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Today, climate is the provenance of scientists, not philosophers, although this gumbo of disciplines — incorporating geology, biology, oceanography, chemistry and, increasingly, social sciences such as history and archaeology — requires more than a little faith.

Mayewski travels the world, saving ice cores from rapidly melting glaciers in hopes that they can reveal the history of the world. Other scientists hunt messages in rock formations. Jacobson seeks knowledge in ancient pollen trapped far beneath lake waters. Each believes that the information is there, waiting to be tapped.

"It's not a simple matter of one kind of evidence telling the whole story," Jacobson said. Only from all these stories from ice cores, lake sediments, fossils, tree rings, coral reefs, rocky cliffs and even old diaries will a full picture of the past emerge.

"The data becomes so diffuse and broad and plentiful that one person can't handle it all," said Hal Borns, founder of the multidisciplinary Climate Change Institute.

At the University of Maine, one of several centers for climate research around the country, scientists are piecing together the history of the natural world in hopes of someday being able to predict the sorts of drastic changes that affected the planet long before our cities were built and that very likely will happen again. And once the natural systems are defined, the role that we play in transforming the climate will become clear, Jacobson said.

"It's only in understanding the natural variability that we can see what's happening today," he said.

'We're still in the ice age'

Mainers joke about the brevity of a New England summer, claiming that all they have to do is blink once and the snow is falling again. But warm periods of time in which the state experiences anything that can be called a summer have been tremendously rare — just 10,000 years of heat for every 100,000 years of snow.

Earth is still in the throes of an ice age, a period of alternating warm and cool phases that began 2½ million years ago.

"We're still in the ice age, and most people don't know what the ice age is," Borns said.

The woolly mammoths that once marched over the sheets of ice atop what is now Bangor are long gone, but millions of years of climate data indicate that the world may be poised on the edge of the next glaciation, or cool phase of the ice age. Of course, to climate scientists, who think on mind-boggling time scales, that edge could last for many human generations.

"Some people say we're 500 to 1,000 years overdue," Borns said. "We've been through the warm spell."

Four times over the past 500 millenniums, ice has advanced, as though on a regular schedule. The most recent glaciation, which ended between 12,000 and 17,000 years ago, formed Maine's landscape. Glaciers scraped over the rocky ground, chiseling the peaks and valleys of Baxter State Park and the White Mountains.

Then, as the ice receded, melting water rushed over the land, leaving long, narrow deposits of sand and gravel that snake across the state.

"Over a period of just 4,000 or 5,000 years, there was an incredibly rapid change from Maine being covered by ice to being covered by forest," Jacobson said.

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OCEANOGRAPHY

Changes in temperature, salinity, currents mean ripple effects elsewhere

When the wind starts to blow and the rain starts to fall, most people don't blame the oceans for their plight.

But the waters that cover more than 70 percent of Earth's surface are intimately linked to the planet's climate.

"Many people think climate is the weather. In fact, the ocean is the largest driver of climate," said Fei Chai, an oceanographer with the Climate Change Institute at the University of Maine.

In the real world, the oceans and the atmosphere lack the distinct boundary lines depicted in textbooks. Water, carbon dioxide, oxygen and other molecules constantly travel back and forth between the air and the sea.

Most coastal residents understand how the oceans help to moderate temperature by warming or cooling breezes that pass over the water en route to land.

The oceans play a similar role on a global scale. The sea can absorb or release a tremendous amount of heat, slowing the impact of a climate shift.

The oceans also hold a great deal of carbon dioxide, one of the most abundant greenhouse gases. Carbon is present in all living things — including plankton and the calcium carbonate structure of clams and corals — which will eventually decompose, creating more carbon dioxide.

"A cooler ocean tends to hold carbon dioxide — like a can of Coke," Chai explained. "When you have warmer water, the CO_2 starts bubbling out of the water into the air.

This is just one of the many climate phenomena that concern scientists, like Chai, who produce models predicting what might happen if the climate changes. For example, high levels of CO_2 in the atmosphere could warm the oceans, prompting the release of still more CO_2 and spurring further warming.

And as Hurricane Katrina so aptly demonstrated, warm oceans also can trigger more immediate effects. Monster storms will happen occasionally in any climate, but warmer water has the potential to breed more ferocious hurricanes.

The ocean currents that bring monsoons to India, El Ninos to Peru, and nor'easters to Maine are also at the whims of global climate. Currents are put in motion by cold water sinking to the sea bottom in the polar regions because it becomes more dense and holds more salt as it loses its heat to the air. The cold water moves downhill along the sea bottom toward the equator, where it warms and returns to the surface. Prevailing winds then drive the warm surface water back toward the poles. The result is continual motion throughout the oceans.

This system was dubbed "the great conveyor belt" by climatologist Wallace Broecker of the Lamont-Doherty Earth Observatory at Columbia University, because it drives much of the world's weather. Scientists cite changes in the circulation pattern as a major factor in past ice ages. The system has been relatively stable for the past 200-300 years, after likely playing a role in the cold phase known as the Little Ice Age between the 14th and 19th centuries.

But if Earth becomes too warm, millions of gallons of fresh water from melting polar glaciers and icebergs could pour into the sea, interfering with the temperature and salt balance, or thermohaline, that maintains the currents.

"The ocean transports a lot of heat from the western side of the Atlantic to the eastern side," Chai said.

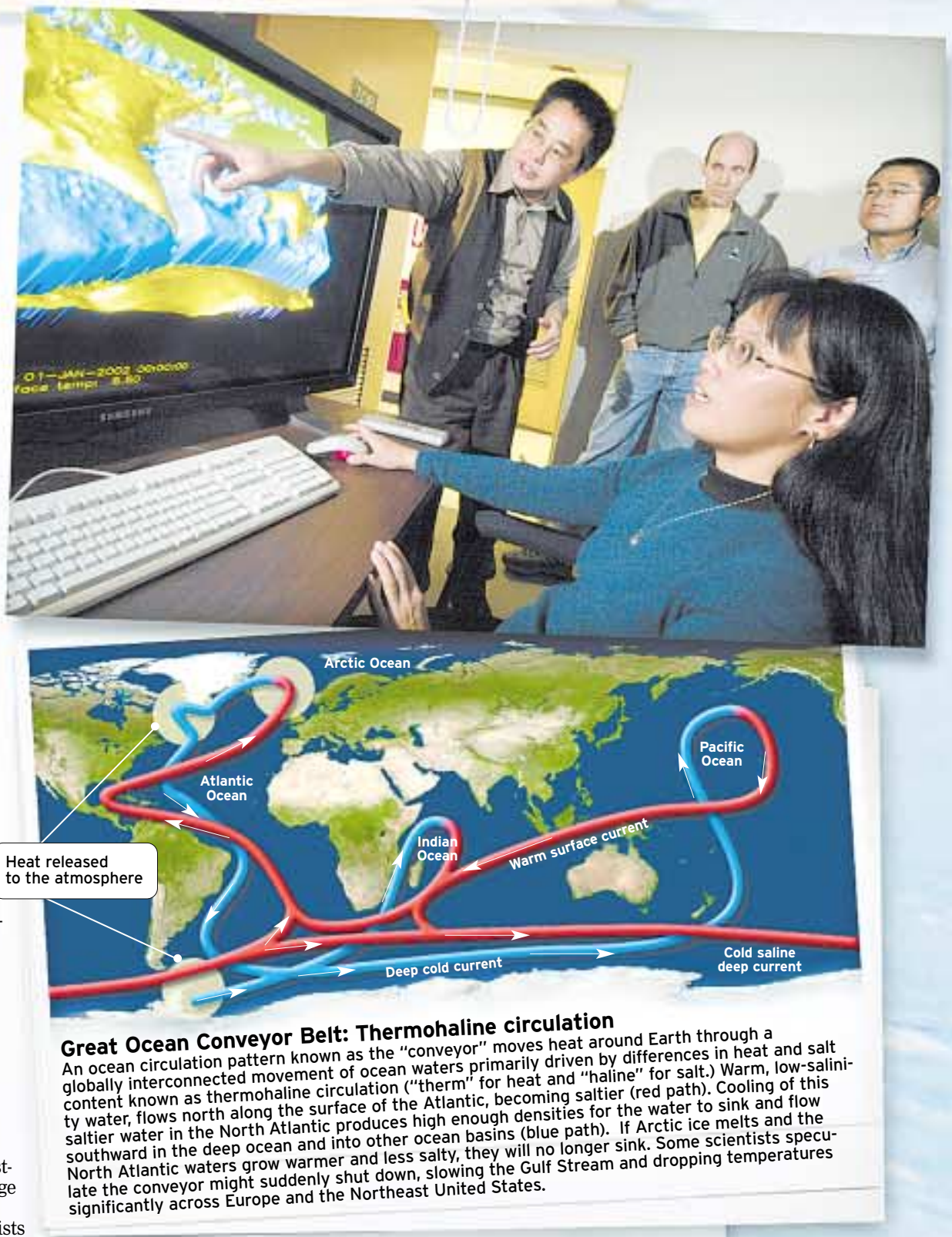
Without this conveyor belt, the Gulf Stream, which carries warm water to the United States and Western Europe, could weaken or change path.

Broecker and some other scientists believe they have evidence from ice cores that suggests that this system has changed in the past, bringing ice and snow to the temperate regions. The disaster movie "The Day After Tomorrow" was based on Broecker's theory — albeit in a dramatically exaggerated form that depicted the start of a new ice age in Manhattan over a period of a few days.

To better understand, and predict, the behavior of these systems, scientists have deployed a small army of buoys and free-swimming rovers to monitor the high seas, transmitting their data by satellite.

Chai uses this and historical climate data to create complex models on a supercomputer with the capability of 256 high-powered PCs, showing how the oceans change over time, their warm and cold currents strengthening and dissipating.

Internationally, the goal is someday to have thousands of live data collectors, drifting in all of the world's oceans, searching for the signals that the climate is beginning to change.



Great Ocean Conveyor Belt: Thermohaline circulation
An ocean circulation pattern known as the "conveyor" moves heat around Earth through a globally interconnected movement of ocean waters primarily driven by differences in heat and salt content known as thermohaline circulation ("therm" for heat and "haline" for salt.) Warm, low-salinity water, flows north along the surface of the Atlantic, becoming saltier (red path). Cooling of this saltier water in the North Atlantic produces high enough densities for the water to sink and flow southward in the deep ocean and into other ocean basins (blue path). If Arctic ice melts and the North Atlantic waters grow warmer and less salty, they will no longer sink. Some scientists speculate the conveyor might suddenly shut down, slowing the Gulf Stream and dropping temperatures significantly across Europe and the Northeast United States.

University of Maine oceanographer Dr. Fei Chai (left) and Professor Huijie Xue (seated) explain an ocean circulation model they have extrapolated from a dozen remote moorings with cell phone and satellite uplinks from the Gulf of Maine. Next to them is research associate Steve Cousins and post-doctoral researcher Masa Fujii.

IMPACT: LITTLE ICE AGE

Course of American history shaped by mysterious deep freeze

Every year, schoolchildren hear the tale of George Washington and his band of barefoot soldiers in ragged clothes huddled in the blood-stained snow near the Delaware River during the bitter winter of 1777. Today, Chester County in Pennsylvania, where Valley Forge is located, is known for its mild winters, averaging only about 3 feet of snow over the course of a year.

The drastic difference isn't evidence of global warming. Rather, it shows a historical climate shift that helped shape the course of American history. The years between 1300 and about 1850 are known as "the Little Ice Age," years in which temperatures were, on average, much colder than today.

Crops failed across Europe, contributing to political and social strains that led to the French Revolution and the potato famine in Ireland. In the Alps, advancing glaciers swallowed up entire villages, including a famous chapel that was encased in ice despite the frantic prayers of clergy.

In the North Atlantic, the Vikings abandoned centuries of expansion into Greenland, Iceland, Atlantic Canada and possibly even New England when colder weather brought sea ice into their shipping lanes and made their journeys increasingly perilous.

In the United States, the onslaught of cold and drought was likely a factor in "lost" 16th and 17th century British colonies at Popham Beach in Maine and Roanoke Island in North Carolina.

Ice cores and historical accounts reveal that temperatures throughout the temperate regions dropped significantly within just a few stormy years. In 1315 alone, thousands died when wild storms heralded the start of the Little Ice Age, bringing widespread famine to Europe.

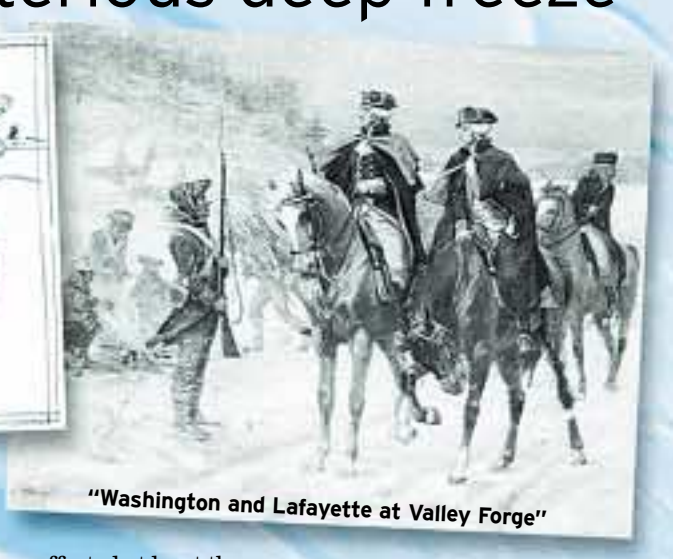
As the most recent example of drastic climate shifts, the Little Ice Age has attracted extensive study.

"It happened within historic time, the data sets are good, [and] it was severe for humans," said Hal Borns of the University of Maine Climate Change Institute.

Climatologists now know that this shift to colder, often less predictable weather affected at least the entire Northern Hemisphere and perhaps the whole world. But many questions remain about the cause.

Some point to a dearth of sunspots as the primary cause of the Little Ice Age. Others theorize that different natural climate cycles overlapped to cause the deep freeze. Some even argue that the Little Ice Age might have continued to the present day, if not for the climate-changing impact of the Industrial Revolution.

The John Hunt map of Fort St. George, dated October 8, 1607, Popham Bay colony.



"Washington and Lafayette at Valley Forge"

1932
Geologist W.J. Humphreys introduces the idea that Earth's climate is not stable and that an ice age could return. "We are not wholly safe from such a world catastrophe," he wrote.

1947
A team of scientists at the University of Chicago develops radiocarbon dating, a technique for determining the age of any organic item, such as a fossilized plant or a human bone, by measuring how its constituent carbon has changed with time. The technique can accurately date items as old as 50,000 years, and made paleobotany a key element of understanding past climate shifts.

1962
Bangor is snowbound as the year ends with a storm that delivers 20-foot drifts. The biggest snowstorm in recent memory, the Blizzard of '62 cripples the city, reducing I-95 to a single lane and stranding more than 600 people in a local restaurant.

1970
The United States celebrates its first Earth Day, the symbolic start of the modern environmental movement, which helps to shift the discussion of climate change from academia to the public.

1980
Mount St. Helens erupts in Washington state, sending ash around the world over the course of a month. Neighboring Idaho and Montana briefly experience drastic temperature decreases because of ash and dust in the atmosphere.

1982
The world's climate is affected by a particularly dramatic El Nino event. This ocean circulation pattern named for the Christ child tends to occur every four to 12 years, bringing drought to eastern Australia and Indonesia and heavy rains to western South and Central America.