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Big Picture: How Climate Change Shaped Humanity

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Could the study of hard times in the past teach us how to deal with global warming in the future?

by Andrew Grant

While climate researchers struggle to refine their projections of the changing global climate and to anticipate the social impact of those shifts, a growing number of scientists are realizing that the past may contain valuable lessons about our future.

Humans have faced environmental changes before. In fact, those changes molded every facet of life—what food could be cultivated, what kind of clothing and shelters were required, what goods were produced—and most likely played a role in determining which civilizations thrived and which perished. In the distant past, climate variations may have shaped the very nature of our species. Earth scientists and climatologists are joining forces with archaeologists and anthropologists to build a comprehensive understanding of the climate record that is written into our own past. “Climate change is one of the most neglected aspects of human history,” says Brian Fagan, an anthropologist who has written multiple books on the topic. “Now we are acquiring tools to look at its effects on human society.”

This work builds on studies of paleontological climate clues—tree rings, ice cores, clamshells, even the inner ears of fish—that have been used to reconstruct ancient temperatures and humidities, providing a broad look at past conditions on earth. Better instruments and techniques have brought an unprecedented level of precision to these analyses, allowing researchers to zoom in on ever narrower timescales relevant for understanding climatic effects on human populations.

Clams, for example, add a tiny layer of carbonate to their shells virtually every day of their lives, which typically span two to nine years. Using a new micromilling technique that harvests thin samples from the shells, scientists can probe each layer for a particular isotope of oxygen that varies in step with temperature, essentially providing a daily weather report over the life of the clam. “We are getting to the point where we can look at paleoweather —how hot it got in the summer, individual major storms—rather than just paleoclimate,” says William Patterson, a geologist at the University of Saskatchewan in Canada, who developed the technique. By analyzing clamshells unearthed on Canada’s Melville Island, he can pinpoint individual summers in the region dating back 370 million years.

Patterson’s latest study looks at a far more recent era. He has analyzed clamshells to gain perspective on the Vikings, who migrated from Europe’s mainland to Iceland, Greenland, and northeastern stretches of North America hundreds of years before Columbus. Patterson’s findings, published in March, suggest that Viking settlers in Iceland ran into trouble when a cool period hit around A.D. 970, just a few decades after they arrived. Summer temperatures there dropped 9 degrees Fahrenheit.

Writings confirm that this period was a difficult one for Norse settlements in the area, marked by devastating crop failures. “Men ate foxes and ravens….The old and helpless were killed and thrown over cliffs,” reads one contemporary account. “We have written records that we can evaluate by looking at the cold, hard facts” from physical evidence, Patterson says, allowing scientists to quantify the cold spell for the first time. The Vikings’ experience indicates that “when the climate changes, the most vulnerable, marginal environments fail first,” Patterson says.

His study joins a burgeoning collection of research documenting climate’s role in the rise and fall of ancient civilizations. In another March study, dendroclimatologist Brendan Buckley of Columbia University examined tree rings that yielded clues to the fate of Angkor, a once-bustling city in what is now Cambodia that thrived for five centuries before mysteriously collapsing in the 1400s. Buckley’s analysis of tree rings from a species of cypress in the region revealed that 13 of the 40 driest years in the 760-year record were clustered close together in the late 14th and early 15th centuries. These droughts, he realized, corresponded to the time of Angkor’s fall.

Historians have pegged the city’s demise on war and social conflict. Climate was probably just one of many factors that brought it down, but prolonged drought probably exacerbated the political and societal problems. And while Angkor was overwhelmed by climate change at the scale of a few decades, Buckley says, “a more nimble society might be able to adapt in response.”

Pushing this theme further, Ezra Zubrow of the University of Buffalo is launching a gargantuan undertaking in areas of Russia, Finland, and Canada aimed at understanding how the people there adapted to a rapid temperature rise that occurred about 5,000 years ago. “This can give us some perspective on how people respond to a warming world with more drought,” Fagan says. “You can’t understand the present and future without looking at the past.”

Other researchers are exploring deep timescales to look for climate's influence on our evolutionary origins. In March the National Research Council (NRC) published a report urging more research into whether "critical junctures in human evolution and behavioral development may have been affected by the environmental characteristics of the areas where hominids evolved." The report highlights evidence of a dramatic shift toward drier conditions in Africa about 2.8 million years ago. Soon afterward, members of our genus, *Homo*, started using stone tools.

Various human species, including our own *Homo sapiens*, have endured ice ages and warming periods as well as floods and droughts. These ups and downs might have forced our ancestors to adapt quickly; big-brained humans may have had a survival edge in an unstable environment. Peter deMenocal, a Columbia University paleoceanographer who coauthored the NRC report, says "our study of human evolution in the context of major changes in African climate indicates that our species was honed by climate."

BuzzWords

Carbonate A mineral based on the carbonate ion, CO32-. Many invertebrates have shells of calcium carbonate that bear evidence of the physical conditions in which they formed.

Micromilling A technique for obtaining thin slices. A new robotic micromilling device developed at the University of Saskatchewan can harvest 20,000 slices per millimeter of material.

Paleoclimate The climate conditions of geologic periods in the ancient past.

Dendro-climatologist A researcher who uses tree rings to study the climate record.