Ancient ice reveals sudden climate shift

From deep within Greenland's ice cap, investigators have retrieved signs that the North Atlantic region took fewer than 20 years to shift from glacial conditions to warmer ones at the end of the last ice age. The discovery underscores the possibility that a similarly dramatic climate swing lies just around the greenhouse corner.

Previous studies suggested that the ice age's final cold spell, called the Younger Dryas, ended abruptly around 10,700 years ago. The refined analysis of a deep ice core from south Greenland reveals the extreme speed of the transition to a milder, less stormy climate.

As it emerged from the ice age, the North Atlantic bounced between several warm and cold times. The Younger Dryas period, which started around 11,500 years ago according to ice core dates, marked the last time this region slipped back into glacial conditions. The system of ocean currents that warms Europe ceased operating, and sea ice covered much of the North Atlantic during this period.

Greenland's ice cap, which builds layer by layer each year, provides a climatic record of such events. By comparing deuterium and oxygen isotope levels in the ice cores, researchers can estimate the extent of the ancient sea ice. These data show that the ice retreated quickly to the north, in less than two decades. At the same time, dust concentrations in the ice cores dropped by a factor of three, indicating a weakening in the storms that carried North American dust to Greenland, say W. Dansgaard of the University of Copenhagen in Denmark and his colleagues from the United States and Iceland.

While the sea ice retreated and for 30 years afterward, Greenland warmed by a substantial 7°C, which was half the total temperature difference between peak glacial and interglacial times for this area, Dansgaard and his co-workers report in the June 15 NATURE.

It is unclear what triggered the rapid changes that ended the Younger Dryas, says ice core chemist David A. Peel from the British Antarctic Survey in Cambridge. This year, U.S. and European researchers began drilling two new cores in central Greenland that will help answer these questions.

An understanding of the Younger Dryas climate changes may provide warnings for the future. Scientists use computer models to estimate how increasing greenhouse gases will heat the globe. Yet, says Peel, "the current global models are totally inadequate to deal with rapid climate fluctuations. They can't account for the shifts that we're seeing at the end of the Younger Dryas." — *R. Monastersky*

Oracle bone shows a once-shorter day

"Three flames ate the sun. Big stars [seen]."

These cryptic words, inscribed in Chinese characters on an ancient piece of tortoise shell, record a total solar eclipse in which the sun's corona and its streamers became visible and stars appeared in the sky. They also give a way of determining the Earth's rotation rate thousands of years ago.

In an ingenious piece of astronomical and historical detective work, Kevin D. Pang of the Jet Propulsion Laboratory in Pasadena, Calif., and his collaborators pinpointed the eclipse date: June 5, 1302 B.C. In turn, they deduced that a day is now 0.047 second longer.

"With such an analysis, we can get a better idea of how much the Earth's rotation rate varied in antiquity," Pang says. He described his team's findings this week at an American Astronomical Society meeting in Ann Arbor, Mich.

Before the invention of paper, scholars in ancient China wrote predictions and recorded events, including eclipses, on fragments of bone and tortoise shell known as oracle bones. Pang and his colleagues studied one particular eclipse record. By using computers to calculate the dates and paths of solar eclipses visible in China during a certain period of the Shang dynasty, they found two candidates that appeared to fit the oracle-bone data.

The team then turned to records of five lunar eclipses during the same period of Chinese history. After establishing that the Chinese day, as recorded in the oracle bone, started at roughly 3 a.m., the researchers found a pattern of lunar-eclipse dates that fits the date of one solar eclipse but not the other. At the same time, because any changes in the Earth's rotation rate would shift an eclipse's path from where it occurred, they worked out how much the length of the day had changed. — *I. Peterson*

A light touch changes the biological clock

Airline passengers leaving San Francisco for London might one day use a precisely timed dose of light to reset their biological clocks to English time and avoid debilitating jet lag, if future research confirms a study reported this week.

Scientists have just begun unraveling the complicated circadian rhythm that governs sleepiness, hormone levels and other daily cycles of the body. Three years ago, researchers in Boston described a case study in which a 66-year-old woman with a fast-running biological clock sat in front of bright lights each night before going to bed (SN: 8/30/86, p. 136). Just one exposure to light shifted many aspects of her circadian cycle — a finding that surprised scientists, who believed the human biological clock was not very sensitive to light but instead relied on social cues.

The same research team now has completed a larger study designed to find out how people with normal sleep patterns react to different light patterns given at varying stages in their circadian cycles. Charles A. Czeisler, director of the Center for Circadian and Sleep Disorders Medicine at Brigham and Women's Hospital in Boston, and his colleagues studied 14 men aged 18 to 24. The subjects checked into the Boston sleep laboratory, where scientists charted their normal biological cycles using hormone levels and endogenous body temperature, a measure that corrects for subtle temperature fluctuations caused by activity. Subjects then went through three 24-hour cycles that included eight hours of darkness, 11 hours of indoor room light and five hours of bright light equivalent to sunlight.

In 45 trials, the researchers found that the men with the largest shifts in their biological clocks had been exposed to light at a time when their endogenous body temperatures were at a minimum, generally about two to three hours before their normal waking time. The team reports in the June 16 SCIENCE that subjects exposed to light at that time experience a shift of up to 12 hours in their biological clocks—a complete inversion of the cycle, equivalent to a New Yorker getting accustomed to Bangkok time.

The researchers found they could reset the biological clock backward or forward by giving certain amounts of light at various points in the circadian cycle. In addition, they discovered that artificial room light affects both the direction and the magnitude of a shift induced by exposure to bright light. That finding may be important for insomniacs who turn on a light to read, Czeisler says.

Eventually, such research may lead to light therapy for people with certain types of sleep disorders, such as elderly people who wake up in the predawn hours because of a fast-running clock, Czeisler says. But, he cautions, "this is basic research. It's really too early to give a prescription."

Sleep researcher Charmane Eastman at the Rush Presbyterian Saint Luke's Medical Center in Chicago agrees, adding that research conducted in a laboratory may not reflect the real world. More work needs to be done to find practical ways for people to alter their biological clocks, she says. — *K.A. Fackelmann*