno, Nevada.

For now, scientists remain unsure how much the climate changed during the early Holocene cooling. In his studies of soluble chemicals within the GISP 2 core, Paul A. Mayewski of the University of New Hampshire in Durham finds evidence of several other, more dramatic coolings during the Holocene.

—R. Monastersky

White dwarf in pas de deux: Cooler, slower

Sometimes a youthful companion makes all the difference. Consider the elderly, shrunken star known as a white dwarf. Left alone, it slowly radiates heat away and eventually drops out of sight. But if it attracts a less mature partner, it won't fade away. Drawing fresh material from its companion, the dense star will refuel, generating recurrent fireworks bright enough to be visible to the naked eye from a distance of several million light-years.

Astronomers have known for decades about such dynamic duos, known as cataclysmic variables. But new findings suggest that a white dwarf locked in a gravitational embrace with a younger partner spins more slowly and has a much lower temperature than predicted.

Edward M. Sion of Villanova (Pa.) University and his colleagues base their conclusions on Hubble Space Telescope spectra of two Milky Way white dwarfs at the heart of the cataclysmic variables VW Hydri and U Geminorum.

If observations of other cataclysmic variables confirm these results, the work "calls for revision of theory," says Sion. He adds that the findings, reported in the May 10 and May 20 ASTROPHYSICAL JOURNAL LETTERS, may shed light on the dynamics of other stellar twosomes, such as a normal star delivering gas to an object much denser than a white dwarf—a neutron star or black hole.

The material that a white dwarf draws from a younger, less dense companion forms a swirling disk around the dwarf's equator. Gravity pulls material from the disk to the white dwarf's surface. When enough has accumulated, it erupts in a thermonuclear explosion.

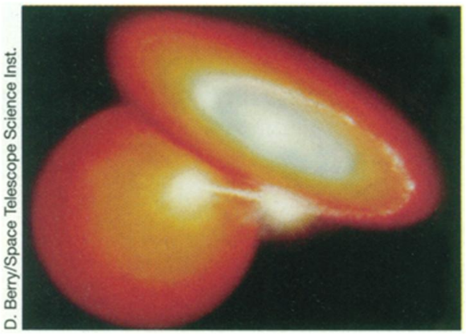
Researchers had predicted that the swirling motion of the gas would rev up the white dwarf's spin to several thousand kilometers per second—about half the rotation speed that would break it apart. Astronomers had reasoned that if these stars spun any more slowly, the rapidly rotating disks would crash violently into them, generating intense X-ray emissions. The absence of these predicted X rays suggested that white dwarfs indeed rotate rapidly.

Nonetheless, the Hubble measurements reveal that the white dwarfs in VW Hydri and U Geminorum are downright sluggish—spinning at one-tenth the expected rate. "It's not often that you get a result as decisive as this," says Joseph Patterson of Columbia University. "This means that the problem for the past 15 years in understanding where the energy goes [when matter is dumped onto a white dwarf]. . . can't be blamed on a rapidly rotating white dwarf."

Astronomers had also thought that the periodic explosions would raise a dwarf's temperature to several hundred thousand or perhaps a million kelvins. But the Hubble observations show that the surface temperature of the white dwarf in VW Hydri is 20,000 kelvins, while that of the white dwarf in U Geminorum reaches about 40,000 kelvins.

To account for the slower spin and lower temperatures, Sion speculates that instead of all the violence happening at the star's equator, where the gaseous disk crashes into the dwarf, some of the energy burrows in deeper or spreads across the star's surface.

—R. Cowen



D. Berry/Space Telescope Science Inst.

Drawing of a white dwarf (upper star) girdled by gas accreted from a companion.

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