BOOK REVIEW

Fixing Climate: What Past Climate Changes Reveal About the Current Threat—and How to Counter It. By Wallace S. Broecker and Robert Kunzig. 2008. Hill and Wang, New York, NY, USA. 272 p. US$25.00. hardcover. ISBN 978-0-8090-4501-3.

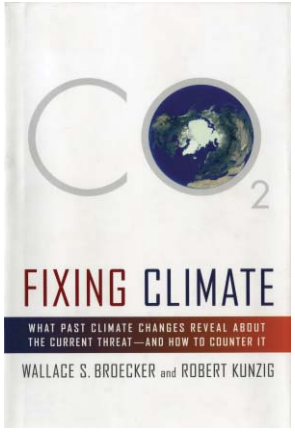
Most debates about global warming focus, understandably, on the future: What will happen? When and where? Who will suffer? What should we do about it? These are important questions, but they are subject to wide disagreement for the obvious reason that the future can never be predicted. Too much depends, for example, on future emissions and on feedbacks that are poorly understood or almost impossible to predict. What's more, our major scientific tools for looking forward—general circulation models—are open to a variety of criticisms, from both sides of the debate, even as they become more and more powerful.

It would be wise, though, to pay more attention to the past. It may concern us less than the future—after all, it's over—but it provides much more solid evidence of how the climate works and what can happen to it when various factors change. In the last fifty years, scientists in myriad fields have extended our knowledge of climate millions of years into the past and refined that knowledge to units of decades and years rather than centuries and millennia. They have done this by developing new techniques to examine new sources of data—natural records preserved in ice caps, ocean floor sediments, and geological formations, for example—and by generating new theories to explain the infinitely complex global climate system.

Wallace Broecker of Columbia University has been a central figure in this half-century of scientific discovery, and he and coauthor Robert Kunzig here provide an engaging account of it for a general readership. Half science journalism and half (auto)biography (it is told in the third person), *Fixing Climate* traces Broecker's career from his doctoral research into the causes of ice ages through later studies of the carbon cycle, ocean chemistry and currents, and glaciers and droughts. Broecker's life provides a unifying narrative, while the work of dozens of other scientists is deftly spliced into the story; this works well because Broecker has read, studied with, taught, learned from, collaborated with, or debated almost all of them. The result is a fascinating tale of the emergence of climate science from relative obscurity into a sprawling enterprise at the forefront of research and policy.

Fixing Climate is at once sobering and hopeful. On the one hand, it makes it overwhelmingly clear that global warming is both real and gravely serious. The world's climate has changed dramatically over time, raising and lowering sea levels, covering continents in ice or vegetation, rearranging plants and animals on every scale we can measure. And it has sometimes been abrupt as well as persistent, swinging tens of degrees in as little as a decade or two. Throughout the record, though, one thing has *always* been true: changes in temperature and changes in atmospheric carbon dioxide have correlated tightly. As a matter of physics, this has been known since the 19th century; today we have more empirical evidence to support and illustrate it than anyone should need to be convinced.

On the other hand, Broecker is no alarmist. In the closing chapters of the book he considers a range of options and concludes that we must find ways to remove carbon directly from the atmosphere and store it, most likely in the oceans—the place it would end up eventually in any event—by technological means. He focuses on the efforts of pioneering inventors, backed by private venture capital, to develop ways to do this that would be economical and effective—provided they are developed and deployed rapidly and on a massive scale. Instead of the conventional approach to so-called carbon capture and storage—installed at power plants and other point sources of emissions—Broecker envisions thousands, perhaps millions, of small devices distributed virtually anywhere, converting CO_2 from the air into inert forms by chemical reactions.



Many might accuse Broecker of an unfounded optimism about this approach to confronting global warming. Whether such technologies can work, and whether we can muster the will and the resources to realize them, are questions surrounded by as much uncertainty as the future itself. But his hunches, insights, and determined inquisitiveness have produced remarkable knowledge before, and he is surely right to question whether other solutions, such as the Kyoto Protocol, will work any better.

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