Frozen Earth: The Once and Future Story of Ice Ages

by Doug MacDougall
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reviewed by Steven Newton

It’s warm out there. I’m not referring to the record-setting anthropogenic warming of this century, but to the interglacial period in which the planet has been basking for the last eleven thousand years. This brief interval in which humanity’s greatest achievements have been attained—the invention of agriculture, the building of pyramids, the discovery of the Twitter hashtag—has been a climate exception, an unusual period in which thick glaciers do not smother Europe and Canada. When people talk about the entire history of civilization, geologists simply call it by the bland name “marine isotope stage one” (MIS-1). Since the major worldwide cooling at the Eocene–Oligocene boundary over thirty million years ago, the normal state of Earth has been—to paraphrase Frost—ice rather than fire.

“The Earth is still in an ice age. We are in a warm period, one of the many interglacial intervals that have occurred throughout the Pleistocene Ice Age … It is easy to forget that this may be just a short respite before another glacial interval begins” (page 232). Thus concludes Doug MacDougall’s book Frozen Earth (published originally in 2004 and reissued with a new preface in 2013), which does an admirable job of bringing this surprising information to a lay audience. MacDougall traces the history of the thinking about climate and ice ages from its early roots with Louis Agassiz through the orbital calculations of James Croll and Milutin Milankovitch and up to modern measurements.

Along the way, MacDougall tells fascinating stories, such as the tale of how geologist J Harlen Bretz struggled to have the scientific community recognize the evidence for gigantic glacial meltwater floods in eastern Washington. These floods were fueled by the end of the latest ice age, when unimaginable volumes of water trapped on land as glacial ice melted and burst forth, rushing home to the seas as the ice dams holding them back gave way. In the process of doing so, these waters carved unique features in the landscape of eastern Washington—the less-than-euphoniously named Channeled Scablands—giving geologists important clues about how the ending of the latest ice age shaped the land.

The father of continental drift, Alfred Wegener, also makes an appearance as he works with Milankovitch to understand how puzzling glaciation patterns carved in ancient rocks—glaciers appearing in areas that are now tropical; glaciers that seemed to move uphill from the oceans toward present-day mountains—make more sense on the hypothesis that continents were once arranged differently than they are today.

MacDougall also explains Snowball Earth, the contentious idea that hundreds of millions of years ago periods of glaciation were so extensive that they effectively spread ice from
pole to pole, sealing off the atmosphere from the ocean, transforming Earth into something like the Star Wars ice planet Hoth. A Frozen Earth indeed.

MacDougall then delves into the modern techniques geologists use in understanding past climates, such as the shipboard retrieval of oceanic sediment cores, and the drilling for glacial ice cores in Greenland and Antarctica. Sediment and ice cores both present formidable technical difficulties, but the information we can glean from them is invaluable. By sampling wispy bubbles of gas set into ice hundreds of thousands of years ago, geologists can determine concentrations of carbon dioxide in the past, thus yielding a long-term perspective on our anthropogenic changes to the atmosphere. Similarly, by measuring oxygen isotopes from foraminifera extracted from muddy sediment cores, geologists can ascertain oceanic temperature trends millions of years in the past. These modern tools provide documentation of Earth’s climate history that the early pioneers could have only dreamed of.

MacDougall then addresses issues closer to home: how climate affected human evolution, and what the future may bring. He notes that human evolution may well have been conditioned by climate:

Right around the time when the Earth’s average temperature plunged downward at the beginning of the Pleistocene Ice Age—about three million years ago—the rate of change accelerated drastically. Hominids quickly evolved away from their apelike ancestors … Would we be here at all were it not for the Pleistocene Ice Age? (page 188)

In the final chapter, on future climate, MacDougall brings home the point that though our modern warm snap is unusual in the context of the “icehouse” conditions over the last tens of millions of years, those “icehouse” conditions are themselves anomalous when viewed over the longer time of Earth’s history. Ice ages have been rare when viewed at the billion-year scale. MacDougall notes that “we do know that the past few million years of the Pleistocene Ice Age have been fairly unrepresentative of the long history of our planet” (page 232), reiterating a point that he makes at the outset of his book: “for the past few million years, the Earth has been considerably colder than over most of its four and half billion years of existence” (page 8).

This book will be a good resource for those needing an introduction to what we know about past climate and how we know it. Those familiar with these subjects may find the book doesn’t cover much new ground, but for everyone else it is a readable guide to a complex, multifaceted topic.

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