drical coordinates, with each radial arm describing levels of constant opinion about whether gravity waves have been seen, each concentric ring denoting levels of hearsay (or directness of observation), and the temporal dimension rising out of the pages of the book like a cylinder. Collins's job, he explains, is to "describe these regions and the way news, certainty, and 'seeing' move around the target, from center to periphery and, perhaps, back again" (p. 10). A second book, already under development, will complete the project, picking up the story from 2001, focusing less on resonant masses and more on interferometers, and closing when scientists have agreed that gravitational waves have been directly observed.

The "target diagram" grounds two of the book's main arguments. The first is a familiar claim about the dynamics of knowledge formation: because the meanings of experiments are underdetermined by technical considerations, a host of nonscientific factors—funding agencies, political pressures, historical contingencies—play into the birth and death of scientific claims and the instruments and publications that launch and challenge them. The second argument, spelled out fully in the penultimate chapter, is an endorsement of methodological relativism. That approach, a species of social construction, sets Collins apart from many others in the sociology of scientific knowledge and from most analytic philosophers of science. It has also opened him up for criticism during the most heated periods of the science wars, the memory of which haunts this book.

With this in mind, *Gravity's Shadow* has two aims: to introduce nonscientists to the "esoteric" world of gravitational wave detection and to introduce nonspecialists (including gravitational wave physicists themselves) to the "esoteric" world of science studies. The first half of the book describes the rise and fall of five detection claims, starting with Joseph Weber's influential work at the University of Maryland in the 1960s. Here, and throughout the book, Collins's discussion of the science of gravitational wave detection is a joy to read, and his sociological analysis draws on a wide swath of historical materials, including scientific papers, funding reports, and innumerable interviews (many of which were left out of the book but have been archived on Collins's Web site). The book is at its best in these careful sociological observations of what scientists read and, more amazingly, what they do not read and in its treatments of the fascinating oral culture of gravitational wave research and of the recurrent notion of tacit knowledge that Collins has done more than nearly anyone else to advance. Most of the second half of the book concentrates on the sociopolitics of detector development, on the discipline's transformation into "big science," and, particularly, on the growth of interferometry and the interpretive techniques (like data-pooling) that have come to characterize it. A final group of chapters develop a new theme about the relationship between experts and nonexperts and bring together Collins's methodological reflections on the project and on the discipline more broadly.

If *Gravity's Shadow* has a fault, it is that it sometimes strains under the weight of its ambitions. With so much material, the book sometimes reads like a number of separate projects. Alongside his "target diagram," for example, Collins introduces a number of ancillary metaphors that occasionally muddle the otherwise clean and fascinating narrative. His later framing of methodological relativism as a position between "technical history" (which, Collins argues, reproduces the thoughts of scientists) and cultural studies "and the like" (which treats science as a form of culture and requires little or no expertise in science) will perplex some historians of science and infuriate others. But even these shortcomings point us to the ways in which *Gravity's Shadow* performs a twofold act of preservation, and an enormous service, by capturing both the historical richness of gravitational wave research and the methodological reflections of one of science studies' most imaginative and engaging writers.

EDWARD JONES-IMHOTEP

**Lynn Eden.** *Whole World on Fire: Organizations, Knowledge, and Nuclear Weapons Devastation.* xiv + 365 pp., index. Ithaca, N.Y.: Cornell University Press, 2004. $32.50 (cloth).

This well-written and scrupulously researched book addresses a significant anomaly in the way that the U.S. government has planned for nuclear war: "How and why, for more than half a century, has the U.S. government seriously underestimated the damage that nuclear weapons would cause? How and why did the government, in devising its plan to fight strategic nuclear war shortly after World War II, develop detailed knowledge about the blast damage caused by nuclear weapons but fail to develop knowledge about an even more devastating effect?" (p. 1). The effect in question is mass fire, or what is more popularly known as "firestorm."

Lynn Eden describes the historical context that led to this state of affairs. Prior to World

War II, U.S. bombing doctrine grew to favor "precision" bombing aimed at targets considered central to the enemy's war effort. By contrast, the British favored blanket bombing, more suited to night raids in which the bombers were less vulnerable to air defenses. To achieve the best results from such blanket bombing, the British quickly came to see the value of incendiary bombs for causing fire damage in cities, whereas the U.S. preference for precision bombing made high-explosive bombs the weapons of choice.

Despite the advent of nuclear bombs at the close of the war, the U.S. approach to bombing remained largely unaffected. As Eden notes, "a conception of employing atomic weapons to carry out precision bombing doctrine may seem absurd"; owing to the rather indiscriminate destructive power involved, the planners "incorporated the atomic bomb into their inherited sense of organizational goals, knowledge, and problems to be solved" (p. 94). However, Eden's detailed and nuanced account shows that in practice Curtis LeMay's Strategic Air Command was too pragmatic to be overly focused on precision targeting. Instead, the early postwar period, when atomic bombs were scarce, saw SAC mainly geared toward leveling cities. However, SAC planning depended on target intelligence provided by the Air Force's Air Intelligence Division, and here the assessment of target hardness was based entirely on blast effects.

This bias in favor of investigating blast damage but not fire damage became particularly significant with the advent of the hydrogen bomb and higher-yield nuclear weapons because the thermal energy released increased proportionately more than blast overpressures. Unfortunately, the one significant attempt to study the effects of fire misconceived the issue by failing to distinguish between line fires (started by one or a few initial ignitions) and mass fires (with many near-simultaneous initial ignitions). The study failed to demonstrate a method for predicting fire effects, and thus fire effects were considered unpredictable. Although the nuclear test program collected data on thermal effects (including the bizarre but gruesome exposure of pigs dressed in military uniforms), these effects were considered significant simply for the direct damage caused and not as a possible initiator of mass fire.

Things began to change only in the late 1970s, when Harold Brode, a defense consultant specializing in nuclear weapons effects, began to develop a model for fire damage. Rather than attempting to derive an understanding from the messy and limited empirical evidence, Brode worked from "first principles" to produce a simple model of what happens following a nuclear detonation. Using this model "led to overall fire damage estimates that were broadly consistent with the historical data on damage from atomic bombing" (p. 236). Despite its questionable empirical basis, the model was to prove persuasive because of its theoretical elegance. Fire effects began to be taken more seriously in U.S. targeting, although not, it appears, to such an extent that war plans have actually been changed.

Eden's account relies heavily on organizational inertia for explanation, arguing that once particular contingent factors have led to a problem-solving approach this then becomes institutionalized. In turn, this means that vested interests form around continuing the chosen approach and that alternatives are neglected. It is easy to understand how organizations are resistant to change, especially where the substance of their work involved heavily knowledge-laden routines. The more difficult question to answer is why organizations nevertheless do sometimes change.

GRAHAM SPINARDI

**Matthew D. Evenden.** *Fish versus Power: An Environmental History of the Fraser River.* xvii + 309 pp., bibl., index. New York/Cambridge: Cambridge University Press, 2004. $65 (cloth).

The Fraser, like other large rivers along the Pacific Coast, inspired dreams of hydroelectric development and the prosperity that would follow. The river's enormous potential for waterpower attracted numerous dam proponents throughout the twentieth century—and yet its main stem has never been dammed. This book explains why, focusing on a fisheries conservation coalition that sought to save the Fraser's prolific salmon runs. While set in the Fraser River Basin in British Columbia, the "fish versus power" debate expanded into national and international politics, and Matthew D. Evenden's history has global, as well as local, implications.

His analysis of the role of science is especially interesting. The book begins with the 1912–1914 landslides at Hell's Gate, which blocked the migration of sockeye, prompting efforts to restore the river and develop a transnational research program. Scientists assumed a prominent position in the fish versus power debate during the mid-twentieth century, as pressures for hydroelectric development mounted after World War II. In addition to researching the effects of dams on salmon migration, fisheries biologists increased the public profile of science by advis-