

BOOK REVIEWS

■ General

Michael Adas. *Dominance by Design: Technological Imperatives and America's Civilizing Mission.* 542 pp., illus., notes, index. Cambridge, Mass.: Harvard University Press, 2006. \$29.95 (cloth).

With *Dominance by Design*, Michael Adas provides us with an impressive and broadly written study that documents American attitudes toward colonial expansion, imperialism, and overseas intervention from the seventeenth century to the present. Adas successfully brings together these disparate literatures in American history through a sustained focus on technology. He describes the role that American technological prowess played in this nation's take on the "white man's burden," which in turn justified everything from the historical treatment of Native Americans to our latest interventions in Iraq. Lucidly written, this book, which appears as a Belknap imprint, is designed for a broad historical audience. It demonstrates as well the relevance of the history of technology to the broadest currents in American history. As is typical of works in this genre—think of Civil War or Cold War histories—*Dominance by Design* is written with a political purpose. The book is an unabashed plea to recognize that present-day foreign policies have deep roots in American attitudes and experience and that our insistence on exporting capitalism and democracy through technological and military strategies is bound only to fuel global tensions.

The book itself has a highly linear, if not teleological, design that aims to describe the successive articulations of the "civilizing mission" that derived from a sense of technological progress and social superiority that were integral to the American experience. It opens with an account of Commodore Perry's infamous "black ships" that contributed to the opening of Japan. In carefully documenting the attention Perry paid to making technology an instrument of diplomacy, Adas is able to cast the event in a synecdochic relation to the book as a whole. He then goes on to describe the origins of the American faith in technology and the commitment to internal improvement—of nature and of other races—in the religious and racial attitudes of the early settlers. Adas next documents the transmutation of the Protestant doctrine of internal improvement under the ruthless logic of Manifest

Destiny, its subsequent translation into a formula for foreign development in the Philippines, the further extension and articulation of this formula in Panama and elsewhere (including China and Japan), and its reincarnation as official development discourse during the early Cold War era. The chapter that follows documents how these development policies, when merged with Cold War fears, orientalism, and a technocratic mind-set, produced the human tragedy in Vietnam. Next comes a chapter on the "technowar" of the first Gulf War. Although Adas applauds the multilateralism of George H. W. Bush and accepts the Gulf War's high-tech weaponry as a successful manifestation of the technologies that had failed during Vietnam, he nevertheless points to the limitations of a predominantly militarized approach to foreign intervention. This is followed by an "epilogue" that casts the current War on Terrorism as a predictable retrenchment of U.S. foreign policy into an older unilateralist position, one still backed by a faith in technology and democratic institutions that has little bearing on the experience of other nations and other cultures.

Before proceeding any further, it is necessary for me to remark that I am a specialist neither in American history nor in imperialism and post-colonial history and theory, and therefore it is difficult for me to judge to what extent Adas offers important correctives to established interpretations of American expansionism, writ large. This said, the book offers substantial evidence of the social and ideological continuities that exist between the American experiences of colonialism, westward expansion, imperialism, international development policy, foreign policy, and military strategy, all of which, as noted above, tend to be treated as separate subjects in American history. In terms of the history of technology, Adas's references to and integration of the literature are quite impressive. He includes Carolyn Merchant and William Cronon's work on Western and colonial attitudes toward natural improvements; the early economic historical studies on U.S. resource advantages; a deft reapplication of Leo Marx's metaphor of the machine in the garden; the literature on the American system of manufactures; and more recent literatures on consumer culture, gender and technology, and Cold War technologies.

From the standpoint of the history of science, some readers will find the book to contain unopened doors and missed opportunities. For example, in discussing the U.S. imperialist expan-

sion into the Philippines, Adas touches on the influence of eugenics movements and social Darwinist thought, but he draws only marginally on the vast literature on this subject. Likewise, although Adas draws attention to the substantial influence of Walt Rostow's "take-off" model, he does not attempt to describe the dissenting views that must have existed during this period. At minimum, I would have expected contemporary developmental economists to have recognized the risks of overcapacity that would have resulted from a uniform policy of accelerated industrial development. On the other hand, the fact that the "trickle-down" theory in economics persisted during the Reagan era despite substantial scholarly opposition suggests that Adas is right to focus on the body of ideas that influenced those in power.

Still, it could be said that the book's major strengths are also its major weaknesses. Adas, for the most part, brackets out indigenous experience on the basis of the argument that how America understood its "civilizing mission" provides the best historical window into U.S. actions, both past and present. Yet in privileging a specific thread in the history of ideas—albeit with a justifiable motive—*Dominance by Design* frequently grates against broader social historical sensibilities. One is left wondering, for instance, whether Japan's shift to modernity might have had more to do with conflicts internal to the Tokugawa Bakufu. And although American actions may indeed be best accounted for through a focus on American ideas and ideologies, a U.S.-centric interpretation nevertheless winds up reinscribing the very set of myths that Adas sets out to deconstruct. This is somewhat ironic, given the book's aims. There are also passages in the book where Adas's interpretations appear too facile, especially in dealing with issues of race, gender, and difference. My suspicion is that the same history, written with the most recent insights from subaltern studies and postcolonial and feminist theory, might reveal the more subtle causes for the haunting experiences that Adas so aptly describes. In both respects, this book could have benefited from a more reflexive stance toward the knowledge claims of history itself, especially as applied to the interpretive limitations of a broadly written historical narrative.

But these remain scholarly quibbles about a book that sets out—and quite successfully—to explain the historical origins of present-day U.S. foreign policies to a very large and diverse historical audience. *Dominance by Design* is likely to find a serious following among general U.S. history enthusiasts, as well as among public

officials, makers of foreign policy, and military strategists. It should also receive broad recognition among academic historians and will be valued as an advanced undergraduate and graduate text in U.S. history and the history of technology.

ATSUSHI AKERA

Clifford D. Conner. *A People's History of Science: Miners, Midwives, and "Low Mechanics."* xiii + 554 pp., bibl., index. New York: Nation Books, 2005. \$17.95 (paper).

Clifford Conner's book takes as its premise that science was not necessarily the product of geniuses asking transcendental questions, but was often the product of knowledge gained by workers, the "low mechanics" of his title. In a generally chronological fashion, the eight chapters of *A People's History of Science* take us from our hunter-gatherer ancestors to the birth of the internet. Most of the book is presented as vignettes looking at topics such as Chinese biology or the work of Leeuwenhoek. Readers will find much of interest, but the book must be read with some reservations in mind. Presentism is a concern, since many of the examples work only if the knowledge of the people can be linked to modern ideas.

A number of reviews have compared Conner's work with Howard Zinn's *A People's History of the United States* (HarperCollins, 2005); and it does bear some relation, with its focus on the largely unacknowledged or even deliberately ignored people in history and its socialist perspective. Yet in many ways it is closer to James W. Loewen's *Lies My Teacher Told Me: Everything Your American History Textbook Got Wrong* (Touchstone, 1996). After briefly establishing in Chapter 1 what he means by "science" and "the people," Conner attempts to correct the many historical fallacies he sees in the history of science.

He starts with the knowledge base of prehistoric people in Chapter 2, "Prehistory: Were Hunter-Gatherers Stupid?" This is a bit of a straw man, since it would be difficult to find any historian today who would hold that our ancestors were our inferiors. Conner is perhaps arguing with an earlier generation of scholars. In particular, the section on the navigation skills of the people of the South Pacific would make a perfect reply to Jacob Bronowski's argument in *The Ascent of Man* (Little, Brown, 1973) that most of the people of the ancient world lacked some essential idea that could have led them to "science."



A. B—TWO FURNACES. C—TAP-HOLES OF FURNACE. D—FOREHEARTH. E—THREE TAP-HOLE. F—DIPPING-POTS. G—AT THE ONE FURNACE STANDS THE SMELTER CARRYING A WICKER BASKET FULL OF CHARCOAL. AT THE OTHER FURNACE STANDS A SMELTER WHO WITH THE THIRN HOODED BAR BREAKS AWAY THE MATERIAL WHICH HAS FROZEN THE TAP-HOLE OF THE FURNACE. H—HOOKED BAR. I—HEAP OF CHARCOAL. K—BARROW ON WHICH IS A BOX MADE OF WICKER WORK IN WHICH THE COALS ARE MEASURED. L—IRON SPADE.

An illustration of smelting methods from Agricola's *De re metallica* (taken from Conner, *A People's History of Science*).

Conner moves from the prehistoric world to question the idea that the foundation of science came from Greece. In Chapter 3, "What 'Greek Miracle'?" he points—à la Martin Bernal and *Black Athena* (Rutgers, 1987), to the pre- and non-Greek origins of "Greek" natural philosophy and mathematics and the importance of contemporary centers of learning that have not received due credit. Chapters 2 and 3 offer some useful information to balance the Eurocentrism that tends to creep into the history of science.

Having established the idea that the people's knowledge was at the heart of the systematic study of nature, Conner then gets to the heart of his work, looking at the early modern era and the scientific revolution in Chapters 4–6. These chapters contain the bulk of his work and his main arguments about the misrepresentation of the history of science. They are also the most controversial of Conner's material because they depend the

most on interpretation. Here is Conner on Bacon, for example: "We need not concern ourselves with how typical or aberrant Bacon's willingness to utilize torture was in the context of his time; it is sufficient to note that he viewed 'mankind' through the lens of the dominant social class. His claim that the new science he advocated would benefit 'the whole race of man' must be evaluated in this light. The Baconian call for scholars to learn from craftsmen can thus be seen not as a benevolent program of knowledge-sharing, but rather as an appropriation of working people's knowledge in the interest of the ruling class" (p. 363).

Chapters 7 and 8, on Victorian and twentieth-century science, are brief, mostly just passing notes. Darwinism gets five pages, but Darwin himself gets about five paragraphs. One has the impression that there might be a companion book in the future that looks at science in the age of the lab coat.

The idea of putting class in the forefront of the history of science is not new, but it has rarely been so forcefully done, especially in a book aimed at a mass audience. Conner belatedly tips his hat to the Zilsel thesis: "No contribution to a people's history of science is more important than the one made by Edgar Zilsel" (p. 281). Zilsel should have been introduced at the start, if only to give the reader a theoretical foundation for what was to follow.

Conner's best sections explore the importance of practical skills, such as navigation, as the foundation for the developments of modern science. He argues that such knowledge has been vastly undervalued. And there is certainly reason to accept his position, as the growing number of scholars looking at the significance of skilled workers and mathematical practitioners shows. The less satisfactory sections are the ones that interpret history as class war or part of an antiproletarian conspiracy. Conner's examination of Galileo's tidal theory, for example, is presented as an elitist rejection of mariners' knowledge and gives no hint that any other issue was at stake.

This is a thought-provoking and useful book for any historian of science, but it picks careful examples and does not make a sustained argument other than to elevate the "low mechanics." The problem is that for every navigator who linked the moon to the tides, there was a host of people who held ideas that did not survive; and thus, even for Conner, some low mechanics are more equal than others.

ANDREW EDE

Michael Hagner. *Der Geist bei der Arbeit: Historische Untersuchungen zur Hirnforschung.* 284 pp., figs., bibl., index. Göttingen: Wallstein Press, 2006. €28 (cloth).

Michael Hagner's *Der Geist bei der Arbeit* (probably best translated as "The Mind at Work") is not what it at first glance appears to be. Although the preliminary matter states that the book "concludes his trilogy on the history of the modern brain," this volume by no means stands on the same level as his earlier *Homo cereбрalis* and *Geniale Gehirne*. Apart from the introduction, every chapter was previously published in German-language edited volumes (see p. 261 ff.), and some of them were coauthored with other historians of the life sciences, such as Cornelius Borck and Margarete Vöhringer. Thus readers who anticipated that this volume would be the cornerstone of Hagner's trilogy on the modern brain might be disappointed. A closer look, however, reveals that the reprinted essays form a unified selection and effectively convey Hagner's message that the euphoric rhetoric of neuroscientists about deciphering the working brain is completely misleading (p. 7).

The chapters cover themes like "Brave Neuro Worlds," "War Brains," and "The Mind at Work" and analyze the pervasive neuroscientific intention to represent cognitive brain processes as visually evoked perceptions at the interface of science and fiction. The historiographical narrative covers the late nineteenth century, World War I, the Weimar period, the late 1950s, and present-day developments. Hagner's collection is wittily written, learned, and well illustrated with thirty-nine figures.

The author's main historical interest concerns the self-enlightenment of the sciences: he asks how we are to understand the intricate relation between human minds and their technological and scientific products. But unlike his two earlier monographs—which focus on their subject along specific time axes—this volume scrutinizes the epistemic, the cultural, and the social entanglements between the modern brain and its contexts in disparate historical periods. Because the "cerebralization of man" should not be discussed only in restricted academic circles, Hagner wants to see his views disseminated through various representational spaces ("*unterschiedlichen Repräsentationsraeumen*"; p. 10). This volume is hence a popularization of science studies in the best sense of the word.

With regard to the more distant historical subjects—for example, the history of migraine since early modern times or debates on the structure and function of speech around 1800—

Hagner delineates close relations between scientific innovations and their respective milieus. From the two hundred years of brain research covered by the nine chapters of the book, it becomes clear how neuroscientists' theories on the faculties of thought, imagination, or emotion have been determined by cultural, social, and political circumstances. The project of the "cerebralization of man" thus shows itself to have inherited a "proleptical structure"—that is, an unchanging set of research problems that manifest themselves in existing terrains of knowledge production. Understanding the workings of the mind and solving the last riddle of mankind ("*das letzte grosse Rätsel der Menschheit*") appears to be the unfinished project of modernity (p. 36).

Even where Hagner's essays impinge on more recent subjects, such as neuroimaging or cognitive localization, he shows how they are rooted in historical conundrums. For example, he draws a direct genealogical line from the early nineteenth-century approaches of the organologists Franz Joseph Gall and Caspar Spurzheim to such visualization techniques as CT, fMRI, or SPECT when describing our modern-day efforts in terms of a cyberphrenology (pp. 182–187). And it is at this point that the neuroscientific research program of cortical localization takes on an empiricist, if not to say positivist, stance, which Hagner describes in terms of a transition by which "science has now yielded to philosophy" (p. 185). But whether the technological and representational advances provide us with the answers so urgently needed for the self-understanding of (post)modern man remains a question not to be answered by images of the brain.

Der Geist bei der Arbeit is intended for a general readership interested in the development of modern-day neuroscience. For those who are not acquainted with his earlier work, it provides good access to the wide range of Hagner's historical perspectives. For the specialist, however, there won't be any news here apart from the ten-page introduction. Let's then consider its explicit agenda: the volume aims at dismantling the rhetoric of so many influential neuroscientists, who lock modern anthropological thought in a "stranglehold of transmitters, synapses, impulses, and neuronal wiring" (p. 260). And for that very reason, I would wish that this powerful stranglehold was challenged by new examples of Hagner's pointed writing—putting the mind back to work in dissecting the hidden agendas of present-day neuroscientific discourse.

FRANK W. STAHNISCH

Michael Hoskin. *The History of Astronomy: A Very Short Introduction*. x + 123 pp., figs., apps., index. Oxford: Oxford University Press, 2003. \$9.95 (paper).

Michael Hoskin remarks in *The History of Astronomy: A Very Short Introduction* that Johannes Kepler “is no fit subject for any sort of Introduction, let alone a Very Short one” (p. 54). Nonetheless, Hoskin has succeeded here in the still more difficult task of distilling several millennia of the history of Western astronomy into a pocket-sized book of no more than 125 pages. Drawing on two related volumes that he edited for Cambridge University Press (*The Cambridge Illustrated History of Astronomy* [1997] and *The Cambridge Concise History of Astronomy* [1999]), Hoskin offers a highly readable account of some of the major conceptual developments of Western astronomy.

The book begins with a fascinating but all-too-short chapter on prehistoric astronomy, raising important questions about what we can learn from cultures that did not use traditional texts. Chapter 2 provides an efficient study of astronomy in ancient Mesopotamia, Egypt, and Greece that is conventional in its attention to the intersection of cosmological concerns with the mathematical techniques designed to “save the appearances” of celestial phenomena. Chapter 3 treats astronomy in the Middle Ages with an overt awareness of broader social motivations, describing the theories and practices of medieval Islamic astronomy and the merger of these with the surviving traditions of the Latin West. Two further chapters deal primarily with the achievements of the canonical figures Tycho Brahe, Galileo, Kepler, and Newton, describing the challenges of crafting and recrafting a new physics in light of the new astronomies of the sixteenth and seventeenth centuries. The sixth and final chapter, on stellar astronomy in the eighteenth and nineteenth centuries, is excellent in weaving together the related concerns with stellar brightnesses, motions, and distances and the broader goal of understanding the structure of the stellar system. The narrative ends circa 1850, but a brief epilogue outlines the astrophysics that would exemplify much of the twentieth century.

There are minor instances when the story looks forward in ways that seem ahistorical, notably a digression on Kepler’s laws in the midst of a discussion of Ptolemy’s equant (pp. 1–20). However, Hoskin also provides careful analysis of issues ranging from the rationality of astrology, to a historiographical critique of the so-called Olber’s Paradox, to the just but subtle

placement of Nicolaus Copernicus as the culmination of the ancient astronomical tradition. A reader for whom this book is his or her initiation into the scholarship should come away with a nuanced understanding of many familiar stories and perhaps be persuaded to rethink some common assumptions.

Although there is no shortage of introductions to the history of astronomy, none are as accessible in terms of price, length, and readability as this one. For the casual book buyer Hoskin’s work is superb. The history of science teacher, though, might wish for a slightly more expansive bibliography in order to provide students with more pathways into the wider literature. The fact that the volume excludes details of the conceptual developments of the last 150 years also restricts its use as a comprehensive introductory text. Neither these points nor the inherent difficulty of striking an appropriate balance in a work of this kind (why not more on non-Western astronomy, for instance, or on astronomy and social values?) should obscure the character of Hoskin’s achievement. This book ought to be admired and utilized as a succinct and lucid introduction to the history of astronomy by one of its leading scholars.

PETER J. SUSALLA

Max Jammer. *Concepts of Simultaneity: From Antiquity to Einstein and Beyond*. ix + 308 pp., illus., figs., index. Baltimore: Johns Hopkins University Press, 2006. \$49.95 (paper).

As you read this sentence, the moon is circling the earth at a particular location. Einstein taught us, however, that for someone moving with respect to you, your reading that sentence was simultaneous with the moon being located at some quite distinct position. Simultaneity is relative to inertial frame. But is it also conventional? That is, is there a fact of the matter, even given an inertial frame, whether two distant events are simultaneous? Famously, Einstein thought not; and his thinking so was crucial to his discovery of special relativity.

Recall that in 1905 Einstein postulated that the speed of light propagates at the same speed in all directions. This stipulation suggests and is suggested by a natural synchronization procedure. Let Alice be an inertial observer (say, in a spacecraft) and Bob be a distinct observer at rest with respect to Alice. Bob conveniently happens to be holding a mirror oriented toward Alice, and Alice reflects light off Bob’s mirror, directing it back to herself. The synchronization pro-

cedure holds that an event on Alice's worldline is synchronous with one on Bob's just in case

$$t_2 = \frac{t_1 + t_3}{2},$$

where t_1 is the time Alice reckons she sent the light signal, t_2 the time on Bob's worldline of the reflection, and t_3 the time Alice receives the return signal. By assuming that all observers also use this method of synchronization, Einstein derived the Lorentz transformations, the heart of relativity. Could Einstein have used a different synchronization procedure—one making the speed of light variable while keeping the average round-trip speed constant—and still arrived at a consistent theory? This question exercised Einstein, Reichenbach, and scores of philosophers of science and physicists in the twentieth century. *Concepts of Simultaneity* is a history of our grappling with the important concept of simultaneity, from antiquity to now, but the centerpiece is a detailed history of the conventionality thesis. Think of this book as the prequel and sequel to the celebrated synchronization procedures of Poincaré and Einstein.

Written by the eminent historian and philosopher of physics Max Jammer, the book consists of fifteen chapters. After terminological preliminaries in the first chapter, the next five chapters trace the notion of simultaneity from antiquity through classical physics. The next three introduce relativity, its impact, and the conventionality thesis. The remaining six chapters focus on this thesis: its promulgation, its clarification, and scores of arguments (old and recent, for and against). Here the reader encounters the debates among Adolf Grünbaum, Brian Ellis, Wesley Salmon, Allen Janis, John Winnie, David Malament, and others involving clock transport synchrony and more recent geometric arguments. This episode in the intellectual history of relativity is a worthwhile one to document, and Jammer's discussion of this material is well informed and authoritative. Moreover, it is fascinating to see the twists and turns the debate has taken through the twentieth century.

For myself, I particularly enjoyed the early history of simultaneity. Virtually everyone is discussed (Aristotle, Avicenna, Aquinas, Barrow, Leibniz, Newton, Kant, . . .), and experts will find much to quibble about in these short treatments. However, the novelty of organizing these thinkers around the topic of simultaneity more than compensates for the quibbles. In one

chapter we meet Sextus Empiricus's critique of astrology based on the Chaldean method of determining distant simultaneity (sound transmission via gong). Later we discover that Alexander of Aphrodisias was perhaps the first to define a worldwide standard time by defining time via the motion of the outmost fastest celestial sphere. Jammer then highlights Ole Roemer's discovery of the finite speed of light and what that meant for the "visual simultaneity thesis"—namely, the claim that all events one sees together are simultaneous. Anyone interested in time in science will take pleasure in this material.

Because many readers will be familiar with the author and his distinctive style, perhaps the most useful description I can give of this book is that it's very much like his others. I consider this high praise. Jammer's books on force, space, quantum mechanics, and mass occupy a central place in the history and philosophy of science. The present book has the same strengths and weaknesses as the others. The weakness is that the depth of analysis is occasionally uneven. The author will sometimes build up material in exhaustive detail and at other times abruptly drop a topic without resolution. The strength is—as always—Jammer's almost unimaginable erudition. The author is as much at ease writing of the concept "now" and cognates in Egyptian, ancient Hebrew, ancient Greek, medieval Latin, and contemporary German as navigating through hairy tensor algebra in general relativity. As a result, even an expert in the field will come away having learned something new.

Although I highly recommend the book, I did find one critical omission troubling. When treating the pre-relativistic period, Jammer often measures developments against Einstein's later operationalism of simultaneity via synchronization—for example, "That a rigorous definition of simultaneity cannot be obtained without specification of a physical operational procedure was never recognized in antiquity" (p. 41). Even if we don't mind history spun this way, should we regard the synchronization procedure as the gold standard in the history of simultaneity? I think the answer is no. Granted, an operationalist procedure was important for the development of Einstein's ideas. But one doesn't require the synchronization postulate to derive or understand relativity. And after Quine's famous critique of the analytic/synthetic distinction (not mentioned), it's not clear that the idea of some parts of a theory being conventional and other parts being empirical makes much sense. Hence the question of rival synchronization

procedures takes on less importance. If any question remains, it is whether Einstein's choice was reasonable; but as we learn from the anticonventionalists, clearly Einstein's choice was the simplest and most natural one given the rest of his theory. A critical appraisal of this entire intellectual episode would have been welcome.

CRAIG CALLENDER

Mark Monmonier. *Rhumb Lines and Map Wars: A Social History of the Mercator Projection.* xiv + 242 pp., illus., bibl., index. Chicago: University of Chicago Press, 2004. \$25 (cloth).

In 1566 Gerard Mercator published his famous world map "ad usum navigantium," which showed lines of constant compass direction (rhumb lines or loxodromes) as straight lines. The map according to Mercator's projection has become a standard representation of the world. Quite undeservedly so. For navigators intent on plotting a course, the map is indeed extremely useful. For other purposes, however, it has severe defects. In particular, Mercator's world map exaggerates the size of countries situated far to the north or south compared to those in the tropics. For this reason, it has been attacked in recent decades for having an imperialist bias, downsizing the importance of the third world.

There is a story to be told here, and Mark Monmonier is certainly the person to tell it. He does so with gusto. The book can be divided in three parts. In the first, Monmonier describes early sea charts, Mercator's innovation, and the mathematical elaboration of his work by Edward Wright and Johann Heinrich Lambert. Despite the book's title, there is not much "social history" here. The cartographic problems are explained in a clear way, but it is evident that Monmonier is not really at home in sixteenth-century history. These chapters rely almost exclusively on secondary sources, ignoring most work in languages other than English.

The second part shows how, in the nineteenth century and later, Mercator's map became popular as an all-purpose map. This part contains much useful information. Interestingly, among the most fervent propagandists for Mercator's projection was the military. Loxodromes are useful not just for navigation, but also for calculating the trajectories of long-range artillery. It was the French who first realized the use of Mercator's projection for aiming cannons. The main part of Monmonier's story, however, deals with the United States. He writes about the adoption and use of the Mercator projection by

such bodies as the U.S. Geological Survey, the U.S. Army Map Service, and the U.S. Coast and Geodetic Survey. It is clear that this is an area wherein the author is very much at home. But one would like to know how the developments in the United States tally with the general story. Mercator's map, after all, is a world map, and its adoption was not limited to America.

The final part of *Rhumb Lines and Map Wars* deals with the attacks on Mercator's projection in recent years, especially by propagandists for the so-called Peters projection. Monmonier clearly has an ax to grind here. As he shows in detail, Mercator's critics are generally driven by ideological motives rather than by any real knowledge of the characteristics of map projections. Many alternatives to Mercator's projection have been proposed over time, and the one propagated by Arno Peters is among the worst. One of the book's aims appears to be to dispel misunderstanding and prejudice about the Peters projection. As such, it explains the "correct" principles of cartography and map projection, rather than presenting an impartial description of the social factors that promote this or that picture of the world.

Although the book does offer new information, it cannot be deemed thoroughly researched, nor does it present a balanced historical view of the subject. However, Monmonier's personal involvement with the subject makes the volume excellent reading. *Rhumb Lines and Map Wars* will be relished by a general audience; and although it is not a real social history, it certainly shows the social relevance of history of science.

RIENK VERMIJ

Marco Piccolino. *Lo zufolo e la cicala: Divagazioni galileiane tra la scienza e la sua storia.* (Saggi Scienze.) 359 pp., figs., bibl., index. Turin: Bollati Boringhieri, 2005. €26 (paper).

Marco Piccolino's book includes an introductory section, seven chapters, a concluding section, a bibliography, and an index of names. The book treats a bundle of loosely connected topics, ranging from Galileo Galilei (1564–1642) and seventeenth-century astronomy to contemporary biochemistry and physiology. The first chapter focuses on Galileo. The second is mostly about Galileo and Lazzaro Spallanzani (1729–1799), in particular the biological and geological researches of the latter. The third concerns John Walsh (1726–1795) and his experiments on the torpedo, or electric ray, conducted in 1772 at La Rochelle and l'Île de Ré, in France. The fourth is devoted to Marcello Malpighi (1628–1694),

the history of medicine, and contemporary biochemistry. The fifth concerns science and literature, from Helmholtz to Proust. The sixth is about vision and perception. The seventh deals with color vision, from Galileo and Newton to Goethe and Thomas Young (1773–1829).

As the reader will have gathered, *Lo zufolo e la cicala: Divagazioni galileiane tra la scienza e la sua storia* is almost impossible to categorize. As the title suggests, the book is indeed made up of “digressions” (*divagazioni*), which, however, have been assembled in a rather confusing fashion, in part from earlier research by the author himself, and apparently with no clear plan in mind. The introductory section does not state the objectives of the book. All the reader is told is that it was inspired by Piccolino’s felicitous teaching experience as a university professor and that he, in turn, wishes to instill the passion for science in the reader. The intended audience seems to be the general public rather than professional scholars of the history of science and its allied disciplines, but again this is not explicitly stated.

The historiographical framework of Piccolino’s book is the history of ideas. In his chapters scientific episodes, generally unrelated to one another, tell us stories about ideas that need not be placed in relevant contexts—social, philosophical, or political—and that can be wholly understood in terms of internal intellectual developments. Piccolino is interested in what he calls the “pathos” of science, an emotional attitude that, in his view, characterizes the process of discovery in the age of science (which, he holds, began in early modern Europe, with Galileo and the so-called scientific revolution).

I will not discuss the contents of the loosely connected chapters in detail, since the fragmentary nature of the book makes it impossible to give a fair summary. All the chapters have strengths and weaknesses, which I will try to address succinctly. The author is fascinated by the figure of Galileo and makes a great effort to see Galilean motives at all the crucial junctures of the discussion. This approach has serious drawbacks, though. Piccolino seems not to be aware of recent developments in the historiography of early modern science—and specifically in the field of Galileo studies. Thus—as the subtitle of the book might suggest—Galileo is presented in a wholly naive way. Little is said, for instance, about the complex social, mathematical, and philosophical contexts in which recent scholars have placed Galileo and early modern science more generally. This perhaps comes as no surprise, since Piccolino is a physiologist by profession, not a historian or a phi-

losopher of science. At some points in the book there are critical remarks about philosophers of science and their supposedly erroneous reconstructions of the history of science. I suspect, however, that these sparse remarks will not engage professional philosophers of science.

The chapter I find the most convincing is that on John Walsh and his experiments. It is a genuine piece of original research on animal electricity, based on primary materials that Piccolino has investigated thoroughly, after discovering a manuscript by Walsh preserved in the archives of the Royal Society. In my view, however, the value of this piece arises from the contact with hitherto little-known documents, not from the naive historiographical framework of the book.

Finally, I find it puzzling that Piccolino, in trying to convey his fascination with the practice of science—which seems to be the underlying theme of *Lo zufolo e la cicala*—has chosen not to rely on his firsthand experience as a professional physiologist. Rather, he has ventured to frame narratives that will inevitably appear naive to professional students of the historical and philosophical dimensions of the sciences. Hence the significance of this book for the history of science is modest.

PAOLO PALMIERI

Carroll Pursell. *The Machine in America: A Social History of Technology.* xvi + 398 pp., illus., notes, index. Second edition. Baltimore: Johns Hopkins University Press, 2007. \$22.95 (paper).

The Machine in America’s modest preface fails to acknowledge the magnitude of the task undertaken by Carroll Pursell, an acclaimed historian of technology. He describes this undergraduate history of technology textbook as a “brief introduction” that is “necessarily selective” (p. xi), but it stands as a synthetic overview of the technologies, systems, and networks devised throughout America’s history, with explicit emphasis on their societal context. This book succeeds in achieving Pursell’s goals: his many narratives “de-mythologize technology” (p. xii) by explaining the development, deployment, adaptation, and social impact of major technologies from colonial times to the present.

The Machine in America uses a chronological approach to break American history into fifteen fairly sequential chapters (with some necessary overlaps) focusing on the technological systems in each time period. Chapters such as “Importing the Industrial Revolution,” “Creating an Urban Environment,” “The Coming of Science and

Systems,” and “Our (Un)Wired World” organize and focus the overarching narrative structure by suggesting larger topics that unite the many smaller stories. Early chapters highlight how Americans imported European tools and methods, adapted them to unique American circumstances, and established transportation, manufacturing, and agricultural infrastructures that used natural resources first for survival, then to advance their economies, and finally to compete with the “Old World.” Later chapters detail America’s development of large, hierarchical, and centralized technological systems that enabled population growth, urbanization, westward expansion, and an increased American role on the global stage. The final chapters explore events in the late twentieth and early twenty-first centuries, with an eye toward the interplay between America’s ever-growing industrial supersystems, national policies, and the often-decentralized global culture. Science plays an understandably small role in early parts of the text, corresponding to America’s initial emphasis on practical technologies resulting from field experience, but becomes more prominent when the narrative details the rise of industrial research and the growing importance of American universities. Topical coverage throughout *The Machine in America* is quite remarkable, even in comparison to some of the main texts in this field, and this second edition covers events up to the present.

The volume’s chronological approach emphasizes the connection and explanation of many smaller narratives. In Pursell’s masterful hands the chapters flow in a very readable manner, with different contemporary technologies juxtaposed and connected to one another without needless complexity. Pursell provides minimal detail on the historical context of each period: relevant well-known events such as depressions and wars are briefly mentioned in light of the technologies they inspired or altered but play a supporting role as Pursell spotlights the technological narratives. One of the book’s greatest strengths is the plethora of gripping images, captions, and quotations that immerse the reader in advertisements, propaganda, firsthand descriptions, or responses to the technologies of each time period. The microanalyses of each technology’s development and impact avoid the pitfalls of oversimplification, whig history, and technological determinism. Pursell connects technologies to the people who make and use them, as well as to prevailing ideologies or social movements, often invoking multiple perspectives to illustrate how participants from different ethnic groups, social or economic classes, and genders react to the same developments.

The focus on smaller narratives de-emphasizes major interpretive frameworks or explicit themes

that might suggest connections between the topics and conclusions in different chapters and help the nonexpert target audience. The text does flag long-term issues such as America’s ongoing struggle to define intellectual property policies, problematic recurring attempts to paint science and technology as value free and neutral, the role of the state in technological development, and the changing role of engineers in societal planning and management; but these themes would have more resonance if they received a longer and more coherent treatment or built on existing concepts such as Thomas Hughes’s theory of large technological systems.

The closest counterpart to *The Machine in America*, Ruth Schwartz Cowan’s *A Social History of American Technology* (Oxford, 1996), explores fewer technological systems in greater detail, taking a more thematic and deeper approach at the cost of some content. Merritt Roe Smith and Gregory Clancey’s *Major Problems in the History of American Technology* (Houghton Mifflin, 1997) also covers fewer technologies but offers an array of lengthy primary sources and scholarly essays on the topics it does cover. And texts such as James McClellan and Harold Dorn’s *Science and Technology in World History* (Johns Hopkins, 2006) use a global approach that gives science added emphasis but sacrifices depth of study to achieve this greater breadth. *The Machine in America* splits the difference between these texts: it confines the scope to America, emphasizes technological rather than scientific narratives, and covers a wide span of content at the cost of some depth.

The Machine in America is tailor-made for undergraduate history of technology courses, though it might also serve to broaden the scope of history of science or general American history courses if instructors are interested in drawing connections between other fields and the technological and social narratives in this thorough and organized work.

ROBERT MARTELLO

Juan José Saldaña (Editor). *Science in Latin America: A History*. Translated by **Bernabé Madrigal**. vi + 256 pp. Austin: University of Texas Press, 2006.

Until the 1980s, little work on the history of science in Latin America was available in English. With the publication of this book, the editor and contributors hope to bring the historical study of Latin American science to a wider audience and out of obscurity, to end its “hidden” or “secret” status (p. 5). *Science in*

Latin America: A History, originally published in Spanish in 1996, is edited by Juan José Saldaña, a prominent historian of science in Mexico. With essays by renowned scholars from both sides of the Atlantic, the volume is organized around an implicit and explicit challenge to the master narrative of centralized scientific production that privileges European and North Atlantic science, a view increasingly taken up by historians and social scientists; but though there is now a significant amount of high-quality scholarship on the history of science, medicine, and technology in Latin America, there are still few good overviews of the subject as a whole. For that reason alone, the translation and publication of *Science in Latin America: A History* is a good thing for the field. Moreover, its appearance is well timed, given growing interest in the Atlantic perspective in the history of science and in the circulation of scientific ideas in general.

The goal of this volume, according to the editor's introduction, is not just to make clear the diverse and vast experience of Latin American science, but also to recognize how much is at stake, politically and economically, for the region. The more people, both inside and outside of Latin America, who understand the region's scientific potential (and often squandered resources), the more that potential can be harnessed to the benefit of ordinary Latin Americans. A concern for the present and future of Latin America underlies the volume's scholarly work. Clearly motivated by this concern, Saldaña states in his introduction, "It is now when scientific efforts must be increased considerably in order to respond to the enormous challenges resulting from the nation's underdevelopment. This step is necessary for forming a regional or local scientific culture and for continuing to build the 'ecological niche' that the science of Latin America needs. . . . The history of science must be written to allow the construction of national scientific capability" (p. 20).

The nine chapters of the volume collectively emphasize the commonalities in scientific events and achievements in Latin America across time and space, but also address the differences in timing, cultural factors, religion, and policy decisions. The book is somewhat skewed chronologically toward the early phases of Latin American science, with an emphasis on the complex and tense intellectual and political relationships between Spain and its colonies. (There is also an emphasis on continental Spanish America, with relatively little material on

Brazil and the Caribbean.) Thus the first five chapters focus on the colonial period, independence, and the new republics. The remaining chapters consist of overviews of scientific trends in the nineteenth and twentieth centuries. The final chapter, a brief but thought-provoking essay by Regis Cabral, serves as a conclusion. These essays have been edited so that they are uniform in quality, though they vary in format. A provocative chapter by Xavier Lozoya excavates indigenous medical concepts of the sixteenth century. Saldaña provides a chapter on the unique features of libraries, journals, universities, gardens, and other scientific institutions in Enlightenment-era Spanish America. Luis Carlos Arboleda and Diana Soto Arango look at the reception of Copernican and Newtonian theories in Latin America. Antonio Lafuente and Leoncio López-Ocón explore unknown scientific expeditions in eighteenth-century Spanish America, especially those sponsored by the church and local governing bodies. In a chapter on independence, Saldaña offers an analysis of the critical role of science and technology in creating nationalist consciousness. A chapter by Emilio Quevedo and Francisco Gutiérrez documents the influence of French, Dutch, and other non-Iberian medical schools in the creation of public health systems in Latin America in the nineteenth century. Hebe M. C. Vessuri provides an overview of the rapid professionalization and institutionalization of science in the century after 1880. Marcos Cueto then offers a chapter on twentieth-century biomedical science, a version of his well-known work on "excellence in the periphery"—a theory that has forced historians of science to rethink the nature of scientific production. Finally, Cabral's concluding essay ties this broadly conceived volume together by asking questions that really matter, such as how we should envision the future of Latin American science. He concludes that the region will be free to develop science—and itself—"only if Latin America controls its own past, its own history, the necessary tool for equal relations" (p. 253).

On the whole, *Science in Latin America: A History* is more concerned with the history of ideas and institutions than with a cultural and social analysis of science. While the book provides valuable information (and is a vital reference text, given the scarcity of published work on the topic), its emphasis on institutional history means that it is removed from the actual outcomes of scientific activity. It also means that the book does not take advantage of much of the cutting-edge research on the history of science, medicine, and technol-

ogy in Latin America of the last ten to fifteen years, especially that which incorporates questions of social and cultural history. Thus, factors such as gender and, to a lesser extent, race and class are largely absent from these essays. Nonetheless, the book remains indispensable for students and scholars interested in learning more about the complex, fascinating, and underappreciated history of Latin American science.

JULIA RODRIGUEZ

Raffaella Simili (Editor). *Scienza a due voci*. (Biblioteca di Nuncius, 50.) xix + 372 pp., figs., index. Florence: Leo S. Olschki, 2006. €38 (paper).

Valeria P. Babini; Raffaella Simili (Editors). *More Than Pupils: Italian Women in Science at the Turn of the Twentieth Century*. (Biblioteca di Nuncius, 63.) xviii + 216 pp. Florence: Leo S. Olschki, 2007. €24 (cloth).

“Notwithstanding all the dreams of theorists, there is a sex in minds.” So opens *Scienza a due voci* [The Two Voices of Science] (p. vii), a collection of biographical essays that grew out of a series of seminars and workshops organized by the University of Bologna several years ago under the direction of the science historian Raffaella Simili. The aim of this book, as Simili announces in her introduction, is to enhance the visibility of a number of women astronomers, mathematicians, chemists, and engineers whose contributions were mostly unsung in their time and in some instances have remained so. Taken together, these fourteen essays cover a wide swath of European cultural and social history and a rich range of topics relating to the relationship between women and the pursuit of science from the mid-seventeenth to the mid-twentieth century, with an emphasis on Italy, France, and England. The contributors include Alan Cook, Massimo Mazzotti, Marta Cavazza, Marco Beretta, Kathryn Neeley, Soraya Boudia, Joan Mason, and Sandra Pàttaro, and there is an essay by Paola Govoni surveying the extensive literature relating to the history of women in science both in America and elsewhere.

Several of the essays profile women who worked in collaboration with members of their family: the astronomers Elizabeth Hevelius (1647–1693) and her husband, Johann Hevelius; the mathematicians Grace Young (1868–1944) and her husband, William Henry Young; the criminal anthropologists Gina Lombroso-Ferrero (1872–1944) and her father, Cesare

Lombroso. Others examine the absence of a support group, as in the case of the physical chemist and crystallographer Rosalind Franklin; or the reverse, as exemplified by the significant population of women researchers in the Curie Laboratory of the Radium Institute of the University of Paris between 1904 and 1934. (Soraya Boudia points out in her essay on the Curie Laboratory that the relative abundance of women there is explained by the fact that work on radioactivity was new and less institutionalized and therefore the field was more accessible.)

In all instances, the biographical essays follow the development of these women as scientists in parallel with their personal histories, which were often troubled and constrained by official rules and conventional ways of thinking. All had curious minds; for them, science was a calling, not a hobby or a way to fill up free time. It was a passion, for which they had real gifts and substantive abilities, as Simili’s extended essay on Mary Somerville, the Scottish science writer and polymath (and the target of the line from William Whewell quoted at the beginning of this review), makes abundantly clear. Often they were steered to science by an unusual education, with the crucial help of enlightened family members who favored their studies. And just as often they were supported in their careers by male figures, such as fathers or husbands. Their value was sometimes recognized—although never at the level of their male colleagues—by the scientific community and by open-minded public figures of their time; for example, Pope Benedict XIV recognized the talent of the eighteenth-century mathematician Maria Gaetana Agnesi by appointing her an honorary lecturer at the University of Bologna. However, more formal honors, such as memberships in the most prestigious scientific societies, often eluded them.

Male dominance in these women’s environments often meant that they had to fill atypical roles and spaces, and indeed they showed creativity and pragmatism in carving out niches of their own where they could express themselves. In prerevolutionary France, Marie Anne Paulze-Lavoisier learned English and German in order to translate important scientific treatises for her celebrated chemist husband; she also assisted him in the laboratory, keeping the records of his experiments. Scholars have only recently begun to study her extensive archive of correspondence and documents.

The exhaustive footnotes listing primary sources and key secondary publications on the subject of women in science add to this book’s value as a reference volume.

More Than Pupils: Italian Women in Science at the Turn of the Twentieth Century is a collection of writings on female science students and their teachers, a theme that allows the nine essayists considerable latitude in telling the stories and experiences of a handful of exceptional women who battled their families, the climate of opinion, and the Italian academic system to gain professional acceptance, autonomy, and in some cases a tenured academic position. Simili views *More Than Pupils* as a work in progress that “seeks to fill a gap in the history of Italian women scientists, and still empty spaces in [Italy’s] scientific and academic institutions” (p. xii). Her coeditor, Valeria Babini, a historian of the human sciences, is more interested “in the dynamics of power between man and woman” and the psychology underpinning “the growth, intellectual and scientific emancipation of women in the entourage of a male teacher” (p. xv).

Ambitious and thought-provoking essays follow. Roberta Passione writes about the pathologist Giuseppina Cattani, who graduated *cum laude* in medicine from Bologna in 1884, competed unsuccessfully for several university chairs, and wound up instead, in 1897, as head of the radiology, morbid anatomy, and bacteriology laboratory at a hospital in Imola, near Bologna. C. Silvia Roero introduces us to the mathematician Giuseppe Peano’s clutch of women students at Turin between 1914 and 1932. Miriam Focaccia analyzes the pupil-teacher relationship between Cornelia Fabri, who graduated in mathematics from Pisa in 1891 (the first woman in Italy to graduate in this field), and Vito Volterra, one of the finest mathematicians Italy has ever produced. True to her research agenda, Babini contributes a paper on Gina Lombroso-Ferrero and her father, who is considered the founder of the science of criminology. Sandra Linguerrì considers the case of the malariologist Giovanni Battista Grassi, of the University of Rome, and his pupil Anna Foà, who went on to do research on the grape phylloxera parasite and the silkworm and became a full professor at the Portici Agricultural College in 1924. Simili writes about the fiery anti-Fascist histologist Giuseppe Levi, who held the chair of human anatomy at Turin from 1919 until 1938 (when the racial laws deprived him of his university position), and his equally famous student, the Nobel laureate Rita Levi Montalcini. The spectroscopist Antonio Garbasso (1871–1933), of the University of Florence, and his pupil Rita Brunetti share center stage in Sonia Camprini and Giovanni Gottardi’s essay; and the story of the freshwater biologist Rina

Monti-Stella, a professor of zoology and comparative anatomy at Sassari from 1907 to 1915—she was the first woman to obtain a university chair in Italy—is recounted by Ariane Dröscher. Enrico A. Giannetto tries hard to make the case that Volterra’s writings between 1915 and 1940 owe much to “the reading, judgments, translations and frequent corrections made by [Elena] Freda” (p. 113), a mathematical physicist who taught at the University of Rome from 1924 until her retirement in 1959.

Barred from attending universities in Italy before 1877, Italian women scientists have generally gotten short shrift from Italian historians of any ilk, let alone scholars abroad. These two volumes go a long way toward plugging that particular gender gap.

JUDITH R. GOODSTEIN

Fred Watson. *Stargazer: The Life and Times of the Telescope.* x + 342 pp., bibl., index. Cambridge, Mass.: Da Capo Press, 2004. \$24 (cloth).

As the four hundredth anniversary of the telescope’s invention approaches in 2008, we expect to see numerous articles, books, Web sites, and activities commemorating its origins, its evolution, and the discoveries telescopes have enabled. Many interested readers will profitably begin with Henry King’s classic *The History of the Telescope* (long available as a Dover reprint), but the most important technical source will be the upcoming English translation of Rolf Riekher’s *Fernrohre und ihre Meister* (to appear as *Telescopes and Their Masters, Translated, Expanded, and Updated*, by Thomas Dobbins; published by Willmann-Bell), an extraordinary volume that will now reach readers beyond the former Eastern bloc and the most devoted telescope specialists.

Such references may seem an odd way to begin a laudatory review of an apparent competitor in the telescope history sweepstakes, but I do so because Fred Watson’s *Stargazer* takes a rather different approach, one complementary to these (and other) more detail-oriented volumes. To be sure, *Stargazer* also includes clear and accurate descriptions of telescope optics, their limitations, their improvements, and their increasing size and complexity. Beginners will find everything necessary to understand how a telescope works and will enjoy practical examples that illustrate fundamental principles, such as how the currency of resolution—milliarcseconds—can be understood as the apparent size of a U.S. quarter (or British pound or Australian dollar) seen at a distance of 5 kilometers. These

and other down-to-earth examples, and clear illustrations, provide helpful ways to understand basic and more complex concepts.

Stargazer differs from these other volumes in that Watson has chosen to focus on *why* telescopes have changed the way they did. His answer: curiosity about the universe (and about instrumentation itself) and professional competitiveness have played equally important roles in pushing the telescope to larger optical elements that probe ever more deeply into space. Stories about Tycho Brahe, Galileo, William Herschel, Joseph Fraunhofer, and other famous figures are complemented by tales of lesser-known characters and developments associated with them. In each case, contextual details provide interesting insights about their motivations, their innovations, and the roles their telescopes played.

The most obvious absence in the volume is any significant treatment of telescopes made after about 1930. Although more recent telescopes and their designers make appearances in the first few pages and once again in the final pages, those discussions are rather disconnected from the main story line about the telescopes of the more distant past. For example, Watson mentions only in passing the topics of segmented mirrors and mirror arrays or the astonishing, nearly magical technique of adaptive optics. By necessity, the types of stories told about recent telescopes would look rather different: whereas the earlier stories involve individuals (or partnerships), twentieth-century telescopes involve teams. Telling those later stories would have provided an instructive contrast to the previous ones and shed much light on the changing technical and social practices of astronomy. While my personal interests are certainly served by the stories included, it does seem a lost opportunity. One can dare to hope that Watson will tackle the twentieth century and beyond and tell the rest of the story he has so nicely started.

Nonetheless, for an engaging introduction to historical telescopes, I know of no better place to start. Indeed, *Stargazer* is the book I regularly recommend as the best narrative introduction to the history of the telescope. Watson tells his stories with enthusiasm, supplies sketches when needed, and avoids excessive or unnecessary detail. And all but the most informed and sophisticated readers will learn new stories and details. Watson also includes a good bibliography so that readers can continue their exploration; some of the texts he lists are classics (such as the King and Rieker volumes, where readers can find more technical details), many are readily available,

and a few will challenge most readers to track them down. *Stargazer* will not only engage readers with diverse levels of interest and knowledge about telescopes; it may even inspire some of them to make the additional, and worthwhile, effort to take a look through one.

MARVIN BOLT

■ Antiquity

James Evans; J. Lennart Berggren. *Geminus's Introduction to the Phenomena: A Translation and Study of a Hellenistic Survey of Astronomy.* xviii + 325 pp., illus., apps., bibl., index. Princeton, N.J.: Princeton University Press, 2006. \$49.50 (cloth).

We have from James Evans and J. Lennart Berggren the first English translation of one of the very few astronomical texts surviving from the period between Hipparchus of Rhodes (second century B.C.) and Ptolemy (second century A.D.). This makes the *content* of Geminus's *Introduction* important for our understanding of a particular period in Greek astronomy. But, as Evans and Berggren point out in their introduction to this volume, the *form* of Geminus's text is also interesting: it is essentially a textbook meant to introduce students to what was for Geminus contemporary astronomy. While its introductory nature has for the most part given Geminus something of a sideline role in modern research into serious Greek astronomy, Evans and Berggren make a convincing case for why we should take him more seriously. On the one hand, he is our best—in some cases our only—source for some important topics in the history of ancient astronomy (lunisolar cycles, for example). On the other, why should we not look at textbooks more closely? A grand theoretical synthesis like Ptolemy's *Almagest* gives us insight into the highest levels of astronomical theory, but what is everyone else up to? How is astronomy taught? What will more general ancient readers be interested in? What phenomena, what technical or philosophical concepts can Geminus take for granted? What does he need to explain? What myths or errors does he need to dispel, and how does he go about it? The answers to these and other questions will give us considerably more insight into the place of astronomy in wider Greek culture than we could ever get from a Ptolemy, and this fact makes Geminus an interesting and important read.

Evans and Berggren's book comes in two parts: a meaty, 110-page introduction to the

Geminus text and its astronomy, followed by a translation of the text itself. The astronomical explanations in Evans and Berggren's introductory section are exemplary: clear as can be, thorough, and detailed. They laudably do not shy away from mathematical explanations whenever necessary, but their discussion is accessible enough to be useful even to those who might normally tend to avoid the more technical ends of ancient astronomy. Specialists will find much in it that is interesting, and, as Geminus had intended with his own text, this book will be a very useful teaching tool (though even more useful should it come out in an affordable paperback edition). If I had to cavil, my complaint would be that I have a number of points of disagreement with Evans and Berggren's treatment of the ancient astronomical weather "calendars" known as *parapegmata*—but then these texts and instruments are perhaps a little too close to my own heart for me to be fully objective. I do, however, worry that the repetition in this volume of some of Albert Rehm's and B. L. van der Waerden's mistakes will give them a second life. I am thinking particularly of the relationships claimed between *parapegmata*, lunisolar cycles, and civil calendars, where lunisolar cycles are said, for example, to have been used to "regulate" *parapegmata*. This simply misunderstands how a *parapegma* works. So also the claim (again based on Rehm) that *parapegmata* are in the first instance observation based and essentially theory free (Evans and Berggren use the word "prescientific") is dubious. This gripe is perhaps a little too fine tuned to be a representative comment on their work, however; and to be perfectly fair, I should say that there are quite a number of topics handled in their introduction from which my own book would have benefited immeasurably.

Two points of particular interest in the introduction are Evans and Berggren's discussion of genres of ancient mathematical writing (p. 43 f.) and their detailed look at issues of what we now call realism and instrumentalism as applied to ancient astronomy. They give us a helpful survey of the kinds of topics ancient mathematical writers took on, in both pure and applied mathematics (though they perhaps have a tendency to stretch the meaning of the word "genre"). Finally, they give us a welcome and very clearly argued case for realism in Geminus, with some interesting and useful discussion of other authors often mistakenly taken for instrumentalists (Ptolemy, most prominently).

The translation of Geminus's text is richly illustrated, interestingly using photographs of manuscript diagrams as often as possible. It is

clear and accurate, though it does have a tendency to prefer accuracy over idiom such that the wording is perhaps more complex than Geminus's Greek. A sentence that begins "Said to be in syzygy are signs that rise from the same place . . ." (p. 132) is certainly true to the Greek word order, but the inverted English reads more like the highbrow prose of a Ptolemy than the bare simplicity of Geminus to me. This is not to say that the translation is not accessible. It certainly is very readable, just perhaps more academic in places than Geminus himself is. But this "true-to-the-style-of" question is a very minor quibble in the end. This is an excellent volume that will broaden our understanding of Hellenistic astronomy, its genres, its audiences, and its contexts.

DARYN LEHOX

David L. Thurmond. *A Handbook of Food Processing in Classical Rome: For Her Bounty No Winter.* (Technology and Change in History, 9.) x + 294 pp., illus., bibl., index. Leiden: Brill Academic Publishers, 2006. \$138 (cloth).

David Thurmond's new book is the latest addition to Brill's series on Technology and Change in History and the second volume in it devoted to food technology. While the earlier book was my more broadly focused treatment, *Ancient Food Technology* (Brill, 2001), Thurmond focuses on food processing in the Roman world between the first century B.C. and the second century A.D. He details the science of food processing, emphasizing not only the why and the mechanics of how Romans processed their food but also explaining the underlying scientific principles in clear prose suitable for a broad audience. His book is both a scientific commentary on the ancient sources—particularly the agricultural writers, Cato, Varro, and Columella—and an illustration of, if not scientific knowledge, then certainly the practical bent, bordering on the ingenious, that Romans displayed in processing their foods for storage, transportation, and later consumption.

In his brief introduction Thurmond discusses microbes and their often deleterious effects on foods, which necessitate processing. He defines the goal of food processing as the creation of microenvironments to provide biological stability in foods where it is lacking and to make palatable many naturally stable foods that are, nevertheless, otherwise indigestible (p. 10). Thurmond organizes his book into six chapters, each one devoted to food processes specific to a particular category of food, beginning with the

Mediterranean “triad” of cereals, olives, and grapes and continuing with discussions of legumes, vegetables, and fruits, animal by-products, and condiments. While most of his choices of processes for discussion are clear, some are not. So, for example, threshing of cereals, harvesting of grapes and olives, cleaning of olives, and warehousing of olives prior to processing have, I think, more to do with agriculture than with food processing. The bibliography, while helpful, has some prominent omissions, such as K. D. White’s *Greek and Roman Technology* (Cornell, 1984) and Jean-Pierre Brun’s four recent volumes on the archaeology of wine and oil (Errance, 2003–2005). These omissions point up one of the weaknesses of Thurmond’s otherwise useful book. While providing full coverage of the literary sources for food processing, he is less successful in integrating the archaeological material. So, for example, he omits discussions of butchery of meat and beer production, presumably because evidence for them is almost entirely archaeological. He augments his text with footnotes, an easy-to-use index, and thirty-two figures of fair to very good quality. A few photographs of at least some of the processing equipment or physical remains would have been helpful.

Thurmond is at his best in making sense of the often complicated, vague, and frequently incomplete descriptions of food processing by ancient writers and in explaining them in terms of modern scientific knowledge. He frequently goes beyond mere description both by fleshing out an ancient author’s incomplete discussion with comparative modern methods and by using modern scientific knowledge to posit answers to questions raised by the ancient source. So, for example, I found particularly interesting his hypothesis on the origin of the apparent Roman aversion to crushing olive pits in their mechanical crushers (p. 90) and his discussion of the use of gum arabic to seal the inside of terracotta olive oil containers (p. 108). Occasionally he perhaps goes too far, as when—on the basis of recent practice—he posits the fermentation of pickled olives, for which no ancient evidence exists (p. 182). On the whole, however, he is careful and judicious in identifying modern parallels with ancient methods.

Thurmond can at times be inconsistent and occasionally betrays some misconceptions. He exhibits a certain chronological looseness, for example, with his references—without comment—to works of ancient authors, such as Palladius and the author of the *Geoponica*, who lived outside of his chosen chronological period; and he misconstrues how one cooks with the Roman *clibanus* (pp. 64–65). But these (and

others) are slight cavils about a work that has much to commend it.

Thurmond makes a valuable contribution to a much-neglected aspect of the ancient world. His obvious delight in the subject matter comes across on every page of a work that is clearly and engagingly written for an audience of both scholars and informed general readers.

ROBERT I. CURTIS

■ Middle Ages and Renaissance

H. L. L. Busard. *Campanus of Novara and Euclid’s Elements*. 2 volumes. (Boethius, 51.) 768 pp., figs., bibl. Stuttgart: Franz Steiner Verlag, 2005. €115 (cloth).

Between 1255 and 1259, Campanus of Novara (b. first quarter of thirteenth century, d. 1296) produced an edition with commentary of Euclid’s *Elements*, based largely on Adelard of Bath’s translation from the Arabic as modified in Robert of Chester’s version of the same. Campanus’s reworking of Euclid had the distinction of being the most widely read rendition of the *Elements* from the thirteenth to the sixteenth century (when printed editions were made from the recovered Greek texts); it is also the first printed edition of Euclid, put out by Erhard Ratdold in Venice in 1482.

It is therefore surprising that this Euclidean medieval text has remained unedited until now. Fortunately, Hubertus L. L. Busard, the doyen of editors of the medieval Euclid (he has edited all three known Latin translations of the *Elements* from the Arabic and the direct translation from the Greek, as well as other versions and compilations of the work), has now accomplished this task in the two-volume work under review. It is a credible, convincing job, of the kind we have become accustomed to see from this scholar from Venlo. Campanus’s commented edition of the *Elements*, extant in more than 130 manuscripts—a fact that bears witness to its great popularity—is, like other medieval geometrical treatises, primarily concerned with matters of logical consistency, the quality of the argument (and not, chiefly, its content), the form and character of the proofs of the various propositions, their mutual dependency (as corollaries and converses, among other things), their place in the *Elements* as a whole, and their appositeness in other areas of learning. Campanus’s definitions are those of the so-called Adelard II version, now ascribed to Robert of Chester, while his proofs seem to be independent of Robert’s. Campanus’s additions to the Euclidean

text are meant to make the *Elements* as self-contained as possible, striving to inscribe the work into contemporary mathematics by drawing in his *additiones* on Jordanus's *Arithmetica*, Anaritius's commentary on Euclid, and both Johannes de Tinemue's version and the direct translation of the *Elements* from the Greek.

Busard's edition is presented in two volumes. The first contains a short preface and an introduction, covering fifty-two pages, that surveys the Arabic–Latin and Greek–Latin translations and their derivatives and also contains a brief biographical note, an inventory of the works ascribed to Campanus, and a list of the manuscripts and of the *editio princeps* used in the preparation of the text. This is followed by the established text of the *Elements*. The second volume is devoted to the notes and commentaries, bibliography, and critical apparatus.

Campanus of Novara and Euclid's Elements is, as already stated, a solid work of scholarship. Still, it could be better. To begin with, from the 131 extant manuscripts of the work, Busard chose, sensibly enough, the two oldest (F, a Florence manuscript of 1259; and N, a Columbia University manuscript of uncertain date, perhaps as early as 1261 but possibly as late as 1300) and P, the *editio princeps* of 1482, which he fully collated. (N was chosen because it may be the copy handed over by Campanus to Jacques Pantaléon, the future Pope Urban IV.) He also occasionally consulted eight further manuscripts. No attempt was made, however, to establish a *stemma codicum*. Dismissing the need for a *stemma*, somewhat cavalierly, with the remark that “131 manuscripts of Campanus' version in [*sic*] Euclid's *Elements* are known. Thus it was impossible to collate them” (p. 46) is too expedient an answer to be acceptable. The same kind of approach is displayed in dealing with the diagrams: “It was not possible to give variants of the figures in the various redactions [!]. The figures in the text are based on those in F, but I have drawn the figures more in conformity with the text” (p. 51). Historians of mathematics (e.g., Reviel Netz) have recently begun to pay increased attention to the role and evolution of the diagrams in mathematical texts, an attention that pays off nicely in a better understanding of the character and transmission of the texts. Also, Busard's criteria for inclusion of variants in the critical apparatus are, to my taste, too lenient, as too many potentially significant readings are therewith excluded. Finally, the rather lean introduction, which is otherwise competent and up to date, contains a number of what seem to me arbitrary, unjustified assertions: “I doubt whether the assumption of John

Murdoch that a single translator [from the Greek] has made the version of the *Elements* is correct” (p. 31); Why? “It is plausible to suppose that Campanus derived the following enunciations from either Jordanus or from Anaritius” (p. 33); Why plausible? Did he or did he not derive them from either of the two? These examples should suffice. Moreover, the English of the introduction is sometimes stilted, though, as a rule, it is correct.

To sum up, Busard's *Campanus of Novara and Euclid's Elements* fulfills a long-standing desideratum for a scholarly edition—though, alas, not a fully critical one—of the most important medieval and early Renaissance Euclidean text. For this, historians of mathematics are in Busard's debt.

SABETAI UNGURU

Piero Falchetta. *Fra Mauro's World Map.* (Terrarum Orbis: History of the Representation of Space in Text and Image, 5.) 829 pp., illus., apps., bibls., CD-ROM. Turnhout, Belgium: Brepols Publishers, 2006. €110 (cloth).

Fra Mauro's world map, one of the most valuable pieces now held in the Biblioteca Marciana in Venice, is a depiction of the known world of its time, annotated with a vast assortment of information. It was composed in the middle of the fifteenth century by Fra Mauro, a monk with a great reputation as a man of science, who lived and worked in the monastery of St. Michele of Murano in the Venetian lagoon.

Fra Mauro's World Map, a bulky volume dedicated to this monument of cartography, is organized into several sections. After an introduction by Marino Zorzi, the director of the Biblioteca Marciana, the first part presents an in-depth discussion of historical, scientific, and philological issues related to the map, mainly as they pertain to interpretation of text and inscriptions, and of its more significant innovations. This critical section concludes with a complementary essay about the pictorial decoration of the planisphere, written by Susy Marcon, that offers new arguments in favor of a possible attribution of the corner scene of the earthly Paradise to Leonardo Bellini.

The central part of the volume (560 pages) provides a complete transcription of the map's inscriptions (nearly three thousand in number) in the original Italian, as well as offering an English translation and a commentary. The three appendixes that follow present a comparison with the inscriptions on the Borgia Map, an index to the key words on the map, and an index

of the rivers on the map. Finally, after bibliographies listing manuscript and printed sources, a few pages present the operating instructions for the CD-ROM that accompanies the book, which allows for cross-consultation of text and images. The book's intended readership is a very specialized one, although by making the rich information embodied in the inscriptions more generally available the volume may also invite attention from a wider audience.

The reason for undertaking such a painstaking enterprise is that Fra Mauro's world map, although recognized as a work of primary importance—it is mentioned as such in all histories of geography and has been widely reproduced in a small format—is not very well known or understood. It has been thought of—and gazed at—more as a monument in the history of cartography than as a work that would repay critical attention. The first and only serious study of the map, written by Placido Zurla and widely discussed by Falchetta, dates back to 1806.

Falchetta's study aims to provide answers to a number of questions concerning the content of the pictures, the kind of geography the map depicts, the knowledge on which it is based, and its mastery and presentation of a huge amount of information; finally—summing up all these questions—Falchetta seeks to establish whether Fra Mauro's work is the mature fruit of a centuries-old tradition of medieval geography or heralds the advent of a new kind of geographical knowledge.

In discussing its sources Falchetta dismantles the map, pointing out how it stands as an innovative cultural compendium of different streams of knowledge: cartographic models the author reinterpreted; oral accounts and written sources, explicitly quoted by the author himself or generally recognizable; and even, more simply, the general geographical information of the moment. Information inherited from the classical tradition is mingled and integrated with new facts, and Fra Mauro did not hesitate to contradict Ptolemy whenever he found contradictory evidence in the new sources. There remains, however, the question of how he had access to such masses of data.

The cosmological notes that occupy the space between the map itself and the borders of the work deal with subjects like the number of heavens and the distance of the stars; the theory of tides and of the continental land masses; the description of the earthly Paradise; and the theory of the elements and of the inhabitability of the southern regions. Fal-

chetta points out that in this part of his work Fra Mauro is very much a traditionalist, channelling his comments within the ideas of the great classical and medieval *auctoritates*. In Falchetta's opinion, however, this contrast serves to emphasize even more his experimental position as a geographer and a cartographer and the authentically innovative features of the map, not bound by any ideological considerations.

Falchetta's long and patient work of transcription and interpretation has accomplished, first, the valuable achievement of making every single part of this complex artifact accessible to scholars and future researchers. Just as important, drawing attention to this "neglected" (in terms of the scarcity of scholarly studies) document serves to refute once again a notion that still persists, though the age of scientific positivism has passed: that the history of geography, and of cartography, should be understood as the development from a primitive, prescientific stage to a scientific stage, based on mathematical models, in which the "exact" and the "measurable" are the pertinent features. From the point of view of the ideology of scientific progress, historic maps are subjected to positive or negative judgments, depending on the degree to which they approach modern standards; those that fail to meet such criteria are dismissed as works of slight scientific significance and acknowledged only—though perhaps with due reverence—as documents of the more primitive phase.

It is a mistake to apply modern categories to Fra Mauro's map. Falchetta asserts that ancient maps existed as "autonomous texts in their own right; due to the synthesis operating within them, they themselves generated knowledge and skills. And such knowledge and skills were not merely the synthesis of components that might exist independently of each other; their most efficient manifestation—sometimes their sole manifestation—lay in their expression within works of cartography" (p. 22).

The sort of critical-philological approach adopted by Falchetta seems, at the moment, the one best suited to the reading and interpretation of ancient maps. Its limitation is, of course, that Falchetta has deconstructed Fra Mauro's map without providing a new synthesis—if such a thing is possible. For the synthesis that was possible in Fra Mauro's culture, and in his mind, is forever lost.

LUCIA NUTI

Chiara Frugoni. *Books, Banks, Buttons, and Other Inventions from the Middle Ages.* Translated by **William McCuaig.** xiv + 178 pp., illus., bibl., index. New York: Columbia University Press, 2003. \$19 (paper).

This paperback edition of *Books, Banks, Buttons, and Other Inventions from the Middle Ages* is a welcome addition for teaching about medieval technology, although it may be better suited for interested relatives than for students. The work itself is neither groundbreaking in its scholarship nor encyclopedic in its coverage, but it does provide a profusely illustrated and quite readable survey of common material culture deriving from the Middle Ages. When the introduction rattles off nearly five dozen medieval inventions in just over a page, one might fear that the volume will try to cover too much in its mere 150 pages, not including notes. Chiara Frugoni has chosen to divide her book into six chapters that appear to narrow the scope somewhat; but then when one reads the chapters, it becomes a whirlwind and somewhat stream-of-thought tour. What the book most reminded me of is a slimmed-down and heavily illustrated version of Urban Tigner Holmes's densely scholarly look at the material culture of the high Middle Ages, *Daily Living in the Twelfth Century* (Wisconsin, 1952), that somehow got crossed with James Burke's television series *Connections*, where one thing led to another that led to another—and suddenly eyeglasses lead us to book cubicles, Arabic numerals, papermaking, and printing. I very much appreciate both Holmes's and Burke's scholarship and approach, and they stand Frugoni in good company, even if her book may not manage to be quite as successful in its brief foray into the topic.

Frugoni's six sections do not try to break new ground in terms of textual scholarship, although she seems fully aware of canonical primary and secondary sources in her areas of study. The prose is very fluid, and one would not know that it was translated from the Italian except for the preponderance of Italian sayings used to illustrate continuity in our way of interacting with the world. If nothing else, these offer a welcome pause for thought in which readers may wonder how it is that in English we often have different or even antiparallel embedded cultural references tied to our heritage technologies. Frugoni's chapters, however, get progressively shorter, as if her main thrust had been to examine eyeglasses and printing (that treatment runs to 68 pages) and she then fleshed out what was too short to be a book by itself with clocks (34

pages), augmented that with clothing (14 pages), glossed it all with eating utensils (14 pages), and then merely garnished the top with military inventions and transport (12 and 6 pages, respectively). My culinary metaphor is purposeful here, as it would also have been nice had she included a section on the foods on our tables that derive from the Middle Ages; regardless, it would have been best if her later sections had more evenly balanced the first.

The production of the book is quite lavish, with approximately as much page space devoted to large, full-color images of manuscripts, ivories, paintings, and occasional medieval artifacts as to text. Some of these illustrations will be familiar to the Anglo-American audience, but many come from Mediterranean sources and therefore offer interesting comparisons with those that might be more familiar. Readers may even find themselves attending to these images in more detail than to the narrative, such as it is. There are a few production flaws, with curiously situated figure captions in a few places, text running out of sync with its associated layout of images, and at least one slightly awkward full-page mirror image. And one might also quibble with Frugoni's willingness to use sixteenth-century paintings to illustrate medieval material culture. None of these flaws is damaging to the work as a whole, but the index, which includes only persons, omitting both artists and the subjects of illustrations, seems strangely terse in a book about technology. Given that there are only about 80 pages of text, it would not have been that difficult to provide a more thorough index. Given the somewhat erratic path the text takes, such an index would certainly have helped me find that choice fact or reference that piques my interest as I read through the book. On the whole, the book is a fast read, an enjoyable browse, and may offer some choice entrées into source materials the reader could use for lectures or for conversation. If nothing else, it will be very useful to hand to relatives who get that quizzical look when you tell them you teach about "medieval technology," which increasingly seems like an oxymoron to the modern world.

STEVEN A. WALTON

Miguel Ángel Granada. *La reivindicación de la filosofía en Giordano Bruno.* 285 pp., table, bibl., index. Barcelona: Herder Editorial, 2005. €17.79 (paper).

Miguel Ángel Granada's book explores some areas of the rich and complex thought of Gior-

dano Bruno (Nola, 1548–Rome, 1600), the Italian philosopher who divulged and defended the Copernican theses and provided them with a solid theoretical, epistemological, physical, ontological, and theological foundation. Bruno also explored the consequences of Copernicanism—an infinite universe, material homogeneity of the universe, innumerable worlds, a multiplicity of “synods” or solar systems like ours, the existence of innumerable celestial bodies not visible to simple sight, the habitability of other worlds, and so on—thereby opening new routes, and also polemics, for natural philosophy, astronomy, and metaphysics in the late sixteenth and seventeenth centuries.

Granada is, without doubt, one of the most important authorities on Bruno, thanks to his Spanish translations of the Italian works, his collaborations in the preparation of critical editions (particularly that of *Les Belles Lettres*), and, especially, his studies on Bruno and the cosmology of his era in general.

La reivindicación de la filosofía en Giordano Bruno [The Vindication of Philosophy in Giordano Bruno] deals chiefly with Bruno’s understanding of moral conduct in relation to his philosophy and, especially, his cosmology. Noting the varied origins of the essays included in the book, Granada asserts: “all of them constitute, nevertheless, part of a reading and full interpretation of Giordano Bruno’s work as a conscious and polemical vindication of Philosophy, in the *strong* sense that this word possessed in the Greek origins and in the tradition of the Islamic and Judaic *Falsafa*, which maintained the Greek idea of Philosophy in a more strict way than the medieval *philosophia* in Christian lands” (p. 45).

The book contains seven chapters (nine, counting the appendixes). While it is true that all of them touch the principal matter Granada specifies, their content is heterogeneous because of their varying provenance: papers for academic meetings, articles for specialized publications, an entry for the *Enciclopedia Bruniana e Campanelliana*. However, the introductory text and Chapter 1—both explicitly written for this new publication—establish a common ground. Some of the chapters are very specialized and require a certain familiarity with Brunonian thought for their proper appreciation.

Granada emphasizes several central aspects of philosophy’s vindication: the specifically philosophical feature of Brunonian theology, which excludes dogma from revealed religions; the moral foundation that necessarily supports genuine philosophy; philosophy as a necessarily free activity and the only way to access God; the

need to confront Aristotelian and anti-Christian polemic (aspects Granada has long emphasized) in order to purify philosophy of pedantic imposition (pp. 53, 55, 117, 141); and the reevaluation of the “heroic enthusiast” and the accompanying freedom of the authentic philosopher (p. 223). An important part of the work comments on Epicurus, Lucretius, Saint Augustine, Averroës, Maimonides, Dante, and Erasmus as antecedents of Bruno’s philosophy. Pascal is considered in light of Bruno’s influence on his thought.

Granada’s treatment of Bruno’s self-assessment is worthwhile, but it might have given consideration to *The Ash Wednesday Supper*, where Bruno’s self-valuation is said to be as a “new sunrise,” or “Mercury,” announcing the renaissance of genuine wisdom—though this does not contradict Granada’s treatment of the question (pp. 62, 107, 188, 224).

Finally, in my view, the most significant contribution of *La reivindicación de la filosofía en Giordano Bruno* is its analysis of the general notion of vicissitude (Ch. 7 and App. 1), demonstrating its main task as the explanation of the motion and change of physical and social reality (p. 249). This is a matter that has not received the attention it deserves from other authorities on Bruno.

ERNESTO SCETTINO

Katharine Park. *Secrets of Women: Gender, Generation, and the Origins of Human Dissection.* 499 pp., illus., bibl., index. New York: Zone Books, 2006. \$36.95 (cloth).

This book is about the religious, cultural, social, and intellectual meanings of cutting open women’s bodies from the late thirteenth century to the middle of the sixteenth century in Italy. The practice of embalming by evisceration (for funerary rituals), the cult of relics, autopsies for forensic and public health cases, and *sectio in mortua* (Caesarean section) had become widespread in Italy by around 1300. What is somewhat surprising is that primary sources for the dissection of male bodies are scarcer than those for the dissection of female bodies. This was not because fewer men were dissected but because it was thought that there was something to be gained from dissecting women’s bodies, whereas male bodies tended to be more familiar and not particularly interesting. For some, what was to be gained was proof of sanctity; for others, dissection was about legitimacy and the preservation of offspring; and for still others, it was increasingly about developing expert

knowledge of the most opaque and difficult organ of the female body.

In the early fourteenth century, Chiara of Montefalco was found with an image of the cross in her heart; images of Mary and the Nativity were impressed on three stones found in Margherita of Città di Castello's heart. These "feminized" (p. 68) the model of sanctity already embodied by St. Francis and his stigmata: while Francis's stigmata were exterior wounds, visible from the outside, the proof of holiness for a woman lay deep inside her body. Female saints were dissected because women tended to be associated with the body and men with the soul or the mind, because women's porous bodies were more susceptible as vessels of divine grace, because male writers and confessors felt the need to demonstrate visible marks of sanctity, and because of the fundamental identification of women's bodies with the power of generation. Only a female saint could generate a relic in her body.

In contrast, the majority of women were associated with "secrets," as knowers (i.e., possessors of knowledge) and the known (i.e., objects of knowledge). Women's knowledge of the natural world was experiential (rather than causal), concrete (as opposed to universal) snippets of therapeutic recipes that were transmitted orally. Women themselves were also originally regarded as experts regarding pregnancy and the uterus, concealed deep inside the body. Lanfranco of Milan and Guglielmo of Saliceto would concede that something worthwhile could be learned from such secret knowledge possessed by women, but they regarded it as ultimately inferior to the knowledge offered by the newly emerging academic discipline of medicine. The latter developed out of an orally transmitted, artisanal practice into a causal and universal knowledge based in the *studia*; it was transmitted in Latin, openly and publicly, through writings. Following Galen, academic physicians believed that anatomy was best mastered through autopsy and dissection. This anatomy was a public affair, conducted in lecture halls and publicized in books. Johannes Ketham's *Fasciculus de medicina* (1494) includes the first Italian figure of an anatomized uterus drawn from nature ("figura dela matrice dal natural"). The hand gestures of the female figure in the *Fasciculus* suggest a modicum of help and instruction from women about the female body; but twenty-odd years later, Jacopo Berengario da Carpi dismissed such a need. In his *Commentaries on the Anatomy of Mondino*, in which he elevated the practice of anatomy over and above textual authority, Berengario presented himself as the su-

preme surgeon and dissector who could reveal what even women themselves didn't know about their bodies.

In practice, also, physicians—now formally trained and practicing in Italian cities—were successful in developing their authority and expertise with regard to diseases of female genitals and reproductive systems, such that they became expert witnesses in cases of contested virginity and legitimacy, while well-to-do women began to request the presence of medical men in cases of difficult birth and other gynecological problems. Indeed, the belief that dissection conducted by a university-trained physician was the best way to obtain knowledge about the body was reflected in requests by dying mothers. Bartolomea Dietisalvi, for instance, asked to have her body opened after her death in order to determine whether she had consumption; if so, she hoped that medicine could be given to her daughters, who would be susceptible to the same illness. Holy anatomy was also transformed. Instead of producing wonder-working relics inside the body, female bodies offered up anatomical evidence for interpretation and confirmation. The postmortem lactation of Elena Duglioli and the empty stomach of Columba of Rieti were now seemingly natural matters whose supernatural causes were to be determined by medical experts. Gendered associations were thus removed from holy anatomies, and in the sixteenth century holy men such as Ignatius Loyola, Carlo Borromeo, and Filippo Neri began to be dissected.

Andreas Vesalius's *De humani corporis fabrica* is an appropriate place to end a history of "women's secrets." The frontispiece shows a dissected uterus, the ultimate secret and difficult object of anatomical inquiry. It was the uterus of a criminal woman who was executed after feigning pregnancy, which midwives had declared false. Vesalius, by means of dissection, made the midwives' conjectural, fleeting knowledge certain, public, and permanent. Katharine Park reads the frontispiece as a manifesto of Vesalius's "imperial" ambitions (he sought, successfully, to curry imperial favor) as well as of his intellectual program. Vesalius wanted to unify hands-on dissection and the theoretical *physica*; but he also presented himself as a transgressive, heroic figure, symbolizing imperial domination and violent control.

Secrets of Women decenters the story of the rise of dissection and anatomy as an academic discipline; it resists the simplified readings of gender relations such as "male, active subjectivity vs. female, passive objectification"; it argues that various models of generation coexisted; it

shows the many ways in which the uterus was a “social” organ (p. 264). It successfully and conclusively shows the centrality of gender analysis for the history of anatomy, the science of bodies (p. 38). This book should, once and for all, put to rest the claim of nineteenth-century historiography (which also flattened the earth for this period) that there was a widespread taboo in medieval Europe—religiously or otherwise motivated—about cutting open human bodies.

Those who teach history of medicine, religion, the body, or gender will find this an excellent textbook for undergraduate courses. Its suggestions, historiography, and methodology are subtle and rich enough, however, that it could be used profitably by graduate students as well. In particular, I hope that our next generation of scholars will take as exemplary Park’s meticulous and generous acknowledgments to the work of other scholars, since generosity never detracts from originality.

SACHIKO KUSUKAWA

■ Early Modern (Seventeenth and Eighteenth Centuries)

Richard J. Blackwell. *Behind the Scenes at Galileo’s Trial: Including the First English Translation of Melchior Inchofer’s Tractatus syllepticus.* xiii + 245 pp., index. Notre Dame, Ind.: University of Notre Dame Press, 2006. \$35 (cloth).

William R. Shea; Mariano Artigas. *Galileo Observed: Science and the Politics of Belief.* xi + 212 pp., figs., bibl., index. Sagamore Beach, Mass.: Science History Publishing/USA, 2006. \$30 (cloth).

More than twenty years ago, Pietro Redondi lobbed his historiographical Molotov cocktail at the shrine of the 1633 Galileo trial. Brilliant, daring, and iconoclastic, *Galileo eretico*—recently reissued with a new introductory essay (Einaudi, 2004)—has inspired and infuriated a generation of historians of science. Redondi’s central, fascinating, and intensely problematic document, known as “G3,” was a previously unknown anonymous denunciation of a virtuoso passage in Galileo’s *Assayer* (1623). G3 claimed that Galileo’s atomic matter theory threatened the Catholic Church’s description of transubstantiation. Redondi’s reconstruction maintained that the familiar account of the subject of the trial, whether construed as contradictory cosmo- or personality politics, was in fact a mere smokescreen, successfully diverting at-

ention from a deeper and more dangerous charge of eucharistic heresy.

The archives of the Holy Office (now known as the Congregation for the Doctrine of the Faith), where G3 resides, opened in the late 1990s; soon after, historians were allowed to read the rest of volume “EE,” in which document G3 appears. Immediately preceding G3, on folios 291r–v, is a related document, “EE 291,” which repeats and develops the charges made in G3. One of the most problematic aspects for some readers of Redondi’s book was his attribution of G3’s anonymous denunciation to the Jesuit Orazio Grassi. What is especially interesting about EE 291 is that, unlike G3, we know for sure who wrote it.

The author was a Hungarian Jesuit called Melchior Inchofer (1585–1648). Called to Rome from teaching duties in Sicily in 1629 to defend his first (nonscientific) publication before the Congregation of the Index, he seems to have swiftly befriended powerful Jesuit professors in the Roman College and secured himself an invitation onto the commission of consultors to draw up reports in the early stages of Galileo’s trial (his report was the most hostile). At a later stage he turned against his order, was found guilty of authoring the infamous anti-Jesuit satire *Monarchia solipsorum*, was imprisoned, and may even have been assassinated by his zealous confreres (see Thomas Cerbu’s essay in *Largo campo di filosofare* [Fundación Canaria Orotava de Historia de la Ciencia, 2001]).

The paradoxical figure of Inchofer is central to the two works under review. Richard Blackwell, who has previously provided us with excellent accounts of Galileo’s relationship with Bellarmine and Campanella, here offers a fine introduction to, and translation of, Inchofer’s little-known *Tractatus syllepticus* of 1633. While the *Tractatus* sheds little light on the trial itself, it is a wonderful example of the way in which some Roman intellectuals, especially Jesuits, sought to provide Urban VIII with an authoritative statement of philosophical orthodoxy. Relevant sections of another book written the same year, the *Prodromus pro sole mobile*, by Galileo’s sunspot sparring-partner Christoph Scheiner, S.J., are also included (though much recent scholarship on Scheiner, especially that of Franz Daxecker, is not mentioned). Blackwell provides a concise and readable account of the trial and Inchofer’s role in it. He clearly traces the development of anti-Copernican biblical exegesis from Bellarmine to Inchofer, as well as the hardening of disciplinary divisions and the forging of interpretive positions (especially Inchofer’s interesting notion of “probable *de fide*

truths"). The attempt to impose philosophical orthodoxy within the Society of Jesus has been impressively described by Ugo Baldini and Peter Dear; what is important in *Behind the Scenes at Galileo's Trial* is Blackwell's insistence that this trend provides us with a central key to understanding the inner disputes of the Galileo trial.

The key document EE 291—discovered and published independently three times in 2001—is, however, not discussed, and so an opportunity to revisit Redondi's thesis through the figure of Inchofer is missed. While the relationship between Inchofer's antiatomism and his anti-Copernicanism would make a fascinating study, it is a characteristic mark of all Blackwell's contributions to the problem of the Galileo trial that they generously provide the reader with easy access to hitherto-unexplored contexts and open up new fields of inquiry.

One of the discoverers of EE 291 was Mariano Artigas, who coauthored *Galileo in Rome* (Oxford, 2003) with the distinguished Galilean William Shea. Whereas that book sought to provide a new perspective on the Galileo trial by privileging the viewpoint from the Eternal City, their new collaboration attempts to "demystify" the episode by taking a series of previous accounts to task. *Galileo Observed*, published with the support of the Templeton Foundation, displays its own sympathies in a refreshingly clear manner, asserting, for example: "In Galileo's day the challenge was to find room for a new form of knowledge (what we call modern science) in a worldview shaped by another way of knowing, namely religion. The challenge nowadays is to reintroduce this older kind of knowledge into an intellectual context structured by science" (p. 197). Such conclusions in no way necessarily follow from the Galileo trial.

The authors' case studies range from the works of the familiar nineteenth-century American polemicists John Draper and Andrew Dickson White to a varied yet predictable selection of recent narratives by authors such as Dava Sobel, Mario Biagioli, and Annibale Fantoli. On the way, they take on, and put down, Bertolt Brecht, Arthur Koestler, and, of course, Pietro Redondi. Unfortunately, these critiques are, on the whole, uninspired and repetitive. The historiography of the trial is complex and fraught and has recently been exhaustively described (up to and including Pope John Paul II's "rehabilitation," at any rate) in Maurice Finocchiaro's balanced *Retrying Galileo, 1633–1992* (California, 2005). Perhaps the most disappointing aspect of the authors' approach is their unconvincing attempt to explain away the problematic existence

of EE 291 and G3 as irrelevant to understanding the trial, even though the former document was written by a central protagonist and begs a serious reexamination of Redondi's hypothesis. There is much still to understand about Galileo, even more about Inchofer. The trial is over, *eppur si muove*.

NICK WILDING

Neil Chambers. *Joseph Banks and the British Museum: The World of Collecting, 1770–1830*. Foreword by **Michael Dixon**. xiv + 195 pp., figs., table, app., bibl., index. London: Pickering & Chatto, 2006. \$99.95 (cloth).

This work pursues in considerable detail the role of Sir Joseph Banks in the development of the collections of the British Museum between the 1770s and the final disposition of the Banks collections in the years after his death in 1820. It is informed by a detailed command of the manuscript evidence available from the Banks Papers (of which Neil Chambers is the editor) and from the archives of the museum itself.

The first substantive chapter provides an overview of Banks's career, especially his travels and his collecting activities, which sets out the basis and terms of his relationship with the British Museum—as donor, trustee, and what Chambers calls "museum agent" (p. 28). Beyond making gifts to the museum from his own collections, and beyond playing a role in the management of the museum as a trustee, Banks informally, but powerfully, shaped the development of the collections by putting his vast networks of contacts and influence at the service of that task. Subsequent chapters trace the details of this process for the collections in ethnography, natural history and zoology, the earth sciences, and libraries and antiquities. Those with an interest in the detailed development of these various types of collection in the British Museum will find much material of interest and value.

Important broader themes, of wider interest to historians of science, are also broached. The chief of these is the transition from a museum world built on private collections and private influence to one in which the British Museum became a genuinely public institution. This is the main focus of concern with the "world of collecting" of the subtitle. Yet, peculiarly, in the development of this theme there is little substantive reference to, or use made of, the extensive scholarship on it in recent years. This is true also so far as interpretations of the career and influence of Sir Joseph Banks are concerned. Indeed,

there is a strange defensiveness about the approach to Banks. The first words of the introduction state baldly: “No attempt has been made in this work to enter into the historiography surrounding Banks” (p. 1). This is both disappointing and also, in an important sense, misleading. The final paragraphs of the conclusion, and sections littered through the book, do in fact engage with Banksian historiography, largely without mentioning names—though to be fair the last footnote of the conclusion does refer to Bruno Latour, who is described as a “French geographer” (p. 170). The lack of direct engagement with what we might call the more adventurous interpretative work on Banks (including, it must be said, my own) is unfortunate. Direct engagement is replaced by occasional sniper attacks on unnamed targets. My *Jugendwerk* on the “Banksian Learned Empire,” of which the British Museum was a part, is ignored (except to replace it by a remarkably similar analysis of Banks’s ubiquity in what Chambers calls “London Learned Society” [p. 4]). An explicit discussion of differences in the conception and interpretation of Banks’s networks implicated in these terms might have been interesting and productive. My later provocations in deploying (and distorting) the work of the “French geographer” on “centers of calculation” by estimating the utility of treating Banks as a center in himself are also ignored, even though much of the analysis offered in this book appears to be an argument against the position that I took there—and, it must be said, an argument not without point. My concern is not personal. It seems to me that other writings are similarly treated. Although they do get a mention, the more subtle interpretations of Banks offered by John Gascoigne, for example, are not thoroughly engaged with. Such an approach is disappointing in that an opportunity is missed to develop further the historiography of the remarkable phenomenon that was Sir Joseph Banks.

DAVID PHILIP MILLER

Annie Chassagne. *La bibliothèque de l'Académie royale des sciences au XVIIIe siècle.* 303 pp., illus., bibl. Paris: Éditions du CTHS, 2007. €37 (paper).

The French Académie Royale des Sciences (Paris, 1666–1793) may well be the best-studied institution in the historiography of science. With the present work, Annie Chassagne, head conservator of the library collections of the Institut de France, adds to this rich literature and gives

us pause to rethink how the academy saw its mission.

Using inventories prepared in 1744, 1765, and 1784, Chassagne shows that the academy’s library hardly existed as such before S.-F. Morand began to serve as unofficial librarian in the 1740s. Even then, the academy seems to have paid little attention to its holdings. Not counting its own publications, in 1744 the academy’s “library” held a mere 266 volumes; by 1765 the total reached 1,000, and it rose to 1,200 in 1784 and then to 1,770 volumes by 1793. The personal libraries of individual academicians and the libraries of other Parisian and provincial institutions, discussed by Chassagne in revealing comparisons, greatly exceeded these low numbers. Dortous de Mairan’s library, for example, held 3,367 volumes, while that of the Bordeaux academy numbered an astounding 12,000 tomes. These figures raise the question of what the academy thought of its repository of books. The academy certainly seems to have accorded greater importance and space to its natural history collections and its collections of machines. Chassagne suggests (p. 69) that the academy *per se* did not consider books to be on the cutting edge of science; but such a view is at odds with the acknowledged role of the academy as the arbiter and judge of truth in science, which judgments were then enshrined in its own publications and those receiving its imprimatur. This puzzling disjuncture, highlighted by this volume, deserves further analysis.

Chassagne provides statistics on various aspects of the academy’s collections (scientific subjects, places of publication, changes over time) that show a surprising preponderance of medical works (18 percent). The defining element of this volume is the author’s sustained emphasis on images and the role of illustrations in the books and manuscripts she surveys. Hers is a meditation on the connections between contemporary science and art, and she discusses not only engravings that accompanied scientific texts but also design and decorative elements, such as frontispieces, borders, and tailpieces, that added to the aesthetic value of contemporary works of science. Necessarily, therefore, *La bibliothèque de l'Académie royale des sciences au XVIIIe siècle* is itself spectacularly illustrated, with ninety well-chosen images taken from books held by the academy. (The high production values of this work generally deserve to be remarked upon.) Engravings were especially important to botanical works and those concerning machines. The author documents a tight link between illustration and text and a movement toward less baroque engravings—

ultimately recognized as best done from life by authors themselves or at least under their supervision. In these considerations Chassigne is attentive to interactions between and among authors, artists, engravers, and printers, and she opens up their world, an essential and too often unheralded dimension of the production of knowledge in the eighteenth century.

The second half of the book highlights forty-seven different books and manuscripts, across a wide range of scientific disciplines, taken from the academy's collections. These include publications of the academy itself, those of other French and European learned societies, translations, and works sent to the academy by its correspondents or others seeking to ingratiate themselves. In three or four pages each, using published and archival sources, Chassigne describes authors, the work in question, its illustrations, the scientific background to the text, and what is known of its reception within the academy. Why she chose these texts and not others is not explained, and what one is ultimately to make of this self-styled "miscellany" is not clear. Yet the vignettes will be useful to historians wanting to learn more about the texts in question, and, more than that, they present a marvelous *tour d'horizon* of eighteenth-century science as it was likely experienced by contemporaries who saw one book appear after another, without foreknowledge of the place we assign them in the history of science.

Particularly for its focus on illustrations and images, this book is a welcome addition to the library shelf set aside for the Académie Royale des Sciences, and the issues it raises should stimulate yet further work and research.

JAMES E. MCCLELLAN III

Desmond M. Clarke. *Descartes: A Biography.* xi + 507 pp., apps., figs., bibl., index. Cambridge: Cambridge University Press, 2006. \$40 (cloth).

Richard Watson. *Cogito, Ergo Sum: The Life of René Descartes.* viii + 375 pp., figs., bibl., index. Boston: David R. Godine, 2002. \$35 (cloth).

Descartes has been well served by biographers. In the past sixteen years, besides these volumes offered by Desmond Clarke and Richard Watson, William R. Shea produced a scientific biography (*The Magic of Numbers and Motion: The Scientific Career of René Descartes* [Science History Publications, 1991]), Stephen Gaukroger an intellectual biography (*Descartes:*

An Intellectual Biography [Clarendon, 1995]), and Geneviève Rodis-Lewis a general biography (*Descartes: His Life and Thought*, trans. Jane Marie Todd [Cornell, 1995]). Watson, in carving out a space for his efforts, classifies previous biographies into a "French Catholic apologetic" (p. 22) tradition (Rodis-Lewis) and a "scientific apologetic" (p. 23) tradition (Gaukroger; Shea fits here as well). He would surely place Clarke in the religious apologetic tradition. He describes his own work as a "skeptical" biography, because he explodes various myths about Descartes, such as that he penned a ballet for Queen Christina of Sweden, *La naissance de la paix* [The Birth of Peace]—a myth that goes back to Adrien Baillet's first biography of Descartes (1691). And whereas Rodis-Lewis and Clarke seem intent on preserving Descartes's Catholicism in good faith, Watson treats Descartes as "cosmopolitan and pragmatist" (p. 150) about his religion and emphasizes his good relations with and sympathy for Protestants (pp. 59–61).

Cogito, Ergo Sum: The Life of René Descartes is a general biography that pays about equal attention to Descartes the philosopher and Descartes the scientist and gives greatest attention to Descartes the man. Some of Watson's appreciation of Descartes's life is conveyed by recounting his own experiences of Poitou (the region where Descartes was born and raised), Ulm and Neuburg (where Descartes's stove-heated room of 1619 may have been), the Alpine pass of Mont-Cenis (through which Descartes traveled to Italy), and towns and cities in Holland, Friesland, and Sweden (where Descartes died). Like Rodis-Lewis and Clarke, Watson covers Descartes's whole life, paying attention to his family, speculating about where he was raised (in La Haye with his grandmother or in Châtellerauld with his great uncle), discussing the suggestion that his relationship with Isaac Beeckman was homoerotic, and doubting that he was secretly married to the Dutch Protestant Helena, the mother of his daughter, Francine. He tracks settings and events as they interact with Descartes's projects and pursuits: his early travels, his later frequent moves within the United Provinces (primarily the provinces of Holland and Utrecht), his trips to France, encounters and disputes with other intellectuals, anatomical observations and vivisections, efforts to ascertain the Catholic orthodoxy of his metaphysics, the birth and death of his daughter, quarrels with his brother over managing his inheritance from their father, trouble from Calvinist theologians, relations to Princess Elisabeth and Queen Christina, and the composition and publication of his ma-

jour works. The close descriptions of these episodes, based on published sources and Watson's trips to local libraries, archives, and residences, are interspersed with Watson's often entertaining commentary on the state of Descartes scholarship and the question of how to make sense of this man. The central biographical chapters are bracketed by Watson's own philosophical appreciation of Descartes's scientific and philosophical achievements, including the ways in which Descartes's thought continues to shape debates about the place of the mind in nature. In these philosophical discussions, Watson reveals his respect for the Cartesian legacy and his sympathies on the side of materialism.

Descartes: A Biography, like Watson's volume, is the product of sustained and fruitful research. Clarke characterizes his as the first biography in English to address "the full range of Descartes' interests in theology, philosophy, and the sciences" (p. i). Clarke himself was trained in Catholic theology, and he brings this knowledge to bear on Descartes's discussion of transubstantiation and of free will in relation to predestination (Clarke finding Descartes's answers unsatisfactory). Watson also covers Descartes's engagements with theology, but with a different outlook: Clarke takes Descartes to be directly interested in proving the existence of God and the immortality of the soul in order to fulfill the theological charge of the Council of Trent to Catholic philosophers, and he treats his other theological efforts seriously and finds them wanting; whereas Watson (more plausibly, in my view) has Descartes presenting the arguments about God and the soul as a way of securing foundations for his physics and sees his other theological engagements as prudential (on behalf of his metaphysics or defending against the serious charge of atheism). Clarke's book, however, is not primarily focused on theological matters, and he covers Descartes's life and the circumstances of his philosophical and scientific publications in great detail. He is less kind to Descartes in some cases. Whereas Watson (as Rodis-Lewis) believes that Descartes formed a strong emotional attachment to his daughter and was shaken by her death, Clarke paints a cooler picture (p. 134). At the same time, he adds a new fact to the story, revealing (courtesy of private communication from Jeroen van de Ven) that Descartes later served as witness at Helena's wedding in 1644 and may have provided money to support the marriage (pp. 135–136). Clarke portrays Descartes as "a reclusive, cantankerous, and oversensitive loner" (p. 180), a judgment with which Watson only partly agrees (comparatively showing sympathy toward Descartes in his fallout with Beeckman). No less than Watson, though perhaps

less openly, Clarke permits himself to speculate, as when he suggests that Descartes's discussion of prenatal mental states (an extension of his detailed theory of the passions or emotions) simply reflects his own postnatal memories of his wet nurse rather than "reliable medical research" (p. 10) or presents as established fact that Descartes did not receive the approbation of the Sorbonne (pp. 205–206), as he asserted on the title page of the first edition of the *Meditations* (1641). There are some odd lapses, as when Clarke baldly states that there is no indication prior to 1640 that Descartes "was remotely persuaded by skeptical doubts about the possibility of knowledge" (p. 189). This is doubly odd, for it appears to ignore the opening paragraphs of Part 4 of Descartes's *Discourse on the Method* (1637), which introduce skepticism based on dreaming, and it suggests that Descartes actually was persuaded of a skeptical threat after 1640, as opposed to his merely raising a more radical doubt in the *Meditations* than he had in the *Discourse* so that he could make more metaphysical hay through the instrument of his method of radical doubt. All said, Clarke's careful and thorough work is a welcome contribution.

Although each author describes the circumstances in which Descartes published his various works and gives some characterization of their contents and of Descartes's aim in composing them, neither enters into detail regarding their contents or results. For exposition of the scientific content of Descartes's works, especially, one should turn to Shea or Gaukroger—or to more specialized studies. Clarke provides a useful map and table of where Descartes lived and when. Each work has a modest but useful bibliography. Clarke's index is meager, Watson's extensive. The corrected paperback edition of Watson's work (which appeared in September 2007) is preferred.

Historians of science who are interested in Descartes's biography, as opposed to his scientific biography in particular, will be well served, in different ways, by these two works. Clarke's is a more standard biography, Watson's more personal. There is much to learn from each.

GARY HATFIELD

Anne Ashley Davenport. *Descartes's Theory of Action.* (Brill's Studies in Intellectual History, 142.) xvii + 310 pp., bibl., index. Leiden: Brill Academic Publishers, 2006. \$129 (cloth).

This is not the first book to deal with Descartes's religious convictions, but despite some limitations and questionable interpretations, it is one of the best. Anne Davenport's primary focus is on Descartes's development of the *ego* and its

relation to God's infinity. The action in the title refers to the activities of mind and how the *ego* must come to conceive itself through God.

The main limitation, and strength, is simply that most of the book consists of an intensive reading of Descartes's *Meditations*. This reading is sandwiched between some quite provocative, insightful discussions of Descartes's relation with Abbé Bérulle and his presumed reliance on Francis of Sales (the latter motif continues off and on, most usefully, through the reading of the *Meditations*) and some limited references to Descartes's religious comments in his letters to Elizabeth.

However, there are sparse references to Descartes's later works, from the *Principles of Philosophy* (1644) onward. This makes one wonder whether Descartes retained such religious convictions in his later life. The same themes do not seem to play a large role in the *Principles*. This raises the possibility that though he may have been sincere in the *Meditations*, he later changed his mind about the importance of such reflections; alternatively, he may have been constructing the *Meditations* in a quite deliberate way in order to curry favor with the theologians.

I have one serious problem with Descartes's *Theory of Action*. Though the scholarship is excellent and the reading is quite detailed and, for the most part, a worthy interpretation of the *Meditations*, I often could not tell when the author is approving of Descartes's arguments and believes that they are good or even plausible and when she is just reporting what his position is. Her style is frustrating in this respect, especially when it comes to importing certain anachronisms as expository tools.

At times Davenport says the strangest things as though they should be obvious to all her readers. Consider, for example, "Incomprehensibility, in the limit when logical possibility is infinite, necessary Truth necessarily exists" (p. 165). This is written toward the conclusion of discussion of God's infinity relating to the *ego*'s finitude. About human knowledge of infinity she earlier writes: "By conceiving of reality logically as a quantitative progression, the *ego* 'manifestly knows' that there is 'more reality in an infinite substance than in a finite substance.' *Manifeste intelligo*: the positivity of the infinite signified by the name of God is evident to the *ego* because the *ego* has framed for itself an infinite structure in which one and the same abstract quantity progresses from zero, through an open-ended series of finite degrees, to infinity" (pp. 161–162). This suggests that humans do have content for their concept of infinity and that said content is set theoretic in character. At

one point she even cites Paul Halmos's classic text on naive set theory (p. 160). This is anachronistically strange. Yet then she goes on to explain how there really is no content to human knowledge of infinity: "Finite *perseity*, starting with the *ego*'s own self subsistence, now appears to be limited, relative, imperfect—analogous to God's *perseity*, but in such an infinitely lower order as to lose its essential meaning." Or again: "The *ego* knows now that the idea of infinite substance is valid and knows that its content is incomprehensible" (p. 162). Yet, she concludes, "since the paradigmatic case of *perseity* . . . is, as such, incomprehensible to the finite *ego*, only the logical (or mathematical) term at infinity remains clear and distinct" (p. 163). So set theoretic intuitions and logical necessity are part of Descartes's philosophy? I must admit to finding this an odd way to get some content for infinity. But then the topic of God's infinity and its role in finite human understanding is not, in general, one that lends itself to pellucid prose.

Despite these reservations, I strongly recommend this book to anyone who wishes to delve into the depths of Descartes's religious thoughts and read about some of its contextualization. Davenport makes a convincing case that you cannot understand the *Meditations* unless you take that leap.

PETER MACHAMER

Larrie D. Ferreiro. *Ships and Science: The Birth of Naval Architecture in the Scientific Revolution, 1600–1800.* 441 pp., illus. Cambridge, Mass.: MIT Press, 2007. \$45 (cloth).

The *Oxford English Dictionary* now defines "naval architecture" as the planning or design of ships and the superintendence of their construction. Historically, the term emerged in the late 1500s to describe a new approach to the design and construction of warships, organized around the use of three-view, architectural-style plans.

Ships and Science gets off to a shaky start with a strange definition of "naval architecture" as the application of scientific theory to ship design, the theory in question being that developed by various European savants in the eighteenth century and generally referred to as "naval science" in England, after the title of a book by Leonhard Euler.

In light of the dictionary and historical definitions of "naval architecture," readers may note a certain confusion as to the subject matter here. It can't be the "birth" of a naval architecture that already existed. It might be naval science, but

this is confused with naval architecture as a whole. It might be naval architecture, but theory is only a small part of that subject. Muddying the waters still further, the prologue gives a detailed account of the doings of the French scientist Pierre Bouguer up to 1744, when he is described as “ready to bring the laws of naval architecture down from the mountain” (p. 22). This makes it seem that Bouguer is the subject of the book, and he is certainly its theory-hero, but this is not his biography.

Bouguer? Naval science? Naval architecture? Larrie Ferreiro seems to have been unable to choose one or the other of these subjects and arrange his material accordingly. The result is a disorganized book that contains an excessive amount of extraneous material.

The nature of the problem is apparent in the preface. If this were a biography of Bouguer, then biographical details would definitely belong. If the subject is naval science, then we don't really care what Bouguer and his colleagues and their mistresses were doing in the mountains of Peru on a geological expedition for several years. Similarly with the first chapter: if the subject is naval science, then this chapter should have described the problems in shipbuilding that naval science was supposed to solve. Instead, it's filled with a hodge-podge of often mischaracterized, seemingly irrelevant information about the number of ships in various European navies, the use of cannon, the line of battle, and ship models, along with mention of the use of plans, a few words about early treatises on naval architecture, and so on.

Naval science is indeed the focus of the book's three main chapters. The first deals with mathematical theories relating to the maneuver and masting of ships. The second deals with theories of ship resistance. The third deals with theories of ship stability (that is, the ability of ships, when inclined, to return to the upright position). Mathematical theories of maneuver are not usually considered part of naval science, and theories of masting are not traditionally thought to be part of naval architecture. So the author may have done good service here by drawing attention to conceptual relations between these topics, just as he has done good service in bringing together a large number of French citations for the English-speaking reader.

Regrettably, each of the three main chapters suffers from the same combination of odd organization and extraneous material. One might think, for example, that a chapter on maneuver should start with a discussion of maneuver. It starts instead with a history of the Jesuits. The

chapter on resistance contains a completely unnecessary discussion of Cartesian vortices, as well as several other apparently irrelevant aspects of the Scientific Revolution. Two-thirds of the way through the chapter on stability there is suddenly a discussion of Robert Merton's theory of simultaneous invention. And so on.

The structural oddity of the book is rounded out by a very peculiar fifth chapter that, after repeating biographical details given earlier, literally lists the tables of contents of the “great books” of naval architecture already discussed in the text (more than once). The last chapter purports to describe the professionalization of various European navies in the nineteenth century as if maybe *this* was the subject. The epilogue completes the biography of Bouguer abandoned after the prologue.

The main problem caused by the inclusion of all this material is that not enough time, space, or effort has been devoted to an explanation of the actual science. Too-ready recourse is had to the calculus, as if writing out equations is the main work of the historian. Too little attention is paid to conceptual underpinnings. The diagrams are particularly unhelpful. They are generally not accompanied by any explanation.

In the end, it's clear that Ferreiro has done an enormous amount of reading and made a great many notes. Alas, it seems he could not bring himself to leave any of them out.

DAVID MCGEE

Erica Fudge. *Brutal Reasoning: Animals, Rationality, and Humanity in Early Modern England.* x + 224 pp., figs., index. Ithaca, N.Y.: Cornell University Press, 2006. \$45 (cloth).

Brutal Reasoning explores the role of nonhuman animals—both real and symbolic—in the evolution of early modern ideas about what it was to be human. According to Erica Fudge, animals provided the essential foil against which pre-Cartesian philosophers, theologians, and literati defined and delineated the boundaries of humanity. So much so, she claims, that “without animals, humans would not only lose companions, workers, sources of food, clothing, and so on; they would lose themselves” (p. 36). Secondly, *Brutal Reasoning* also attempts to redress what the author rightly sees as a sort of historical cover-up: a marked tendency within the humanities to ignore or make figurative the animals that were widely referred to in early modern texts. By bringing these animals back into focus, Fudge seeks not only to enrich historical analysis of the period but also to introduce new

ways of conceptualizing humans and their place in the world.

The book comprises seven chapters, each of which covers a different aspect of the debate. Chapter 1 focuses on the so-called discourse of reason—that is, the relatively single-minded efforts of early modern thinkers to establish the distinctiveness and superiority of humans over other animals on the basis of the latter's supposed lack of rationality. Initial attempts to uphold this orthodoxy, however, soon ran into a range of conceptual problems (addressed in Chs. 2–5). For instance, if “human” is defined by the possession of a rational soul, what is the status of a young child who is clearly lacking in reason? In short, when does a human become human? Upon conception? At birth? Or at some other point in biological development? In which case, does humanity emerge naturally as a person matures, or does it require cultivation via education? Conversely, if children are like animals, then it follows logically that animals are like children; and if so, should they not therefore be entitled to a comparable level of ethical treatment? Such paradoxes were further accentuated by occasional examples of unusually sagacious animals. Fudge dedicates an entire chapter to the case of “Morocco the Intelligent Horse,” an early version of Clever Hans, who baffled and intrigued sixteenth- and seventeenth-century audiences with his apparent reasoning abilities and whose cognitive capacities were still the subject of philosophical discussion more than a century after his death (reputedly at the hands of the pope in Rome, where the horse and his master may have been burned as witches). Chapter 6 is dedicated to the writings of René Descartes and their influence (or lack thereof) on contemporary English thought. This, and the concluding chapter that follows, provides one of the best summaries of Cartesian ideology and its historical impact that I have ever read. The gist of Fudge's argument is that, by clearly separating the animal automaton from the rational, human “self,” Cartesian dualism not only gave moral legitimacy to human “dominion” over nature and other animals; it also effectively eliminated animals from future philosophical discussions concerning the nature of humanity. In the traditional discourse of reason, being human was a relative concept that depended on the extent to which one was able or willing to transcend animality through the exercise of reason. To Descartes, being human was an absolute distinction, and any reference to, or comparison with, other animals was simply misguided anthropomorphism.

Brutal Reasoning is not without flaws. The

historical confines of the book are narrow, and it might have been enhanced by more discussion of medieval precursors to the early modern debate. However, the author provides a compendious and helpful bibliography of both primary and secondary sources that offers the reader ample guidance on where to look for supplementary information. Although thoroughly articulate, the text may be too dry for some tastes, and the subtitle of the book is a trifle misleading given that Fudge devotes nearly as much space to the seminal influence of leading French thinkers—Montaigne, Charron, and Descartes—as she does to the English ones. Despite these minor criticisms, *Brutal Reasoning* is a valuable reappraisal of the early modern period and an important contribution to the growing field of human-animal studies. More to the point, perhaps, it also speaks directly to current debates in cognitive ethology, evolutionary psychology, and moral philosophy, where the animal/human boundary has once again become a hotly contested territory.

JAMES A. SERPELL

Stéphane Garcia. *Élie Diodati et Galilée: Naissance d'un réseau scientifique dans l'Europe du XVIIe siècle.* Preface by **Isabelle Pantin.** (Bibliothèque d'Histoire des Sciences, 6.) xix + 448 pp., figs., apps., bibl., index. Florence: Leo S. Olschki, 2004. €46.

Élie Diodati et Galilée is a three-part work detailing some of the intellectual activities of Élie Diodati, one of the two personages named in the title of Stéphane Garcia's book. The significance of Galileo does not have to be defended for readers interested in the history of science, but that of Diodati, an “obscure satellite” orbiting Galileo's “exploding star,” does. Garcia provides a detailed intellectual biography of Diodati, concentrating on him as friend and correspondent of Galileo, and giving also a thorough account of the activities and reactions of Europe's scholars, mathematicians, and natural philosophers after Galileo's trial; as its subtitle announces, the book is concerned with the beginning of a scientific network in early seventeenth-century Europe (a few decades before the birth of scientific societies, such as the Royal Society and the Académie des Sciences, and journals, such as the *Journal des Savants* and *Acta Eruditorum*).

Using archival materials, the first part of the book discusses Diodati's atypical life story. His powerful and wealthy family came from Lucca, an independent city in northern Italy, but immi-

grated to Geneva because of its conversion to Calvinism. Élie Diodati, the eldest son, who was expected to stay in Geneva and to take a religious course in life, as defender of the faith, went instead to Paris to study law. He established himself there as a lawyer and court diplomat. Garcia relates tantalizing bits that demonstrate Élie's independent streak, defying his father's wishes, including possibly a deathbed request. He also finds a formal reprimand of Élie's behavior by collegiate (ecclesiastic) authorities—specifically, he conversed too frequently and in too familiar a manner with a married woman during evening hours and continued this behavior after friends and relatives had warned him against it. Thus Diodati became the odd combination of an Italian-Swiss Calvinist who served as a diplomat for the (Catholic) government of France (and who even immigrated permanently to France before the Edict of Nantes).

The second part of the book discusses Diodati's participation in the "republic of letters." Diodati maintained relations with a large number of geographically scattered scholars, meeting personally with many of them, traveling in the Netherlands, Italy, Germany, England, and France. His large circle of friends and acquaintances was perhaps not quite as large as that of Marin Mersenne and N.-C. Fabri de Peiresc, but it included the latter two and such quality correspondents as Hugo Grotius and the Huygens family (the statesmen Christiaan and Constantijn and the physicist-mathematician Christiaan) in the Netherlands; Cesare Cremonini and Galileo in Italy; Matthias Bernegger and Wilhelm Schickard (a correspondent of Kepler's) in Germany; Herbert of Cherbury and Thomas Hobbes in England; and Pierre Gassendi in France. Diodati was a member of the Tétrade, a group of four close friends, also referred to as *libertin érudits*: Diodati, Gabriel Naudé, Gassendi, and François de La Mothe le Vayer.

The third part of Garcia's work is a reconstruction of Diodati's correspondence with Galileo, most of which was lost, as were many such epistolary exchanges from the period. Diodati oversaw the Latin translation and 1635 publication of the *Dialogue on the Two Chief World Systems* as *Systema cosmicum* by the Elseviers in the Netherlands, as well as his own Latin translation, with an introduction presented under a pseudonym, of the *Letter to the Grand Duchess Christina* in 1636. The latter was intended to be published in *Systema cosmicum* but did not arrive in time. The Latin translation of the *Dialogue* was accomplished by Bernegger—Diodati's frequent correspondent, professor of history

at Strasbourg, correspondent of Kepler—who had previously translated into Latin Galileo's first published work (1606) on the geometric and military compass (the Latin translation was published in 1612). Diodati also acted as intermediary in the publication of the *Discourse on the Two New Sciences*.

Élie Diodati et Galilée is an excellent piece of work, a very welcome treatment of seventeenth-century intellectual life. In the penultimate chapter on *Libertas philosophandi* Garcia analyzes the tactics behind Diodati's attempts to publish Galileo's works and examines the arguments in his introduction to the *Letter to the Grand Duchess Christina*. He describes Diodati's recognition of the importance of contact and correspondence, along with his role as discreet intermediary, in deepening the level of philosophical discussion on behalf of the new philosophy.

ROGER ARIEV

Michael Hunter. *The Boyle Papers: Understanding the Manuscripts of Robert Boyle*. With contributions by **Edward B. Davis, Harriet Knight, Charles Littleton, and Lawrence M. Principe.** xi + 674 pp., apps., index. Burlington, Vt.: Ashgate, 2006. \$99.95 (cloth).

The Boyle Papers is, in the first instance, a book about an archive. Its subject is the enormous deposit of papers deriving from the eminent seventeenth-century natural philosopher Robert Boyle (1627–1691) that has been at the Royal Society of London since 1769. As such, it contains an extended treatment of the papers and letters included in the archive, outlining their history, their contents, and the various strata within them. The volume also contains a revised catalogue of the Boyle Papers, which completely supersedes the catalogue published in 1992 (Michael Hunter, ed., *Letters and Papers of Robert Boyle* [Univ. Publications America]).

But the volume is much more than a descriptive account of and navigational tool for one of the richest scientific troves to come down to us from the early modern period. For *The Boyle Papers* includes a set of studies of the contents of the archive that together furnish us with an exemplary model of how scholars can quarry a mass of over twenty thousand leaves in order to glean new and important insights into the intellectual development of a leading scientist and his methods of work.

The volume opens with a short introduction that summarizes the ensuing chapters and sets the archive in its wider context, relating the Boyle Papers to other substantial archives from

the period of the Scientific Revolution, such as those of Newton and Leibniz. This is followed in Chapter 1 by a substantially revised version of the account of Boyle and his archive that introduced the 1992 catalogue. As Michael Hunter notes, the original catalogue was, in a sense, the victim of its own success, insofar as it was a catalyst for new research on the archive that had the effect of rendering the original catalogue obsolete. The same can be said for the introductory essay to that catalogue, for since 1992 an enormous amount has been discovered about the Boyle Papers that has given us a more accurate understanding of its various strata and diffuse contents. In the updated account we are provided with a useful overview of recent developments in Boyle studies and the ways in which the archive has been put to use. For instance, we learn of the identification of a hitherto-unknown amanuensis of Boyle's, Thomas Emes, and about various other improvements to our understanding of the handwriting found in the archive. We also get a sense of the collaborative nature of recent work on the archive. This is well illustrated by the summary account of the discovery by Lawrence Principe of an inventory by the eighteenth-century non-conformist divine Henry Miles (BP 36, fol. 196) of bound volumes within the archive. This inventory proved to be an important key for the discovery and identification of additional, unknown Boyle manuscripts elsewhere in the Royal Society's general manuscript series.

Not surprisingly, some of these manuscripts, as well as material within the archive itself, have been lost, and Chapter 2 (by Hunter and Principe) documents the state of our knowledge of materials that, frustratingly, have disappeared from the archive. Chapters 3 and 4 are those that will be of greatest interest to historians of science, for they provide introductions to and detailed analyses of two particularly rich sources for Boyle's method of work and his approach to the organization of knowledge. In an importantly augmented reprint of Hunter and Charles Littleton's article on Robert Boyle's Workdiaries, we learn of an extraordinary and yet underutilized set of experimental diaries that is randomly distributed throughout the archive. The following chapter is a hitherto-unpublished study by Hunter, Harriet Knight, and Littleton of another set of documents within the archive that constitute the basis of an uncompleted work, entitled *Paralipomena*, that Boyle was preparing in the 1680s.

The *paralipomena* were supplements or appendices to natural philosophical works that Boyle had published and that comprised repos-

itories of newly accumulated data or data that had not made it into the original publications. Boyle's chapter headings for this work and the methodological rationale he gives for the arrangement of its various parts reveal both the extent to which his natural philosophical methodology was an elaboration of Francis Bacon's method of natural history and the extent to which Boyle viewed his own publications as merely first installments in an ongoing, even collaborative, enterprise. On the one hand, the *paralipomena* serve as a kind of key to those experimental and data-gathering projects that had continued into the last decade of Boyle's life; and on the other hand, they reveal the difficulties Boyle had in ordering and arranging the plethora of observations and experiments with which he was dealing. But the importance of the *paralipomena* transcends the archive itself, shedding important light on some of Boyle's major publications from the last decade of his life, such as *Human Blood* (1684) and the posthumous *General History of the Air* (1692).

The fifth and final chapter preceding the catalogue (which comprises over half of the volume; pp. 277–651) is a study by Hunter and E. B. Davis of the process of composition of another of Boyle's important publications from his last decade, the *Notion of Nature* (1686). In all, *The Boyle Papers* is an important and timely publication. One hopes that other substantial early modern archives will soon be subjected to the same level of expert scholarly analysis.

PETER ANSTEY

Vincent Jullien. *Philosophie naturelle et géométrie au XVIIe siècle.* (Science, Techniques et Civilisations du Moyen Âge à l'Aube des Lumières.) 477 pp., figs., table, index. Paris: Honoré Champion, 2006. €83 (cloth).

"If this book were a novel, one would have to acknowledge Descartes and Roberval as its main heroes" (p. 439). However, it isn't a novel but a collection of essays, half of them dedicated to "natural philosophy," half to "mathematics and philosophy," and many of them previously published elsewhere, albeit sometimes in fairly different form. Still, Descartes and Roberval do provide the thematic nucleus of Vincent Jullien's collection. In the Adam-Tannery edition of Descartes's correspondence, Roberval is the most frequently mentioned author, although it appears from contemporary sources that on the few occasions when the two men met they spent their time loudly disagreeing with one another. Professional rivalry and jealous competition for

Marin Mersenne's esteem may explain the emotional aspects of their uneasy relationship, but Jullien prefers to stress their intellectual differences, and in particular these: First, for Descartes, all science sprouts from the roots of metaphysics, whereas Roberval has little time for first philosophy. Second, the two men differ over the foundations of their respective geometries: whereas Descartes tries to derive his geometrical notions from a set of basic intuitions, Roberval embarks on novel applications of mathematical indivisibles. Third, Roberval subscribes to a radically different view of natural philosophy than Descartes does and attacks the latter's belief in mechanical explanations, his denial of the vacuum, his theory of light, and his mental derivation of an ordered world from initial chaos (Ch. 12). Incidentally, Jullien resents that Roberval has not been treated fairly in the historiography, and some of his best pages are dedicated to his vindication. For example, Jullien finds that Roberval's claim to have developed a geometrical method based on infinitesimals at least as early as Cavalieri is not implausible. In Chapter 11 he not only provides a detailed chronology of Roberval's application of his method to geometrical figures, beginning with the 1630s fragments on the trochoid, but also explains the fundamental difference from Cavalieri's indivisibles. In Roberval's case, the indivisibles were homogenous with respect to the magnitude analyzed (surfaces being the indivisibles of surfaces, etc.), but in Cavalieri's case they were heterogeneous (lines being the indivisibles of surfaces, etc.).

All the other chapters have in some way or other to do with the above-mentioned issues separating Roberval and Descartes. For example, the memorable title of Chapter 9 states that "in Descartes, intuition stands to deduction as geometry stands to algebra." The thesis behind this analogy constitutes one of the leitmotifs of Jullien's book. Descartes felt that geometrical magnitudes were directly present to the mental eye, whereas he thought of his geometrical algebra as a type of formalism that could be used, notably, for treating polynomes but that by itself was not directly accessible to intuition, in the same way that he thought of a deduction as an ordered chain of intuitions that, as a whole, went beyond what was given directly in intuition. Descartes's view of algebraic formulas as artifacts implied that they had to be derived from basic geometrical intuitions. But what to do when one encountered an empirically valid formula that had not first been derived from such intuitions? In what may be the most fascinating theme in his book—and one that he addresses in a number of chapters—Jullien investigates the

problem provoked by the law of refraction, on whose mathematical formulation everyone agreed and on whose presumed physical basis everyone disagreed. In Chapter 2, for example, he analyzes Newton's and Leibniz's respective theories of light in great detail. His conclusion is that whereas both men mathematized physics, "Newton develops a mathematics to validate his physics, while Leibniz turns to physics so as to affirm and validate his mathematics" (p. 124). The phenomenon of light is also, for Jullien, a paradigmatic case where experimental evidence propels natural philosophy in new directions, often against the latter's abstract tendencies (Ch. 3).

This book is full of interesting insights, notably where it speaks of the evolution of French physico-mathematics. It is somewhat less convincing on the few occasions when it opens its angle of vision to survey the wider European scene. Jullien knows his French sources but is less well acquainted with the scholarship available in other languages and treating of other countries. In fact, his non-French quotations and bibliography are sloppy. Furthermore, his first chapter in particular, on the debate concerning the vacuum, is too skewed toward the French situation to be entirely reliable. The oddest thing about it is without doubt the appended chronology (pp. 68–69), which suggests that the international debate concerning the void started with that utterly inconsequential corollary found in Isaac Beeckman's medical thesis on tertian fever, defended at Caen in 1618, and passes over in silence the Italian engineering context of 1630 in which the debate truly originated. This distortion (which is only partly corrected in the chapter itself) is possibly due to the intellectual position that Jullien feels he must embrace in the introduction to his book. That introduction, which is the only truly bad part of *Philosophie naturelle et géométrie au XVIIe siècle*, is an orgy of anachronistic and seemingly unmotivated anger. It whips Thomas Kuhn's allegedly externalist school of historiography and hails Jean Dhombres (to whom the book is dedicated) as the redeeming internalist alternative. Dhombres is quoted as insisting on the primary desire of figures such as Galileo and Descartes "to do science while dissociating the problems of their lives from the intellectual problems at hand" (pp. 20–21). The assertions of the introduction are too unsophisticated to rebut—all the more because they are not at all required by the content of the book. Readers are strongly advised to start perusing this otherwise fascinating book at Chapter 2.

CHRISTOPH LÜTHY

Eve Keller. *Generating Bodies and Gendered Selves: The Rhetoric of Reproduction in Early Modern England.* xi + 248 pp., figs., bibl., index. Seattle: University of Washington Press, 2007. \$30 (paper).

In *Generating Bodies and Gendered Selves*, Eve Keller studies well-known anatomical, medical, and obstetrical texts published in England between the early seventeenth and early eighteenth centuries, noting how they construct gendered identities. In focusing on reproduction in early modern England, she joins an expanding group of scholars who analyze the changing representations of gender and the body produced during a period of religious and political upheaval (Lisa Forman Cody, David Cressy, Mary Fissell, Elizabeth Harvey, and Adrian Wilson, to name only a few). Keller's overall argument is that although Galenic models of physiology were being challenged in the texts she investigates, concomitant gendered hierarchies were reinforced and even intensified. Men were increasingly associated with a disembodied form of individuality, whereas women were identified with their wombs and not awarded a similar degree of personhood.

Keller claims that in his anatomical text *Microcosmographia* (London, 1615), Helkiah Crooke strove to adhere to Galen's theories but ultimately diverged from them by implying that a disembodied self presided over the parts of the body. Crooke explained that the stomach, for example, became full so that "wee may have leisure for other business" (*Microcosmographia*, p. 118; cited in Keller, p. 59). Keller argues that such references to "we" and "us" posit an entity separate from the body, presaging an autonomous sense of the person. She distinguishes her interpretation of Crooke from that of David Hillman and Carla Mazzio, editors of *The Body in Parts: Fantasies of Corporeality in Early Modern Europe* (Routledge, 1997), who assert that a new aesthetic of the part was created during the early modern period. They contend that when Crooke claimed that "a part is a body cohearing or cleaving to the whole" he produced a contradictory image of attachment and detachment in keeping with contemporary practices of anatomical dissection (Hillman and Mazzio, p. xv).

Keller goes on to address how the revision of Galenic theories in early modern English publications could retain the one-sex model of the body famously described by the historian Thomas Laqueur in *Making Sex: Body and Gender from the Greeks to Freud* (Harvard, 1990) while nevertheless insisting on sexual difference. In her discussion of *A Directory for Mid-*

wives (2nd ed.; London, 1656), she notes that Nicholas Culpeper employed Galen's concept of the bodily homology between men and women in order to stress difference. After describing the male testes, he asserted that "the Stones of Women (for they have such kinds of toys as well as Men) differ from the Stones of Men" (Culpeper, p. 29; cited in Keller, p. 89). Keller relates Culpeper's subsequent characterization of the female stones as "less" than those of men to his rigid insistence on female inferiority, a point also made by Mary Fissell in *Vernacular Bodies: The Politics of Reproduction in Early Modern England* ([Oxford, 2004], p. 143).

Keller's book offers a compelling series of close readings of selected texts, undertaking detailed analyses of their language to reveal implicit ways of thinking in early modern England. Though Keller refers to the anxieties caused by the religious and political turmoil of the time, the historical context of the publications is studied in greater depth in Fissell's book. *Generating Bodies and Gendered Selves* will thus be of most interest to literary scholars concerned with the emergence of the modern subject in written texts, but it should also appeal to historians of medicine as a companion to the historical accounts.

LIANNE MCTAVISH

Maria Teresa Monti. *Spallanzani e le rigenerazioni animali: L'inchiesta, la comunicazione, la rete.* ix + 424 pp., figs., bibl., index. Florence: Leo S. Olschki, 2005. €47 (paper).

Maria Teresa Monti has investigated a central, but rather unanalyzed, part of the scientific work of Lazzaro Spallanzani (1729–1799). Spallanzani's few publications on animal regeneration constituted a partial *post festum* presentation of his experimental discoveries. Monti is the first to have scrutinized the immense wealth of manuscripts on the Italian scientist's groundbreaking inquiries in that area, in particular the notebooks of experiments, research agendas, and plans for defining a "canon" of laws based on the parameters of organic self-restoration. Spallanzani's interest in the regeneration of organs had been triggered by investigations such as Réaumur's on crayfish, lobsters, and crabs, Trembley's on hydras, and Bonnet's on freshwater worms. In 1765–1768 Spallanzani would fill his "Giornali" with extensive and detailed experiments on "riproduzioni animali": he would experiment on worms (especially earthworms), frog and toad tadpoles, salamanders and newts, slugs and snails. In all cases he excised parts following

graded series of mutilations and tried to account for the multiple variables, representing environmental (habitat, temperature, nutriment) and organic (life cycles, anatomical and physiological features, reproductive modes) conditions, that affected the experiments' positive or negative outcomes.

In Chapter 2, "Le esperienze" (pp. 47–134), Monti analyzes those three years of overwhelming experimental activity, when experiments took place between spring and fall and the planning of "cose da farsi" and complementary reading occupied the cold months. Along the way, Spallanzani reported to Bonnet on his work in a rather partial fashion and exploited the Genevan naturalist as a source of information and a sounding-board on interpretive issues. But he did not communicate his real progress to his "mentor"—nor the uncertain results, frequent morphogenetic disorders, and interpretive ambiguities he confronted. Bonnet was essentially interested in collecting proofs for a theory positing the pre-existence of specialized local germs responsible for the reconstitution of organic parts. Needham, who would not meddle in "metaphysical issues," was faced with experimental situations that could be accounted for either by germ-derived organic formation or by epigenetic tissue extension: a case in point was bone reproduction in leg-amputated salamanders. In his investigation of tadpole mutilations, however, Spallanzani—who reasonably suspected that reproductive processes followed lawlike determinations, akin to those of generation—also undertook series of observations on the fertilization of amphibian eggs. Assimilating these eggs with preformed organisms apparently found in an unstructured state, he sided with the supporters of a "visibilità debole" requirement (Bernardi) for preformation theories. Meanwhile, Spallanzani accumulated convergent, but at times ambiguous, observations, especially on the microstructural and physiological conditions of organic restoration, on inordinate morphogenetic processes, on natural and artificial monstrosities, and on the indefinite number of variables that might intervene in vital phenomena set at the borderline of inorganic processes.

Chapter 3, "La comunicazione" (pp. 135–260), examines the multiple publication plans for a "grande opera" on regenerations. The most significant projects pointed to the writing of "mémoires" devoted to the animal species observed. Unlike Bonnet, Spallanzani was not interested in producing a manifesto supporting the pre-existence of germs: "L'epigenese me deplait autant, que je suis porté pour les germes. Je n'aime pourtant pas que mon lecteur s'aperçoive de l'affection pour ce dernier systeme. Je veux

qu'il me juge par les faits et par les conséquences immediates que je tirerai de ces faits" (p. 138). But Spallanzani never succeeded in compiling his innumerable data in an appropriate scholarly form. Instead, he published a "program" for the future treatise, with summaries of experimental inferences extracted from his "Giornali": among those itemized were the iterative reproduction of heads and tails and anastomosis of the natural and artificial parts in sufficiently large excised portions of earthworms; the reproduction of excised tadpole tails, which depended on the relative immaturity of the mutilated organism and resulted in surprising circulatory disorders; the restoration of the antennae, foot, collar, and head of snails, with some disorderly variants in the reproduced parts; and the neoformation of bones in repeatedly excised tails and legs of salamanders. All these would illustrate a "canon" of strict equation between the artificial part and the excised one, any aberration being presumed to result from partial or imperfect mutilations. The *Prodomo di un'opera da imprimersi sopra le riproduzioni animali* (1768) was soon translated into French (1768), English (1769), and German (1769). The regeneration of snail heads instantly became a subject of controversy across Europe. Monti analyzes the various experimental contributions that emerged on both sides of the debate, along with Spallanzani's replies and the incentives he offered supporters for further experimentation. Among the principal scientists involved, mention should be given of the opposition—or reservations regarding various nuances—of Lavoisier, Adanson, Schröter, and Müller; support—though with caveats—came from Bonnet, Girardi, Caldani, and Senebier. Bonnet even resumed experimental work and published a series of "mémoires" in the period 1777–1781 on some of the themes developed in Spallanzani's research program. While still promising the publication of his "grande opera," the now celebrated Italian naturalist issued two memoirs on the regeneration of the snail's head in 1782 and 1784: one rehearsed the statements of the *Prodomo* in a more polemical mode, so as to counter criticisms voiced by the scientific community; the other was an artfully contrived selection of texts from the polemics.

The failed publication of the *magnum opus* is skillfully analyzed in Chapter 5, "Dell'Opera mai scritta" (pp. 337–377). But Monti is especially to be lauded for Chapter 4, "I Lombrici" (pp. 261–335), in which she focuses on Spallanzani's experimental investigations on earthworms. Her close survey of the "Giornali" establishes the outstanding anatomical and physiological features of Spallanzani's analytic work. But, because of the partial or even failed diffusion of his work, we

must wait for later researchers to produce equivalent experimental results. Monti concludes her erudite, well-argued, and enlightening study with what are probably some of the best pages available anywhere on Spallanzani's views about the decentralized organic conditions of biological individuality and on his constant quest for a "canone generale" (p. 386) that would account for the general elementary features of physiological processes. Spallanzani deployed strategies of using interpersonal relations to achieve academic recognition, but his entire effort was grounded in "a slow and tortuous crystallization of partial results that emerged from his re-elaborating observations previously made, rectifying his methodology and working matters through" (p. 390). This monograph will probably remain a landmark for historians of eighteenth-century natural science.

FRANÇOIS DUCHESNEAU

Richard B. Sher. *The Enlightenment and the Book: Scottish Authors and Their Publishers in Eighteenth-Century Britain, Ireland, and America.* xxvi + 815 pp., illus., figs., tables, apps., bibl., index. Chicago: University of Chicago Press, 2006. \$40 (cloth).

Richard Sher's *The Enlightenment and the Book* offers a clever interpretation of the Scottish Enlightenment. Instead of spending reams of paper dutifully recounting all of the debates and existential angst that the term "Enlightenment" engendered for the Frankfurt School or for francophone literary critics, Sher's introduction explains that his approach draws from a long line of well-established scholars who specialize in the history of the book, a subfield of history and literature that has strong connections with what is sometimes called bibliographic history, the history of reading, and the sociology of texts. More specifically, he sees his work as part of a larger tradition that includes authors like Robert Darnton, Elizabeth Eisenstein, and David McKitterick. On a more Scottish level, his research falls solidly within the current school of Scottish book history that has sought to shift the limelight from a canon fashioned in the Victorian era to one that focuses more on the periodicals, books, and other sources of print that were considered to be authoritative by those who lived during the eighteenth century. His research therefore complements the work of Paul B. Wood, David Allan, Stephen Brown, and Warren McDougall. Since the notion of the "Scottish Enlightenment" means many things to many people, Sher uses the term to represent a common core of interests in mid to late

eighteenth-century Scotland that revolved around notions of improvement, sociability, humanity, toleration, and intellectual cultivation. In this sense, his use of the term encapsulates a movement that was "not in a fixed body of doctrines or a universal reform program or an institutional structure or a particular field or school of thought but rather in a set of general values to which proponents of the Enlightenment adhered" (p. 16).

The book is based on an impressive array of primary sources, and it is unequivocally a major achievement that represents the fruition of three decades of research. In particular, Sher scoured archives spread across the world to create a list of 115 authors whose books went on to have a significant impact on Scotland's Enlightenment ideals or became part of the medical, law, arts, or divinity curricula taught in Scottish, Irish, and American universities well into the nineteenth century. His overriding goal is to show how these books, and hence the ideals and values contained in their pages, spread out from the presses of Edinburgh into Scotland, London, Ireland, and then Philadelphia and the American market. Although the book is over 800 pages long, it is neatly divided into four sections. The most important of these is the appendix, the first table of which lists the biographical details of the authors under consideration. A second table lists the format, number of volumes, price, topic, Sher's unique "popularity rating," and publication details for the 360 Scottish, Irish, and American first editions published by the said authors. This is followed by a third table that lists the publishers who brought these books to print. Although Sher's own previous work on the subject has led him to include or omit names of authors and publishers from his impressive lists, his introduction clearly indicates that his research represents the tip of a bibliographic iceberg: "Yet the book history of the Enlightenment, especially the English-language Enlightenment, remains a story waiting to be told" (p. 5). Even so, Sher has sunk a deep shaft down into an extremely dense pile of sources, and his work will no doubt serve as a reference point for historians of print culture and reading practices for years to come.

Drawing from the information contained in the tables, the first section of the book concentrates on Scottish publishers, particularly their partnerships with the London book market but also their innovative commissioning practices (paying authors directly and handsomely, for example), copyright exploitation, and the intellectual predispositions that led them to appreciate both the content and the economic value of

different types of book. In addition to being London's competitor, Edinburgh was notable because its publishers actively participated in the academically charged conversations that took place in the city's coffeehouses, clubs, and societies. This setting allowed publishers to meet fellow Scots who were authors and to receive valuable advice concerning which non-Scottish works were worth translating and reprinting. The book's next section focuses on both Scottish and Irish publishers who operated in Dublin, the self-styled second city of the British Empire. Sher points out that Dublin had a thriving community of publishers (several of whom were women) that reprinted many of the titles listed in his tables. The overarching theme, therefore, is the complex story of the dissemination of Scottish books, especially the intellectual, social, legal, and financial factors that influenced what types of books publishers brought to print. The third section's treatment of Scottish and American publishers addresses the same issues. Although it mentions New York and Boston, it gives the most space to Philadelphia publishers like Robert Bell, William Young, and Mathew Carey.

The real meat of the book, to my mind, lies in the fact that Sher gives a detailed picture of *what* people read, *who* was able to get their ideas into multiple editions of print, and, to a certain extent, the ways in which the changes that occurred between different editions affected *how* people read books. The underlying target of the study is the very canon of texts associated with the intellectual ferment that took place in mid to late eighteenth-century Scotland. In this sense it connects with a larger movement in recent decades that has sought to reevaluate the criteria used to determine how a text becomes canonical. Inspired by Frank Kermode, Walter Ong, and others, "canon busting" is now a standard feature of studies written in just about every branch of the humanities. This type of research has produced a new sketch of what people were reading in different times and places. Since texts were read in many different ways, these studies often focus necessarily on the notebooks of one person, a defined set of letters, or sometimes one commonplace book. To put the point more simply: they use intellectual microcosms to snipe at the traditional canon of their discipline. Yet, ironically, it is still the canon against which they rage, thereby reinforcing its presence.

As Sher has noted several times over his long career as a historian, the list of authors associated with eighteenth-century Scottish intellectual history has remained relatively impervious to opposition. One need only witness the influx

of recent academic and popular books that take David Hume, Adam Smith, Adam Ferguson, James Watt, Thomas Reid, and James Hutton as the starting point for serious discussion of modern Scottish thought. The reason the canon of the Scottish Enlightenment has remained relatively unchanged stems from the fact that it is one thing to poke holes in it and another to modify or replace it. The former action usually occurs on the individual (scholarly) level, while the latter necessitates a larger shift in both popular and academic opinion. More important, before any shift occurs or an intransigent interpretation is offered, we need more detailed studies on the larger context of Scottish readership, curriculum design, and book circulation. Without this type of information, it will be very hard to offer a convincing argument that will allow scholars to agree on how to dismantle, modify, or replace the canon. This is precisely what Sher's work is attempting to achieve—especially in terms of the material circulation of ideas within a defined geographical setting. For natural history, for example, his approach allows him to sidestep the typical historiographic gaze that seeks to divide the views of Edinburgh's 1780s and 1790s naturalists into those of "Huttonian vulcanists" or "Wernerian neptunists." A cursory look at his publication tables quickly shows that there was a whole lot more on offer, most notably in terms of the specialized articles published in the *Encyclopaedia Britannica*, the *Essays and Observations* of the Edinburgh Philosophical Society, the *Transactions of the Royal Society of Edinburgh*, and the *Transactions of the Society of the Antiquaries of Scotland*. Furthermore, from the natural history lectures of John Walker at the University of Edinburgh and James Anderson at the University of Glasgow, to the works of Lord Kames, Lord Monboddo, William Smellie, Charles Alston, John Hunter, Elizabeth Hamilton, Mungo Park, and more, Scots had much to say on topics that, though relevant at the time, have been overlooked by modern historians because they do not easily fit into the "common sense" or "pre-evolutionary" historiographies so often used to evaluate eighteenth-century Scottish authors. Sher's detailed study exposes the weak points not only in the traditional canon used to represent the history of natural history, but also in the canon frequently employed by historians of natural philosophy, medicine (including chemistry), philosophy, rhetoric, and belletristic literature.

This book represents a powerful tool that will no doubt be used to reinterpret and, I hope, to

recast the intellectual framework so often used to understand the books being read in Britain, America, and the British Empire during the second half of the eighteenth century. It makes a plethora of insightful points regarding the factors that motivated writers to write, readers to read, and publishers to publish. The research is solidly based on printed and manuscript primary sources, thereby allowing it to be responsibly innovative. In short, it raises the bar to a new level for scholars of eighteenth-century Scottish thought who are serious about the cultural history of ideas and who prefer specific examples over brushstroke theorizing.

M. D. EDDY

Richard Sugg. *Murder after Death: Literature and Anatomy in Early Modern England.* 259 pp., illus., apps., index. Ithaca, N.Y.: Cornell University Press, 2007. \$45 (cloth).

The plethora of recent books on medicine, anatomy, and English literature by authors such as Jonathan Sawday, Margaret Healy, Hillary Nunn, and Gail Kern Paster made me skeptical that Richard Sugg could find anything new to say in *Murder after Death*. I'm happy to say I was wrong. Sugg's book is quite original; and although it swings between brilliant and opaque, there are enough brilliant moments to make it well worth reading.

Unlike other authors who have used literature, at least in part, to talk about actual practices and public opinion, Sugg seeks something more elusive that he refers to as "the rhetoric of anatomy," defined mainly as the infiltration of anatomy into English literature and culture between about 1550 and 1630. He considers not only the activity but also the idea of anatomy, which includes metaphors and imagery of cutting, tearing, splitting, eating, and flaying the body. Sugg argues that the work of Vesalius led to a new culture of anatomy that "invad[ed] older traditions of spectacular corporeality" (p. 30). In other words, the act of anatomy and the new, grisly imagery in literature combined to remake the relationship between body and self.

He further substantiates this thesis by a survey of works that employ the word "anatomy" in their titles—a total of 120 titles—as well as a list of allusions to anatomy in sermons. This survey is an excellent example of the impact of electronic books, in this case EEBO (Early English Books Online), which have revolutionized

the way early modernists in particular do research. *Murder after Death* well illustrates the merits of this kind of research, as well as, perhaps, some drawbacks.

Sugg makes his case about the pervasiveness of the new anatomical culture by looking less at canonical works (although he includes an interesting analysis of cannibalistic language in *As You Like It* and *Twelfth Night*) than at more obscure works. Of course, there is a reason some of these works are obscure, and Sugg admits that Henry Chettle's *The Tragedy of Hoffman*, which occupies much of his first chapter, is a pretty awful play (a judgment substantiated by the quotations he provides). Sugg uses the play as a way to talk not only about anatomical imagery but about what audiences would have seen in the staging of this play; he argues that public awareness of dissection meant that the public responded to Chettle's play. Indeed, he goes further, arguing that Chettle might indeed have used anatomical imagery to enliven an otherwise poor play because he knew the public would respond to it. Sugg cannot prove this to be the case, but his proposing it is typical of the plethora of ideas that emerge from this book.

In other chapters, *Murder after Death* explores cannibalism, the idea of the body as proof, the search for a corporeal site for the soul, and vivisection. Sugg looks at a number of authors, from Donne, Jonson, and Shakespeare to the more obscure Jacobean Tourneur, Shirley, and Drayton and the Restoration dramatist Thomas Killigrew, as well as Harvey, Helkiah Crooke, and Henry More. The wide net EEBO casts helps support Sugg's contention of the ubiquity of anatomical imagery, but it raises questions (which Sugg does not address) about how representative these particular authors are of any general *Zeitgeist*.

The last chapter looks at vivisection—not at actual animal vivisection, but at imagined human vivisection, focusing particularly on Thomas Nashe's "protonovel" *The Unfortunate Traveller* (1594). Sugg ends this chapter with a look at the Marquis de Sade. Although James Steintrager's *Cruel Delight* (Indiana, 2004) offers a more thorough analysis of Sade's uses of anatomy, Sugg contrasts Sade with writers of the early seventeenth century to suggest that by the 1780s the soul was no longer an issue. If his conclusion that "ultimately, the body becomes the new soul, just as science becomes the new religion" (p. 205), is a little too pat, the journey to get there gave me some new perspectives on the role of anatomy in early seventeenth-century English society.

ANITA GUERRINI

Keith Thomson. *Before Darwin: Reconciling God and Nature.* xiv + 314 pp., illus., bibl., app. New Haven, Conn./London: Yale University Press, 2005. \$27 (cloth); \$18 (paper).

Keith Thomson charts the long intellectual odyssey of English natural theology from Francis Bacon to Charles Darwin in order to illuminate how the scientific revolution and the Enlightenment transformed science from a handmaiden of Christian religious certainty to its dangerous challenger.

The story in broad outline is straightforward. Contradictions to the biblical account of creation accumulated during the seventeenth and eighteenth centuries thanks to the increasingly accurate and sophisticated observation of nature, forcing scholars to devise novel ways to reconcile science and religion. This was not “a cynical exercise in damage control but a manifestation of the belief that rational enquiry ought to lead to new revelations of the power and mysterious ways of God” (p. 141). Natural theology emerged both to embrace and to domesticate science. Ultimately, however, the scientific commitment to explanation via secondary causes posed the most basic threat to the symbiosis between faith and rationality. Understanding nature exclusively through secondary causes demotes God from an all-powerful active presence in the universe to a distant first cause—at best. At worst, God simply fades away. William Paley attempted to neutralize this threat in *Natural Theology* (1802): if the ordered complexity of living organisms could never be reduced to the blind operation of secondary causes, God’s continuous and active role in nature was impregnable preserved. This defensive strategy was rather threadbare by the start of the nineteenth century, and Charles Darwin ripped it apart when he provided a workable evolutionary mechanism. Natural theology proved to be “the last great attempt to find a comprehensive answer to the question ‘Does God exist and what is his nature?’ through the objective, empirical methods of science rather than through revelation, biblical exegesis or the inspiration of God’s vicars on earth” (p. 279).

Thomson writes gracefully, with a keen eye for the revealing anecdote and the telling quotation. He does not lament the scientific passing of natural theology but nonetheless treats its advocates with warmth, sympathy, and admiration. His large cast of characters (which includes Paley, John Ray, Robert Boyle, John Toland, Gilbert White, Thomas Burnet, William Whiston, William Buckland, and Philip Henry Gosse) emerge as honest men who wrestled commendably with difficult problems “at the forefront of an epic enquiry” (p. xiii).

Thomson admits that he is telling “a particular version of the battle between science and religion,” one that is “set squarely within a long English tradition.” Nonetheless, he clearly wants the reader to attach broader significance to this “peculiarly English part of the phenomenon” (p. 7). Unfortunately, the history of English natural theology contains too many local peculiarities to serve as a fully adequate exemplar of broad historical trends. The practical, philosophical, and religious implications of approaching life as the product of chance and blind necessity look much different when one pulls the focus back from the concerns of English naturalists and parsons in the Age of Reason and the Enlightenment.

Before Darwin obscures rather than illuminates the full significance of teleology in the history of biology. Thomson implies on several occasions that naturalists who invoked end-directed processes in nature were keeping faith with Christianity and classical philosophy rather than with the scientific quest for physical properties and natural laws. But the belief that biological systems possess an end-directedness fundamentally different from anything found in the inorganic world cannot be historically understood exclusively in terms of natural theology. Thomson obliquely acknowledges this fact by choosing as a chapter epigraph a question about the relationship between physics, chemistry, and life posed by Erwin Schrödinger in *What Is Life?* (1944). Introduce towering figures like Immanuel Kant and Georges Cuvier into the story—which Thomson never does—and the rise of evolutionary thinking and the attempted reconciliations of God and nature before Darwin acquire a different cast.

Thomson also overestimates the decisiveness of Darwin’s influence on the popular and scientific meaning of Victorian natural theology. The fact that teleological, and often explicitly theistic, evolutionary theories flourished long after the *Origin* is acknowledged only in the passing comment that “it took a while for Darwinism to be fully accepted” (p. 267). And it is flatly false to claim that “once *On the Origin of Species* had been published, the arguments of Buffon, Erasmus Darwin, Hutton, Paley, Priestley, and all the others were pushed to the sidelines” (p. 217). Evolutionists who wished to understand life teleologically, including Darwin’s close ally Asa Gray, continued to do so for decades, even if the respectability of invoking divine will explicitly as an explanatory principle had declined precipitously by the dawn of the twentieth century.

Examining the reaction to the *Origin* by theistic evolutionists like Gray would have allowed *Before Darwin* better to fulfill its explicit goal of

judging whether natural theology possesses “any long-standing merit” (p. 58)—and to do so more presciently. Thomson briefly criticizes Michael Behe for his Paley-esque reliance on “irreducible complexity” (pp. 61, 263). In *The Edge of Evolution* (Free Press, 2007), Behe graduates to an unambiguous acceptance of “common descent,” but with the significant proviso that evolutionary patterns can be explained fully only if we posit “nonrandom mutations” shuffled into the process by an intelligent designer; this simply updates (obliviously, it seems) Gray’s post-*Origin* belief in preordained variation with the language of modern biochemistry and molecular genetics. In *The Language of God: A Scientist Presents Evidence for Belief* (Free Press, 2006) Francis Collins labels himself a theistic evolutionist and identifies Gray as a predecessor (apparently unaware of his eagerness to invoke God’s superintending power in scientific argument). A fuller examination of how teleology and natural theology mixed with evolutionary theory in Darwin’s wake could have allowed Thomson to have forward-looking responses to both Behe and Collins waiting.

Before Darwin succeeds as a series of vivid and appealing portraits of men grappling with issues of faith and rationality amidst maelstroms of intellectual, political, and religious change. But it does not work nearly as well as a coherent account of either the broad historical relationship between science and religion or the intellectual origins of modern evolutionary thought. To put it another way: I marked numerous individual sections of the book as possible undergraduate reading assignments, but I would be loath to assign the book in its entirety.

RICHARD BELLON

Jenny Uglow. *Nature’s Engraver: A Life of Thomas Bewick.* xix + 458 pp., figs., illus., index. London: Faber & Faber, 2006. £20 (cloth).

Thomas Bewick, eighteenth-century wood engraver and fervent naturalist, shot like a “firework” into national fame with the publication of the *General History of Quadrupeds* (1790). This plain-speaking son of a Northumberland tenant farmer and collier sealed his reputation as England’s most masterly engraver with the two-volume *History of British Birds* (1797, 1804). The huge success of these works (*Quadrupeds* sold around fourteen thousand copies) was attributable to Bewick’s exquisitely fine wood engravings. Long after the descriptive text had become outdated, the images continued to en-

trance viewers. Jenny Uglow, in a beautifully written book intended for a general readership, makes use of these images both to tell Bewick’s life and to captivate her own audience. In so doing, she allows historians of science already familiar with Bewick from his now-classic autobiography to see him anew. Although Uglow relies heavily on the autobiography (as any biographer must do), she never loses sight of its primary value as Bewick’s confirmation of his own sense of self at the end of his life—or of the slippages and gaps in such memories. The strength of *Nature’s Engraver* is the way in which the wood engravings themselves are used to illuminate not only Bewick’s views on society and nature but also his world of work.

Throughout, the practical issues involved in the production of Bewick’s images are emphasized, from the manual skills involved in the engraving of hard boxwood to the trials, tribulations, and triumphs of his business and the daily management of apprentices in his workshop. Moreover, when he began illustrating quadrupeds, Bewick took pains to seek out living examples of the more exotic animals he wished to portray but had never seen. Uglow provides a fascinating glimpse into a world where popular touring menageries offered the only means of direct observation of such creatures, which many readers then saw for the first time in Bewick’s engravings. Although sometimes forced to copy illustrations from other natural history books or work from stuffed specimens, Bewick insisted on drawing only from living models whenever possible because he was less interested in classifying animals than in portraying their character and habits. It is this quality in his work that allies his close observation of the natural world to that of his contemporary, Gilbert White of Selborne. Both were to remain popular throughout the nineteenth century, but while White’s characteristic observation of nature as detached from human society became a model for field studies, Bewick’s pictures shaped a sensibility to the natural world that explicitly encompassed both the social and the political.

This is immediately apparent in Bewick’s natural history works, whose appeal lay not only in the fine depictions of animals but also in the minutely engraved tailpiece vignettes that fill any blank spaces. Bewick believed that serious learning was best imparted if combined with amusement, but the often humorous and whimsical “tale-pieces” (as he punned) also aimed to illustrate some truth or point to a moral. Uglow uncovers and recovers many of these meanings in her reading of these images, which depict

Bewick's own life and that of his community in rural Northumberland as well as his radical conservative politics, including his criticism of actions that curtailed the freedom of the poor, his hatred of war, his Deism, and his radical belief that a knowledge of nature underlay all knowledge. Uglow thus makes great use of these vignettes to elucidate Bewick's values, but she does not tie them in as effectively as she might to the plan and purpose of his natural history works. While the excellent, true-to-size reproduction of many of the vignettes in *Nature's Engraver* allows us to appreciate the sheer visual pleasure these images have imparted to readers ever since they were first published, Uglow's claim that by "floating without captions in the text" the tailpieces "appear as their first readers saw them" is misleading (p. xvi). Although she notes that the positioning of the tailpieces in Bewick's natural history works "often made an oblique comment on the ways of men and animals" (p. 185), in freeing them so completely from this context some of the force of Bewick's moral vision of nature is lost. For example, no reader of Bewick could have come across the image of a poor man huddled under a tree in driving rain tending several fishing lines (reproduced by Uglow on p. 317) without noticing that this appears at the end of the entry on the heron, in which Bewick challenges Buffon's description of this bird as "exhibiting the picture of wretchedness, anxiety, and indigence, condemned to struggle perpetually with misery and want, and sickened by the restless cravings of a famished appetite." Alert to the dangers of judging by appearances, Bewick instead suggests that the heron could be seen as "of a melancholy deportment, a silent and patient creature," whose habit of standing "in the most severe weather . . . motionless . . . fixed to a spot . . . waiting for its prey" more likely indicated pleasure than pain, just as the ability of the poor to partake of nature's bounty was a cherished freedom. Bewick brings his political point home by stating that in England herons "were formerly ranked among the royal game, and protected as such by the laws" (*History of British Birds*, Vol. 2 [1804], pp. 40–41).

There is much material in *Nature's Engraver* for assessing Bewick's importance in the development and use of scientific illustration. Bewick's skill led to his being sought out by the botanist Robert Thornton, who commissioned over a hundred engravings of plants for his *Herbal* (1810). Although only briefly mentioned by Uglow, Thornton's emphasis on Bewick's accurate observation and depiction of living natural objects—in contrast to the dangerous inaccuracy of most illustrations in medical botany

texts—clearly indicates one obvious need for reasonably priced and reliable images.

These, however, are small complaints. In its rich detail and narrative structure—as pleasurable as one of Bewick's vignettes—this is popular biography at its best.

ANNE SECORD

■ Modern (Nineteenth Century to 1950)

Philip Cash. *Dr. Benjamin Waterhouse: A Life in Medicine and Public Service (1754–1846)*. 516 pp., apps., index. Sagamore Beach, Mass.: Boston Medical Library and Science History Publications, 2006. \$56 (cloth).

This book chronicles the life of Benjamin Waterhouse, the Harvard professor of medicine known for introducing and popularizing smallpox vaccination in the United States. Philip Cash examines Waterhouse's medical activities, and the conflict-ridden political and social environment in which he operated, to good effect. As a moderate Federalist with Jeffersonian leanings and a fractious personality, Waterhouse clashed with the High Federalists who dominated the medical community. This estrangement cost him his teaching position in 1812, when, according to Cash, longtime enemies who had made Waterhouse's life at Harvard increasingly miserable ultimately conspired to force him out.

Cash's book is organized chronologically, covering Waterhouse's family background and upbringing in Quaker Newport; his medical education in London, Edinburgh, and Leyden under the patronage of the prominent John Fothergill; his strategies for convincing the public of the virtues of vaccination with cowpox; his trials and tribulations at Harvard; and his work for the army, first as Physician in Charge of the Charlestown Marine Hospital and then as Hospital Surgeon in the First Military District, consisting of Massachusetts and New Hampshire.

Although Cash demonstrates the profound influence that personality and politics had upon medicine, his book tends to be more narrative than analytical. Waterhouse, we learn, wrote and commented on a diverse array of topics in medicine, history, and politics—whooping cough, dysentery, the treatment of American prisoners during the War of 1812, and the career of William Pitt, to name a few—but Cash does not explain how, or if, this mélange of opinions on subjects both medical and political coalesced into a distinctive vision of the role of science

and medicine in the early republic or whether Waterhouse was using his publications to fashion a public identity that he thought would further his greater goals. At times, it would seem that Waterhouse was unconcerned about his image, as when he humiliated two of his most powerful enemies by publishing a newspaper satire about them, oblivious to how his rashness might undermine his credibility. In other circumstances, however, Waterhouse could be interpreted as shrewd, calculating, and more in tune with the ethos of a competitive, entrepreneurial, individualistic, and democratizing republic than his elitist enemies. He was savvy enough, after all, to enter the Jeffersonian patronage network by leveraging the relationship he had forged with the president during early efforts to spread vaccination into the South and West. At the same time, he maintained a cordial relationship with John and Abigail Adams.

Many of the incidents Cash enumerates in the book point toward the conclusion that Waterhouse was forward looking in comparison with his elitist enemies. Waterhouse used the newspapers to spread knowledge of Edward Jenner's insights on the relationship between cowpox and smallpox at a time when his colleagues regarded direct attempts to sway the public as "vulgar" (p. 181). In 1804 he wrote a tract on clean living that would seem to foreshadow the reform movements of the antebellum period, as typified by figures such as Sylvester Graham. Later in his career he supported an unsuccessful plan to create a new medical society, the College of Physicians, to offset the power of the Massachusetts Medical Society. And in his old age he was willing to entertain medical ideas that were frowned upon by the orthodox establishment, as evidenced by his friendship with the botanical healer Samuel Thomsen.

Tantalizing as these leads may be, however, Cash does not venture an argument as to Waterhouse's motives or suggest how we might resolve the disparate faces of Waterhouse. He also neglects to pursue Waterhouse's ideas on race, a particularly volatile issue in this period. While Cash mentions at the start of the book that Waterhouse harbored a "lifelong contempt" for blacks "based on a conviction of their innate inferiority" (p. 3), he never explains whether, and in what ways, this attitude influenced Cash's medical or political thought. This would be a potentially fruitful line of investigation, given Waterhouse's attraction to Jeffersonianism, an ideology whose thrust was to expand equality among white men while at the same time tightening the bonds of race-based slavery.

Despite these omissions, *Dr. Benjamin Water-*

house is an impeccably researched book that helps us to understand the factionalization within the medical community in early nineteenth-century Boston and the monumental difficulties—not to mention drama—that attended the introduction of vaccination. The numerous instances in which attempted vaccinations did not "take" because doctors did not yet know the best time and method for collecting vaccine matter led to public skepticism, as did an epidemic in Marblehead, Massachusetts, that, according to Cash, broke out because smallpox matter was mistaken for cowpox, exacerbating popular fears that cowpox was dangerous. Meanwhile, the public was aware that doctors who advocated vaccination often stood to gain financially from the procedure. Waterhouse himself—who tried, briefly and unsuccessfully, to set up a regional vaccine "trust," or monopoly—was no exception.

Although the book would have been of greater benefit had Cash voiced a stronger thesis, there is much here to be praised. Cash reproduces extensive passages of Waterhouse's writings, so that readers can gain a sense of his flamboyant personal style as well as his thoughts on medical topics. Waterhouse's frustrations with the local hierarchy in Boston are most palpable in passages that Cash quotes from the *Patriot*, a Jeffersonian newspaper in which the doctor poured out his rancor, once going so far as to rail against Boston as the "Head Quarters of Tory Principles" (p. 358). The drama of Waterhouse's life and the struggle to spread knowledge of vaccination will make the book attractive to a wide range of readers, while scholars will appreciate that it generates questions about important issues such as the operation of patronage networks, the relationship between popular and elite medical ideas, the cultivation of public opinion, and the interplay between medicine and politics in the early national period.

LOUISE A. BREEN

Daniel J. Cohen. *Equations from God: Pure Mathematics and Victorian Faith.* x + 242 pp., bibl., index. Baltimore: Johns Hopkins University Press, 2007. \$50 (cloth).

In this book, based on his 1999 Yale doctoral dissertation, Daniel J. Cohen explores the interconnections between mathematics—or, more properly, the philosophy of mathematics—and religious faith in the thought primarily of three nineteenth-century English-speaking mathematicians, the American Benjamin Peirce and the Englishmen George Boole and Augustus De Morgan. Cohen sets his historical stage against

the backdrop of the stunning purely mathematical discovery—and subsequent observation—in 1846 of the planet Neptune. What were the implications of this? For some, it provided dramatic evidence that mathematics was, in fact, the language of God. To understand mathematics was to understand not only God's plan in nature but also divine truth.

Ideas like this were certainly not new, and Cohen opens his analysis with a chapter-length overview of the evolution and implementation of an idealist philosophy of mathematics from Plato to Proclus in antiquity, from John Dee to John Norris and John Wallis in the early modern period, and from Immanuel Kant, Samuel Coleridge, and William Wordsworth into the nineteenth century. For the Victorian mathematicians on whom Cohen focuses, however, "the idea of communing with a unified divine Mind naturally pushed them toward a denial of the Trinity and a skepticism about the importance of the Church and clergy" (p. 40). While Peirce, De Morgan, and, to a more ambiguous extent, Boole entertained Unitarianism, Cohen makes the more all-encompassing claim that "the mixture of Unitarianism and mathematical idealism was a powerful undercurrent to research in pure mathematics and mathematical logic in the Victorian age" (p. 41).

The next three chapters—on Peirce, Boole, and De Morgan, respectively—present three case studies focused on the philosophical and religious ideas (the two are often blurred in Cohen's analysis) as well as, to a lesser extent, the actual mathematical ideas of their respective protagonists. Each chapter also lays out evidence for the "affinity between pure mathematics and idealist Unitarianism in the nineteenth century" (p. 57), with those on Boole and De Morgan especially analyzing their respective developments of mathematical logic as part of their efforts to produce a science of thought. As case studies, these chapters present glimpses from at least one angle into the minds and milieus of their subjects, even if an argument connecting Boole and De Morgan emerges from them much more clearly than does one linking these two British protagonists and the American Peirce.

The issue of argument becomes more acute in the final chapter of the book, where Cohen draws broad conclusions about the professionalization of mathematics in Great Britain and in the United States in the last three decades of the nineteenth century largely on the basis of his three case studies. He contends that in Great Britain, as in the United States, "the correlation between ideological change"—namely, the

abandonment by mathematicians of their "traditional, religiously tinged philosophy of mathematics"—"and mathematical professionalization is conspicuous" (p. 138). This argument—too frequently based on hasty generalization—proves problematic on too many levels to elaborate in the limited space of this review. To give just two examples, it assumes that there was one, monolithic "philosophy of mathematics," somehow shared by nineteenth-century mathematicians in the United States and Great Britain, to be abandoned. Had different case studies been taken, however—say, those of James Joseph Sylvester and Arthur Cayley instead of Boole and De Morgan—a very different picture would have emerged. Cohen's argument also fails to take into account critical cultural and social differences that make the stories of the development of scientific professions and institutions in Great Britain and in the United States so different in the many details. In the United States, the Civil War and the following Gilded Age witnessed the private endowment of new, Prussian-inspired institutions of higher education focused from the beginning on research and the training of future researchers. In England, the slow but ongoing effects both of the so-called Age of Reform and of the development of the new social category of the "professional man" in Oxbridge and elsewhere were key components of change. Cohen has offered food for thought for historians of Victorian science in general and of mathematics in particular. Unfortunately, some of it should be consumed with caution.

KAREN HUNGER PARSHALL

Erik M. Conway. *Blind Landings: Low-Visibility Operations in American Aviation, 1918–1958.* xiv + 218 pp., illus., notes, index. Baltimore: Johns Hopkins University Press, 2006. \$45 (cloth).

Erik Conway's *Blind Landings: Low-Visibility Operations in American Aviation, 1918–1958*, is an important contribution to the history of the technology of flight. Conway's intelligent analysis differentiates this volume from many books on the history of aviation, which are often technologically deterministic and methodologically progressive. In contrast, *Blind Landings* sheds badly needed light on the erratic evolution of an important element of aviation's infrastructure during the formative period of its growth. The book makes it evident that the pursuit of "low-visibility operations," far from being a seamless succession of triumphant events, was an en-



*Ed Link posing with his “blue box,” an early blind fighter trainer. National Air and Space Museum, Smithsonian Institution, SI 99-4151 (taken from Conway, *Blind Landings*).*

deavor filled with pitfalls, institutional rivalries, petty bickering, and bitter politics.

Conway examines the development of what in the interwar years was called “blind flying”; this later evolved into technologies that enabled aircraft to fly in all weather conditions. Ultimately, he concludes that the pursuit of “blind flying” was abandoned not because the problem was impossible to solve but because the competing demands of technology, politics, and culture that shaped the solutions were impossible to resolve. Conway claims that a huge consideration was the reluctance of pilots to trust that an aircraft, fitted with the appropriate technology and tracked and guided by someone on the ground, would be able to find its way in difficult weather. A penchant for self-preservation made pilots believe that only they should be in control of their aircraft.

The book tells the complicated story of forty years of efforts to perfect aircraft landing systems. Nevertheless, Conway manages to deal with the issues clearly and to provide sufficient context to explain that while the technology was a difficult enough nut to crack, the human element was perhaps the most imposing consideration. World War II

had the effect of speeding up the development of blind landing system technology, producing, for example, the MIT Radiation Laboratory’s radar-based Ground Controlled Approach System (GCA). Nevertheless, the conflict between pilot-controlled and ground-controlled systems remained.

After World War II, the competition between GCA and the Instrument Landing System (ILS), which had been tested in 1929 and installed at six locations in 1941, came to a head, with the Army Air Forces (AAF), the Air Transport Association (the representative of the commercial airlines), and the Civil Aeronautics Administration promoting ILS and the Navy and the Aircraft Owners and Pilots Association advocating GCA. Technologically, politically, and culturally, ILS was preferred by the AAF and the commercial pilot community because it was perceived to give pilots more control of the aircraft than GCA. GCA, a radar-based system controlled primarily on the ground, was seen as making flying easier for the private aircraft community.

When the U.S. Congress got into the battle sparks flew, and Conway makes a point of revealing the misleading rhetoric on both

sides of the question, promulgated by the special interests as well as by the aviation press. In discussing the safety issues surrounding each system, Conway says that despite the perception that aviation was unsafe in the early post–World War II era, the reality was that the airways were much safer than they seemed to be. “It simply did not appear that way to a public misled by a number of sensational crash stories and equally ostentatious tales of radar’s [i.e., GCA’s] ‘all-seeing eye.’ Congress chose to act on the appearance rather than the reality” (p. 152).

Eventually, both sides realized that ILS and GCA were complementary systems, and the task of finding a way to integrate them fell to the revived Radio Technical Commission on Aeronautics (RTCA). The RTCA had been formed in 1936 by the Bureau of Air Commerce to deal with problems in aviation associated with radio technologies, but it had no legal authority. The new RTCA, Conway says, “produced a template for not only a landing aids solution but for a comprehensive nationwide system of air traffic control” (p. 164).

Conway concludes that although the concept of “blind landing” was never realized, “the dream of blind landing was . . . important to aviation because it stimulated development of an array of technologies that proved important to related needs” (p. 186). These technologies, Conway contends, made it possible for commercial aviation to achieve better safety and regularity in operations than other systems of transportation.

DOMINICK A. PISANO

Charles Darwin. *The Correspondence of Charles Darwin*. Volume 15: 1867. Edited by **Frederick Burkhardt et alia**. xlii + 705 pp., illus., figs., tables, apps., bibl., index. Cambridge/New York: Cambridge University Press, 2005. \$130 (cloth).

The Correspondence of Charles Darwin is the definitive edition of all known letters to and from Charles Darwin. The volume under review is the fifteenth and most recent, covering the year 1867. Like its predecessors, it demonstrates that the *Correspondence* is a model of academic research and publishing. The letters are meticulously edited and expertly annotated to throw light on the relevant scientific and historical contexts.

In 1867 Darwin, turning fifty-eight, completed the manuscript of his longest work: *The Variation of Animals and Plants under Domes-*

tication (Murray, 1868), begun in 1860. The book covered what had been intended to be the topic of the first two chapters of his larger unpublished work on evolution: natural selection. Much of *Variation* discusses artificial selection; it also presents the first discussion of the provisional hypothesis to explain inheritance: pangenesis. In typical fashion, Darwin had been mulling it over for more than twenty-five years. The book was published on 30 January 1868, just beyond the time frame of this volume of correspondence. Because his health had improved, Darwin was able to pursue several projects simultaneously. In addition to the lengthy task of correcting the proofs of *Variation*, he began an essay on man that would become *The Descent of Man* (Murray, 1871) and *Expression of the Emotions* (Murray, 1872). Much of the correspondence in this volume concerns Darwin’s interest in these topics.

Perhaps most powerfully of all, this volume of the *Correspondence* demonstrates Darwin’s astonishing international network of correspondents on research questions such as human expressions across cultures and races. One of his correspondents, the Russian embryologist Alexander Kovalevsky, sent “a very fine big black Russian bear” skin made into a carpet, complete with head and paws. A footnote (p. 307) reveals that the bear was dutifully brought out and displayed in the drawing room when Kovalevsky came for a visit.

Two important critiques of Darwin’s theory of evolution also appeared in 1867. *The Reign of Law* (Strahan, 1867), by the duke of Argyll, George Douglas Campbell, particularly criticized Darwin’s argument that beauty in nature has an adaptive function. Argyll insisted that beauty was designed by the Creator for the benefit of man. The other important critique was an anonymous review in the *North British Review* by the engineer Fleeming Jenkin. The review claimed that an advantageous variation would not be promoted by natural selection because it would be diluted and lost owing to blending inheritance. In response, Darwin altered the wording in *Origin* (5th ed.; Murray, 1869) to stress the omnipresence of variations in many individuals and the likelihood of multiple variations in a population being selected.

Some of the footnotes may strike some readers as less helpful than others, especially those referring to the contents of the present volume. If the same subject (such as a sick child) is referred to in subsequent letters, it will produce a cascade of footnotes referring readers back to earlier letters in the volume. Yet an interesting external point—for example, the fact that the

first letter in the volume, which was originally published in the *Athenæum*, was republished two days later in the *Times* (7 Jan. 1867; p. 8)—might not be mentioned.

The *Correspondence* is not only the premier Darwin reference work but also the greatest biography of Darwin ever written—or that could be written. It leads us in a detailed, often day-by-day, close-up journey through his life and thought—and it offers windows into the life and thought of those who communicated with him as well. It is impossible to know or understand Charles Darwin without reading and rereading the *Correspondence* volumes.

The funding bodies that have had the foresight and courage to support the long-term research to produce these outstanding volumes should be very pleased. The assembled research experience and expertise concentrated in the project, in addition to the invaluable volumes themselves, is surely worth the price. The only downside that I can see to the *Correspondence* project is that at the current rate of production—slow but magnificent—we must wait another twenty years before we can enjoy all of it.

JOHN VAN WYHE

Judith R. Goodstein. *The Volterra Chronicles: The Life and Times of an Extraordinary Mathematician, 1860–1940.* (History of Mathematics, 31.) x + 310 pp., illus., apps., bibl., index. Providence, R.I.: American Mathematical Society, 2007. \$59 (cloth).

Judith R. Goodstein presents a biography of the Italian mathematician Vito Volterra. She has based her work solidly on archival sources, which include Volterra's personal and professional correspondence with family members (mainly his mother, uncle, cousin, and wife) and with influential mentors and colleagues (among them Antonio Ròiti, Enrico Betti, Tullio Levi-Civita, and Guido Castelnuovo), as well as on interviews with Volterra's descendants and acquaintances.

Born in an Italian Jewish family in the year of the unification of Italy and of the liberation of Italy's Jewish ghettos, Volterra attended the university and the Scuola Normale Superiore in Pisa, where he worked under both Ulisse Dini and Betti. Immediately after graduating in physics in 1882 Volterra became Betti's assistant, and in the following year he joined the faculty.

Volterra's academic career, which started when he was only twenty-three, is discussed in the central part of this biography. Goodstein carefully describes the negotiations that led to Volterra's

appointments, underscoring the mathematician's political and professional struggle to obtain his subsequent professorships in Turin in 1893 and in Rome in 1900. In these years Volterra began to build his reputation as one of the finest Italian mathematicians both in Italy and abroad and established extensive scientific contacts with the rest of the Italian mathematical community and with his European colleagues.

At the turn of the twentieth century, Volterra's career experienced an incredibly rapid rise. The biography's closing chapters describe the ascent that occurred over the course of the first three decades of the new century, when Volterra became the leading mathematician of the Italian school of mathematics and "Mr. Italian Science" to the rest of the world. In this period he delivered invited lectures at international congresses of mathematicians and spoke at universities and institutes in several countries. In particular, he traveled to the United States three times. Goodstein devotes a beautiful and captivating part of the book to Volterra's American experience and to his influence on the American mathematical community.

The rise of fascism in Italy marked the decline of Volterra's career both as a politician and as a scientist. The author provides a detailed and interesting account of those years and shows evidence of Volterra's opposition to Mussolini's regime. His refusal to sign a loyalty oath to the fascist government in 1931 led to his dismissal from the University of Rome. Out of Italy's 1,250 university professors, only twelve refused to sign the oath and lost their jobs; Volterra was the only mathematician. Volterra's health began to decline in the wake of these events and with the enforcement of the infamous racial laws of 1938. He died in his bed in 1940.

This well-written volume is intended for a broad, nontechnical audience; indeed, mathematics and its applications are barely present in *The Volterra Chronicles*. The author succeeds, nevertheless, in conveying the significance of Volterra's work by outlining his mathematical achievements in the context of three appendixes. An analysis of Volterra's mathematical works and a list of his 236 publications are included in Appendix A, which consists of a reprint of the obituary Sir Edmund Whittaker published with the Royal Society of London in 1941. Appendix B consists of a reprint of the inaugural address delivered by Volterra at the opening of the 1901/1902 academic year at the University of Rome; while Appendix C contains his inaugural talk at the first congress of the Italian Society for the Progress of the Sciences, given in 1907. These last two appendixes highlight Volterra's interest

and involvement in the development of science in Italy and in the application of mathematics to the biological and social sciences. All of this more technical material nicely complements the vivid portrait of Volterra's life presented in the main part of the text. The total conveys what made Vito Volterra an extraordinary mathematician, a fine man of science, and a remarkable individual.

I have only one regret: the original Italian of the many interesting quotations is not given. This inclusion would have been useful from a scholarly point of view; at the same time, it would have allowed readers to enjoy the flavor of Volterra's nineteenth-century Italian style.

Notable studies on Volterra and his times have been published recently in Italy, as Goodstein acknowledges in her selected biography. However, the present volume is one of the few sources in English. It is also one of the (too) few biographies of remarkable Italian mathematicians of post-unification Italy (although see Hubert C. Kennedy's *Peano* [Dordrecht, 1980]). It is to be hoped that Goodstein's book will inspire more work in this direction by historians of science in general and of mathematics in particular.

Laura Martini

Ulf Hashagen. *Walther von Dyck (1856–1934): Mathematik, Technik und Wissenschaftsorganisation an der TH München.* (Boethius: Texte und Abhandlungen zur Geschichte der Mathematik und der Naturwissenschaften, 47.) vi + 802 pp., bibl., index. Stuttgart: Franz Steiner Verlag, 2003. €108.

With this book Ulf Hashagen presents one of the most extensive biographies of a mathematician ever written. Walther von Dyck was one of the few university professors of mathematics in Germany at the turn of the twentieth century who had an enduring influence on his country's scientific and cultural development. Dyck contributed greatly to the outstanding reputation the Technische Hochschule of Munich now enjoys. This book traces his life in an unusually detailed and careful way.

Dyck studied at the Technische Hochschule and the University of Munich and took his Ph.D. at the university in 1879 with a dissertation on a topic suggested by Felix Klein (1849–1925). In 1880 he followed Klein to the University of Leipzig, where he completed his *Habilitationschrift* in 1882. In 1884 he was appointed a full professor at the Technische Hochschule of Munich. From 1900 to 1906 and from 1919 to 1926

he was its rector, and he took an increasingly prominent role in German mathematics. Together with his school friend Oskar von Miller he founded the Deutsches Museum in Munich; the founding of the commission at the Bavarian Academy of Science for editing the works of Johannes Kepler can also be credited to Dyck.

Walther von Dyck (1856–1934): Mathematik, Technik und Wissenschaftsorganisation an der TH München is divided in seven parts, with twenty-nine chapters. Parts 1, 2, and 6 are largely chronological in order, while Parts 3, 4, 5, and 7 follow a systematical order. The structure of the book thus reflects Dyck's way of life, for he often pursued several parallel trajectories at the same time. Thus some repetitions and jumps cannot be avoided.

Part 1 treats Dyck's "Youth in Munich" (school and university study), Part 2 "A New World and a Strange Native Country." After his time as an assistant at the University of Leipzig Dyck made trips to Berlin (visiting Kronecker, Kummer, and Weierstrass), Paris (Poincaré), and North America. He became acquainted with mathematicians in Montreal, Philadelphia, Baltimore, Cincinnati, Kansas, New Mexico, San Francisco, Berkeley, and Chicago. Part 3 describes his situation as "Professor of Mathematics at the TH Munich" (here the topics include educating engineers, the rivalry between the Technische Hochschule and the university, and Dyck's own career), and Part 4 is entitled "Politics Concerning Universities and Education in Bavaria in the Time of the Prince Regent Luitpold." Part 5 is concerned with the editing of the *Mathematische Annalen* and the *Encyclopedia*, the founding of the Deutsches Museum, and politics at the Bavarian Academy of Science. Part 6, "A Professor in the War," primarily investigates Dyck's relation to the University of Ghent; and Part 7, "The Unremitting Scientific Politician in the Weimar Republic," turns to his activities as rector, editor, scientific historian, and politician.

Dyck's impact can be ascribed to his personality and to his views about the close relationship between mathematics and the arts. As measured by the number and the extent of his mathematical works, he was not an unusually productive mathematician. His main topics lie in the field of Riemann surfaces, group theory, and topology. He left most of his working fields after some years of research. As Hashagen shows, Dyck—in a manner similar to his mentor Klein—devoted himself to the exciting work of building bridges between his scientific research and public engagement with science. Like Klein, Dyck was cut out to be a teacher, and he

was a far better advocate for the public impact and appreciation of mathematics than some of the more famous and productive mathematical researchers of the twentieth century.

This biography is based largely on unpublished archival papers. Unfortunately, the papers of Dyck himself are presented only in part. A great deal of material—for example, manuscripts of his own lectures and his letters—is missing. Despite this difficult situation concerning the sources, the author uses a well-reasoned methodical conception of his subject to paint a successful portrait of the versatile Walther von Dyck and his impact.

The supplementary materials include a survey of the rectors, teachers, and dissertations at the TH Munich and indexes of abbreviations, the sources used, the literature, and names (there is no subject index). Small misprints are negligible in the face of the book's appealing layout.

This volume is addressed to readers who are interested in the connection of the history of mathematics with the history of culture and institutions; these issues are explored through the treatment of an authoritative figure at an important German university. In deference to this focus, the history of technical and social questions takes second place. This versatile and impressive biography documents an eventful chapter in the history of science as it played out in and around the universities in Munich and Leipzig in the years between 1880 and 1940. It sets a new standard for ambitious scientific biographies.

MICHAEL TOEPPELL

Michael Hau. *The Cult of Health and Beauty in Germany: A Social History, 1890–1930.* x + 286 pp., illus., bibl., index. Chicago/London: University of Chicago Press, 2003. \$22 (paper).

Michael Hau investigates the social and cultural basis of ideas of health and beauty before 1930. His endeavor is geared to explaining why the Nazis demonized such groups as Jews and gypsies as pathological, ugly, and sinister figures. Hau analyzes the discourses around nature therapy and eugenics and works mainly through description, narrative, and occasional biographical sketches. Neither epistemological issues concerning the demarcation and validity of alternative medicine nor the more mundane issues of organizations, collective biographies, professional and national politics, and the economics of medical practice and the publishing market figure in his account to any great extent. The analysis of key issues of health, hygiene, and

fitness consequently has a somewhat impressionistic quality.

Hau attempts to reconfigure the historiography of eugenics by drawing close links with nature therapy. The ideological spectrum of eugenicists involving Lamarckian environmentalism, the eugenic interest in abstinence from alcohol, and links between eugenics and such movements as monism are hardly new topics. That there was Roman Catholic and socialist support for eugenics (pp. 136–151) has long been recognized; more interesting is Hau's evidence as to the prevalence of support for euthanasia among nature therapists. His text revolves around a series of putative, ethereal discourses. Points of ideological tension—as between “constitutional theory” and nature therapy—are not exploited.

There are some errors, indicating a lack of sureness with the material—for example, reference to Adolf rather than Alfred Ploetz (p. 117)—and nowhere is it made clear that Hugo Iltis was Czech. But more significant is the failure to identify key ideological polarities. Hau discusses German racial hygiene in terms of holism, citing the case of Fritz Lenz: this is puzzling, as Lenz—whose work was grounded in genetics—joined the attack on holistic hygiene in Nazi Germany as dangerously theistic. Race hygienists abhorred notions of environmental hygiene or “geo-medicine” drawing on Gestalt theory. Hau expands his categories of interpretation to the point that they become opaque and intangible—and somewhat ephemeral. Although interesting, and with some suggestive illustrations, overall *The Cult of Health and Beauty in Germany* is weakened by its impressionistic approach and a somewhat arbitrary cutoff point in 1930.

PAUL WEINDLING

Daniel Kennefick. *Traveling at the Speed of Thought: Einstein and the Quest for Gravitational Waves.* xii + 319 pp., illus., figs., bibl., index. Princeton, N.J.: Princeton University Press, 2007. \$35 (cloth).

This is a book about how physicists decide when their ideas are right. Much has been written about how physicists conclude that their experiments are correct, but less attention has been paid to how they declare their theories to be finished. Daniel Kennefick's book tackles this question through the history of gravitational waves (ripples in space-time predicted by Einstein's theory of general relativity), a subfield of

physics that has already proven to be a rich topic for science studies.

Part of the appeal of gravitational wave physics for science studies is the peculiar detail that the discipline operated with very little experimental constraint from World War I to the 1970s. The theorists were on their own. How did they function without the experimental anchors that were traditionally supposed to restrain wild speculation and keep physics from becoming lost in deep waters? Kennefick shows that the most valuable tool for theorists navigating in such unknown realms was the analogy. That is, physicists calibrated their sense of how a poorly understood theory (general relativity) was supposed to work by finding fruitful physical, mathematical, or conceptual analogies to a well-understood theory (here, electromagnetism). Specifically, the analogy of electromagnetic radiation functioned as the pole star for physicists investigating gravitational waves, helping them figure out where to look and what to look for. But the “correct” use of an analogy is far from obvious, and this book shows that many of the disagreements over the existence, meaning, or detection of gravitational waves can be traced to how the scientists involved thought about the analogy between electromagnetic and gravitational radiation. Some took the analogy quite seriously and strongly, while some resisted investing it with too much authority. Kennefick tells the story of gravitational waves as a struggle between skeptics and believers battling over the correct use of the electromagnetic analogy, and he does an excellent job with the tricky task of presenting both parties in a respectful and rational light.

The book focuses largely on the development of gravitational wave theory after Einstein presented his general relativity theory in 1915, with some occasional chronological jumps and one chapter on the prehistory of concepts and techniques germane to the discussion. The majority of the narrative traces gravitational waves from their initial prediction through the various controversies when physicists grappled with the question of exactly what (if anything) these waves were and precisely how they should deal with them. Along the way we get a minihistory of general relativity’s birth, nadir, and renaissance. Kennefick illustrates a number of detailed technical controversies and provides vivid portraits of the individuals and conferences involved, often using impressive archival detective work and original oral histories. One missing element that readers might expect is a detailed discussion of gravitational wave detectors such as LIGO. The final chapters of the

book contain very interesting and thoughtful discussions of important issues such as different styles of scientific reasoning and the way physicists use their field’s history as a tool in contemporary controversies.

One of Kennefick’s major explanatory categories is the “theoretician’s regress”: the puzzle of how a theorist decides when a calculation is correct. Everyone in this story wants a crucial experiment to test the theory, but they first need to agree on precisely what the theory predicts, which turns out to be extremely nonobvious. This is an important contribution to the way we think about the relationship between theory and observation, showing that the establishment of a theoretical prediction is no more straightforward than the experimental tests of that prediction. Kennefick also uses this category to discuss the role of intuition in science (it can help break the regress) and how different styles of scientific reasoning shape the debates around uncertain theoretical results.

Kennefick makes heroic efforts to explain the properties of tensors and difficult concepts such as choice of coordinate systems, but sections of *Traveling at the Speed of Thought* will be difficult for someone without a decent physics background (or a fair deal of patience). Other parts are much more accessible, but the book does assume that the reader already knows the basics of gravitational waves.

Gravitational wave studies have been important and controversial in science studies, and Kennefick wades confidently onto that battlefield. He takes a moderate position between Harry Collins and Allan Franklin, asserting that both sides on the Weber controversy can be thought of as rational. This book overlaps very little with other books on gravitational waves, such as Collins’s *Gravity’s Shadow* (Chicago, 2004) or Marcia Bartusiak’s *Einstein’s Unfinished Symphony* (Joseph Henry Press, 2000), and in fact complements both of those books nicely. *Traveling at the Speed of Thought* will be valuable for historians, sociologists, and philosophers of modern physics and others interested in the development and use of scientific theories, and it will also be of significant interest to practicing physicists and physics students.

MATTHEW STANLEY

Leoncio López-Ocón; Jean-Pierre Chaumeil; Ana Verde Casanova (Editors). *Los americanistas del siglo XIX: La construcción de*

una comunidad científica internacional. 355 pp., illus., figs. Frankfurt: Vervuert Verlagsgesellschaft, 2006.

During the second half of the nineteenth century, the term “Americanism” was used in several European countries (“*américanisme*” in France, “*americanismo*” in Spain, “*Amerikanistik*” in Germany) to define a new field of studies primarily concerned with the analysis of primitive American cultures. This discipline emerged with the convergence of two developments. The first was a renewed interest in the study of material culture stemming from Native American communities. The development of ethnographically based museums during the nineteenth century provoked an unprecedented interest in a wide range of items (e.g., tissues/fabrics, weapons, tools) from small-scale American societies. Second, the development of scientific disciplines such as history, anthropology, and archaeology encouraged the study of so-called primitive cultures, then considered representative of a more primitive humankind. In this context, “Americanism” emerged during the nineteenth century as an interdisciplinary field defined by the creation of new scientific societies (such as the French Société des Américanistes), the convening of international congresses (held, for instance, in Brussels in 1879 and in Paris in 1895), and the establishment of international scientific networks.

Los americanistas del siglo XIX analyzes the constitution of this interdisciplinary field in France, Spain, and Germany. The book compiles the proceedings of an international congress held in Madrid in October 2003. The editors have divided the twelve contributions into two parts. The first analyzes the work of several distinguished “americanistas” of the nineteenth century (Désiré Chamay, Florencio Janer, Jiménez de la Espada, Sir Clements Markham) and how traditional American objects were exhibited in France and Spain. The second part focuses on the relationships between “Americanism” and other academic disciplines like history and, in particular, anthropology. As these authors point out, the origins of “Americanism” were multiple and diverse, stemming from a fusion of distinct fields and diverse academic traditions. This interdisciplinarity allows these historians to examine various scientific disciplines treating this new discourse about America.

This examination is, in my view, the book’s main strength. The volume successfully reconstructs and contextualizes ways in which “Americanism” emerged during the second half of the nineteenth century as a new discourse treating Na-

tive American societies. As most of these essays demonstrate, scientists dealt with data and objects, but also with colleagues, journals, international networks, and public and private institutions. In this sense, the establishment of this new field is a process that involved both the definition of a new object of study and the institutionalization of certain structures (e.g., museums, congresses, publications) that supported the emergence of the new discipline. “Americanism” is here rightly defined as a global project that included the constitution of an international community (best exemplified in chapters treating the relationship between the French and Spanish scientific communities), the appropriation of Americans’ primitive material culture (see Pascal Riviale’s and Leticia Ariadna Martínez and Ana Verde Casanova’s essays), and the establishment of personal and professional networks (see, e.g., Leoncio López-Ocón’s piece on Jiménez de la Espada). Most important, “Americanism” established a number of heterogeneous relationships with other disciplines (see the chapters concerning the relationship between “Americanism” and anthropology, for instance). All these processes are appropriately examined here. Therefore, the collection’s chief merit is its reconstruction of the constitution of this scientific field.

The volume pays little attention, however, to how “Americanism” served to support colonialist economic, political, and cultural systems. After the recent boom of work on postcolonialism, it has become evident that Western knowledge examining non-Western cultures has also served to justify imperial practices of domination. “Americanism” is no exception. Unfortunately, linkages between power and knowledge in the constitution of the field are only vaguely explored in this book.

In short, although greater attention might have been given to the political implications of “Americanism,” the academic strength of the volume leaves nothing to be desired, and the claims entertained are significant within the history of science.

OSCAR MORO-ABADÍA

Donna C. Mehos. *Science and Culture for Members Only: The Amsterdam Zoo Artis in the Nineteenth Century*. 212 pp., illus., plates, bibl., index. Amsterdam: Amsterdam University Press, 2006. \$49.95 (paper).

For many a Western capital or large city in the nineteenth century, establishing a zoological garden was a symbol of civic and national pride. To maintain and display a collection of live, exotic animals was to demonstrate a city’s or nation’s wealth, culture, commitment

to science, and ability to command faraway resources. After the first new zoos were founded in Paris (1794) and London (1828), the creation of other zoos proceeded apace. Prominent among them was the zoological garden of Amsterdam. Founded in 1838 with the name "*Natura Artis Magistra*" ("Nature is the Teacher of Art"), the Amsterdam zoo functioned simultaneously as a site for zoological research and a center of bourgeois culture. Donna C. Mehos's *Science and Culture for Members Only* illuminates the scientific and social roles that "*Artis*" played.

Artis was established by three Amsterdam burghers who wanted, as their prospectus said, "to advance natural historical knowledge in a pleasant and illustrative manner" (p. 60). More specifically, they sought to establish a zoological garden and a natural history museum that would be the focus of a new, private social club. The institution indeed proved very attractive to bourgeois Amsterdammers, and by the middle of the century it claimed twenty-five hundred members. Not until the twentieth century were the gates opened to the general public.

A key theme of Mehos's book is the way that *Artis* functioned for several decades as the leading cultural center of Amsterdam. At a time when art museums such as the later-to-be-magnificent Rijksmuseum were unable to attract financial support, *Artis* thrived. Significantly, it was more than just a place to view live and stuffed animals. Members of the club could hear the city's leading orchestras play highbrow music there or dine in a handsome restaurant. *Artis* was a site for cultural elevation and social interaction, where, as Mehos suggests, the burghers who met each other "were perhaps as likely to discuss the latest trends on the stock exchange as natural history" (p. 23).

Several *Artis* members aimed to make the institution a place for serious zoological research. They included the zoo's principal founder, Gerardus F. Westerman, a book publisher whose private collection of live birds became the first animals of the new zoo; Hermann Schlegel, a taxonomist and illustrator; and Willem Vrolik, an expert on pathological and comparative anatomy. When the zoo board initially refused to provide funds in support of scientific research, the scientists formed an independent "Scientific Association for the Advancement of Natural Historical Knowledge" (p. 64). In 1847 this association finally became connected to *Artis*. The following year, under *Artis* auspices, the journal *Bijdragen tot de Dierkunde* (Contributions to Zoology) began publication, sig-

naling *Artis*'s commitment to science and Dutch interests in taking a place on the international scientific stage.

As was true for most other nineteenth-century zoos, the scientific research conducted at *Artis* was not especially innovative. Though *Artis* naturalists recited the advantages of being able to study live creatures, they rarely profited from the opportunity. Neither the behavior nor the physiology of living animals became the focus of their attentions. They were interested primarily in anatomical and taxonomic problems that were best studied after an animal died. Where the naturalists were most likely to make a mark, one guesses, was by describing exotic specimens that came to the zoo thanks to Dutch colonial connections. Vrolik developed an international reputation for his anatomical and taxonomic studies of monkeys.

Did Vrolik and his colleagues actively urge colonial officials, sea captains, and the like to collect specific animals for *Artis*? The book does not tell us. It says much about the scientific and cultural intentions of the zoo's founders but little about the growth of the collection. One reads that the zoo's specimens reflected Holland's colonial reach, but not which species were collected or where they came from. Nor does the author describe how the animals were displayed (though some of the book's illustrations help in this regard) or the various sights, sounds, and smells that zoo visitors encountered. We hear briefly of two hippopotami that arrived at the zoo in 1860, but nothing else about individual animals that may have sparked the interest of Amsterdammers. The book is primarily about *Artis*'s cultural place in nineteenth-century Amsterdam, not about life at the zoo or Dutch attitudes toward animals. One might wish for more on these last-mentioned topics, but Mehos nonetheless provides a very welcome contribution to the growing literature on zoos and what they meant in their particular historical contexts.

RICHARD W. BURKHARDT, JR.

Linda Nash. *Inescapable Ecologies: A History of Environment, Disease, and Knowledge*. xii + 332 pp., figs., notes, bibl., index. Berkeley: University of California Press, 2006. \$60 (cloth); \$24.95 (paper).

In her impressive new book *Inescapable Ecologies*, Linda Nash traces the interconnected histories of health and the environment in California's Central Valley. Her starting point is a nineteenth-century worldview that connected

bodies and places. Nineteenth-century American settlers often mixed their judgments of a landscape's fertility or resource richness with close attention to their sense of its health. To them, health was a quality of the environment, and they judged lands sickly or salubrious on the basis of the perceived qualities of soils, airs, waters, plants, and climates. But the health of the land was not a quality that inhered in the land alone; it also connected body and environment across a porous boundary. This particular worldview had not received much scholarly attention until recently, in part because it was often based on wrongheaded miasmatic theories and thus was easy to dismiss. But Nash suggests that there is much for both environmental and medical historians to learn from these premodern ecologies of health: they provided a sense of connection to which we need to return.

Nash begins her analysis in Gold Rush California, as fortune seekers poured through the Central Valley to access the Sierra gold fields. The Central Valley, then a vast plain of deltaic and seasonal wetlands, produced in many of these migrants both ill health (usually malaria) and constitutional anxieties that together shaped their sense of the landscape. Nash is particularly successful in communicating how foreign, even tropical, the climate and environment seemed to outsiders and how much energy they devoted to assessing whether their bodies fit the place. Today most see California's climate and environment as anodyne, but well into the twentieth century the Central Valley was one of the most malarious spots in North America. For many early California transplants—and the metaphor is an apt one—transforming the environment was not an act of conscious conquest but a more anxious attempt to create conditions under which they might flourish in new soil and a strange climate.

Nash's interest in nineteenth-century ecologies of health is not only about explicating a worldview lost to modernity. What intrigues her, and what defines the second part of the book, is how that nineteenth-century worldview prefigured the Central Valley's postwar ecologies of health. With the germ theory in hand, scientific medicine taught that disease was the result of discrete agents working within bodies. The conceit of modern medical practice as it developed in the early twentieth century, Nash insists, was that environment did not really matter much to health or, to the extent that it did, that it could be mastered through modern methods of sanitary engineering. But as the Central Valley became the global epicenter of agricultural industrialization, a new set of concerns

about toxic pesticides revived nineteenth-century ecologies of health in select ways. Nash does a particularly strong job in showing how bodily response to chemical exposure was rooted not just in a reductive body-chemical relationship, but in the particularities of place and space—in how chemicals interacted with soils, waters, crops, and climates as well as particular bodies. In short, the environment mattered again, and a new ecology of health grew up with these postwar toxic threats. Nash ends her book with a look at a series of cancer clusters in Central Valley communities, examining how modern medical and public health experts flailed in their efforts to connect bodily illness to environmental contamination while those most affected—often poor or working-class Mexican-American farmworkers—fought to have their experiences of illness taken seriously.

Inescapable Ecologies is a sweeping history that isolates in one place a crucial set of transitions in medical and environmental thought and practice. It is mostly successful in doing so, and it should soon become required reading for students of western, medical, and environmental history as well as historians of science. It is, in short, a very good book. But there are also aspects of Nash's analysis that I found unsatisfying. While her theorizing about bodies, space, and modernity usually advances her argument, there are moments when it seems to get in the way. Moreover, however similar the miasmatic and toxic worldviews were in linking bodily and environmental health, and however each bucked modernist medical efforts to confine disease within the body, these two worldviews had profoundly different implications for how people thought about nature. Ultimately, and despite certain important exceptions, nineteenth-century Californians saw unimproved nature in the Central Valley as unhealthy, while postwar Americans saw a landscape polluted by humans as the problem. Nash does not ignore this facet of the story—she notes, for instance, that the “environmentalist demand for absolute purity was itself an outgrowth of sanitary modernity” (p. 214)—but I was surprised by how little developed it was. Finally, in her idealization of the body-environment connection, Nash elides the imprecision of nineteenth-century thinking and, more important, so thoroughly blurs the line between disease experience and causation as to leave the reader wondering how seeing a fundamental porosity between body and environment might help to underwrite clearer, more effective, and more just public health interventions. By her final paragraph, she seems to be wondering the same thing herself.

PAUL S. SUTTER

Elizabeth R. Neswald. *Thermodynamik als kultureller Kampfplatz: Zur Faszinationsgeschichte der Entropie, 1850–1915.* 475 pp., figs., bibl. Freiburg: Rombach Verlag, 2006. €48 (cloth).

This broadly researched study examines the cultural meanings of entropy in Britain, France, and the German lands from 1850 to 1915. Having published in 1850 the first expression of what became known as the second law of thermodynamics, Rudolf Clausius introduced the term “entropy” in 1865 to capture the fact that many natural processes—most notably the flow of heat from a hotter to a colder body—exhibit inexorable directionality. The cognate notion of the “dissipation” of mechanical energy had been introduced by William Thomson in 1852, employing a word rich with connotations. Implicit in all this is the point that frames Elizabeth Neswald’s study: the principle of entropy was ostensibly a universally applicable law of nature, even as the concept of entropy was given a diversity of interpretations embodying a variety of examples and analogies. Hence its appeal to a variety of people who exploited its protean meanings for diverse ends.

The author echoes the view that ostensibly objective scientific knowledge cannot be separated from its cultural context, “that both producers and receivers of scientific knowledge act within a common and heterogeneous cultural space” (p. 21). In the event, she has little to say about the generation of scientific knowledge within the context of technical problems and solutions and nothing about any cultural influences back onto the technical sphere. The language of “producers” and “receivers” correctly suggests that *Thermodynamik als kultureller Kampfplatz* will not achieve the much-sought transcendence of the internal/external distinction.

Neswald analyzes the cosmologies of Buffon, Kant, Laplace, and William Herschel, all of which posited some kind of progressive development, typically involving passage from a hotter to a colder state. Progression is thus a law of the universe, in accord with a theology of historical progression and of creation out of chaos. Drawing on a rich secondary literature, Neswald notes the connection in mid-nineteenth-century Britain between notions of energy conservation and natural theology: energy conservation was compatible with the long-term stability of a divinely governed cosmos. The world might well have evolved from nebular beginnings, but it had to all appearances reached a stable state.

Heat took on enhanced significance with the advance of steam technologies in the nineteenth century. The steam engine became a symbol of progress and of control over the powers of nature; a metaphor for the energetic functions of the animal organism; and a stimulus to preoccupation with the efficient performance of work, one of whose fruits was the elaboration of what became the second law. What gave that law its broad cultural significance was its connection with questions of mechanical and economic efficiency and of the thermodynamic fate of the world. Especially with the popularization of notions of the dissipation of energy and the heat death of the universe, the second law validated a conception of the world as requiring a source of original order and exhibiting a unique sequence of events.

In one of the more original sections of the work, Neswald discusses many lesser-known advocates of a temporally unbounded cyclical universe, an alternative cosmology with radically different theological implications. In her estimation, that cyclical cosmologies found favor principally in German lands reflects the relative respectability of materialism there. The heat-death hypothesis thus constituted an alternative to Ernest Haeckel’s materialistic cosmology of unlimited cyclical time. Employing the entropy law against scientific materialism allowed religion to invoke science on its behalf. Arguing that the heat-death hypothesis had initially been given a theological gloss consonant with biblical notions of creation and the end of time, Neswald maintains that its pessimistic interpretation only arose in connection with late nineteenth-century concerns over the projected exhaustion of coal reserves, whereby the acceleration of economic progress—entailing the increased consumption of energy resources—simply brought closer the inevitable end state of dissipated energy unavailable for work.

Developments in physiology paralleled those in cosmology. Although physiologists were guided by the assumption of energy conservation, they were minimally successful in reducing vital phenomena to physicochemical laws and failed entirely with respect to embryological development, consciousness and thought, and the organism’s complexity, purposefulness, and self-maintenance against forces of decay. Nor did the second law afford them any explanatory purchase. In this context vitalists argued that life, precisely by seeming to run against entropy’s tendency always to increase, required a principle (like Henri Bergson’s *élan vital*) beyond the laws of physics and chemistry. Thus

were the implications of the second law again found agreeable to opponents of mainstream science.

It is impossible here to convey a sense of this book's richness of detail or to display the many nuances that qualify the connections discussed. As befits the book's theme, scholars with different agendas will mine it with profit for their own ends. One problem with Neswald's account, however, is that in shifting back and forth between English, French, and German sources she often fails to tell a coherent story in terms of a specific cultural context. In looking at the acceptance of the first law during this time period, I have been struck by the extent to which one cannot assume the free movement of ideas among these linguistically defined communities.

KENNETH CANEVA

Laura Otis. *Müller's Lab: The Story of Jakob Henle, Theodor Schwann, Emil du Bois-Reymond, Hermann von Helmholtz, Rudolf Virchow, Robert Remak, Ernst Haeckel, and Their Brilliant, Tormented Advisor.* xix + 316 pp., figs., bibl., index. New York: Oxford University Press, 2007. \$55 (cloth).

"Johannes Müller never had a lab" (p. xi). Thus begins the story of *Müller's Lab*. The book's title nicely captures its main message: the stories of the famous anatomist and physiologist as they were told by his students are fictionalized reports, colored by the students' situation, goals, ambitions, and agendas and, last but not least, by their personal relation with their teacher. Laura Otis compares seven accounts of Müller's life and work to examine how scientists' narratives can shape the history of science. Each student's account reflects his personal and professional interests, political position, and institutional context, just as Otis's book reflects current concerns with communicating science, the functions and uses of (re)constructions of past science, audiences, and "scientific personae."

The first chapter presents Otis's own story of Müller's life and career. She stresses that this is not meant as a master narrative or authoritative "true" account of Müller's life but, rather, as a "template" (p. xix) through which the seven students' tales may be read. The subsequent chapters are for the most part biographies of these renowned students; most of them also include a section on Müller's persona as it emerges from the writings—letters, public lectures, obituaries—of the chapter's protagonist

("Schwann's and Henle's Müller"; "Virchow's Müller").

Chapters 2–7 contain vivid depictions of the often grim realities of medical education and research practice in the nineteenth century. They provide a wealth of information about the daily life of a medical student and researcher and are bristling with quirky details, such as Jakob Henle's report that he had just dissected "a baby he had 'cured to death,' then bought from the mother for a taler" (p. 47). The reader can almost smell the stench of the rotting body parts in the dissection room, feel the exhaustion and fatigue after a long day packed with demanding lecture courses, and see the frogs hopping about in the students' cramped and poorly heated living quarters. The reader also learns a lot about the social and professional relations among the members of this diverse group of medical men. Moreover, through the biographical accounts, Otis provides information about the development of main research topics, such as cell theory and histology (Ch. 2, on Henle and Schwann), electrophysiology (Chs. 3 and 4, on Helmholtz and du Bois-Reymond), pathology and public health (Ch. 5, on Virchow), and evolutionary theory (Ch. 7, on Haeckel). Otis does not aim to provide entirely new insights into these individuals' lives and achievements beyond what we know from earlier, in-depth studies by C. Goshler, L. Nyhart, H.-P. Schmiedebach, A. Tuchman, and others. Yet by drawing these accounts together she presents an accessible overview of nineteenth-century German anatomy and physiology and gives the reader a good sense of the richness of this field.

But the book aims to do much more. Otis calls her approach a "literary-historical case study," a study of how history is written. She takes seriously the fact that scientists' accounts of other scientists' lives and works are not transparent windows to the past but self-serving stories, shaped by the narrator's personal, institutional, social, and political situation. Broadening earlier analyses by N. Jardine and others, Otis seeks to draw out the students' motives for writing and their consciousness of their audiences, their choices of words and their favorite words, as well as their narrative tactics.

Otis does not suggest that science is just texts and nothing but texts. Science is done by people who really lived and worked. Exploring multiple perspectives on Müller, she maintains, is the most secure approach to the truth about his life and science. Yet she consciously abstains from offering detailed analyses of the differences between the various accounts of Müller's life and work. She lets her case studies speak for them-

selves and ultimately leaves it to the reader to decide what to make of them. Only in the afterword does she highlight significant differences between the portrayals of Müller as a researcher as they emerge from the seven students' accounts. She links them to social forces like income and class and, most important, to differences in the individuals' personalities.

Her study of scientists' personal styles of writing complements previous works on communicating science (by C. Bazerman, A. Gross, S. Shapin, T. Shinn, and R. Whitley, among others), which examine the significance for knowledge production of textual genres such as the scientific article and popular accounts of science. Otis's principal concern is the emergence of images of Müller, although she does invite the reader to consider how literary studies of scientists' personal styles of writing "can help us to understand their experiments" (p. xix). Her main conclusion is that personal interactions and the interactions of personalities are the key to explaining scientists' motivations and ideas and that scientific work as a whole is, in fact, "driven" by such personal interactions (pp. xvii, 233).

While I agree that studies of scientists' constructions of the past are most valuable, I do not always find Otis's analyses of these scientists' literary techniques enlightening. For example, she compares du Bois-Reymond's description of his encounter with Müller with the tales of seduction in Choderlos de Laclos's *Les liaisons dangereuses* (p. 96)—but what exactly do we learn from the perceived parallels in these narrative styles? Gripes aside, the book does raise many fascinating issues pertaining to the reconstruction of science past. After reading it, I found myself reflecting on many absorbing questions: How did the different accounts of Müller's life and work shape the later history of science and medicine? How, for instance, did du Bois-Reymond's narrative become the master narrative of Müller's life? How should we deal with the multiple perspectives that the book offers? How should we weigh the different tales, and how can we approach the truth about Müller? What exactly is the status of Otis's own account of Müller's life? What are the wider implications of Otis's study for the writing of the history of lesser-known figures and episodes, where we are not so fortunate as to have many accounts to draw on and the multiperspectival approach she advocates is not an option? I would have loved to read more about how Otis grappled with the problem of constructing accounts of her protagonists while writing her book.

Müller's Lab will be of interest to historians of science and working scientists, and the stories of life in and around "Müller's Lab" are gripping enough to hold the attention of the general reader. While an engagement with Otis's historiographical points of course requires consideration of the book as a whole, parts of it could be profitably used in introductory courses in history of science and medicine.

JUTTA SCHICKORE

Dirk Preuß; Uwe Hoßfeld; Olaf Breidbach (Editors). *Anthropologie nach Haeckel*. 256 pp., figs., illus., index. Stuttgart: Franz Steiner Verlag, 2006. €46 (paper).

This volume resulted from a symposium on the history of anthropology held at the Friedrich-Schiller-University in Jena, Germany, in January 2004; it appears in the series "Wissenschaftskultur um 1900" ["Scientific Culture around 1900"], edited by Olaf Breidbach. Breidbach is director of the Institute for the History of Medicine, Science, and Technology and its Ernst-Haeckel-Haus, to which the coeditors of this volume, Dirk Preuß and Uwe Hoßfeld, are also attached. The museum exhibits and archives the manuscripts, letters, and drawings of the German biologist Ernst Haeckel (1834–1919).

Several contributions deal with biological anthropology and medicine at the University of Jena, engaging with the image of the university as a former "fortress of National Socialist race idiocy": Katja Regenspürger (Ernst-Haeckel-Haus) analyzes the Jena University clinics' enforcement of sterilization in the context of the race hygiene laws of the 1930s ("Ein Opfer im Dienst der Volksgesundheit"); on race hygiene at the University of Jena see also Susanne Zimmermann's "Rassenhygiene in Forschung und Lehre an der Medizinischen Fakultät Jena vor 1933". In "Phyletische Anthropologie" ["Phyletic Anthropology"], Hoßfeld speaks of the appropriation of Haeckel's work by social Darwinists, race hygienists, and National Socialists and conveys the impression that Haeckel's early biological anthropology was politically neutral but that his work degenerated into a racist and spiritualist monistic anthropology toward the end of the nineteenth century. This representation seems questionable, given Haeckel's early racial theory. In fact, in another article in this volume, coauthored with Stefan Wogawa and Breidbach ("'Sie ist eine Rassenfrage': Ernst Haeckel und der Antisemitismus"), Hoßfeld himself points to Haeckel's racial hierarchy, which placed *Homo caucasicus* at the top of ten human species (*Natürliche*

Schöpfungsgeschichte, 1868). Again, the authors argue against reading Haeckel as an anti-Semitic prophet of National Socialism.

Hans-Konrad Schmutz provides a case in point for the interconnectedness of scientific discourses on race and sociopolitical settings in “Vermessene Nation” [“Measured/Surveyed/Presumptuous Nation”]. In the construction of the notions of a *Homo alpinus* and of a Prussian race in the late decades of the nineteenth century, craniometric studies that were intended to reveal the racial makeup of populations fed into identity-endowing national histories that served to provide biological roots for one’s own nation or to deconstruct the “myths” of others. Schmutz’s essay, like those of the anthropologists Winfried Henke and Hartmut Rothe on the history of paleoanthropology (“Zur Entwicklung der Paläoanthropologie im 20. Jahrhundert,” “Stammbäume sind wie Blumenstraße”; see also Natalie Chaoui’s “Adolph Hans Schmutz (1891–1976) im Spannungsfeld zwischen Anthropologie und Primatologie”) and Breidbach’s piece on neuroanthropology (“Neuro-Anthropologie?”), illustrates the fact that the volume aims to exemplify the genesis of a biological anthropology and its differentiation into such areas as race hygiene, paleoanthropology, constitutional biology (*Konstitutionsbiologie*), and human genetics more generally. This is further reflected in the contributions of Preuß and Michal Šimunek.

Preuß’s “Zeitenwende ist Wissenschaftswende?” substantiates the editors’ claim in the introduction that the role of professional anthropologists in National Socialism, rather than having been critically examined, became a taboo topic after World War II. Preuß demonstrates the continuities (but also the discontinuities) in the personae as well as the content of German anthropology and ethnology pre- and post-1945 in the case of the anthropological group under Egon Freiherr von Eickstedt, originally at Breslau University. Although von Eickstedt had applied to the NSDAP for membership (in vain), supported the law against hereditarily tainted progeny, issued expert reports on individuals’ racial and familial backgrounds, and wrote anti-Semitic tracts on racial anthropology, he eventually managed to reestablish the Breslauer anthropological tradition at the University of Mainz in the French zone of occupation.

Šimunek (“Biotypologie”) discusses the rise of Czech biotypology as a science applied to the rationalization of large-scale industrial production at the shoe factory of Tomáš Bat’a sen. The goal was to have each employee occupy the job he or she was best suited for, and a central health register was established in the 1930s that con-

tained information on each person’s physical and mental state and family background. On the basis of this information the employees were divided into five groups that also corresponded to the different levels of efficiency required for tasks at the factory. The Czech biotypological society, founded in 1937, emphasized the practical uses of the pronouncedly interdisciplinary, international, and holistic field; it established connections to state institutions such as the ministries for education and health, but also to the military and the eugenics society. The enthusiasm for biotypology was cut somewhat short, however, with the German occupation in 1939, when race hygiene and race biology became the preferred fields in the protectorate.

In view of the broad spectrum in terms of time, place, and kind of anthropological science (in the widest sense) considered here, the volume’s title seems misleading. A common focus of the essays is arguably the politics of bioanthropological theory, practice, and application and their historical and local contexts. This focus is complemented by probings into present-day scientifically informed *Menschenbilder* (Breidbach) and by explorations of future possibilities for the anthropological sciences (Henke and Rothe). *Anthropologie nach Haeckel* contains original contributions to little-known subjects and will be of interest well beyond the small circle of historians of anthropology.

MARIANNE SOMMER

Richard Rapport. *Nerve Endings: The Discovery of the Synapse.* 240 pp., bibl., index. New York: W. W. Norton, 2005. \$23.95 (cloth).

Guests at the 1906 Nobel ceremonies must have wondered at the spectacle of archrivals Camillo Golgi (1843–1926) and Santiago Ramón y Cajal (1852–1934) sharing the award in Physiology and Medicine for “work on the structure of the nervous system.” In 1872–1873 Golgi’s innovative use of silver nitrate (the “black reaction”) to stain nerve and cell structures had revolutionized neuroanatomy. His results supported the “reticular theory” of the interconnection of nervous tissue. But Ramón y Cajal, using Golgi’s methods and his own refinements of them, had since 1887 provided even more beautiful evidence for the competing “neuron theory,” canonically articulated by Heinrich Wilhelm Gottfried Waldeyer in 1891. Cajal integrated theoretical contributions—notably “dynamic polarization”—with laboratory observations in his monumental *Textura del sistema nervioso*

del hombre y de los vertebrados (Moya, 1900–1904). While Golgi's Nobel acceptance speech was a last-ditch, unconvincing defense of reticulation, Cajal graciously acknowledged that his neuron theory would underpin twentieth-century neuroscience.

The title of *Nerve Endings* flaunts Cajal's victory, which identified the "gap" between neurons—Charles Sherrington dubbed it the "synapse"—as a definite entity and the key to nerve function. However, Richard Rapport's very readable book is not a scholarly history of neuroanatomy but a compact retelling of Ramón y Cajal's elegant and voluminous autobiography, bracketed by the neurosurgeon author's reflections on how Cajal's life and work have framed his own.

Both Golgi and Cajal saw brain and nerve tissue as (literally) the core of what makes us human. The actual means of visualizing it—the technology, technique, and artistry—were central to their work. While Rapport does not attempt a detailed reconstruction of their laboratory (sometimes, kitchen) lives, he "stains" this specimen of medical history so that we see both technique and technology in vivid detail. The achromatic light microscope enabled Cajal's work, and he pushed it to the limit: further anatomical detail would emerge only with electron microscopy, shortly after his death. Particularly interesting is Rapport's discussion of Cajal's science in relation to his artistic passions, including photography.

Imagine Cajal's career as a neuron: Rapport dissects nicely the dendritic input and the chemical neurotransmitters stored at the presynaptic membrane. He describes the impulse moving current treatment of illnesses such as Parkinson's disease. Yet Rapport is less satisfactory on what happens at this particular nerve ending. He seems implicitly to attribute "the discovery of the synapse" to Cajal rather than to Sherrington, who appears mainly as Cajal's gracious and admiring host on the occasion of his Croonian Lecture. Yet Sherrington worked in the English physiological tradition rather than the (mainly German) anatomical tradition that culminated with Cajal. While Cajal theorized about function on the basis of observed structures, Golgi had sought structures capable of explaining complex neurological function—a project in some respects more akin to that of Sherrington, who found his answer in Cajal's "gap."

Rapport describes elements found with electron microscopy that might partially vindicate Golgi's reticular theory. He notes, too, that Cajal found it necessary until his death to defend neuron theory. But it is perhaps not helpful to con-

tinue their debate on the other side of the synapse, as Rapport does when describing results as "concessions" to Golgi while implying that Cajal, nearly single-handedly, made all of modern neuroscience possible.

Historians will regret Rapport's unself-conscious use of metaphors, his invocations of "national character," his amateur psychobiography, and his uneven attempts to contextualize the scientists' stories. However, his lively storytelling and lucid explanations of scientific concepts will engage and inform—and likely inspire—many grateful readers. The book's melding of the personal, technical, and social aspects of a fascinating story enhances our appreciation of neuroscience as a humanistic endeavor.

BONNIE ELLEN BLUSTEIN

Arnold Reisman. *Turkey's Modernization: Refugees from Nazism and Atatürk's Vision.* xxvii + 571 pp., illus., figs., bibl., index. Washington, D.C.: New Academia Publishing, 2006. \$28 (paper).

The Turkish Republic was founded under the leadership of Mustafa Kemal Atatürk in 1923 on the hot ashes of the Ottoman Empire. The majority of the land contemporary Turkey now occupies was neither very rich nor strategically important to the Ottoman Empire. Although the elite and bureaucratic groups were by and large products of the Young Turk regime that immediately preceded the republic, most other resources had to be created from scratch or reluctantly appropriated from the empire. Darülfünun, the premier institution of higher education of the twentieth-century Ottoman Empire, was practically the only university after 1924, when the Islamic colleges (madrasas) were shut down by Atatürk and his cabinet. The prospects of creating a national science and culture were quite slim. And most contemporary observers of science in Turkey agreed that it still retained its scholastic tint. İsmayıl Hakkı Baltacıoğlu, the former rector of Darülfünun and arguably the most talented pedagogue at the disposal of the new regime, had suggested that it would take decades before the Ottoman intellectual heritage could be ousted in favor of a modern and national replacement from the galleries, institutes, concert halls, laboratories, and schools. It was shortly after this comment, on 31 July 1933, that Darülfünun was shut down. On 1 August the new Istanbul University (which claims to have been founded in 1453) was opened on the very same site. Most Turk-

ish faculty members, including several very prominent intellectuals of the era, were fired without advance notice and replaced by German counterparts who, having lost their jobs after the Nazi party passed the Reconstitution of Civil Service law early in 1933, were invited by the Turkish government to teach at the new university. The vast majority of the émigrés who came to Turkey, many of whom were already prominent in their respective fields, were assigned to the faculties of medicine and natural sciences. Accompanying these new appointments was the setting up of new research labs.

Hence, it was a contingent conjunction of events that set in motion the institutionalization of modern science in Turkey. Arnold Reisman's book is a satisfying prosopography of the German émigrés who made this process possible. The book also serves as a compendium of primary sources relevant to the subject matter. Reisman's account captures the complexity of the relationship between forced migration and scientific change from predominantly German and American testimonials. Reisman's habit of quoting at length makes quite interesting firsthand accounts and memoirs accessible to the interested scholar who would otherwise have a difficult time gathering these dispersed documents, not to mention the fact that he has also carried out extensive correspondence with the families of and survivors among the German-speaking émigrés who spent time in Turkey.

Given that *Turkey's Modernization* is the only work of such breadth in the English language, the book is a must-read for all those who intend to work on science in the twentieth-century Ottoman Empire and Turkey. Those who already have some knowledge about science in the early Turkish Republic might be pleased to know that Reisman's book successfully replaces Horst Widmann's study from 1973, *Exil und Bildungshilfe*. Those who work on German émigrés in the United States will find that the Turkish experience, as portrayed by Reisman, is vastly different from the American one. Reisman's interests also encompass comparative technology transfer and its political and economic effects, as is clear from his final chapter. The book will also be of interest to those who study the relationship between science and collective memory.

Reisman's work marks a beginning rather than an end. There still are many gaps in the historical context that need to be filled before we can understand the scientific culture of Turkey. Reisman's account does not highlight the complex and dramatic nature of Atatürk's university reform, which was an ideologically charged mo-

ment and, as such, has recently drawn the attention of scholars such as Mete Tunçay, Ali Arslan, Rifat Bali, and the late Stanford Shaw. However, several well-known histories of modern Turkey, such as those of Niyazi Berkes, Bernard Lewis, Feroz Ahmad, and Erik Jan Zürcher, have little to say on the role of science, and of the university reform of 1933, in the early career of the Turkish Republic. The influence of the German émigrés on the subsequent generations educated in Turkey and on the institutional composition of Turkish university science (not too different from the German "mandarin" system) is undeniable and merits further research.

B. HARUN KÜÇÜK

Julia Rodriguez. *Civilizing Argentina: Science, Medicine, and the Modern State.* xii + 306 pp., illus., figs., apps., bibl., index. Chapel Hill: University of North Carolina Press, 2006. \$24.95 (paper).

The dawn of the twentieth century appeared to be Argentina's golden age. At the time, it was one of the richest countries in the world. Signs of modernity could be found in the country's railroads, factories, and streetcars and in its urban cityscapes, rivaling those of Paris. In a few decades, several million immigrants flooded to Argentina, hoping to share in this prosperity. This was also—seemingly—a golden age for Argentine science. Scientists there enjoyed institutional and political power that would have been the envy of their colleagues in Europe and North America. Julia Rodriguez's work focuses on the prolific "generation of 1880," a loose group of liberal intellectuals that included some of the country's most eminent scientists and physicians, among them José Ingenieros, Emilio Coni, and Juan Vucetich. They were concerned with the social disorders that accompanied Argentina's rapid modernization. These "social pathologists" included specialists in—for example—hygiene, public health, psychiatry, criminology, eugenics, and puericulture. They were strikingly successful in achieving their goals, building an unprecedented alliance with the Argentine state. Collectively, their mission was to modernize Argentina and to build a national science to meet national aims.

Rodriguez offers a deeply critical and original reinterpretation of this supposed golden age. Beneath this superficial liberal modernization, she argues, the work of Argentina's liberal scientists served reactionary ends. The country's ruling elites used science as a tool for maintaining the existing social hierarchy in the face of massive

immigration and the social and economic transformations that accompanied it. Rodriguez argues that Argentine scientists began to “medicalize” criminality, delinquency, and any sort of deviance that ruling elites found threatening. This medicalization of deviance in turn helped rationalize and legitimize state intervention. For example, Argentina’s social pathologists interpreted prostitution, malingering, and anarchism as caused by “degeneration” in the immigrant communities. Rodriguez builds her narrative on the basis of impressive research into police and penitentiary records, as well as a wide array of medical, criminological, and psychiatric journals published in Argentina during this period.

The book is organized into four thematic sections: symptoms, diagnosis, prescriptions, and hygiene. Throughout these sections, Rodriguez shows how Argentine scientists constructed deviant behaviors as medical and social problems and then developed institutions and technologies to address them. Women, working-class people, and foreigners bore the brunt of these scientific measures of social control. Hygienists carefully monitored and regulated prostitution—not for the protection of the prostitutes but, rather, for that of their clients. Even where secular and scientific institutions supplanted those run by the Catholic Church, they continued to enforce traditional social values. Social pathologists, for example, prescribed domesticity as a cure for problems faced by “deviant” women—frequently prostitutes or working-class women who worked outside the home. Likewise, the new generation of scientists continued to believe in the civilizing influence of motherhood. They promoted puericulture—the rational science of child rearing—as a way of ensuring the future of the Argentine nation.

State repression also became more scientific and rationalized in this period—especially in the face of growing social unrest from those immigrants who were excluded from Argentina’s political systems. Ironically, one of the most important innovations in scientific policing in this period came from someone who was himself an immigrant. The Yugoslavian immigrant Juan Vucetich developed an efficient system of fingerprinting criminals, which eventually was taken up not only in Argentina but in parts of North America and Europe as well. The Argentine state also built a new national penitentiary along the lines of the most progressive prisons in the United States and Great Britain. Argentine criminologists sought to change the goal of incarceration from punishment to rational rehabilitation. In public spaces, hygienists also helped significantly diminish the rates of

infectious disease in Argentina. Here, as elsewhere, sanitation was a “civilizing and modernizing force.” Hygiene and sanitation were also used, however, as a means of excluding people deemed to be sick or weak from full citizenship. Here, Argentina’s elites drew a strict analogy between medical health and social and political health.

This is a pathbreaking and ultimately convincing reinterpretation of Argentina’s golden age, of interest not only to historians of science in Argentina but also to economic and social historians. While the text frequently alludes to the broader context of the Atlantic world, Rodriguez does not develop this broader geographical and comparative context as fully as she might. Nonetheless, *Civilizing Argentina* remains an important work that places the history of science fully at the center of Argentina’s social, political, and economic history. As the book concludes, the scientific model of civilization developed in this period ultimately contributed to the growing bureaucratic authoritarianism that was to plague Argentina for much of the twentieth century.

STUART MCCOOK

David N. Stamos. *Darwin and the Nature of Species.* xix + 273 pp., bibl., index. Albany: State University of New York Press, 2007. \$28.95 (paper).

Whenever I teach a course on or with Darwin, I ask my students, even before they ask me: “Do you think species *exist* for Darwin?” Answers vary; but the best I ever got was from Jessica at UCLA: “Yes, but . . .”—as usual, students are the most useful source of reflection on academic matters. Arguably, the existence of species is the most thought-provoking and obscure aspect of Darwin’s theories. Scholars of the level of Ernst Mayr, Michael Ghiselin, and John Beatty, to mention just three, have given challenging and often at least partially conflicting explanations of that point. Now David Stamos, after other preliminary publications on that matter, has produced a whole book on the issue.

Stamos seems to belong to that rather restricted but extremely active and productive group of historians who still believe that to find out what their author really thought is as important as to unveil the political and sexual inclinations of his or her maid or valet. In other words, Stamos studies the internal history of science (at least mainly, if not entirely), and his book is a fine example of intellectual history of the sort produced by the likes of Bob Richards, Jon Hodge, Michael Ghiselin, John Beatty, Pe-

ter Bowler, Polly Winsor, Antonello La Vergata, and Eve-Marie Engels, to mention just a few of that ilk—few but good, one would be tempted to say.

Stamos expresses his view in a bold and direct way from the very beginning: Darwin *is* a realist; species do exist for him. To support this view, our author analyzes every single aspect of the problem, from Locke's famous nominalist concept of species to the well-known interpretations of species offered by Mayr, Ghiselin, and Beatty. The question—even after the thorough investigations of those scholars—is complex and not much helped by Darwin himself, who seemed to use different concepts of species, whether morphological, biological (often called “physiological” in the nineteenth century), or genealogical. He shifted from one concept to another in his publications and in his private papers—his unpublished notes are vital to understanding his thought, as the Darwin Industry has shown and as Stamos knows perfectly well. Ghiselin is a main character in Stamos's book—almost the main reference—and this is not surprising, given that Darwin's thought is incomprehensible without reference to Ghiselin's seminal publications. Ghiselin is a convinced believer in the individuality of species, and this theme is profusely discussed by Stamos. Also, Beatty's writings on species are discussed by Stamos as perhaps the main critical reference of his book. Another author often quoted and criticized is Gordon McOuat.

Stamos is very strong on the philosophical side of things. He knows how to argue in a precise and clear manner and quotes practically everything that has to be quoted on the matter, with the exception of Jon Hodge's *Origins and Species* (Garland, 1991), a book of great importance that is almost entirely neglected by scholars—including its very author, who proposed the best-founded hypothesis on Darwin's philosophical roots in the thought of David Hume. Stamos gives us a thorough and competent discussion of species and individuality, the reality of species and the nonreality of higher taxa, and the concepts of “laws of nature” and *vera causa*, on horizontal/vertical distinctions. There is a further point that makes Stamos's book particularly interesting: he uses his case—Darwin on species—as an example for elaborating questions in the philosophy of science. Thus the philosophy of science is based not on abstract models but on concrete historical problems: this use of history to elucidate problems of the philosophy of science is extremely fruitful, and Stamos uses it to reconsider Thomas Kuhn's famous view of scientific revolutions.

Perhaps the major fault of *Darwin and the Nature of Species* can be found in the excessively bold and assertive—almost to the point of arrogance—tone of Stamos's arguments, so very different from that used by Darwin himself. We are told repeatedly that Darwin *is* a species realist. But this is not a fact; it is Stamos's well-argued view. Perhaps a less aggressive style would have better suited the gentler style of Darwin himself.

Are we convinced by Stamos's forceful arguments? Are we totally persuaded that Darwin was a convinced species realist? Up to a point Stamos is convincing: he knows the subjects, has read everything relevant, and controls his material admirably. Personally, I see Darwin as a “metaphysical minimalist,” as someone who did not try to replace other people's metaphysical “isms” with his own—whether “nominalism,” “realism,” “populationism,” or whatever. Perhaps his philosophical position, which owed a lot to Hume, as Hodge has shown, is mirrored by W. V. Quine's “ontological relativity”—*relativity*, not *relativism*: species are real when it is useful to consider them real—for example, in their genealogical meaning, as the result of natural selection and descent; species are not real when we see them from a morphological point of view (as often in the *Origin of Species*) or are semi-real as in the biological sense, leading to Mayr's populationism. Quine is the most Darwinian of all philosophers and is mentioned by Stamos only briefly.

This said, there is no way we can ignore the realist stance presented by Stamos when we talk about species, whether we are in discussion with our colleagues or teaching students. Stamos's view will have to be presented as a plausible, well-argued, and empirically sustained interpretation of Darwin's concept of species. It will have to be compared with the views of Mayr, Ghiselin, and Beatty and taught alongside them in classrooms. After all, Jessica's answer to the question “Do species *exist* for Darwin?” remains the best point made on the subject: “Yes, but . . .”

MARIO A. DI GREGORIO

■ Recent (1950–)

Loren R. Graham. *Moscow Stories*. xi + 305 pp., bibl., index. Bloomington/Indianapolis: Indiana University Press, 2006. \$29.95 (cloth).

Loren Graham is a capable raconteur who can deliver teasing comments with a twinkle in the eye and a wink to the onlooker. His wit and

extensive experience as a writer and historian also flow forth in this excellent memoir: an erudite, beautifully written autobiography and meditation on the meaning and role of the historian in modern society with an edge that made me laugh and pause for reflection throughout.

Graham provides an autobiographical account of his interests and motivations in the history of science and Russian science in particular. In doing so, he discusses his many trips and experiences in Russia, mostly in Moscow, during and after the Cold War, always returning to the humanity and the social environment of those he met and interviewed. The description of his meeting with Bukharin's widow, Anna Mikhailovna Larina, forms one of many memorable testimonies. The roster of characters that appear is quite startling: Graham knew Wendell Furry from their hometown of Farmersburg, Indiana; he went to college with Neil Armstrong; he met Yuri Gagarin; and he had a loose knowledge of the whereabouts of Lee Harvey Oswald in 1961.

Graham himself can be succinctly described as the major figure in the history of Russian science in the last fifty years. From the immense brilliance of *Science and Philosophy in the Soviet Union* (Knopf, 1972) to the poignant morality of *The Ghost of the Executed Engineer* (Harvard, 1996), he has set a high standard. His books offer case studies for the student and many nuances and insights for the researcher. *Moscow Stories* is a well-written reflective work that presents some important background material in addition.

A fascinating feature of this volume is Graham's candor in describing and questioning the political context and character of attempts to develop a critical history of Russian science in this period. As one might expect, there are some very amusing and frightening episodes involving KGB interest in a United States citizen, especially one conducting research into Soviet science in Moscow during the Cold War. Graham also relates his experience of attempts by U.S. agencies to elicit his help in espionage. The complexity of friendships under the Russian dictatorship is well documented, but Graham also alludes to complexity in some of his friendships and professional relationships in the United States. His concern about the political undertones of the history of science and its obvious instrumental value to agencies beyond the scholarly arena is brought home in a section on the vetting of research applicants and its relationship to the U.S. government. At the same time, he outlines his own reasons for engaging in the anti-Vietnam War movement.

Throughout, Graham ponders and agonizes about his political role—or, as was most often the case, his deliberate disassociation from such a role. This provides a very interesting and provocative subtext, as Graham considers whether he should have been a spy and reflects on his beliefs about the social responsibility of a historian of science in the modern world. When doing research on left-wing scientists during the Cold War and earlier, one finds that they constantly encountered questions and possibilities of espionage; the aim of such endeavors would always be to support the progressive “socialist state” against capitalism. Here, Graham, with no illusions about such a progressive state, experiences the diametrically opposed problem: whether he should have helped destroy “socialism” by working for U.S. intelligence, even while accepting the limitations and shortcomings of “Western” society.

Thus, an enormous question that stalks history of science internationally is articulated. Is it correct to feign or even to believe in the dispassionate voice of the historian of science, when science is such a politically explosive discourse that conveys a distinct social power? Many historians choose to ignore the potential use of their work in the social or political arena. Graham has impressively refused to ignore it and considers his actual and potential social action.

Consequently, this book is valuable at a number of levels. As the memoir of a celebrated historian, as a series of amusing and poignant anecdotes, and as commentary on the history of Russian science, it is a marvelous read. As a more philosophical and political essay on the social responsibility of a historian and the political dimensions of modern history of science, it is outstandingly provocative.

C. A. J. CHILVERS

Benjamin P. Greene. *Eisenhower, Science Advice, and the Nuclear Test-Ban Debate, 1945–1963.* xiii + 358 pp., bibl., index. Stanford, Calif.: Stanford University Press, 2006. \$65 (cloth).

In September 1963 the United States Senate ratified a treaty, signed in July 1963 by representatives of the United States, the Soviet Union, and Great Britain, banning the testing of nuclear weapons in the atmosphere, in outer space, and under water. As a result of a moratorium issued by President Dwight D. Eisenhower in response to a Soviet initiative, the United States had conducted no nuclear tests

since late 1958. Underground and then atmospheric tests had resumed in September 1961 under the orders of President John F. Kennedy, following a Soviet test. In *Eisenhower, Science Advice, and the Nuclear Test-Ban Debate, 1945–1963*, Benjamin P. Greene reexamines the views and actions of Eisenhower on the matter of nuclear testing during his two administrations, as well as his attitude toward the 1963 treaty. Greene brings to this analysis a detailed study of archival documents and personal papers that were unavailable to some earlier historians who wrote on this issue, as well as a critique of historians who question Eisenhower's genuine commitment to a test ban. In contrast, Greene supports the view that the test ban was one of Eisenhower's major goals during his presidency, that it was an early goal of his presidency, and that technical issues such as international inspections and thresholds for seismic detection were among the factors that undermined Eisenhower's efforts toward a test-ban treaty.

Greene focuses on three main themes in his study: the relationship between Eisenhower and Lewis Strauss, who chaired the Atomic Energy Commission (AEC) from 1953 to 1958; Eisenhower's leadership style of taking recommendations from advisors rather than simply following his own instincts; and Eisenhower's evolving attitude toward scientific advisors and his changing relationships with particular scientists during his presidency. In Greene's view, Eisenhower already favored a nuclear test ban in 1954, when he appointed Harold E. Stassen his disarmament advisor. However, Eisenhower's skepticism about the reliability of scientists' advice on national security matters and his trust in the deceitful and forceful Strauss led him to accept the arguments of Strauss—a nonscientist who shared the views of AEC scientists such as Edward Teller and Willard Libby—that the testing of nuclear weapons was essential to American weapons superiority, that international agreements relying on monitoring were impossible, and that atmospheric tests posed no public health hazards (a position on which Libby changed his mind in 1959 following the detection of dangerous levels of strontium-90 in Minnesota wheat).

After the launch of *Sputnik* in 1957, Eisenhower set up an eighteen-member Presidential Scientific Advisory Committee, which included the physicists I. I. Rabi and Hans Bethe, and appointed a personal advisor for science and technology, with the result that he was no longer so strongly dependent on the counsel of Strauss

and his successor at the AEC, John McCone. Former MIT President James Killian, Jr., was Eisenhower's first personal scientific advisor, and the Harvard University chemist George B. Kistiakowsky succeeded Killian. Adlai Stevenson had made a testing ban a theme in the 1956 presidential campaign, and Rabi used his acquaintance with Eisenhower to offer personal advice to halt testing. After Eisenhower declared the voluntary moratorium in 1958 and opened discussions in Geneva with the Soviet Union and the United Kingdom for banning all testing, he continued throughout his presidency to resist arguments from test-ban opponents at the AEC, the Department of Defense, and the national laboratories at Los Alamos and Livermore that he should withdraw delegates from the Geneva talks and resume testing. Although Eisenhower was told that the moratorium was undermining morale and expertise at Los Alamos and Livermore, Greene notes that the number of staff members in fact increased during the period it was in effect.

Greene makes it clear that Eisenhower viewed a test ban in the 1950s as highly desirable in order to maintain the superiority of the American nuclear arsenal and prevent proliferation to China and other countries. Greene also stresses Eisenhower's determination to press for a general testing ban that would require international monitoring stations and periodic inspections within nuclear countries, rather than dependence on remote detection systems, because of his continued suspicions of the Soviet Union. Eisenhower's farewell speech of January 1961, one of the most famous documents from his presidency, cautioned the American public about the rising influence of the "military-industrial complex" in national affairs. Greene highlights Eisenhower's second warning in the speech, this one against large-scale, government-funded scientific research that makes public policy a captive of a scientific-technological elite. Greene notes that the draft of an eloquent section in the speech expressing disappointment over the lack of progress on disarmament is in Eisenhower's own hand.

Greene's book is a valuable addition to the historical literature on U.S. policy on nuclear weapons and on the role of presidential science advising in the early Cold War period. He succeeds in making a strong case that Eisenhower was disappointed that he did not achieve a nuclear test-ban treaty during his presidency.

MARY JO NYE

Zonggang Hu. *Jingsheng sheng wu diao cha suo shi gao* [*Historical manuscript of Fan Memorial Institute of Biology*]. (Zhongguo jin xian dai ke xue ji shu shi yan jiu cong shu.) 250 pp., illus., figs., tables, bibl., index. Jinan: Shangdong jiao yu chu ban she [Shandong Education Press], 2005. 29 yuan (paper).

The history of biology in twentieth-century China is attracting increasing interest from scholars. This is a welcome development, because biology was a crucial part of the history of science in twentieth-century China. Together with a few other sciences, such as geology and archaeology, biology—especially field biology—ranked as one of China's most successful scientific enterprises in the first half of the twentieth century. Field biology was also important because of its role in nation building and national imagining. For Chinese biologists at the time, biological surveys contributed to the mapping and cataloguing of the nation's natural riches.

The Fan Memorial Institute of Biology was one of the first and most active biological research institutes in Republican China (1912–1949). Established in 1928, the institute was a private organization directed and staffed by Chinese scientists. But it also had strong American connections. Most of its funding came from a joint Sino-American foundation. The idea for the institute owed much to the examples of the Wistar Institute and the U.S. Biological Survey, and many of its scientists had received their degrees in the United States. The zoologist Bing Zhi, who served as the first director of the institute, had studied under the entomologist James Needham at Cornell University in the 1910s. Bing's successor Hu Xiansu was a Harvard-trained botanist. However, there were also European-trained staff members, such as the fern expert Qin Renchang. The primary projects of the institute were collecting, field biology, and taxonomy. They covered botany, mycology, ornithology, and ichthyology, among other topics. Later, the institute helped establish the Lushan Arboretum and Botanical Garden, which pursued research on forestry, wood, and horticulture. The Sino-Japanese War broke out in 1937. Officially, the Fan Memorial Institute remained in Beijing, but many of its staff members moved to the Chinese-controlled provinces, where they joined or set up research stations. Since this part of China abounded in botanical riches, these scientists actually had a lot of material to work on. But they were hampered by lack of funds. The Sino-Japanese War was followed by the Civil War. After the Communist

regime took power in 1949, all scientific institutes were nationalized and put under the direct control of the government. Consequently, the Fan Memorial Institute was abolished and absorbed into the national scientific organizations.

This book is a straightforward, chronological account of the Fan Memorial Institute of Biology, from its founding in 1928 to its abolition in 1950. The main focus is on the major scientists and supporters of the institute, the principal achievements of its scientific work, the financial and other difficulties it encountered in its short but eventful history, and the impact of major political events, such as wars, on the fate of the institute. The book is narrowly focused, and its goal is modest. (A better rendition of its Chinese title would be "A draft history of the Fan Memorial Institute of Biology," rather than the official English title given above.) It does not try to situate its subject in the overall context of science in twentieth-century China, nor does it try to engage in academic scholarship in the history of science. Nevertheless, the book adds a key piece to the picture of science in Republican China. Field biology constituted a vital part of that science, and the Fan Memorial Institute was a leader in that area of research in China at the time. In this regard, the book complements well Laurence Schneider's fine study of genetics in China, *Biology and Revolution in Twentieth-Century China* (Rowman & Littlefield, 2003), which concentrates on the Communist era and neglects field biology. In charting the history of the Fan Memorial Institute, moreover, Zonggang Hu's book touches on many significant historical issues and questions that merit further investigation. For example, I find very interesting the brief account of the pioneering science illustrator Feng Chengru and the development of modern science illustration in China. There is a great dissertation topic here!

Overall, the author has done a solid job of piecing together the history of one of the most important scientific institutes in twentieth-century China.

FA-TI FAN

Sarah E. Igo. *The Averaged American: Surveys, Citizens, and the Making of a Mass Public*. 398 pp., illus., index. Cambridge, Mass.: Harvard University Press, 2007. \$35 (cloth).

The triumph of the aggregate is a theme so central to twentieth-century U.S. history that mass institutions, majority opinions, and large-scale communities can sometimes seem like the inevitable by-products of modernizing processes

that historians chant like mantras: industrialization, urbanization, immigration. Sarah Igo's fascinating and important book explores the place of social facts and numbers in this story. In survey research and polling—subjects usually consigned to the dusty margins of both history of science and social history—she sees the origin of trends in personal and national consciousness that transformed how people understood themselves and how citizens understood their nation during the middle decades of the twentieth century. “The averaged American” of Igo's title was not axiomatic; it emerged gradually from historically specific knowledge technologies. Community studies, opinion polls, and sex research measured social truths objectively, according to social scientists, as if they did nothing but hold a mirror up to a changing society. Their efforts to make the mass public visible to itself, according to Igo, solidified the culture of consensus evident by midcentury. The history of social science is therefore nothing less than “an index to political and epistemological power” (p. 22).

Igo tackles three substantive cases to support this argument: *Middletown*, by Robert and Helen Lynd; the polling enterprises of George Gallup and Elmo Roper; and Alfred Kinsey's reports on sexual behavior. All three were famous, widely discussed, and controversial for their methods as well as their findings. While Igo details the influence of social science on individuals and communities, she also aims to show us how those individuals and communities “talked back” to the social scientists who claimed to represent them. In Muncie, Indiana, where the Lynds popularized the ethnographic sensibility previously associated with anthropological studies of primitives, residents responded with a mixture of distrust and resignation. They articulated the tension between local, experiential forms of knowledge and the impersonal, quantitative “data” gathered by outside experts.

Igo documents this tension repeatedly. Angry letters written to Gallup, Roper, and Kinsey illustrate that Americans were skeptical about the scientific authority validating neat summaries of their aggregated opinions and behaviors. Sampling methods were objectionable to many people who simply did not believe that pollsters could be correct without consulting them personally. Surveyors' most shocking assertions were aggressively contested as well. The war over Kinsey's findings exposed the slippage between statistical and ethical conceptions of average, typical, and normal sexual behavior. Notwithstanding her

sensitivity to popular reactions, Igo admits that surveys and polls were like “a genie out of the bottle” (p. 189). Whatever their doubts, many Americans were curious, even enthusiastic, consumers of information about themselves.

Of particular interest is the book's illuminating consideration of majorities and minorities. Igo shows how scientific strategies for achieving typicality promoted more homogeneous pictures of American life. The quest to turn Middletown into Everytown, for instance, not only distanced the Lynds from Progressives' explicit concerns about immigrants, juvenile offenders, and other marginalized groups but required them to exclude “foreign elements” and “Negroes.” The drive to enhance the empirical credentials of surveys and polls, in other words, promoted narrower, more ideological understandings of which individuals and groups exemplified “America” accurately. Native-born whites, paradoxically, came to represent everyone in the country. Minorities, when they were considered at all, were consigned to the sidelines. They represented only themselves.

That social scientists quantified Americans so exclusively between the 1920s and the 1950s contributed to the powerful vision of a consensus society and, not coincidentally, frequently united them with marketers bent on fueling mass consumption. The civil rights revolution and waves of immigration associated with the era that followed turned “Who counts?” into the most urgent question facing American democracy. Since the 1960s, majoritarian answers to that question have been discredited, and it is no longer possible to report national polls, as Roper and Gallup did, as if “America Speaks!” in a single voice. In our new age of pluralism, survey researchers and pollsters emphasize multiple publics and diverse views.

This shift has hardly diminished the significance of popular social science. As Igo notes in her conclusion, today's debates over social facts and numbers (from census categories and estimates of the prevalence of homosexuality to vote counting) remain symbols of conflict about what democracy will mean politically, socially, and culturally. Modes of scientific inquiry that contributed to aggregate ways of knowing decades ago have emphatically disaggregated our social world. Niche marketing, a crowded blogosphere, cable narrowcasting, and other practices promising the tightest possible fit between knowledge and democracy simply confirm the stamina of statistical citizenship, now almost a century old. At once intensely anonymous and voyeuristic, detached and reflex-

ive, the legacy of American popular social science remains powerful because we still want to know: Who am I? Who are they? How do commonalities and differences add, subtract, multiply, and divide to define the “we” that is a country?

ELLEN HERMAN

Sean F. Johnston. *Holographic Visions: A History of New Science.* xxi + 518 pp., illus., figs., tables, bibl., index. New York: Oxford University Press, 2006. \$134.50 (cloth).

Sean Johnston has written a timely and much needed book about the history of holography—a “high-tech” science that emerged in the mid-1960s out of the shadows of Cold War secrecy to fascinate the wider scientific community and the general public. Using tiny glass plates and the beams of just-discovered lasers, holography provided realistic three-dimensional images almost “out of nowhere,” thus realizing the ancient human dream of “magic.” The unique properties of this new method of optical reconstruction—high sensitivity to microscopic movements, information richness (each dot of a hologram stores information about the entire object), robustness, inherently parallel data processing, and more—opened incredible possibilities in information technology, nondestructive testing, coding and security, and many other areas. The aesthetic properties of holograms soon attracted artists and artisans, and they seemed to be a promising medium for advertising and the popularization of cultural objects. “Holography hit the world with a bang in 1964,” the author states in the beginning of his book (p. vii), only to show in the chapters that follow that the hopes it generated have not been realized: the protagonists did not succeed in establishing holography as a separate discipline, and its glamour has slowly faded since the late 1980s, with new developments in science and technology (the ICT revolution, work in the life sciences, nanotechnologies, etc.).

Yet holography did establish itself as a recognized research field, as a distinct method for approaching a number of problems in science and engineering, as an endless source of entrepreneurial inspiration, and as an original (if tiny) domain of creative art. The spirit of the first holographers is still alive. So this is a good time to write a history, to go beyond “the hundreds—perhaps thousands—[of] capsule histories” (p. 2), to bring together and analyze numerous partial accounts, personal memories, and oral histories (some of which are on the way to becoming myths). Johnston has chosen the right

moment, carrying out his study in a period of relative calm, before some new discovery comes to dominate the field—as has happened a number of time during the past sixty years.

In writing his history of holography, Johnston has successfully avoided a number of pitfalls described in the first “methodological” chapter. While taking a critical stance toward other popular approaches, he opts for an approach closer to that of authors like Peter Galison, in his study of material culture in microphysics, and especially Terry Shinn, with his notion of research technologies (p. 441). The first three chapters analyze consecutively the contexts of research out of which the three distinct constituents of holography have emerged: the pioneering study of Denis Gabor on optical wavefront reconstruction in electron microscopy, initiated at British Thomson-Houston in the summer of 1947, and his early followers’ research in the United States and the United Kingdom; the Ph.D. thesis of Yuri Denisyuk on wave photography, research carried out at the State Optical Institute in Leningrad between 1958 and 1961; and, finally, the Department of Defense-financed project of Emmett Leith and Juris Upatnieks on radar data optical processing, developed since 1954 at the Willow Run Laboratory of the University of Michigan, which eventually led to the major breakthrough in December 1963. Initially named “lensless photography,” holography was soon the subject of a blaze of publicity, and the two young researchers gained wide recognition. The book describes these events in detail, tracing the emergence and stabilization of new vocabulary, the revival of interest in the work of Gabor and Denisyuk, and interrelations among the three approaches, as well as the intrigues and power games that soon began. It follows the efforts of the main characters and a growing number of disciples, colleagues, and other enthusiasts to develop the new field—the search for applications, experimentation with new schemes, the mobilization of efforts to solve identified reverse salients (laser beam coherence, improving the recording media, white light reconstruction, etc.), related inventions, and so forth. This will make the volume very useful for holographers themselves (scientists, engineers, artists, and artisans): younger workers are already having difficulty maintaining the integrity of their field and tend to mythologize some aspects of its emergence and development.

Johnston has made some real discoveries that provide new evidence on long-discussed topics in science and technology studies, and so *Holographic Visions* will be valuable for STS scholars as well. One such achievement comes from his

analysis (in Pt. 3) of how holographic techniques and artifacts laid the groundwork for the emergence and subsequent stabilization of (new) group identities. Studying artisan holography, he also reveals how a different context of research, with its own political, cultural, and emotional values, contributed to the invention of low-cost sandbox holography as a radically different technique. His study of the decades-long efforts of holographic entrepreneurs to identify and explore promising areas of application reveals interesting patterns, representative of the innovative activities in high-tech fields whose markets are about to emerge or, when established, are marked by sudden new entries, strong competition from both within and outside the field, high levels of technical variability, and so forth. There are interesting reflections on the differences between Western and former socialist countries, the lower scale of autonomous entrepreneurial activity and the “statization” of holography’s applications in the latter being the most important. The book treats decision makers in scientific and technological innovation, as well as the analysts of entrepreneurship and business practices.

I will conclude with two critical remarks. Despite significant efforts to catch the development of holography worldwide, the book mostly presents the history of holography in the United States and the United Kingdom. The detailed analysis of Denisyuk’s work and frequent references to other Soviet holographers and centers of research cannot compensate for the asymmetry in the scale and scope of historical investigation and fieldwork in the two contexts. Some important processes in former socialist countries are mentioned barely or not at all—for example, the role of the All-Soviet School on Holography in building the identity of the holographic community in these countries. Holographic research in Japan, China, Taiwan, and other countries is merely sketched. Even holography in continental Europe, developed both in universities and in corporations such as Siemens, Philips, and Thomson-CSF, is scarcely presented.

The book provides little evidence about the intensive commercial and military-related research on holographic storage and processing of information. I have claimed that—along with embossed and security holograms, which Johnston describes—this has been the most intensive area of research since the late 1960s (Ivan Tchalakov, “The History of Holographic Optical Storage on Both Sides of the Iron Curtain, 1969–1989,” *ICON*, 2005, 11:95–119). In the Soviet Union (as well as in the United States), these researches exceeded all other areas of holography in terms of the number of people involved and the scope of the investment made.

The results remained classified for decades and slowly began to emerge in the 1990s.

Hence further investigations are needed in order to fill the gap. In this respect, Johnston’s analysis of Project MICHIGAN—of the institutional and cognitive context at Willow Run—could be an important point of reference, especially if coupled with a softening of the stance toward the “seamless web” approach in sociohistorical studies.

IVAN TCHALAKOV

John Krige. *American Hegemony and the Post-war Reconstruction of Science in Europe.* (Transformations: Studies in the History of Science and Technology.) viii + 376 pp., bibl., index. Cambridge, Mass.: MIT Press, 2006. \$40 (cloth).

In this fine book, John Krige looks beyond the more familiar role played by science and scientists in shaping the Cold War relations between the United States and the Soviet Union to examine their role in defining postwar relations between the United States and the countries of war-ravaged Western Europe. In doing so, he takes great care to treat those developments as varied and conditioned by widely divergent contexts, specifically in France, Germany, and England. In contrast, Krige describes American involvement in the reconstruction of science in Europe as a coherent “hegemonic postwar American project” (p. 2).

Key concepts, taken from diplomatic and political historians, are “hegemony” (dictionary definition: control or dominating influence by one person or group over others, especially by one political group over society or one nation over others) and “empire” (a group of nations, territories, or peoples ruled by a single authority). Given the enormous disparity in resources between the United States and European countries, Krige accepts as natural “the construction of an ‘informal’ American empire in Western Europe after the Second World War” (p. 4) and looks to examine both the heretofore underappreciated role that science and scientific leaders (both in the United States and in Europe) played in the establishment and maintenance of this “informal empire.” As important, he explores the various ways and the extent to which that hegemony became manifest not only in the relations between American and European science but also in the very organization and practice of science in both places.

Krige emphasizes, above almost all else, that to establish its informal empire successfully the United States required and found committed in-

dividuals in Europe who were willing, even anxious, to collaborate in the reconstruction of European science in a manner consistent with American interests and values. This is his concept of “coproduction.” Going beyond the diplomatic historian’s notion of “consensual hegemony” as a description of postwar American influence in Europe, the use of the term “coproduction,” for Krige, is meant both to draw “attention to the creativity of both partners and to the relative plasticity of U.S. policymakers” and to signal “that the United States gave Europeans room to leave their imprint on the hegemonic regime and implies that empire building is a fluid process” (p. 4).

The theoretical constructs are presented in introductory and concluding chapters, sandwiched around case studies on science and the Marshall Plan, the establishment of CERN (the European high energy physics laboratory) and its relationship to U.S. foreign policy, Rockefeller Foundation support of French science and the CNRS (the French National Center for Scientific Research), Ford Foundation support of European physics, the attempt by the Ford Foundation and NATO to create a European version of MIT, and Philip Morse’s attempt to promote American-style operations research in Europe. Without exception, these studies are well documented and enlightening.

As mentioned, Krige never fails to emphasize the multifaceted characteristics of science in Europe, noting differences not only between countries but internally—for example, within France. It is noteworthy, in contrast, that the diversity and contingency of American actors, actions, and institutions are deemed less important. Krige declares that the major American personalities in his case studies (Warren Weaver, Shepard Stone, Isidore Rabi, and James Killian) were all “liberal, internationalist, deeply concerned about Europe and respectful of its culture and traditions.” And, going further, he characterizes the quartet as “quintessentially American: anti-Communist but not populist, nationalistic but not jingoist, firmly convinced that the United States, whatever its flaws, had a key role in defending the Free World and its values and determined to use science to promote those values abroad” (pp. 257–258).

Although internal American conflicts are barely discussed (the 1954 Oppenheimer fiasco is not mentioned), Krige certainly recognizes that there were powerful, contemporary figures and forces in America who resisted one or more of the views attributed to these scientists. What remains extraordinary, in this and so many other studies of the early postwar

period, is that for decades such divisions did not seem to disrupt the “American project.” Krige is almost certainly correct to highlight that there was an overarching consensus on American exceptionalism and anti-communism and that this consensus was sufficient to swamp deep divisions, at least in the sphere of American foreign policy.

The story by the late 1960s is of course much more complex, in that these deep-seated stresses began to manifest themselves in all aspects of American society. Although the fine structure of American science is not Krige’s focus, anyone attempting to study and understand subsequent—far less coherent and effective—American attempts to dominate Western science and technology will find Krige’s book an essential starting point.

ALLAN A. NEEDELL

Andrew Lakoff. *Pharmaceutical Reason: Knowledge and Value in Global Psychiatry.* (Cambridge Studies in Society and the Life Sciences.) x + 206 pp., bibl., index. Cambridge/New York: Cambridge University Press, 2005. \$88.95 (cloth).

I came away from this book feeling the kind of excitement prompted by the early work of the sociologist Erving Goffman (*Asylums: Essays on the Social Situation of Mental Patients and Other Inmates* [Doubleday, 1961]). Andrew Lakoff’s book began life as a doctoral dissertation in the Department of Anthropology at Berkeley. Goffman isn’t even mentioned in the bibliography, but Lakoff too seeks to lay bare the social relations and power relationships of a psychiatric institution. What gives Lakoff’s book its charm, however, is that it’s not simply the sociology of a mental hospital—of which we have many examples—but of an entire psychiatric milieu: the “mundo psi” of Buenos Aires, a city that has perhaps the highest concentration of psychoanalysts in the world.

Lakoff is truly at home not in the upper-middle-class suburbs, with their multitudes of private-practice analysts, but in the psychiatric institutions of the city, where social and community psychiatry is king, with Lacanian approaches coming a close second. The hook on which *Pharmaceutical Reason* hangs is a French neuroscience company’s efforts to gather DNA samples from local patients with a putative diagnosis of “bipolar disorder”—a diagnosis the analysts despise. So one is said to have bipolar disorder, or not, depending on what ward one is in. Yet the fascination of the study is in learning

that various diagnoses, such as schizophrenia and “bipolar,” have their own anthropology. Many of these patients are quite ill: there is no question of treating them with psychotherapy alone; the *dramatis personae* agree that psychopharmacology is necessary.

But among the nonanalysts, the decision as to whether a patient is bipolar or schizophrenic has a political dimension. Here is Lakoff on “the politics of classification”: “[Psychiatrist] Pablo’s attempt to expand the diagnosis of bipolar disorder is part of a strategy to increase an optimistic population: one whose treatment is less debilitating, whose prognosis is better.” Mood stabilizers for bipolar disorder are less debilitating than the older antipsychotics such as haloperidol. Lakoff: “The bipolar disorder classification is a tool for changing the structure of authority between patients and doctors. Bipolar patients can be more active in their own treatment, and in the evaluation of their care, than schizophrenics, [Pablo] argues. The diagnosis thus structures the doctor-patient relationship” (p. 116).

A brief review cannot encompass the many striking insights with which this highly original work is filled. But historians of science and of psychiatry may appreciate that it is the first serious study in English of the psychiatric milieu in Latin America and that it offers a history of Argentinean psychiatry from the 1960s to the present. Biological psychiatry, to which most of the players are hostile, is just beginning to take off in Latin America. The Argentinean version of social and community psychiatry, with its rampant anticapitalism, is still dominant among the nonanalysts, just as it once carried the day in countries such as Italy. All the Argentines are united in their rejection of the “*DSM*” style that they believe represents U.S. psychiatry. All are hostile to English-language psychiatric imperialism in the form of the *Diagnostic and Statistical Manual* of the American Psychiatric Association and in the form of “neuroscience.” They agree that considering patients’ distinctive personal histories and social circumstances is important; diagnosis is not just applying the checklist of “operational criteria” to which U.S. psychiatry is increasingly being reduced. (There is now a powerful backlash against this *DSM*-checklist approach in the United States as well.)

At a conceptual level, Lakoff introduces several ideas that deserve wide consideration. One is the notion, raised in the book’s title, of “pharmaceutical reason,” which means defining illness entities on the basis of drug response: for example, depression is the condition that responds to “antidepressants” (p. 7). The author’s

own take is that “the effects that a given drug produces depend, at least in part, upon the milieu of expertise into which it enters” (p. 10). This is a concept long known in drug trials as the effect of suggestion, or the placebo effect, but I have never before seen it used as a means of explaining differential efficacy among milieus. Lakoff says that pharmaceutical reason reduces the social complexity of illnesses to somatic diseases and makes the psychiatrist an expert in managing “the neurochemical imbalance that disrupts normal behavior,” as he scornfully puts it (p. 176).

“Bipolar disorder” is taken as a kind of *deus ex machina* that rides in and disrupts traditional authority relationships in the mental hospital. Yet it is not entirely clear that there is such a thing as bipolar disorder, a diagnosis that implies that the depression of unipolar disorder is very different from that of bipolar disorder (if they are not so dissimilar, after all, you really just have episodes of depression onto which mania or hypomania may, or may not, be tacked).

The only off-putting element I found in this work, which otherwise positively jumps with ideas, is the almost impenetrable jargon in which some sections are written. The anthropological descriptions are crisp and clean. But there are more than enough sentences of this type: “What is most concretely at stake in recent transformations of knowledge about abnormal behavior, I argue, is the emergence and consolidation of a linked set of techniques and practices for reconfiguring the human and its ills” (p. 4). Nonetheless, dear reader, press on. Lakoff is a rising star in the firmament.

EDWARD SHORTER

Jake Lamar (General Editor). *Sixty Years of Science at UNESCO, 1945–2005*. 695 pp., illus., figs., tables, apps., bibl., index. Paris: UNESCO Publishing, 2006. €30 (paper).

Many of the United Nations Educational, Scientific, and Cultural Organization’s self-published histories degenerate into chronologically ordered lists of acronyms or inspirational sermons. *Sixty Years of Science at UNESCO, 1945–2005*, is much better, and the structure of the book may reveal as much about this specialized U.N. agency as the contents. Annex 1 is the key to the volume’s 212 acronyms. Annex 6 lists the 63 contributors to the volume. The Table of Contents records 75 headings dividing 638 pages of text, meaning that the average entry is about 8.5 pages long. These short contributions

are organized into six parts. Coordinating five dozen authors and integrating so many entries undoubtedly represents an organizational triumph; at the same time, the brevity of most entries means that, despite the book's length, it is not a satisfying "analytic overview of the history of the natural sciences programme at UNESCO" (p. 22).

Noting this superficiality is not an indictment of *Sixty Years*. It is an essential reference for historians of postwar international science, a book to be consulted rather than read. The brief entries make it easy to locate particular projects or themes. The reader will learn the key conferences, partner institutions, and dates necessary for more in-depth research. Although one wishes that the participant-authors had shared more of their daily experience working in an international bureaucracy, the lack of depth in descriptions of work "in the field" may accurately reflect the organization's programs that attempted to "encourage" and "coordinate" action with limited resources.

Perhaps the most important point this volume drives home is the inextricably intertwined histories of intergovernmental and international nongovernmental organizations. The International Council of Scientific Unions, for example, is an INGO that owes its postwar resurgence to UNESCO, which not only provided office space for ICSU but was its sole significant patron for many years. At the same time, UNESCO relied on ICSU as if it were an operational division. *Sixty Years* shows that building INGO and state competence in the sciences through networking, partnership, and "clearing house" and "pump priming" activities has been UNESCO's principal strategy.

The collection begins with a review of the organization's first two decades. This section is largely written by accomplished historians, but the brevity of the chapters precludes nuanced analyses of the sometimes counterintuitive effects of the Cold War and decolonization. The middle sections focus on the work of particular divisions of the Natural Sciences Sector. Reflecting its importance in UNESCO, "Environmental Sciences" is the longest and most intriguing part of the book. Projects like Man and the Biosphere and the International Geological Correlation Program resonate with themes in recent work at the intersection of environmental history and history of science, particularly in respect to the significance of global infrastructures based on uniform standards. In the Basic and Engineering Sciences Division, the late 1960s and 1970s (tumultuous years at UNESCO) are remembered as

"golden years" during which efforts to develop educational and institutional capacities in developing countries were most generously supported. Work under the rubric of Science and Society included national science policy planning, as well as an intriguing recent program on Local and Indigenous Knowledge Systems. The longest essay in the book presents prosopographic data and a thoughtful synthetic analysis.

Sixty Years ends with the plan of Walter Erdelen, the current Assistant Director-General for Natural Sciences, for mobilizing science to achieve "sustainable development." On the one hand, this seems a world away from the vision of the department's first director (Joseph Needham) of organizing a global network of scientific institutions. Then, science was justified according to its contribution to world peace. On the other hand, the conviction that science and technology are both a cause of and a potential solution to present crises has proven remarkably durable. Furthermore, the imperative of economic development in the context of diminishing natural resources has been a central theme since the late 1940s.

More than the sheer number of authors and entries—which makes one marvel at the production process, though it perhaps detracts from the coherence of the final product—the foreword to *Sixty Years* reflects the organization it describes. We learn from the current director-general that this is "not an official history" of UNESCO (p. 14). Commemorating its sixtieth anniversary, published by the organization, and written and edited mainly by staff members, this is certainly not an unofficial history. The "officially not official" nature of the book mirrors the reality of the intergovernmental sphere, where the semi-official and the quasi-governmental are the rule. Formal categories may reveal surprisingly little. As Vladimir Zharov, former director of the Division of Basic Sciences, notes: "Over time, there have been many modifications in the logical breakdown of the [Basic Sciences] programme. . . . But the programme per se has remained steadfast in its goals, strategy, and intrinsic structure" (p. 96). Taken as a whole, this collection suggests the remarkable durability of bureaucratic structures, even as they contributed to radical change in the political world order.

PERRIN SELCER

Barron H. Lerner. *When Illness Goes Public: Celebrity Patients and How We Look at Medi-*

cine. xv + 334 pp., figs., index. Baltimore: Johns Hopkins University Press, 2006. \$25 (cloth).

Not long after reading Barron Lerner's engaging and intriguing book, I happened to learn (from the news crawl on CNN) that the legendary opera singer Luciano Pavarotti was, in the words of his wife, "fighting like a lion" against his pancreatic cancer. The lessons of Lerner's analysis immediately caused me to zero in on everything I might otherwise have taken for granted: that the private health matters of a celebrity should be deemed international news; that part of what it means nowadays to be a celebrity is that the details of one's sicknesses and treatments should be shared, so that celebrities can serve as the public faces of illness; that an unflagging optimism in the face of death is part of the performance that celebrities are now obliged to enact; and that, in part through the mythmaking that surrounds celebrity illness, "'fighting' one's cancer has become the only appropriate response to the disease in American society. Indeed, the metaphor has become so ubiquitous it is almost invisible" (p. 157).

When Illness Goes Public takes up the stories of a set of well-known twentieth-century Americans who suffered diseases ranging from the relatively unusual (amyotrophic lateral sclerosis) to the all-too-common (cancer and Alzheimer's). Most of the cast of characters, like the diplomat John Foster Dulles, the athlete Brian Piccolo, and the actress Rita Hayworth, were already famous before they became ill, but some of them, like Augusto and Michaela Odone (the parents of a sick child who were also portrayed in the film *Lorenzo's Oil*), became celebrities of a sort by virtue of their close encounters with disease. The slippage between these two different kinds of "celebrity patients" will be unsatisfying to purists. But the juxtaposition of cases permits Lerner to periodize the history of the twentieth century in a way that connects the mushrooming of the cult of celebrity to simultaneous shifts in the "sick role," the doctor-patient relationship, and the possibilities for patient activism. In the first era (roughly 1935–1970), famous people who became ill and chose to go public became inspirational figures but rarely challenged conventional understandings of the role of the patient. By the second era (1970–1980), the most notable celebrity patients were those who actively pushed the medical system to do better—both for themselves and for others with the same condition. And by the third era (1980–1995), just about anyone could get his or her Warholian "fifteen minutes"

as a celebrity patient, but more and more of them had come to act like wary consumers—self-empowered patients who had taken responsibility for educating themselves about their conditions and who were too savvy, or too cynical, to imagine that their own interests and those of their doctors happily coincided. Over the course of this sixty-year shift in attitudes, the performance of the celebrity patient became increasingly scripted, with predictable narrative arcs, confessional moments, and public exhortations. Like the actor Steve McQueen, who "reacted to a hopeless prognosis by becoming, in effect, one of his film characters, defiant and confident" (p. 149), celebrity patients spun illness narratives that read like movie scripts—small wonder that many of them inspired books and Hollywood films that were "based on a true story." Meanwhile, over this same sixty years, "by corollary, 'ordinary' patients were supposed to act like ill celebrities" (p. 271)—increasingly borrowing from them the scripts of how to confront disease with bravado and medical authorities with suspicion.

This is a book that can be appreciated on many levels. Constructed as a dozen very readable chapter-length stories, *When Illness Goes Public* can be enjoyed by a broad public interested in the modern intertwining of the concerns of celebrity and health. At the same time, the book self-consciously wrestles with historiography: it explores the tension between telling a history of famous individuals and analyzing broader social developments; and it seeks to examine the mythic dimensions of cultural narratives of disease while attempting, simultaneously, to get at "what really happened" in the course of these individuals' illnesses and treatments. Together, these qualities also make the book well suited for undergraduate teaching. I can easily imagine pairing a screening of *Lorenzo's Oil* with Lerner's chapter about the Odone's, because Lerner not only describes the controversy over the film's accuracy but also explores what it means when a film becomes more "real" than the story it depicts—for example, when the actress Susan Sarandon, who played the role of Michaela Odone, became a public authority on the virtues of the experimental therapy that the Odone's had promoted.

Lerner speaks to still other audiences in this volume. For the medical sociologist, his account complements and complicates the story of the twentieth-century emergence of patient activism by emphasizing the complex interaction between well-placed individuals and large-scale social movements. And Lerner raises important questions of epistemology that will be of interest

to scholars in science and technology studies: What is the epistemic status of the anecdote—what Lerner calls the “n of 1” data derived from a single, well-publicized case? What does it mean that the growing fascination with drawing lessons from the one-off experiences of celebrities has paralleled a mirror-opposite tendency: the rise of evidence-based medicine, whose promoters maintain that the hard data gleaned from randomized trials and meta-analyses hold unsurpassed epistemic virtue? Rather than simply lament the tendency of many laypeople to treat the celebrity as more credible than the statistician, Lerner asks serious questions: Is there really a clear hierarchy of medical evidence? How do ordinary people embed statistical knowledge within cultural narratives in order to make decisions in the face of illness? Lerner might have gone further to try to answer such questions—but that would have been a different book. This one provides entry into a wide range of debates without ever straying too far from its basic task of telling some fascinating stories.

STEVEN EPSTEIN

Inken Rebentrost. *Das Labor in der Box: Technikentwicklung und Unternehmensgründung in der frühen deutschen Biotechnologie.* 309 pp. Munich: C. H. Beck, 2006.

Eric J. Vettel. *Biotech: The Countercultural Origins of an Industry.* 273 pp., notes, index. Philadelphia: University of Pennsylvania Press, 2006.

The history of molecular biology witnessed an early wave of historical reflection and commemoration by the actors and shortly thereafter spawned a growing scholarly industry led by historians of the life sciences. Surprisingly, historical scholarship on the development of recent biotechnology—including its core, genetic engineering—is not abundant. The two books under review here are most welcome because they help to fill a gap, each of them in its own characteristic way. Eric Vettel traces the origins of molecular biotechnology to California's Bay Area, in particular Berkeley, Stanford, and San Francisco, with the eye of a general historian interested in American politics and the culture of science after World War II. Inken Rebentrost, a bioscientist by training turned historian, presents us with a case study of the conditions under which the first German biotechnology start-up company arose out of an academic setting and made its way to the market. In particular, it reflects on the distinctive characteristics

of molecular biotechnologies. Taken together, the two books also allow—within limits—for a historical comparison between the United States and Europe, in particular Germany.

Vettel's book starts with an assessment of the life sciences in the Bay Area just after World War II. Whereas the physical sciences there had played a major role since the 1930s and throughout the war, the Bay Area was, according to Vettel, “a virtual backwater” in the biological sciences. Though this statement should probably be qualified (the work of George Beadle at Stanford, David Greenberg at Berkeley, and Henry Borsook at Caltech comes to mind), such work could well be perceived as small scale in light of what was to come. Vettel's primary example is Wendell Stanley's Biochemistry and Virus Laboratory, established in Berkeley in 1948. Stanley's enterprise exhibits, in a paradigmatic fashion, two aspects of American bioscience policy that Vettel considers characteristic for the first two decades after World War II: first, the transition from selective philanthropic funding, such as that practiced by the Rockefeller Foundation, to massive federal funding, unprecedented in its dimensions, in the immediate postwar period; and second, an equally unprecedented emphasis on basic research, with a concomitant explicit effort to sever traditional links to medical and agricultural departments and practices. Vettel is ambivalent in assessing Stanley's success. On the one hand, Stanley put his bets on protein research and thus missed the turn to DNA around which the molecular biological revolution of the 1950s gained shape and lasting momentum. On the other hand, his “freestanding” laboratory, with its emphasis on the physics and chemistry of life, served as an incentive for Stanford and the University of California at San Francisco to reshape their life science research programs accordingly.

Vettel then describes at length the rise, particularly around Berkeley, of an academic as well as popular counterculture with an emphasis on environment and health, issues that the basic life sciences appeared not to address, and its detachment from a generation that was perceived to have lost sight of the values of real life and had led America into the war in Vietnam. On the federal level, this movement coincided with a policy shift initiated under Lyndon Johnson and continued under Richard Nixon. This shift emphasized the need for practical returns from the basic biosciences and also, in response to the economic depression during the later 1960s, put an end to the miraculous increase in federal research money that had characterized the decade immediately after World War II and

the decade following the *Sputnik* shock. This is the climate in which Vettel places the origins of a molecular biotechnology that, on the one hand, resulted in a complete realignment of the relation between basic and applied research and, with it, a complete shift in the academic self-perception of a new generation of bioscientists, while, on the other hand, leading to an equally complete realignment of the relationship between academia and industry. Accordingly, the book ends with a brief history of the early years of Cetus, history's first biotechnology company, founded in Berkeley in 1972.

Vettel's book is a powerful and fascinating argument for viewing scientific development, including the perception of what it means to do good and cutting-edge science at a particular point in history, as culturally embedded. Concomitantly, however, he underestimates the epistemic constellation underlying the advent of genetic engineering: what a former generation of scientists had to constitute as *objects of research* could be turned by a later generation into molecular *instruments and tools*. This very turn completely redefined what biotechnology was all about. Unfortunately, whenever it comes to the particulars and details of the research work at issue, Vettel's descriptions become somewhat imprecise, at points even misleading.

Das Labor in der Box (the published version of Rebentrost's dissertation) starts with a description of Germany's path into modern biotechnology. The comparison to the United States is illuminating. On a broad scale, German research in molecular biology began to be federally funded to an appreciable extent only about a decade after World War II. The new basic molecular biological research complex only became effectively established another decade later, toward the end of the 1960s—by which time the transition to gene technology in the United States had already been fully set in motion. Yet another decade later, around 1980, it was the German government that tried to create conditions under which Germany's bioscience would move into the gene technological era. In America, by contrast, research universities and industry, particularly biotechnological start-up companies funded by venture capital, were the major players in this transition. In Germany, however, academia and also the big pharmaceutical industry remained reluctant. Where the latter did become engaged, it was in the United States rather than at home. And while the cultural movement in America during the 1960s was, as Vettel aptly describes it, a ferment for the biotechnological revolution, the situation in Germany a decade later was just the opposite.

The growing ecological movement of the 1980s perceived gene technology from the perspective not of its potentials but of its dangers.

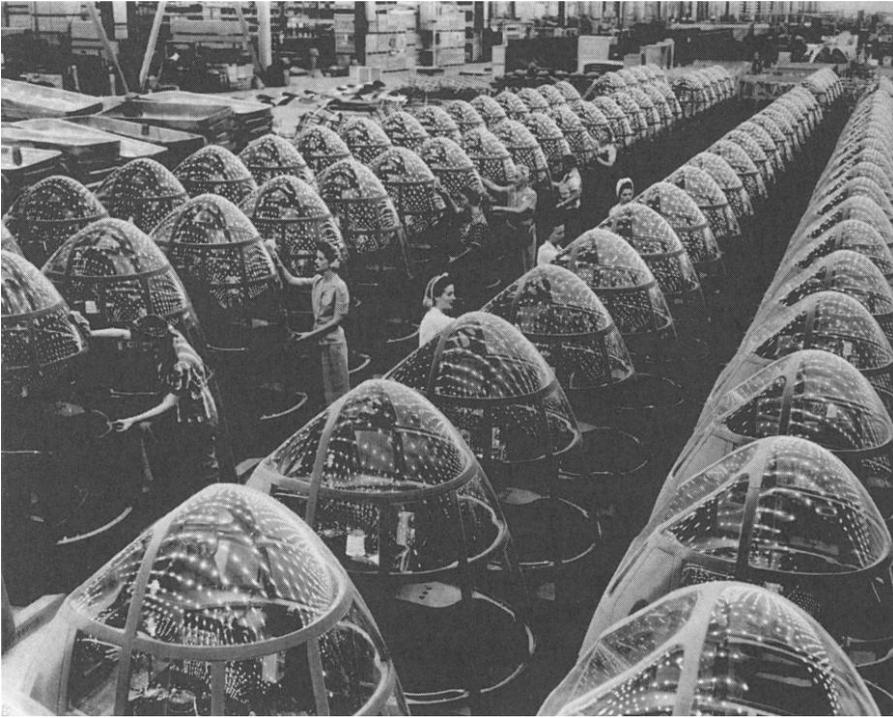
The first biotechnological start-up company of the new type in Germany was founded in Düsseldorf in 1984. Detlev Riesner, a young professor of physical biology, together with a group of students, took the initiative to found DIAGEN, a company that was aimed at developing biotechnical products to be used in agriculture, diagnostic tests for virus diseases, and molecular analytical separation techniques. Tellingly, one of the very early venture capitalists who engaged in the formation of this business happened to be the founder of Cetus, Moshe Alafi. Going into considerable detail and using highly interesting archival sources—industrial sources are rare matters in history of science—Rebentrost describes the early struggle for survival of DIAGEN and how, working through the vagaries of available market niches, the company finally settled on the development of a new molecular separation technology built around the purification of nucleic acids, in particular recombinant DNA plasmids.

The "laboratory in the box" is a metaphor for what helped to transform tedious molecular benchwork in the second half of the 1980s: the separation and purification kits that became ubiquitously known under the label of QIAGEN. The chromatographic procedure underlying the technology not only had a deep impact on the working culture of molecular biological laboratories, both academic and industrial; it also formed a key component in the transformation of nucleic acid technologies into automated procedures, without which the genomics of the 1990s would have been impossible.

The strength of Rebentrost's book is that it relates to both the laboratory in culture and culture in the laboratory. It gives readers a sense of the inner makeup of the sorts of technologies that brought gene technology into the realm of the feasible and that, from the late 1980s onward, started to permeate molecular laboratories of the second generation in the form of ready-made kits. Less strong is the form of this monograph: it bears all the traces that characterize dissertations as a particular form of academic writing.

HANS-JÖRG RHEINBERGER

Vaclav Smil. *Transforming the Twentieth Century: Technical Innovations and Their Conse-*



Women working on transparent noses for A-20 attack bombers (taken from Smil, *Transforming the Twentieth Century*).

quences. x + 358 pp., illus., figs., bibl., indexes. Oxford: Oxford University Press, 2006. \$45 (cloth).

It is difficult to determine the audience for which Vaclav Smil's wide-ranging *Transforming the Twentieth Century* is intended. As Smil amply demonstrates, his knowledge of industrial technologies is formidable, and most of the work is devoted to detailed accounts of key twentieth-century innovations that are written to be accessible to informed readers. Ample photographs, well-conceived schematic illustrations, and highly informative graphs markedly enhance Smil's discussions of the genesis, ever-expanding applications, and effects of vastly improved, fundamentally reconfigured, and in a few instances new technologies that he convincingly argues undergirded the fossil fuel-dependent, affluent societies and globalized international system that dominated life on most of the planet during the last three or four decades of the century. His vignettes detailing technological changes that in almost every case yielded increased returns on existing technologies that span several orders of magnitude are grouped in

four long chapters that cover, in succession, modes of tapping ever-greater inanimate sources of energy, innovative production techniques—with a whole chapter devoted specifically to automation and robotization—and vastly improved systems of communication and information gathering and dissemination.

The typically divided subsections of each of the long chapters of *Transforming the Twentieth Century* suggest the multivolume encyclopedias that eighteenth-century French savants were so fond of churning out. This impression is reinforced by Smil's neglect of the broader historical contexts in which pivotal technological innovations occurred and copious references to his companion volume, *Creating the Twentieth Century: Technical Innovations of 1867–1914 and Their Lasting Impact* (Oxford, 2005). This, then, is a book that few are likely to read straight through. But it should serve as a concise, erudite, and accessible reference work for those interested in interrelated scientific and technological transformations in the mature and late industrial eras. And in contrast to Smil's earlier study, which is highly Western-centric, *Trans-*

forming the Twentieth Century provides a somewhat more global perspective, with quite extensive and particularly revealing sections on Japan and considerable attention to China, whose post-World War II technological and environmental history Smil has analyzed in depth in two books and numerous articles. Nonetheless, there is surprisingly little on the other industrializing societies of East and Southeast Asia, India, or Latin America and negligible coverage of Africa and the Middle East. This oversight is reflected in his cursory treatment of watershed scientific-technological breakthroughs that were centered on the developing world, such as the Green Revolution, which receives a brief paragraph and does not figure at all in Smil's assessment of the global environmental and social consequences of the shift to mechanized, monocrop farming that has been reliant on the extensive use of chemical fertilizers and irrigation.

Smil's direct and informed descriptions of the scientific-technological transformations that are the focus of much of his considerable corpus of scholarly work ought to enhance the prospects of *Transforming the Twentieth Century* for adoption as a textbook for courses on technological innovation and its impact on economic, environmental, and social change. Particularly useful in this regard are his consistently provocative, often well-considered, and substantial reflections on key shifts in a diverse range of extraction, manufacturing, and communication technologies as well as the advances in scientific understanding associated with them. But depending on one's pedagogical inclinations, Smil's highly interpretive handling of his many case studies and his persistent interjection of judgments that are at times highly contentious, such as his prosecutorial treatment of Microsoft's capture of the market for personal computer software or his conclusion that the effects of the nuclear arms race were ultimately benign, are likely to affect its appeal for classroom use. These concerns may well be heightened by his harshly negative assessments of the uses to which influential technologies, particularly those intended for mass consumption—such as television, transistorized audio devices, and the internet—have been put. Even if one sympathizes with these strictures, they are often delivered in abbreviated, curmudgeonly asides that have the simplistic, imbalanced quality of the sound bites that have contributed significantly to the decline in media standards that Smil finds so troubling.

Although Smil concludes *Transforming the Twentieth Century* with an engaging chapter weighing "Accomplishments and Concerns"

and provides striking comparisons throughout the study of, for example, increases in productivity, levels of dependence on inanimate fossil fuels, or per capita energy consumption and indexes of social well-being, there is little sustained analysis of broader historical factors. His case studies of the genesis and development of technologies in different sectors and his general thesis that the twentieth century was overwhelmingly one of innovations based on inventions of the half century preceding World War I rather than new creations are rarely connected to prevailing economic, political, or sociocultural forces. In addition, he simply assumes rather than seeks to account for the synergy between scientific breakthroughs and technological advances that was essential for the processes that are the focus of his inquiry. Smil explicitly refuses to address issues relating to the extent to which technology drives history, despite the fact that his stance on this vital question appears to be implicitly confirmed by his repeated return to the transformative power of improved machines and often ingenious techniques for generating ever-greater amounts of energy from inanimate sources. These lacunae may leave many historians of science and technology less than satisfied with Smil's ambitious survey of a century of unprecedented, but often troubling, change. But we are all in his debt for this smart, incisive compendium of the breakthroughs and global repercussions associated with these critical human endeavors.

MICHAEL ADAS

Kaushik Sunder Rajan. *Biocapital: The Constitution of Postgenomic Life.* xi + 343 pp., bibl., index. Durham, N.C.: Duke University Press, 2006. \$84.95 (cloth); \$23.95 (paper).

Kaushik Sunder Rajan's *Biocapital: The Constitution of Postgenomic Life* elucidates the mechanisms through which hubristic biomedical researchers, technology-savvy entrepreneurs, and federal bureaucrats drove each other into a global frenzy of promise and expectation in the 1990s. *Biocapital* therefore provides historians of very recent science and technology a valuable resource in their efforts to push analyses of the heady dot-com years beyond the superficial.

Developed from Sunder Rajan's 2004 MIT STS dissertation, *Biocapital* takes an ethnographic approach to the problem of demystifying the biotech sector's fervor during the late 1990s. The author, who is trained in biochemistry as well as anthropology, clarifies complex scientific ideas and even more complex scien-

tific rituals. He is not content, though, with mere description and explication; he applies what he has observed in biotech start-ups and regulatory bodies in both the United States and India to an effort to inform discussion of the theoretical tools—particularly those provided by Karl Marx—employed in the social sciences and humanities.

Sunder Rajan begins by defining his ambitious concept of “biocapital.” He posits that a new form of capitalism has emerged as a consequence of economies transformed by information technology fusing with biomedical research that has also been transformed by computers. In the biocapitalistic system—as with other components of the NASDAQ boom—value is derived not from goods or services but, rather, from *potential*; wealth is therefore generated by the expectation of profitable production or service. What sets biocapitalism apart, though, are its ties to the discourses of biology, medicine, and spirituality. It is such ties that compel investors, be they individuals, major corporations, or governments, to devote so many resources so unquestioningly to what amounts to mere hope.

To shed light on how entrepreneurship, epistemological frameworks, scientific practices, and the always-heated public discussion of life itself shaped one another, Sunder Rajan explores how two societies, the United States and India, each constructed the moral and ritualistic systems that would support biocapitalism. In the United States he focuses on start-up genomics companies, while in India he explores larger, government-sponsored endeavors. Although he often juxtaposes the two societies’ approaches to biotechnology, he also takes pains to point out that U.S. and Indian ventures are often intermingled and depend heavily on each other. This makes analysis tricky, and the reader must exert considerable effort to keep up with Sunder Rajan as he demonstrates how globalized, capitalized biomedical research complicates the central claims of popular models of society, namely those derived from Marx, Weber, and Foucault. The reward, however, is understanding: first, that excitement about biotech’s potential has radically altered epistemology, ideology, and scientific and economic institutions worldwide; second, that expectation of new biomedical insights and technologies can be as transformative as their advent and spread.

Each chapter approaches the power of expectation, particularly the prospect of profitably altering life, from a different angle. In the book’s first part, “Circulations,” Sunder Rajan explores the flow of knowledge, tools, and anticipatory excitement through the political, economic, and

scientific landscapes of the United States and India. Examining the United States, the author demonstrates how big pharmaceutical corporations, small genomics firms, and governmental entities created and navigated biotechnology’s legal terrain. By focusing on the dispute over patents, he clarifies the complex and often counterintuitive alliances, such as those between large pharmaceutical corporations and anti-gene patenting activists, that form within networks of exchange.

Sunder Rajan’s coverage of India raises thorny questions about the relationship between biotechnology and the legacy of colonialism. Drawing from extensive observations of Indian biotech projects and their sponsors, he explains how the promise and prestige of biotechnology lured India into largely abandoning its ideological commitment to appropriating medical and agricultural technology for the benefit of its own and the world’s impoverished people. By casting India’s biotechnology sector as a “constituent” of that of the West, the author highlights the tension between the goals of pro-capitalist Indian governments and those of their often anti-Western, anti-capitalist citizenries.

The book’s second section, “Articulations,” seeks to clarify the mechanisms of the speculative hype propelling biotech’s growth. Sunder Rajan shows that biotechnologists often employed—and believed—the messianic rhetoric one finds in discussions of life’s fundamental nature and purpose. We find, for example, Randy Scott, cofounder of Incyte Genomics, toasting the genomics community: “Because they aren’t in genomics for themselves, they are in it for Life” (p. 57). The author argues that in Scott’s case, as well as those of PXE International’s cofounder Patrick Terry and Human Genome Project head Francis Collins, there was a confluence of the zeal for genomics research and evangelical Christianity. In India, where millenarian excitement was more subdued, biotech was cast as the means to create a new, “modernized” national identity without addressing the nation’s poverty.

Biocapital culminates in its final chapter, where Sunder Rajan surveys GeneEd, a Bay Area start-up formed in 1997 by scientists of Indian descent. GeneEd, which specializes in providing e-learning courses to biotechnology companies, serves as a locus for the many forces Sunder Rajan has hitherto described. Although the GeneEd survey is deep and enlightening, the author does not explicitly state the connections between what he observed in California and the fascinating theoretical claims of his earlier chapters. A book-length guided tour of GeneEd,

where the author could point out how the quotidian activities of the company exemplify the claims made in *Biocapital*, would be of great use.

Historians reading *Biocapital* must bear in mind that it is more a work of anthropology than of history. As an anthropologist, Sunder Rajan relies on personal observations and casual statements that can be acquired only through immersion in the culture he is studying. Thus, there are many cases where the author's claims cannot be easily corroborated. Worse, from the historian's perspective, he supports arguments by drawing from individuals and indeed whole organizations whose identities he has deliberately kept anonymous. These important caveats aside, *Biocapital* has more than enough interesting verifiable claims to make it essential reading for anyone studying biotechnology and other contemporary hype-driven fields like nanotechnology and alternative energy.

JOSEPH NOVEMBER

Liba Taub; Frances Willmoth (Editors). *The Whipple Museum of the History of Science: Instruments and Interpretations, to Celebrate the Sixtieth Anniversary of R. S. Whipple's Gift to the University of Cambridge*. xx + 492 pp., illus. Cambridge: Cambridge University Press, 2006. £35 (cloth).

In 1944 Robert Stewart Whipple, former chairman of the Cambridge Scientific Instrument Company, presented his rich collection of more than a thousand scientific instruments and fifteen hundred books to the University of Cambridge. This generous gift, including an 8-inch reflecting telescope from William Herschel and first editions from Newton and Christiaan Huygens, marked the founding of the Whipple Museum of the History of Science. Right from the start, the intention was that the museum would be more than "a repository of scientific objects," and there was to be a link with "the allied wider and fundamental question of the future position of the History of Science as a subject of study and research in the University" (p. 1). To this very day, the integration of teaching, learning, and research, based on a highly accessible and adequately documented collection, has been the museum's driving principle. The Whipple Museum, housed since 1958 in the former Laboratory of Physical Chemistry in Free School Lane, and with a collection that now totals some six thousand objects, wants to do more than arrange exhibitions; it is an active part of the Depart-

ment of the History and Philosophy of Science of the University of Cambridge.

To mark the sixtieth anniversary of the Whipple Museum, twenty-one authors who have or have had close ties with the museum have contributed to *The Whipple Museum of the History of Science: Instruments and Interpretations*. Part 1 of this anthology concerns the history of the museum. In the selection of original documents that open the book, we find Rupert Hall, who in 1948 became the first paid (part-time) curator, complaining bitterly in the annual report of 1951 about the cramped housing of the museum. More than half a century later, he fondly recalls unpacking chests of instruments, his first explorations of the collection, and the liberating relocation to Free School Lane.

In Part 2, eighteen authors review specific instruments or books from the museum collection, reflect on special exhibitions held by the museum, or consider methodological or historiographic issues. The editors have completely refrained from imposing any further structure on the book, and the contributions are presented alphabetically according to the authors' names. Therefore, it is pure chance that in Chapter 13 (of all numbers) Robert Jenks reveals, after careful research, that what was always thought to be a sixteenth-century Venetian silver globe is probably a nineteenth-century English fake. This case is a fine illustration of how an incorrect designation, made on the basis of a superficial examination by an uncritical eye, can survive for decades. At the same time, Jenks's detective work shows that inauthentic instruments can sometimes tell us more than objects whose provenance is beyond doubt.

Robert Whipple donated instruments and an accompanying set of books, and several authors emphasize how fortunate that combination can prove to be. Jim Bennett, curator of the Whipple Museum from 1979 to 1994, illustrates this point with an analysis of Edward Worshop's *Discovery of Sundry Errours* (1582), a book that contains one of the oldest advertisements from an English instrument maker. In her contribution on so-called "Newtonian" orreries, Liba Taub, the present curator, politely but emphatically demonstrates how art historians can make considerable errors in their interpretations of instruments if they consider only textual and pictorial evidence.

How cross-fertilization can help the history of science is most powerfully demonstrated by the Cambridge Latin Therapy Group, a research seminar that in the academic year 2002/2003 brought a group of paleography and Latin students of various abilities together with experts

and novices in the study of scientific instruments. The outcome of this interaction was that a cardboard model of a *navicula* (a small portable sundial, shaped like a ship, which can be used at any latitude) provided the group with a very plausible explanation for what had to that point been an obscure passage in a text about this instrument. And when, at an auction on 30 October 2002, the Whipple Museum acquired a sundial bearing a Rojas projection, with a series of instructions in Latin, the group's efforts to translate this led them to realize that part of the instrument (a slender pointer on the sliding cursor) was missing. The subsequently completed instrument again inspired a correct translation.

"Despite all their recent talk of the importance of 'material culture,' concludes the Latin Therapy Group in its delightful contribution to the anthology, "historians of science outside the domains of technology and museums have rarely paid close attention to the nitty-gritty of the production, distribution and uses of instruments; and, though there are splendid exceptions, historians of instruments and technology have tended to concentrate all too exclusively on the nitty-gritty. A further and equally unfortunate division within the history of science is that between the producers of critical editions and translations of sources, and those who base their historical narratives on those sources, all too often treating the sources as 'given,' as the unproblematic fruits of the exertions of expert under-labourers" (p. 281). Merely absorbing this message makes reading the Whipple anthology a worthwhile activity.

DIRK VAN DELFT

Charles Thorpe. *Oppenheimer: The Tragic Intellect*. xvii + 384 pp., illus., bibl., index. Chicago: University of Chicago Press, 2006. \$37.50 (cloth).

Historical studies on J. Robert Oppenheimer have not yet quite approached the scale of the Darwin or Einstein "industries," but the American physicist's centenary in 2004 has coincided with a remarkable outpouring of excellent scholarship on his life and times. Most prominently, Kai Bird and Martin Sherwin's 2005 biography, *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (Knopf), won both critical and popular acclaim as a captivating chronicle of its subject. Charles Thorpe's *Oppenheimer* is a quite different book, yet it provides a worthy and even necessary complement to the Pulitzer winner.

Thorpe, a scholar in science and technology

studies, calls his book a sociological biography that aims to account not only for Oppenheimer's life but also for "the making of social, institutional, and cultural forms" that both shaped and were shaped by Oppenheimer's actions. Thus, in contrast to the predominantly narrative form of the Bird and Sherwin volume, Thorpe's is much more analytical, aptly deploying a number of dialectical concepts such as individual identity and collective norms, charismatic leadership and collaborative fashioning, vocational duty and broader social responsibilities, to explain Oppenheimer's views and behavior from childhood to the atomic bomb. Although original archival research and oral history interviews are an important part of the book, its strength is not in adding new biographical detail but, rather, in situating Oppenheimer at "a nodal point at which competing cultural tendencies converged and intersected" (p. 18).

Oppenheimer emerges from Thorpe's study as a tragic figure, not only in terms of his persecution during his infamous security clearance case in 1954 but also in the sense that he lived a life of contradiction: even though he held an idealistic view of the potential of science, he eventually adopted a "soldierly ethic of duty," driven in part by a profound psychological insecurity, toward the military leadership during World War II and the national security state during the ensuing Cold War (p. 197). In one of the most riveting chapters (Ch. 4) of the book, Thorpe details how Oppenheimer (and others) used scheduling as a way to discipline the Los Alamos laboratory toward the goal of delivering an atomic bomb, brushing aside moral and political questions as a waste of time or worse. In an October 1944 letter to General Leslie Groves, military leader of the Manhattan Project, Oppenheimer denounced "the fallacy of regarding a controlled test as the culmination of the work of this laboratory" (p. 149).

In many ways, Thorpe is more critical than Bird and Sherwin in evaluating Oppenheimer's actions and influence, especially during the postwar years. For example, in November 1945 Oppenheimer declared in his famous farewell speech at Los Alamos that it was "good" for scientists to make discoveries and "turn over to mankind at large the greatest possible power to control the world," because it was in the nature of science and because that power might bring forth "a new spirit in international affairs." While Bird and Sherwin regard the speech as a warning against American unilateralism, Thorpe sees it as an attempt to justify the making and use of the atomic bomb and "a defense of the administration." By appealing to scientists to

focus on their apolitical “vocational ideals,” Oppenheimer, according to Thorpe, helped make science a neutral instrument in service to the American Cold War strategy (pp. 177–178).

Likewise, in examining the H-bomb debate, Thorpe faults Oppenheimer for his failure “to sustain a principled rejection of the H-bomb” and for advocating, instead, the deployment of tactical nuclear weapons as an expedient alternative (p. 199). Unfortunately, Thorpe does not explore in more depth why, given his identification with the national security state, Oppenheimer would oppose the H-bomb in the first place. (The book mentions Oppenheimer’s remnant faith in arms control and the influence of James Conant only in passing.) Did Oppenheimer oppose the H-bomb, for example, in part owing to his “misplaced pride about the device he was responsible for producing,” as his rival in the debate, Edward Teller, claimed (Teller, *Memoirs* [Perseus, 2001], p. 372), or was this explanation more revealing about Teller’s view toward the H-bomb than Oppenheimer’s toward the atomic bomb? In any case, Thorpe’s analysis of Oppenheimer’s thinking in this period suggests that his opposition to the H-bomb on moral and political grounds may have been an aberration rather than an exemplification of his views on the proper—and narrow—role of scientists in matters of policy. Ironically, however, it was this incident that became a key element in Oppenheimer’s 1954 security case, leading not only to the denial of his clearance but also to the official discrediting of a broader social and political role for scientists—which Oppenheimer had actually been somewhat uneasy with.

Thorpe’s analysis of Oppenheimer’s later years suggests a further irony: Oppenheimer, as an anti-Communist liberal intellectual, underwent a conservative, not radical, self-refashioning following his humiliating 1954 security case. A believer in cultural elitism, he became deeply involved in the Congress of Cultural Freedom (secretly funded in part by the CIA), which sought to promote liberal pluralism in the world; he was wary of Einstein’s open criticism of McCarthyism; and he lamented the fragmentation of American culture and society during the Vietnam War era. Like many other American scientists, Oppenheimer had faith in the identity of the ideals of science and of American democracy; but he could not reconcile the liberal vision of science with its potential for mass violence, as represented by Hiroshima and Nagasaki.

Overall, *Oppenheimer* is a refreshingly critical analysis of both the physicist’s life and the gradual integration of science into the apparatus of the state that he facilitated. While not everyone will agree with Thorpe’s sometimes harsh

critique of his subject, most will find the book thoughtful and well written, built on rich sources, cogent arguments, and original insights. Like the works of Steven Shapin, Thorpe’s former mentor at the University of California, San Diego, and others, this book demonstrates once again the promise of sociologically informed historical studies of science and technology.

ZUOYUE WANG

Keith Wailoo; Stephen Pemberton. *The Troubled Dream of Genetic Medicine: Ethnicity and Innovation in Tay-Sachs, Cystic Fibrosis, and Sickle Cell Disease.* x + 249 pp., index. Baltimore: Johns Hopkins University Press, 2006. \$21.95 (paper).

The title of this book is not very informative about its content. Its main objective is to contrast the therapeutic approaches successively proposed during the last forty years for three major genetic diseases: Tay-Sachs (TS) disease, cystic fibrosis (CF), and sickle cell (SC) disease.

This objective is not fully original, since it is very close to that of Troy Duster’s *Backdoor to Eugenics* (Routledge, Chapman & Hall, 1990). However, new information has been included because of the time elapsed since this earlier publication: for instance, the description of new treatments for SC disease, both bone marrow transplantation and drugs such as 5-azacytidine and hydroxyurea; and discussion of the problems raised by the extension of the strategies used to reduce the incidence of TS disease in the Jewish community to other, less severe, genetic diseases. The case of CF, with the hopes and disillusionment resulting from the first attempts at genetic therapy, was also absent from Duster’s book.

The central argument is also different. Whereas Duster positioned the new therapeutic approaches in relation to the eugenic objectives of the past, Keith Wailoo and Stephen Pemberton aim to demonstrate that, in the case of each of these diseases, different historical experiences shaped the sensibility, representations, and attitudes of the different groups involved: patients, doctors, associations, the public, industrialists. The main factor was the position, real or imagined, that the three ethnic groups mainly affected by these diseases—Jews in the case of TS, “white people” for CF, and African Americans for SC—have within American society.

The Troubled Dream of Genetic Medicine offers interesting information and pertinent discussions on the reasons for the successes and

failures of the different therapeutic attempts, which came in rapid succession, for these three diseases. It raises important issues, such as the major role of financial interests and the irresponsibility of premature announcements of success. This book certainly constitutes a good reference point from which to appreciate the present promise of stem cell therapies. Good examples of the permanent and perilous trade-offs between risks and advantages that any new therapeutic approach offers are given. For all these reasons, the book deserves to be read by a large public—and in particular by those who are in charge of, or concerned with, decisions about health politics.

But I am only partially convinced by the central argument of this book: the major place of the ethnic dimension in the contrasted histories of these three diseases. In particular, I was not convinced that the “white” or “Caucasian” nature of CF was fundamental in explaining the evolution of therapies. The distinct nature of these diseases—the age of the patients, the seriousness and diversity of the symptoms, the existing ways to improve patients’ conditions and to alleviate their pain—is probably more important in explaining the contrasting results: the successes and failures of the therapeutic approaches to these diseases have not been so different in other countries, where the ethnic landscape is obviously very different.

One weakness of this book is the vagueness of the expressions used to describe the new therapeutic approaches. “Genetic therapy” has different meanings, designating the use of recombinant proteins, the addition of functional copies of a gene when the endogenous copies are nonfunctional, or the “dream” of substituting a functional copy of a gene for a nonfunctional one. Enzyme replacement and gene replacement therapies are confounded, as are the uses of chemical drugs and recombinant proteins. The most serious problem is the recurrent use of the expression “gene for disease” to designate the specific form of a gene associated with a disease. It is a pity that, in a book that could serve as a reference in a field where sensationalized “information” prevails, the authors did not pay more attention to the correctness of the expressions they used.

Moreover, the text is highly repetitive, and the organization of the book could have been improved. The reader has the feeling that the entire manuscript was not carefully read after the different chapters were put together. The presence of a glossary and the insertion of additional documents is welcome. Nevertheless, a

short general bibliography would have been useful for the lay reader.

MICHEL MORANGE

Elizabeth Siegel Watkins. *The Estrogen Elixir: A History of Hormone Replacement Therapy in America.* ix + 351 pp., notes, index. Baltimore: Johns Hopkins University Press, 2007. \$45 (cloth).

Ever since the distinguished seventy-two-year-old French-American-Mauritian physiologist Charles-Edouard Brown-Séquard announced in 1889 that he had “rejuvenated” himself with injections of testicular extracts from dogs and guinea pigs, the sex glands and their secretions have been thought to hold the secret, if not of eternal youth, then at least of youthful vitality. Many medical procedures (of which “monkey gland” transplants were only the most colorful) were introduced in the early twentieth century to combat aging and debility by boosting the gonadal secretions. Simultaneously, there was much serious research on endocrine functions, and virtually all the major hormones had become available in chemically pure forms by the end of World War II. Inevitably, researchers and clinicians now attempted to use these hormonal preparations for rejuvenation—menopausal women, in particular, were singled out for attention, and to this day numerous middle-aged women receive long-term hormone replacement therapy (HRT).

In her informative study, Elizabeth Siegel Watkins chronicles the history of hormone replacement therapy for women in America. She begins with a chapter on the isolation and commercial production of estrogen and related sex hormones around the time of World War II. The “explosion of estrogen products,” she argues, marked “the beginning of a new age, in which medical views and cultural circumstances converged to create a climate in which female aging became the target of treatment” (pp. 30–31). Concurrently, medical and cultural attitudes toward menopause were changing fast. The New York gynecologist Robert Wilson famously called for long-term hormone replacement to keep women “feminine forever”—menopause, he and many others claimed, was not a natural condition but a deficiency disease that ought to be treated with sex hormones. Supported by physicians and encouraged by the pharmaceutical industry, HRT became routine for increasing numbers of older women in the United States.

The pharmaceutical industry, predictably, played a big role in this medicalization. The

leading manufacturer of estrogen in the United States spent a million dollars a year to advertise the product, and by the mid-1970s it had become one of the five most prescribed drugs in the nation. Watkins explores the mechanics and forms of advertising estrogen products to doctors and consumers at length, demonstrating the ways in which shifts in medical and cultural attitudes were related to changes in the publicity campaigns. The increasing prominence of feminist health campaigners challenging the medicalization of the menopause prevented any uncontested imposition of HRT on American women, and the twists and turns of medical opinion on the association of estrogens with cancer, osteoporosis, and cardiovascular disorders ensured, in any case, that no medical consensus on the desirability of long-term HRT endured unrevised for long.

Even the old clinical conviction that estrogen “protected” against cardiac disease was undermined by late twentieth-century research, and Watkins shows that similar, if less dramatic, perturbations have long characterized the fortunes of HRT in America. These shifts in medical views were reflected in debates on regulation and advertising within Congress and the Food and Drug Administration. Watkins chronicles these in instructive detail; but even more absorbing are her analyses of the diverse reactions of women themselves, especially the differences between groups of feminists on the subject of hormone replacement and the ways in which these differences were sharpened or reduced by the often unexpected findings of medical research.

The Estrogen Elixir is an important and well-documented contribution to the historiography of twentieth-century American medicine. Its careful analysis of the diversity of attitudes with which American women and their physicians approached the question of hormone replacement is particularly valuable. One could, of course, always ask for more. The initial chapter, on early twentieth-century glandular and hormone research, could have said more about the preoccupation with ovarian functions; and the importance of “rejuvenation” in the history of endocrinology, always denied by clinician-historians, could have been brought out more clearly. More important, Watkins does not say much about the ways in which the science of hormones, although rooted in cultural concepts of the body, gender, and aging, eventually undermined and partially redefined those very concepts. Also, it might have been wise not to confine the book exclusively to female HRT. While it is true that HRT has largely been pre-

scribed for women in the second half of the twentieth century, the early twentieth-century precursors of HRT were almost entirely for men; moreover, a new push by the pharmaceutical industry to medicalize the male menopause (the so-called andropause) has been under way from the 1990s. Analyses of these oscillations in scientific, medical, and cultural attitudes toward gender, aging, and pharmaceutical intervention would have enriched the book considerably. In spite of its lack of interest in such intellectual and cultural questions, however, *The Estrogen Elixir* is a significant work on the social history of American medicine and a major contribution to the growing literature on hormonal therapeutics and research.

CHANDAK SENGGOPTA

Weimin Xiong; Kedi Wang. *He cheng yi ge dan bai zhi: Jie jing niu yi dao su de ren gong quan he cheng* [Synthesize a protein: The story of total synthesis of crystalline insulin project in China]. (Zhongguo jin xian dai ke xue ji shu shi yan jiu cong shu.) 194 pp., figs., bibl., app., index. Jinan: Shandong jiao yu chu ban she [Shandong Education Press], 2005. \$25 (paper).

In 2000 the Institute for the History of Natural Science in Beijing launched a major research initiative, which has resulted since 2004 in at least twenty published monographs constituting the series “Research on the History of Science and Technology in Modern China.” Especially notable is the excellent coverage of the period since the Communist revolution of 1949, which previously suffered from severe neglect. As a whole, the series authors actively engage with the international field of science and technology studies. Together with the new journal *East Asian Science and Technology Studies*, published in Taiwan, this marks an exciting new period of East Asian research on themes of interest to *Isis* readers.

This contribution to China’s exciting new research into the recent history of science tells the much celebrated but poorly understood story of synthetic insulin. In 1966, Chinese scientists announced that they had synthesized biologically active bovine insulin and thus achieved the first successful protein synthesis. Since then, this accomplishment has served as a testament to socialist China’s scientific capabilities. Through interviews, published sources, and previously unavailable archival documents, the authors provide the fullest account to date of this historic research.

The book covers the initial decision in 1958

to research insulin synthesis; the subsequent mobilization of almost a thousand researchers in close to ten disparate research institutes; a comparison of U.S., German, and Chinese research; media propaganda on the significance of the achievement; and the question of why the research has never been awarded a Nobel Prize (an honor no China-based research has yet received). The appendix offers transcribed interviews with key participants.

The authors' most important contribution is their analysis of a specific Mao-era "style" of scientific research, characterized by heavy planning, an emphasis on collaboration, a military "flavor," secrecy, and extensive mobilization of human resources. Using a slogan common during the Great Leap Forward, they dub this style "the great armies do battle" (*dabingtuan zuozhan*) and conclude that at least with respect to insulin synthesis it was a failure. While the researchers succeeded in synthesizing insulin, the pressures burned out many young talents, the obsession with secrecy impeded communication of significant intermediate results, and the extraordinary resource deployment cost China opportunities in many other, more important research areas.

Weimin Xiong and Kedi Wang also offer a fascinating discussion of the Nobel Prize issue. On several occasions, foreign scientists advocated for the nomination. But in 1966, with the beginning of the Cultural Revolution, people feared the political taint of associating with foreign institutions. And in 1972 and 1975 Chinese officials nixed nominations because Alfred Nobel was the inventor of dynamite (and thus a warmonger) and claimed that China did not need "capitalist prize money." When in 1978 political conditions were more favorable, the researchers faced the challenge of nominating no more than three scientists (the Nobel limit) for a project in which at least thirty played key roles. They initially forwarded eight names and intentionally included one woman—not because she was among the top eight but in order to recognize the significant number of women who had participated. (These two issues—the individualist bias of the Nobel Prize and the question of gender in socialist Chinese science—deserve somewhat more attention than the authors give them.) In the end, they nominated just one scientist, Niu Jingyi, but he still did not receive the prize. The authors boldly assert a conclusion unlikely to be popular in China: although impressive, the research was not up to Nobel Prize standards. The researchers failed to recognize a point of key significance: that low-

level protein structures determine high-level ones.

At times Xiong and Wang's prose appears to reflect the nationalism of their subject matter. They often use the first person plural, as in "Our work was the most meticulous, and our evidence was the strongest. Without hesitation . . . we can proclaim: our country was the first in the world to synthesize insulin!" (p. 101). But elsewhere they step outside such sentiment and explain its historical significance. Especially powerful is their critique of the nationalistic motivations of Chinese insulin researchers: "They were not conducting research, but waging a war. They were fighting for China's honor!" (p. 95). (Importantly, however, they note that many Chinese scientists, like their U.S. counterparts, did believe in science for its own sake, despite outward denunciations of this attitude as bourgeois.) Ultimately, I found the combination of empathy and criticism compelling.

I do wonder whether the authors reflected with any amusement on their own participation in a research project (the book series) that in its scale, pace, and mobilization of resources is a bit reminiscent of the Mao-era research style they analyze so well. Given the project's enormous contribution, this could be only the nicest kind of joke. Xiong and Wang take a subject many have wanted to understand much better and offer an account that is at once satisfying and provocative.

SIGRID SCHMALZER

■ Sociology and Philosophy of Science

Evan Selinger; Robert P. Crease (Editors). *The Philosophy of Expertise*. vi + 421 pp., figs., index. New York: Columbia University Press, 2006. \$49.50 (cloth).

This volume assembles fifteen previously published essays in order to explore the conceptual grounds of epistemic authority, especially given the practical necessity of deference and trust on the part of nonexperts. The first such collection to treat expertise from a philosophical standpoint, it exposes a topic that appears ripe for continued inquiry. This much is implied in the stated purpose of the volume: to identify the "key issues and indispensable features" (p. 1) necessary for any philosophically comprehensive framework. Insofar as expertise is a defining feature of the modern world, and yet a concept whose problematization can be traced to Plato's early dialogues, the fact that classical

philosophy and science studies “avoid addressing the issue” (p. 214) itself warrants attention.

Not surprisingly, the book’s contributions traverse a range of epistemological, social, and political issues. In a straightforward and telling move, the volume is organized into three sections, corresponding to the elements of a social taxonomy: those who provide expertise, those who “consume” it, and the relationship between these two “parties” (p. 5). Thus, Part 1 considers the relationship between experts and nonexperts and largely involves individual and institutional capacities to integrate expert advice. Alvin Goldman surveys basic philosophical challenges posed by the expert/lay divide, particularly in the case of conflicting expert accounts. In this section, as well, Scott Brewer critiques the U.S. legal system’s ability to arbitrate among experts, and Stephen Turner assesses the dilemmas posed for the modern liberal state in deploying knowledge as opposed to privileging ideology.

The essays in Part 2 delve into the constitution of experts and expertise. For instance, the chapters by Hubert Dreyfus and Julia Annas, both of which consider apprenticeship, respectively contrast education with distance learning and modern epistemological assumptions with ancient alternatives. Finally, Part 3 centers on the remaining term in the relationship, treating the nonexpert critique and negotiation of expertise in view of its “impacts” (p. 6). This section includes Paul Feyerabend’s provocative “How to Defend Society against Science” and Don Ihde’s closing chapter, which criticizes the expert/lay divide—a concept that not only frames but permeates much of the book—as overly dichotomous.

In several ways, the volume hints that one reason expertise has not received more disciplinary attention may have to do with its disciplinarily untidy implications. In the case of philosophy, the conception of expertise as “embodied cognition” (p. 194) opens the door not only to phenomenological analysis but, by extension, to its treatment from sociological perspectives—a point emphasized both by likening the book’s divisions to social actor categories and by its sociological contributions. In “The

Third Wave of Science Studies: Studies of Expertise and Experience,” H. M. Collins and Robert Evans propose that science studies has so far consisted of a first wave, which conceded scientific authority its claims to knowledge and truth, and a second wave, which demystified scientific authority. They propose that a third wave of science studies would do well to attend to the “pockets” (p. 54) of “experience-based expertise” (p. 42), found outside the core groups of certified experts, that can and ought to participate in technological decision making.

For scholarship more generally, inquiry into expertise may raise contextual questions about the relevance of the scholar’s own expertise. This could perhaps be termed the tar-baby effect. Reflexive occasions are accordingly found in the book, most notably in the case of Collins and Evans, who task sociologists with the need to take their own expertise seriously (p. 43) and suggest “a duty to make history as well as reflect on it” (p. 45). In this light, John Hardwig’s claim that “rationality sometimes consists in refusing to think for oneself” (p. 328) would appear to reside snugly within the first wave of science studies. One is tempted to note other instances of the tar-baby effect, such as Brewer’s proposal that the same person will need to possess legal authority and scientific epistemic competence if the U.S. legal system is to “satisfy its own just intellectual aspirations” (p. 149) and Peter Singer’s suggestion that if moral philosophers are not generally “better suited” than nonphilosophers to reach “the right, or soundly based, moral conclusions . . . one might wonder whether moral philosophy was worthwhile” (p. 189).

The Philosophy of Expertise is worthwhile because of the subject matter, because it contains a number of engaging chapters, and because the contributions tend to engage one another. While the organization involves overlaps and may invite the reader to second-guess placement of some of its chapters, this is only a minor distraction. Overall, this stimulating collection is crisply introduced and thoughtfully compiled, and it succeeds in setting the stage for the next wave of studies of expertise.

ERIK FISHER