Global Warming, the Ruddiman Thesis, and the Little Ice Age

Daniel Headrick

Journal of World History, Volume 26, Number 1, March 2015, pp. 157-160 (Article)

Published by University of Hawai'i Press
DOI: https://doi.org/10.1353/jwh.2016.0000

Global Warming, the Ruddiman Thesis, and the Little Ice Age

DANIEL HEADRICK

Geoffrey Parker's *Global Crisis* is one of those books that appear once in a generation and define the field—in this case, the crisis of the seventeenth century—for years to come. It is also the culmination of a lifetime's devotion to the scholarly study of that century in all its ramifications: political, social, cultural, environmental, and economic. Rather than comment on the entire book, I will, as a budding environmental historian, limit my comments to the first chapter, "The Little Ice Age." In that chapter, Parker describes all the environmental anomalies that afflicted Earth in the seventeenth century—unseasonably cold weather, storms, volcanic eruptions, floods in some places, droughts in others—and their impact on harvests and on other aspects of human life. Rather than simply generalizing, he provides specific data from both human and natural archives, as well as quotations from the writings of people who lived through that terrible century.

I had read Parker's earlier works, especially *Europe in Crisis* and *The General Crisis of the Seventeenth Century*.[1] Yet I found much new information in *Global Crisis*, especially about the world outside of Europe, that buttressed my own views of the Little Ice Age. All that new data

[1] *Europe in Crisis, 1598–1648* (London: Fontana Paperbacks, 1979); *The General Crisis of the Seventeenth Century*, edited with Smith.

Journal of World History, Vol. 26, No. 1

was very welcome indeed, and I had no critique to level at Parker's interpretation of the Little Ice Age.

None, that is, until I stumbled across a sentence in the epilogue that reads: "Although humans appear to have played no part in precipitating the climate changes of the seventeenth century, they suffered and died from its consequences all the same" (p. 687). Actually humans did contribute to the climate changes of the seventeenth century, alongside such natural phenomena as the El Niño episodes, volcanic eruptions, and the lack of sunspots that Parker emphasizes. I base this statement on the work of William Ruddiman. William Ruddiman is a climatologist, now a professor emeritus at the University of Virginia. He is best known for two books, *Earth's Climate: Past and Future*, a textbook in paleoclimatology, and a popular book, *Plows, Plagues, and Petroleum*. In these books and in numerous scholarly articles, he makes two arguments that I will oversimplify here.[2]

The first argument concerns the impact of humans on the natural cycles of the global climate. During a period scientists call the Pleistocene, from about 2.5 million until circa 8,000 years ago, Earth's climate was largely determined by the amount of sunshine reaching the planet and the concentration of greenhouse gases in the atmosphere. The amount of sunshine was a result of three factors: the tilt or angle between the Earth's axis and its orbit; the shape of the orbit, which varied from slightly to very elliptical; and the precession or wobble of the Earth's axis of rotation. Over the past 900,000 years the combination of these three factors caused the global climate to warm and cool in 100,000-year cycles. Meanwhile, the concentration of greenhouse gases also varied. The concentration of methane in the atmosphere is a function of the intensity of solar radiation: the more sunshine, the more vegetation grew and then decayed, releasing methane; that concentration followed a 22,000-year cycle until 5,000 years ago. The carbon dioxide cycle is more complex, as that gas is released by volcanic eruptions and the chemical reaction of rainwater with exposed rocks. That amount followed a 100,000-year cycle, with amounts increasing during ice ages until there was sufficient CO_2 in the atmosphere, along with methane and sunshine, to cause interglacials, a period of warmer average global temperatures separating glacial (or cold) periods during an ice age. Eight thousand years ago, had these natural cycles not been

[2] See especially William F. Ruddiman, "The Anthropogenic Greenhouse Era Began Thousands of Years Ago," *Climatic Change* 61 (December 2003): 261–293.

interrupted, the Earth's climate was about to enter a cooling phase that would eventually lead to another ice age.

Instead of a new ice age, we have enjoyed a period of comparatively steady climate called the Holocene. Ruddiman has argued that this turn of events was due to two human innovations, farming and herding, that affected the concentration of greenhouse gases. When farmers cleared forests and burned trees and other vegetation, they released carbon dioxide. At the same time, cultivating rice in paddies and raising herds of ruminants, especially cattle, emitted methane. These two greenhouse gases were released in sufficient quantities to offset what would have been the beginning of another ice age. Thus the Holocene, this generally equable climate that we have lived through for the past 12,000 years, is not a natural but an anthropogenic phenomenon.

If that is so, then how can we explain the Little Ice Age? Geoffrey Parker lists several factors at play in the seventeenth century: the lack of sunspots, hence a drop in solar irradiation; volcanic eruptions that created a sunlight-blocking haze; and a shift in global air currents that caused an increase in El Niños. Ruddiman's second argument does not contradict these factors but adds yet another influence, this one anthropogenic, namely a drop in the concentration of carbon dioxide in the atmosphere. While that concentration had been gradually rising since the Neolithic, ice cores from Antarctica show a long and deep downturn from 1500 to 1750, corresponding to the period that most climate historians call the Little Ice Age. This downturn had a more powerful effect on the global climate than the other factors that Parker mentions.

What caused this anomaly in the concentration of carbon dioxide in the atmosphere? Ruddiman attributes the drop in carbon dioxide to a drastic reduction in the number of human beings, as epidemic after epidemic imported from Europe swept through the New World in the sixteenth and seventeenth centuries, reducing the Native American population by 90–95 percent. As the indigenous population shrank, natural vegetation replaced their fields. In North America, the Amazon basin, and elsewhere, trees grew fast enough to achieve the biomass of full forests within fifty years, for young trees absorb carbon dioxide much faster than mature ones. As carbon dioxide was withdrawn from the atmosphere, it reversed the long-term warming trend, contributing to the global cooling that Parker describes.

Ruddiman's thesis has provoked a debate among his fellow climatologists. After initial surprise, however, most of them now accept its

validity.[3] Thus it does not contradict, but it complements what Parker and other historians have written about the Little Ice Age. In other words, in the seventeenth century, the world was already cooling for anthropogenic reasons when sunspots, volcanoes, and other natural phenomena only made things worse. In short, humans cannot escape the blame for influencing the climate of the seventeenth century, any more than we can today.

[3] A review of the subject can be found in M. James Salinger, "Agriculture's Influence on Climate during the Holocene," *Agricultural and Forest Meteorology* 142 (2007): 96–102. Reviews of Ruddiman's *Plows, Plagues, and Petroleum*: Sam White, *Technology and Culture* 52, no. 1 (2011): 182–183; and Carlos E. Cordova, *Holocene* 20, no. 4 (2010): 653.