figs., tables, bibl., index. Cambridge: Cambridge University Press, 2000. $64.95.

This collection of twenty-two papers by nineteen authors derives from a research program on the evolution of knowledge and invention undertaken by the "Epistemology Group" of London, directed by the noted scientist and science policy scholar John Ziman. The issues involved were debated in a series of seminars that began in 1994 and culminated in a workshop three years later. The result is an integrated (i.e., cross-referenced and nonduplicating) proceedings volume divided into five thematic sections: "Evolutionary Theory," "Innovation as Cultural Practice," "The Process of Invention," "The Institutionalization of Innovation," and "General Reflections on Technological Change."

As these themes indicate, crucial to the argument is an otherwise unanalyzed distinction, traceable to the economist Joseph Schumpeter's work from the early twentieth century, between invention—the creation of new artifacts or processes—and innovation—the economic development and exploitation of such artifacts or processes. As the volume's title emphasizes, the main interest here is innovation, not invention. But when evolution is described as the selective retention of variations, technical invention providing the variations among which various types of innovation "select" to produce technological change, then innovation becomes the more inclusive concept. The aim of the book as a whole is to articulate more clearly than before the multiple mechanisms of technological variation and, especially, selection—historical, cultural, sociological, economic—and their interactions. Although Charles Darwin began the *Origin of Species* (1859) with observations about how the artificial breeding of plants and animals leads to the evolution of new varieties, and numerous authors from Karl Marx on have attempted to turn the tables and use Darwin's theory of natural selection as a paradigm to explain technical change, this volume constitutes the most intensive effort to date. Yet the authors are perhaps even more at pains to note the manifold differences between organic and technological evolution—the most obvious being that with technology neither variation nor selection is blind in the same way that it is in the organic world—and thus the limitations of the paradigm.

Scholars from at least four different disciplines have attempted to utilize evolution as a framework to explain various dimensions of technological change: epistemologists, historians, sociologists, and economists. The present volume is in fact dedicated to the late evolutionary epistemologist Donald Campbell, although its interdisciplinary center of gravity is the work of historians and sociologists. Indeed, almost a third of the chapters constitute something like historical or sociological case studies on, for example, Europe versus Japan (Ch. 7), Gothic architecture (Ch. 9), Edison and the telephone (Ch. 11), bridge design and aeronautics (Ch. 13), education (Ch. 14), innovative enterprises (Ch. 19), and warfare (Ch. 20). Historians of technology such as Walter Vincenti (Ch. 13) and Edward Constant (Chs. 16 and 20) do much of the case study heavy lifting; historians of science and those who might deal more with the epistemic dimensions of technical change are conspicuous by their absence.

The interests of the editor (who authors or coauthors four chapters) permeate the book. Its extended attempt to explain the extent to which the social selection of technological variation is analogous to the natural selection of chance variations among organisms is undertaken not simply as an academic exercise but in order to improve social intelligence. Despite its limitations, "an evolutionary perspective—whether we call it an 'analogy,' a 'metaphor' or a 'model'—is clearly a very fruitful way of [posing] practical questions and suggests useful answers for designers, technology managers, policy makers and others in industry, government and academia" (p. 316). This interdisciplinary, cooperative analysis thus ultimately aims not just at scholarship but at the increase of practical intelligence.

There are three qualifiers to my generally positive assessment. One, the referencing system is unnecessarily clumsy. Of the 631 notes, all but three simply give names and dates that then must be looked up in the bibliography. A whole step in the reading process could have been eliminated by placing the relevant names and dates in parentheses in the text itself. Two, there are a few significant works on technological evolution that are not referenced, one of the most noteworthy being Gilbert Simondon's *Du mode d'existence des objets techniques* (Aubier, 1958). Third, the proceedings could have been measurably enhanced by a comprehensive bibliographical analysis of previous contributions to the topic.

CARL MITCHAM

Edward Teller; Judith Shoolery. *Memoirs: A Twentieth-Century Journey in Science and Politics*. xii + 640 pp., illus., app., index. Cam-

bridge, Mass.: Perseus Book Group, 2001. $35 (cloth).

Legend has it that at a conference one physicist told another: "If you've got a problem, Ed's got a bomb." Perhaps more than any other scientist, Edward Teller has been associated in the public mind with the dark force of modern science and technology as he aggressively pushed for various nuclear weapons programs, notably the hydrogen bomb and the Strategic Defense Initiative, during the second half of the twentieth century. While conservative politicians and military officials adored him as an icon during the Cold War, many of his physicist colleagues and other scholars condemned him for fueling the nuclear arms race and especially for testifying against J. Robert Oppenheimer in the latter's security clearance hearings in 1954. Now Teller tells his side of the story in a long-awaited memoir written with the assistance of Judith Shoolery, a book editor, now retired, at the Hoover Institution of Stanford University, where Teller is a senior research fellow. The book is highly readable and adds more detail about his version of the facts but, despite its bulk, reveals little beyond what we already know.

Teller opens the book with a detailed and at times moving description of his childhood and youth in Hungary, where his Jewish family suffered at the hands of the Communists who briefly gained power in 1919 and from prevalent anti-Semitism. In the 1920s Teller pursued chemistry at Karlsruhe Technical Institute in Germany on his father's advice but switched to theoretical physics, his true love, briefly at Munich (where he lost his right foot in a trolley accident) and eventually at Leipzig with Werner Heisenberg, who became a lifelong friend. Teller completed his thesis on the energy states of the hydrogen molecular ion, received his Ph.D. in 1930, and then headed for Göttingen as a research assistant to a physical chemist at the university. With the rise of the Nazi menace, he moved to several places in Europe—Rome, Copenhagen, and London—for long or short stays in the 1930s. Gregarious by nature, Teller made friends with many of the major figures in modern physics in this period. In 1935 he came to the United States as a professor of physics at George Washington University.

The rest of Teller's career is well known: he went to Los Alamos to work on the atomic bomb during World War II, left for the University of Chicago at its end, helped develop the H-bomb, lobbied successfully for the founding of Livermore (which became his new and final institutional home) as a second nuclear weapons laboratory in the early 1950s, testified against Oppenheimer, opposed the test-ban treaty, advocated antiballistic missiles in the 1960s and the Strategic Defense Initiative (Star Wars) in the 1980s. In the book Teller curiously minimizes his role in the test-ban and ABM controversies. On other matters, he largely confirms what has been reported in two previously published biographies based on interviews with him: *Energy and Conflict,* by Stanley Blumberg and Gwinn Owens (Putnam, 1976) and *Edward Teller,* by Blumberg and Louis Panos (Scribner's, 1990). For example, he traced his political differences with Oppenheimer to a conversation they had in 1942, when Oppenheimer reportedly said, in reference to the Manhattan Project, that "the time is coming when we will have to do things differently and resist the military." Teller was shocked and replied, "I don't think I would want to do that" (p. 163 in *Memoirs;* pp. 134–135 in *Energy and Conflict*). In the new book Teller explains further that "even today, I find the idea of civil disobedience in a democracy wrong" (p. 379). It's not clear whether he opposed and still objects to the civil rights movement for this reason.

ZUOYUE WANG

Samuel P. Hays. *A History of Environmental Politics since 1945.* ix + 256 pp., index. Pittsburgh: University of Pittsburgh Press, 2000. $19.95 (paper).

A fuller title for this book might add the phrase "in the United States, with special reference to the federal government." Since the 1950s Sam Hays has explored the terrain of U.S. environmental politics, and he knows it as well as anybody. Here he offers a capsule account of the last fifty-five years' worth, reviewing and updating matters that he explored at greater length in one of his landmark books (*Beauty, Health, and Permanence: Environmental Politics in the United States* [Cambridge, 1987]).

The scope is relentlessly domestic. Like most historians of the United States, Hays writes as if Canada and Mexico did not exist. Even acid rain is treated exclusively as a domestic political issue. The chronological scope is mainly 1945–1997, although Hays does cast a glance backward in time wherever appropriate.

After a brief chronological survey of environmental issues and politics in the United States from Amerindian times to the present (Ch. 2), Hays adopts a thematic approach in which the entire postwar era appears as a whole. Fourteen