

but on terms that often draw their meaning from an analogy with the experience of travel on trains, buses, or automobiles. Facts can sometimes go it alone, for example, but often flourish only in the company of traveling companions (in the form of allied facts). The authors explore the ties and the tensions between “integrity” and “fertility” of travel, involving a dialogue of replication and variation. None of this is shockingly original as theory, but we encounter here a variety of perspectives on the problem of travel, presented in papers, often attractively written, that take seriously their particular topics.

10.1126/science.1207944

EARTH SCIENCES

We Need a Deeper Sense of Time

Scott L. Wing

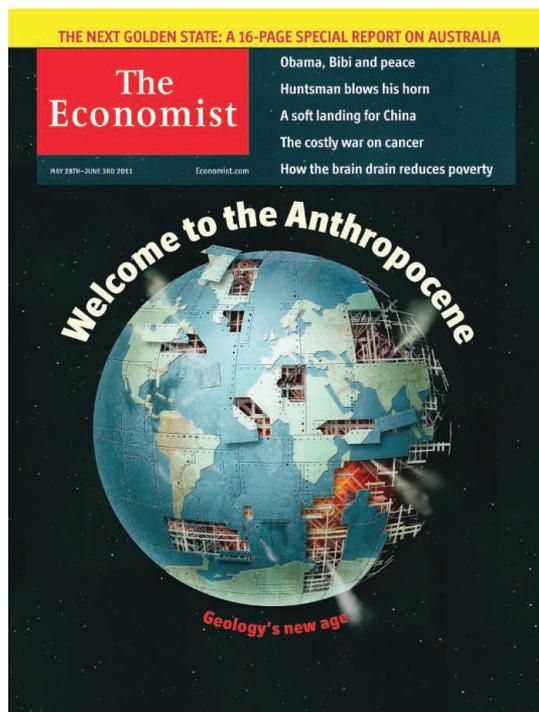
For almost 500 years, science has been relentlessly removing humans from a privileged place in time and space. Copernicus put the Sun at the center of the solar system. Hutton inferred that Earth was ancient, and Holmes estimated its age at 4.5 billion years. Darwin revealed that we are, like every other species, descended from earlier life forms. Increasing scientific knowledge has seemed to lead almost inevitably to the view that we are just a blip—one among millions of species, occupying a few recent moments of Earth history. Although science will never place humanity back at the center of creation, the accumulation of findings from several fields has shown that we no longer play a bit part on the planet.

The role of humans on the global stage is the theme of Curt Stager's *Deep Future*. Stager (a paleoecologist at Paul Smith's College, New York) begins by welcoming readers to the Age of Humans (Anthropocene). He immediately follows with words that will discomfit many traditional conservationists: “Welcome to the end of the natural world as a realm that is somehow meaningfully distinct from humanity.” The remainder of the prologue makes the book's argument clear: human effects on the

Deep Future
The Next 100,000 Years
of Life on Earth

by Curt Stager

Thomas Dunne Books,
New York, 2011. 300 pp.
\$25.99. ISBN 9780312614621.



Cover story. The 28 May 2011 issue of the *Economist* spotlighted “humans as a geological force to be reckoned with.”

globe are pervasive, the processes we are changing are slow, and thus understanding our own impact requires a long temporal perspective. Even those who study global change commonly take 2100 CE as the outer temporal limit for their projections, failing to realize that human effects are, as Stager puts it, “so large, powerful, and long-lived that they cannot be fully understood from a mere century-scale point of view.”

Through the book's 11 chapters, Stager explains many of the basic processes that affect climate, such as orbital oscillations, ocean circulation, and the carbon cycle. Maintaining a casual style and providing vivid metaphors, he makes his account entertaining and easy for nontechnical readers to understand. Along the way, he focuses on important examples of past climate change, such as the Eemian interglacial 130,000 years ago and the “super greenhouse” Paleocene-Eocene Thermal Maximum (PETM) of 56 million years ago. Although I found a few small points to quibble with in the chapter on the PETM (my specialty), Stager shines in making these episodes from climate history relevant to the future by comparing them to moderate and extreme scenarios for anthropogenic global warming.

The chapter on Greenland presents Stager's most compelling story of the deep future.

Relying on simulations of the effects of high partial pressure of carbon dioxide by Richard Alley, Jeff Ridley, and others, Stager lays out the development of Greenland's landscape and economy as its ice cap melts. He even playfully proposes a name, Ny Fjord (New Fjord), for the giant tongue of ocean that could come to occupy central Greenland by 5000 CE. He envisions a thriving Arctic-fishing industry lining the shores of the 400-m-deep fjord, then explains how the fjord would (to the shock of most nongeologists) empty over the succeeding 50,000 years as isostatic rebound following deglaciation raises the crust of central Greenland. This example demonstrates that a lot of drama can be found in linking results from long-term models to a specific landscape and imagining how people would fit into that world to come.

The deep future will never be as salient as tomorrow, nor should it

be. Nonetheless, the consequences of anthropogenic environmental change are so large and play out so slowly that the really long-term perspective must be considered. Stager argues that a mature perspective on the global environment cannot find escape in the apocalypse, in false hope of a return to some prehuman state, nor in cynical resignation that short-term benefits will trump all long-term costs. We lack the capacity to “destroy the planet” as it is sometimes formulated but also the ability to return it to a “state of nature,” if such a state implies no human influence. The Earth sciences community has been very focused on improving our ability to predict, but now we must help develop and spread the habits of mind and society that will allow people to use our predictions.

Books such as *Deep Future*, along with recent articles on the Anthropocene in the *New York Times*, the *Economist*, and *National Geographic*, offer hopeful signs that a truly long-term perspective is spreading to lay audiences. Perhaps residents of the later Anthropocene will look back and see the early 21st century as the time when humanity's perspective on itself changed again—when we realized that our descendants will live in the world we knowingly shape. Our outsized influence entails a responsibility to figure out not just how our planet works but also how to pragmatically use that knowledge to improve our future.

10.1126/science.1209934