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C. Wright Mills: *Letters and Autobiographical Writings*

Letters and Autobiographical Writings by C. Wright Mills; Kathryn Mills; Pamela Mills.; Dan Wakefield.

Review by: rev. by Robert C. Bannister

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BOOK REVIEWS

■ General

Roger Herz-Fischler. *The Shape of the Great Pyramid*. xii + 293 pp., figs., tables, apps., bibl., index. Waterloo, Ontario: Wilfried Laurier University Press, 2000. \$29.95 (paper).

The existence of a mathematical theory determining the shape of the Great Pyramid is a long-standing assumption, and speculation on the subject dates back to Herodotus. Roger Herz-Fischler's study presents and discusses eleven major theories and their proponents in the light of archaeological and philosophical considerations. The historiographical aspect of the study is very useful, as is the formulation and discussion of some of the problems. A brief sociological case study of the Pi-theory and the reasons for its propagation and popularity in Britain is particularly interesting. But although this book offers much that will be of interest to professional and amateur historians of mathematics and pyramid enthusiasts, it does not provide a definitive conclusion to the 2,500-year-old debate.

Having dismissed all but three of the theories and unable to decide among them, Herz-Fischler reaches the rather extraordinary conclusion that there may have been no true theoretical basis for the angles of inclination that might have been established "by eye" (p. 168). In settling for this interpretation, however, he fails to consider how the angle would have been replicated on the different sides of a pyramid or how angles of inclination would have been maintained or transferred to other pyramids of different sizes: for example, Khufu's three queens' pyramids have slopes virtually identical to those of the main pyramid (see V. Maragioglio and C. Rinaldi, *L'architettura delle piramidi menfite IV* [Centro per le Antichità e la Storia dell'Arte del Vicino Oriente-Roma, 1965], pp. 80, 86, 92).

The three theories among which Herz-Fischler cannot decide are all proportion-based theories, two relating to the angle of inclination and one to the angle of the arsis (all theories involving complex mathematics were those Herz-Fischler dismissed). This conclusion is significant in its own right and relates to practical building considerations. Herz-Fischler is keen to distinguish mathematically between integer proportional systems and the *seked* theory (see note on p. 28), a system attested in ancient Egyptian mathemat-

ical texts and related to the division of the cubit into seven palms, each of four fingers. But the close relation between these two methods of measurement in practical terms is clear, and either one could have been used with ease by an ancient builder.

Herz-Fischler states that "there simply is no archaeological evidence for the above three rise over run based theories" (p. 168). Here he is too quick to dismiss the evidence presented by Flinders Petrie from a mastaba at Meidum (pp. 41–42, 168). Outside the corners of the structure are walls with traces of horizontal lines at cubit intervals and sloping lines marking the inclination of the faces. Herz-Fischler points to the lack of marks to indicate how the slope was constructed, but he fails to consider how an identical slope was constructed eight times around the structure if such a horizontal measurement was not used. Nor are the corners of the structure level; thus the correct measurements must be calculated relative to the depth. Mark Lehner, in his *Complete Pyramids* (Thames & Hudson, 1997), page 220, offers evidence from Giza that the builders constructed the corners by measuring in a certain distance from reference points outside the sides. The pyramid drawing from Meroe based on a rectangular grid (pp. 37–38) does not necessarily conflict with a rise and run theory and certainly shows that a proportional system was used relating side length to height. I find this archaeological evidence for the use of rise over run theories convincing, if limited, and it strongly supports side-inclination based theories over those relating to the arsis.

The Meroe drawing cannot be taken as reliable evidence that the *seked* theory was not used in Fourth Dynasty structures (p. 38), as it dates to over 2,000 years after the Great Pyramid was constructed and lies outside Egypt. As for the question of whether a *seked*-based system or integers were used to construct the angle of the sides, Herz-Fischler could have used the measured angles of sloping corridors and shafts inside the Great Pyramid that must have been constructed using similar techniques. Further, he makes no attempt to apply these theories to the slopes of other pyramids, although in some cases he does consider examples presented by other authors. Applying these theories more broadly might lead to more decisive results. Before readers undertake to do so themselves, however, they should be alerted that some of the measurements

given in Appendix 2 are out of date. Corrected figures are: Abu Rawash, c. 52° (Michel Vallogia, *Au coeur d'une pyramide* [Musée Romain de Lausanne-Vidy, 2001], pp. 56–57); Bent Pyramid, $55^\circ 00' 30''$ (lower section), $43^\circ 01' 30''$ (upper) (Josef Dörner, "Form und Ausmaße der Knickpyramide," *MDAIK*, 1986, 42:43–58); Red Pyramid, $44^\circ 44'$ (Josef Dörner, "Neue Messungen an der Roten Pyramide," in H. Guksch and D. Polz, eds., *Stationen: Beiträge zur Kulturgeschichte Ägyptens Rainer Stadelmann gewidmet* [P. von Zabern, 1998], pp. 23–29). In this last example considerable variation (up to $43'$) was noted in the inclination of different stretches of the same pyramid face, which suggests that an angle of 45° was intended. This observed variation is very significant considering how little of the casing of the next pyramid constructed—the Great Pyramid—is preserved (as we can see in the photograph on the cover of the book).

Although I find Herz-Fischler's conclusions rather weak and some of his treatments of archaeological sources too dismissive, this volume provides a useful introduction to the subject and a clear formulation of the problems involved. It is, then, a thought-provoking contribution to a long-standing debate.

KATE SPENCE

Die Schrift des Ibrāhīm b. Sinān b. Tābit über die Schatteninstrumente. Translated and annotated by Paul Luckey. Edited by Jan P. Hogendijk. (Islamic Mathematics and Astronomy, 101.) xvi + 283 pp., illus., bibl. Frankfurt am Main: Institute for the History of Arabic-Islamic Science at the Johann Wolfgang Goethe University, 1999.

This book is one volume in a series consisting of reprints of writings on the history of science in Muslim societies undertaken by the Institute for the History of Arabic-Islamic Science at the Johann Wolfgang Goethe University, Frankfurt am Main, and edited by Fuat Sezgin. This particular volume presents Paul Luckey's 1941 doctoral thesis on Ibrāhīm ibn Sinān's treatise on sundials, now published for the first time. It also includes an introduction by the editor of the volume, Jan P. Hogendijk, that describes Luckey's life and scholarly career; a bibliography of Luckey's works; the Arabic editions of two texts by al-Kindi (d. about 874), of ibn Sinān's text on the sundials, and of the beginning of a treatise by al-Mahani (ninth century); Hogendijk's notes; Luckey's curriculum vitae; diagrams prepared by Luckey as well as by Hogendijk; and the (technically poorly executed) facsimile of

MS Istanbul, Aya Sofya 4832, fols. 66b–75b, which contains ibn Sinān's treatise.

Hogendijk offers this reprint of Luckey's thesis as "a tribute to the man and his work" (p. viii). This dedication reflects the opinion that, as Hogendijk says, Luckey was one of the foremost historians of Arabic-Islamic mathematics in the twentieth century (p. vii). His thesis focused on the mathematical and astronomical contents of ibn Sinān's treatise. Luckey embedded the technical analysis of ibn Sinān's particular work in brief surveys of the religious community ibn Sinān belonged to—that of the so-called Sabaeans—of the medieval scholar's life and works, of his method of determining the area of the segment of a parabola, and of the theories of sundials espoused by ancient and medieval (Arabic) authors. Finally, he discusses two writings by al-Kindi and some aspects of a text by al-Mahani, both of whom lived in the ninth century. Luckey's work is thus a good example of the particular approach to the history of mathematics that prevailed at the time he wrote.

His dissertation does, however, have a few peculiarities. Luckey is concerned not only with mathematical progress and sources but also with the intellectual excellence of individuals and groups (see, e.g., pp. 2, 3, 18, 22, 32–33, 80–81). Like the author of his major source for the chapter on the Sabaeans, Daniel Chwolson (1858), Luckey is interested in the issue of their race (p. 2). He applauds or chastises historical actors or communities for their actions and speculates on their aspirations and emotions (pp. 2, 7, 31, 83). He introduces problems outside the limited realm of his own subject but does not engage in a deeper historical investigation in order to discuss or evaluate them (see, among other passages his discussion of ibn Sinān's preference for the chord function over the sine, cosine, and versed sine functions used by his two predecessors Thabit ibn Qurra and al-Battani [p. 45]).

These aspects of Luckey's study raise an important question: Shouldn't reprinted works based on approaches to the historiography of science and mathematics that, by now, are themselves historical be accompanied by at least a brief consideration of the author's historiographical methodology? Such a consideration, of course, may entail its own difficulties, as Hogendijk's attempt to provide some context in fact illustrates. In his biographical sketch of Luckey, Hogendijk remarks on Luckey's concern with issues of race in his other papers and notes that he published an article in the racist journal *Deutsche Mathematik*. Although Hogendijk saw the need to ask what these facts imply about

Luckey's political positions—that is, his attitude toward the Nazi regime—Hogendijk did not ask whether they represent beliefs that were widespread among the community of historians of science and mathematics, not only in Germany but also in other Western countries, during the first half of the twentieth century. In Luckey's case, there may not be sufficient documentation for an extensive investigation of his political view. The publication of his thesis, however, reminds us that no good studies of the methodological as well as political stances of German historians of science and mathematics are currently available.

Hogendijk's work as an editor was complicated by the fact that Luckey's thesis does not include a critical edition of any of the four texts he examines. Hogendijk discovered the Arabic versions of two of them as prepared by Luckey in his papers at the Oriental Seminar of the University of Tübingen, but he himself had to edit the two remaining texts, among them *ibn Sinān's* treatise. In doing so, he was guided by Luckey's remarks on the philological peculiarities of this text as manifested in MS Aya Sofya 4832 (pp. 75–78). Further, in ambiguous cases Hogendijk reasonably decided to choose “a reading which is consistent with Luckey's translation” (p. 96). He inserted in Luckey's German translation a few references to his notes as editor (these appear on p. 222) but without, unfortunately, catching all the typographical, and other, errors. Finally, he supplemented Luckey's own reproductions of the diagrams, which are adaptations to modern convention (pp. 96, 225–247); these diagrams reconstruct the figures of the original manuscript (pp. 96, 248–263).

As reasonable as Hogendijk's approach to editing the Arabic text is—that is, maintaining consistency with Luckey's German translation—it creates some problems. I discuss these problems in detail, with a list of corrections to Hogendijk's edition, in a review in *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften*, in which I compare this edition with the one published by Roshdi Rashed in 2000 (Roshdi Rashed and H  l  ne Bellosta, *Ibrahim ibn Sinan: Logique et g  om  trie au Xe si  cle* [Leiden: Brill, 2000]). Rashed and Hogendijk edited the text independently, without any knowledge of each other's work. Both editions contain errors that could have been avoided had the two editors consulted each other, so it is a pity they did not collaborate on this project.

As Luckey's dissertation deals with an important text on mathematical and astronomical issues by an outstanding scholar of the tenth cen-

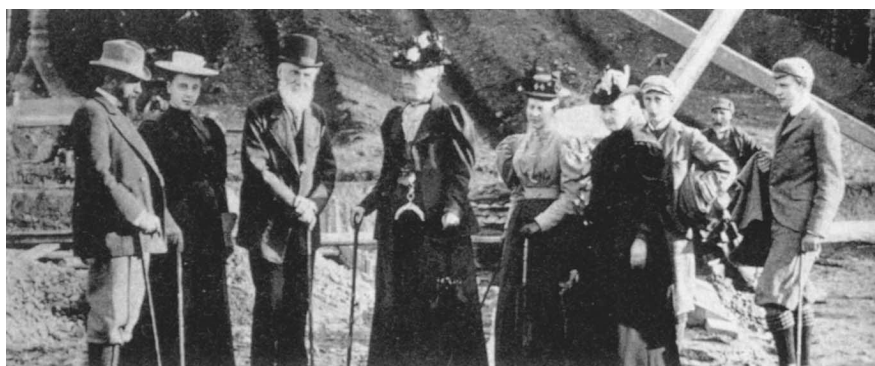
tury, and as Hogendijk's editing, despite the problems I have mentioned, is basically sensible and responsible, this reprint can only be considered a welcome addition to the substantial, though far from satisfying, number of publications of original mathematical and astronomical works by scholars of the medieval Muslim world investigated by contemporary historians of science and mathematics.

SONJA BRENTJES

Colin A. Russell (Editor). *Chemistry, Society, and Environment: A New History of the British Chemical Industry*. xvi + 372 pp., frontis., illus., figs., tables, indexes. Cambridge: Royal Society of Chemistry, 2000.  59.50.

In this book Colin Russell and his colleagues tread a somewhat difficult path between apologia for the British chemical industry and the historical account of its development. It is not an altogether comfortable journey, less from the point of view of maintaining balance between apologetics and critique, a difficulty of which the authors are clearly aware, than from the need to balance “general” history of the industry with the “environmental” theme. Looking first at the former, the book represents a considerable achievement for the authors. They have marshaled a very wide array of technical and other information in order to offer largely narrative accounts of a wide range of industries. It is unlikely that this degree of expertise could be brought together in any other group, particularly since the death of W. A. Campbell. The broad canvas that they cover means that many of the themes and topics are skated over quite briefly. Nevertheless there is a good deal of technical detail and substantial, though rather less, social and human detail. I did find myself wondering who would read this study: it attempts to be all things to all people, but risks satisfying neither the specialist nor the general reader, if the latter person exists. Overall, however, the authors have fulfilled effectively what I take to have been their brief and can expect their book to become a standard reference work.

I was less convinced by the environmental theme. The very self-conscious evenhandedness of the authors grew wearisome—in fact I began to feel as if I was being talked down to in the final chapter. Surely a reader of this book does not need to be convinced that “modern life would be impossible without the methods and products of the chemical industry” (p. 348). Similarly, there is little to be gained, in my opinion, from offering quasi-moral judgments on the failures or otherwise of the chemical industry or



Inspection of construction at Foyers in the early 1890s. Lord Kelvin is third from left (from Russell, ed., Chemistry, Society, and Environment, p. 314).

from telling us in the manner of a school textbook that “chemists have endeavored to improve the quality of water supply” (pp. 345–346). Chemists, I suspect, have done what they were told and paid to do. We know that the chemical industry has been a polluter and has attempted to recycle its waste products for economic and political reasons. What is of interest are the technical and socioeconomic determinants of this. We get a good deal of the former but rather little of the latter. This is disappointing when one knows that one of the authors, Sarah Wilmott, has written a sophisticated analysis of one aspect of this question, particularly emphasizing how the industry employed chemical knowledge to reconfigure the notion and legal positioning of chemical pollution (in E. Homburg, A. S. Travis, and H. G. Schröter, *The Chemical Industry in Europe, 1850–1914* [Dordrecht: Kluwer, 1998]). Of course it would be asking a lot to extend this type of empirically grounded analysis across the divisions and issues associated with the chemical industry.

This then is a worthy book of reference that brings together good technical and synoptic accounts of many aspects of the British chemical industry in one location. However, it employs a cautious—if one were being brutal one might say pedestrian—historiography, and I did not feel that it broke new historical or conceptual ground. But perhaps it was never intended to.

JAMES DONNELLY

Robert Fox; Anna Guagnini. *Laboratories, Workshops, and Sites: Concepts and Practices of Research in Industrial Europe, 1800–1914.* ii + 214 pp., illus., tables, index. Berkeley: Office

of the History of Science and Technology, University of California, 1999. \$24 (paper).

In this monograph Robert Fox and Anna Guagnini aim to reinterpret the nature of “research” and the relations of science and industry in Europe between 1800 and 1914. They compare and contrast industrial developments in what they call the “slow-lane” countries (Britain, France, and Italy) with those in the “fast lane” (Germany and the United States). They make their case by examining four large issues.

The first is conceptions of applied research before 1870. Fox and Guagnini notably begin not with the English industrial revolution but with a discussion of how France’s state-supported savants and engineers in the revolutionary and Napoleonic eras helped bring science into the industrial realm, principally that of the chemical industry. By the mid-nineteenth century, they argue, the British slowly, and the Germans quickly, began to change their attitudes toward applied science, while the French remained largely at a standstill. Yet the main result of these developments was not any dramatic impact of science on industry but, rather, the diffusion of a new rhetoric bearing the message that science could be applied to aid national industry, although to do so it must, paradoxically, also retain and advance its “pure” dimension.

Fox and Guagnini next outline the functions of physics laboratories in Germany, France, and Britain. They stress that these laboratories grew part and parcel with the rise of new aspects of teaching (especially the training of future secondary school teachers and technologists) and an increased interest in research in the discipline. They believe that the new teaching goals were

probably the single most influential cause of the rise of physics laboratories. Especially by the 1870s and 1880s, the ideals of academic physics began to affect and were affected by applications of physics (above all, electricity) in industry; this development in turn initiated a never-ending debate about the “demands of utility” versus “disinterested inquiry” (p. 42).

Third, the authors analyze the rise of electrical engineering as an academic discipline from the 1880s on. They discern two patterns: electrical engineering was introduced either as an integral part of the mechanical engineering curriculum or as a one-year, advanced program based on a student’s previous training in mechanical or civil engineering. They emphasize that teaching, not research, remained the principal activity of academic electrical engineers until late in the century. They argue that the search for novelty in electrical (as in mechanical) engineering occurred principally in the manufacturer’s workshop or on work sites.

Fourth and finally, Fox and Guagnini address “the realities of industrial research.” Although they fully recognize that many industrial research laboratories (above all in the United States and Germany) were first conceived and took embryonic form before World War I, they think that to understand the nature and loci of industrial research before 1918, scholars must consider two broad interpretations: first, that even in the nascent “research laboratories” in Germany and the United States there was a strong emphasis on “testing, quality control, and investigations directed at the protection of patents, rather than a preoccupation with the development of new products and processes” (p. 149); second, they assert that experimental work occurred largely on “the shop floor and the site by technical staff engaged in day-to-day work of design, production, and installation” (p. 150).

Fox and Guagnini persuasively argue that assessment of developments in the slow-lane countries must be appreciated in terms of their demographics, politics, economies, and traditions of higher education. Innovation, they demonstrate, appeared in a variety of contexts and places in both fast-lane and slow-lane countries. They maintain that our understanding of “research” must be expansive enough to include the incremental sort that occurred in the workshops and sites as well as the more theoretical sort that (later) occurred in academic and industrial research laboratories. Their thoughtful monograph should be carefully studied by all scholars concerned with the history of applied research and

of the relations of science, technology, and the economy in general.

DAVID CAHAN

Felix Driver. *Geography Militant: Cultures of Exploration and Empire.* viii + 258 pp., illus., figs., bibl., index. Oxford/Malden, Mass.: Blackwell Publishers, 2001. \$29.95 (paper).

In this widely researched and well-written study, Felix Driver investigates the relationship between geographical knowledge and the cultures of exploration and imperialism in nineteenth- and early twentieth-century Britain. The book’s title—taken from an essay by Joseph Conrad that was reprinted in the *National Geographic* in 1924—refers to the heroic era of exploration that Conrad laments as passing at the close of the nineteenth century. Driver traces the history of this ideal of exploration and is especially interested in the hold it has had over modern understandings of geography.

Driver is one of several geographers and historians who have broadened the history of geography in recent years. In his estimation the traditional focus on the intellectual history of geography as a discipline has come at the expense of other important manifestations of geography, among them the culture of fieldwork. In a related vein, Driver also cautions against the tendency among postcolonial scholars of colonialism to focus excessively on travel narratives. Both of these emphases have led to a misleading characterization of imperialism as having hegemonic motives and essential functions. Instead of emphasizing the textual “end product” of travel narratives, Driver investigates the lives and practices of the explorers themselves. This change of focus makes his a more complex and subtle approach, which in turn highlights the conflictual and contingent role of colonial discourse.

Because he wants to know how geography functioned both as an idea and as a practice, Driver places explorers at the center of analysis and raises questions about how they built reputations, secured funding, and cultivated the myth of the lone explorer that paradoxically depended on recognition by others. Among the most interesting of Driver’s themes is the history of the heroic ideal of exploration that evoked the missionary role of European scientific knowledge. He repeatedly demonstrates that this ideal was only half the story, for it was always contested in practice. The work of Henry Morton Stanley nicely illustrates this problem. By recovering the controversy, criticism, and conflict surrounding

Stanley's explorations, Driver debunks the familiar story of Stanley as representing the ideal of progress that we associate so closely with the nineteenth-century culture of exploration. Substantial attention is given to Stanley's own need to position himself apart from armchair geographers and philanthropists who he felt detracted from his reputation and work. What emerges is a man whose reputation as explorer became as important as the expeditions themselves.

Driver traces both the production and the consumption of geographical knowledge. The interest in the former leads him to the Royal Geographical Society (RGS), the largest scientific society in London by 1870 and a critical institution for the collection of information from around the world in the nineteenth century. One of Driver's great strengths is to demonstrate the sheer diversity of what counted as "exploration" or "geography" in this period. Instead of portraying the RGS as a monolithic structure with a consistent ideological bent, he points out the breadth of the society's membership. As a result, we see a culture of exploration that is full of tension and contradiction, manifest in the mutual suspicion of professional and popular geographers and the increasingly important distinction between exploration and travel. Driver encourages us to think of the RGS as a "coalition of interests" rather than as an organization with one orchestrated position, an "information exchange rather than a center of calculation" (pp. 36–37).

The range of material included in this book, only a portion of which can be covered here, is exceptional. *Geography Militant* is a welcome contribution and will certainly spark a reconsideration of assumptions in a number of fields, including the history of science, cultural history, and the history of imperialism.

SUSAN SCHULTEN

Christopher McGowan. *The Dragon Seekers: How an Extraordinary Circle of Fossilists Discovered the Dinosaurs and Paved the Way for Darwin.* xvi + 254 pp., illus., bibl., index. Cambridge, Mass.: Perseus Publishing, 2001. \$26, Can \$39.50.

Though it is an attractive popular book dealing with some major episodes in the history of nineteenth-century vertebrate paleontology, *The Dragon Seekers* fails to establish the connection between Darwin and his predecessors promised by its title. As scholarship, it is seriously deficient except when dealing with ichthyosaurs, about which its Canadian author, a paleontologist, is thoroughly knowledgeable.

Of the several persons central to Christopher McGowan's topic, Mary Anning, William Conybeare, and Thomas Hawkins had little or no role in the discovery of dinosaurs. All three of them were instead devoted to ichthyosaurs and plesiosaurs; McGowan writes confidently and reliably about each of these impressive prehistoric families. Despite his subtitle, the fossil reptile depicted on McGowan's title page is not a dinosaur but an ichthyosaur—and an excessively "made up" one at that (see p. 138). He begins and ends the book with Mary Anning and her famously fossiliferous hometown. In the Blue Lias cliffs of Lyme Regis, both ichthyosaurs and plesiosaurs were found—but no dinosaurs. Though Lyell, Agassiz, and Darwin appear as dragon seekers also, none of them was associated importantly with saurians. Cuvier, a French seeker of dragons and much else, is mentioned only in passing.

The three dinosaur discoverers important to McGowan's book are William Buckland, Gideon Mantell, and Richard Owen (which is hardly unexpected). A more energetic researcher than some, McGowan actually visited the Kirkdale and Paviland caves made famous by Buckland. He provides up-to-date information about each cave, as he does about other topics throughout the text. Unfortunately, his exploration of the available literature on Buckland, Mantell, and Owen is less impressive. McGowan is clearly unacquainted with major publications by all three; their later thinking in particular is generally ignored. More broadly, McGowan has too obviously written in haste. He never provides the more coherent reading of Victorian vertebrate paleontology and associated sciences that his audience-seeking thesis requires.

Persons familiar with early dinosaur discoveries will notice the absence from McGowan's book of many useful sources and studies. The weak notes and "further reading" bibliography that he provides are inadequate. Only direct quotations have been identified; all other matters of substance, frequently controversial, are left to be taken on faith. In some introductory remarks (p. 1), McGowan tells us that fossils have been known since the time of classical Greece. They have actually been found among the grave goods of Neanderthals. Some persons, Greeks among them, realized the significance of fossils (as records of past life) long before the latter eighteenth century. McGowan even fails to acknowledge that there were evolutionary theories before *Vestigis* (1844). He ignores James Secord's recent facsimile of the latter and is apparently unaware

that a magnificent new edition of Darwin's correspondence is appearing.

A number of factual mistakes are disconcerting. Cuvier's seminal *Recherches* (1812) is dated 1799 (p. 6). No other foreign publication is considered, though there were several of importance. Mantell and Owen are described as physicians, which they were not; both were instead surgeons, an occupation not involving university education. Mantell joined the Geological Society in 1818, not 1820. McGowan is significantly misleading when he describes the financing of Mantell's first book (pp. 44–45) and the chronology of its writing. It appeared in May 1822, not four months later (p. 48). The first chapter of Mantell's book was contributed by the Rev. Henry Hoper, not Harper (p. 48). Mantell was surgeon to three parishes, not just one (p. 49). McGowan fails to realize that the name "*Megalosaurus*" had been published by James Parkinson in 1822 (p. 77). He also distorts the history of Buckland's famous 1824 paper on *Megalosaurus* by assuming that some later additions were already in it at the time of presentation (pp. 77–78). Once again, however, he includes some useful modern knowledge.

On page 87 McGowan insists that Mantell and Conybeare had not yet met, though they were both present at the meeting of 20 February 1824 and had corresponded earlier. Mantell did not receive Conybeare's most recent letter "shortly after" 10 February 1825 but on 24 November 1824 (p. 87). On page 89 Robert Trotter is not fully identified, and his later generosity to Mantell is ignored. Though Lyell's geological views influenced Mantell's, they would never be entirely congruent. Mantell was still very much a catastrophist in 1832 (p. 93). On page 111 McGowan's explanation of British money is erroneous. According to page 113, Mantell and Benjamin Silliman never met. Yet they spent several days together in 1851. In January 1837 Darwin was actually living at Cambridge (p. 160). On page 179 McGowan claims that "our present preoccupation with dinosaurs dates back less than three decades." Finally, there is some inadequate editing, as with "their's" (p. 137) and "Gooses" (p. 165). On page 229 a note from Lyell to Owen is quoted but not cited.

Though many of these lapses will be of no consequence to the general reader, scholars should be forewarned. This is not a book on which one can rely, despite occasionally useful points. It should not be recommended to students, for whom better sources are available. It should not be taken as a model. Several would-be popularizations of the history of the earth sci-

ences have appeared recently, none of them based on sound historical arguments. The writing of defensible history is not so simple a task as these facile popularizers would like the public to believe.

DENNIS R. DEAN

Michael Ruse. *The Evolution Wars: A Guide to the Debates*. Foreword by **Edward O. Wilson**. xx + 428 pp., illus., figs., index. Santa Barbara, Calif./Denver: ABC-CLIO, 2000.

Beginning his fourth decade as one of the leading students of the evolution controversies, the philosopher Michael Ruse is well known as a gifted writer, able historian, and careful observer of the many facets of the response to Darwin. This latest contribution seeks to perform a different task from his earlier endeavors. Ruse has designed this book to provide a succinct overview of the background of and response to Darwinism, focusing equally well on the history, religion, politics, and science involved. His goal is to inform the lay reader of the substance behind the continuing controversy, correcting errors and clarifying often-misunderstood concepts. He succeeds admirably in achieving this goal.

Ruse rounds up the usual suspects in his discussion of the development of Darwinian evolution. Examining the work of earlier naturalists, he describes developmental ideas and lays the foundation for the concept of evolution through natural selection. His necessarily brief account of Darwin's own work nonetheless provides the reader with a clear understanding of what Darwin did and did not argue in *Origin of Species* and *Descent of Man*. Equally impressive, though, Ruse discusses the major developments in evolutionary theory that followed Darwin in the same informative way. The impact of genetics and the varied roles of paleontology are well covered, as are various theoretical developments. Ruse's discussion of Sewall Wright's concept of the "adaptive landscape," for example, is especially well done. He is no less effective in integrating recent developments into his account of the present state of evolutionary knowledge.

Ruse also provides the reader with a good analysis of the various challenges to Darwinian evolution, exploring the antievolutionists of the 1920s as well as the creation scientists who have been active since the 1960s. He rightly emphasizes the current "intelligent design" campaign as the latest manifestation of antievolution sentiment, but carefully presents these ideas as distinct from earlier ones. Ruse similarly analyzes

the “punctuated equilibria” concept of Stephen Jay Gould, pointing out weaknesses in this idea and suggesting that Gould may be doing more harm than good in educating the public on the realities of organic evolution.

Ruse includes much that will aid the reader in the pursuit of additional understanding of the controversy. Each chapter includes a brief essay discussing and evaluating standard sources. A list of references, a chronology, and a glossary add to the volume, as do nearly 100 pages of documents that are included as a separate section. The writings of individuals as diverse as Alfred, Lord Tennyson, Thomas Henry Huxley, and Pope John Paul II are complemented by works of such noted scientists as Darwin, Gould, Edward O. Wilson, and Richard Dawkins.

Ruse makes another important contribution in his effective critique of the “science studies” focus that seems increasingly popular among historians of science. Rejecting the concept that science is merely another belief system, Ruse stresses that the personal beliefs of scientists are largely irrelevant to an evaluation of the science they produce. Of even greater value, Ruse stresses that scientists’ beliefs must, at any rate, be evaluated on the basis of their own times, and not on the basis of current perspectives or fashions. This observation should, of course, be obvious to historians, so it is somewhat embarrassing that a philosopher must come along and remind us of this fact.

Ruse has provided a well-written and thought-provoking study of the evolution controversy in its myriad forms. In his foreword, the sociobiologist Edward O. Wilson argues that *The Evolution Wars* would be his choice for the single volume to read by someone who had no knowledge of the evolution controversy. Wilson’s evaluation cogently describes the value of this book.

GEORGE E. WEBB

Edward J. Larson. *Evolution’s Workshop: God and Science on the Galápagos Islands.* xiv + 320 pp., frontis., illus., index. New York: Basic Books, 2001. \$27.50, Can \$41.50.

I first visited the Galápagos Islands in June 1998, and little was as I expected. Rather than craggy barrens covered with scrub, lush foliage beautified many islands. Rather than flourishing coastal habitats, surface water temperatures were well above normal, and throughout the archipelago dead or dying sea lions, sea birds, and marine iguanas littered the shores. All of this was the result of increased rainfall and the disruption of the normal upwelling in waters surrounding

the archipelago caused by the 1997–1998 El Niño event. When I visited Galápagos again, in February 1999, the islands were suffering one of the driest periods on record, and terrestrial vegetation had died back; but the cool, nourishing upwelling had resumed, and the marine environment was thriving.

A “study in contrasts” aptly describes the two extremes in environmental conditions in the Galápagos Islands in 1998 and 1999 and, as Edward Larson captures beautifully in this book, many aspects of their history. Indeed, a theme that emerges in Larson’s historical account of the Galápagos is one of irony. Compare Herman Melville’s characterization of the islands as “an archipelago of aridities, without inhabitant, history, or hope of either in all time to come” (p. 7), with modern biologists’ and eco-tourists’ view of the Galápagos as “hallowed ground” and “enchanted”; the view of Galápagos as a place where one can so easily see Creation (e.g., Agassiz) with the view that is a place where one can so easily see evolution (e.g., Darwin); the popular belief that Darwin used Galápagos finches as the basis of his theory of natural selection with the reality that a complete picture of Galápagos finch evolution didn’t emerge until it was unveiled in 1947 by David Lack, who renamed “Galápagos finches” “Darwin’s finches”; the treatment of Galápagos as a land of plenty from which early sailors, buccaneers, and greedy naturalists removed tens of thousands of tortoises with its current status as a land in which a single tortoise named Lonesome George is an icon for conservation worldwide; and its small stature in terms of geographical size with its monumental stature in terms of impact on the history of biological science.

Expanding on the last contrast, Larson offers the following insight from Robert Bowman: “No area on Earth of comparable size has inspired more fundamental changes in Man’s perspective of himself and his environment than the Galápagos Islands” (p. 12). As such, the comprehensive history of the place provided by Larson is well justified. It is also fascinating, and Larson tells the tale well—concisely, occasionally with wit, and always with inclusive documentation. The text is divided into three parts, the first covering the period from the discovery of the New World, including Galápagos in 1535, to Darwin’s legendary visit in 1835 and the subsequent publication of *On the Origin of Species* in 1859; the second, the explosion of interest in the archipelago by American and European naturalists in the late nineteenth and early twentieth centuries; and the third, the remarkable transformation

of the Galápagos between World War II, during which it served as a military base for the United States, to the present. Following and cited in the text are sixty-three pages of notes, a veritable gold mine of references to classic and obscure published material that demonstrate both how thoroughly Larson researched the topic and how persistently this small archipelago has pervaded scientific, governmental, religious, and public thought.

This book is more than a historical account of scientific exploration in Galápagos; it is also a dramatic story of the history of Galápagos in human thought. By incorporating thoughts and findings of nearly every famous, infamous, and forgettable player in Galápagos exploration in roughly chronological order and in the context of prevailing social or scientific mores, Larson provides an extraordinary glimpse into human nature. Regarding the evolution of human thought in conceptualizing organic evolution, Larson demonstrates that spiritual concerns or other constraints prevent some individuals from progressing intellectually, others eagerly abandon all tradition to embrace new concepts, and still others find middle ground. As noted poignantly, no less than ironically, by Larson, creation science, not evolution, is taught in Galápagos schools, and this once-pristine archipelago is now bustling with humans and the predictable problems that accompany us. The history of Galápagos, both in terms of its ultimate fate and its influence on human thought, is not finished. The sequel to *Evolution's Workshop* may be equally intriguing.

CAROLE BALDWIN

Nico Stehr; Hans von Storch (Editors). *Eduard Brückner: The Sources and Consequences of Climate Change and Climate Variability in Historical Times*. Translations by **Barbara Stehr** and **Gordon Gamlin**. x + 338 pp., illus., figs., tables, bibl., index. Dordrecht/Boston/London: Kluwer Academic Publishers, 2000. \$167, £96, NLG 275.

Eduard Brückner (1862–1927), professor of geography at Bern, Halle, and Vienna, editor of *Meteorologische Zeitschrift*, and founder of *Zeitschrift für Gletscherkunde, für Eiszeitforschung und Geschichte des Klimas*, focused his research on climatological and glaciological themes, broadly construed, with forays into hydrology and oceanography. He is most widely known for his observation that cool, damp conditions seemed to alternate with warm, dry conditions in approximately thirty-five year cycles, subse-

quently called “Brückner cycles.” This was apparently a rediscovery of a similar weather cycle long noted in the Netherlands and first remarked upon by Sir Francis Bacon. Brückner popularized his ideas by attempting to correlate these (real or imagined) fluctuations with sunspots, economic conditions, migrations, lake levels, and other cyclical phenomena worldwide.

This book includes eleven articles or chapters in English translation that are broadly representative of Brückner’s writings on climate variations with one article each on hydrology and oceanography. These include “Ground Water and Typhus” (1887–1888); “Fluctuations of Water Levels in the Caspian Sea, the Black Sea, and the Baltic Sea Relative to Weather” (1888); “How Constant Is Today’s Climate?” (1889); three chapters from *Climate Change Since 1700* (1890); “The Current Status of the Inquiry into Climate Changes” (Ch. 1), “Periodization of Climatic Variations” (Ch. 8), and “The Significance of Climatic Variations in Theory and Practice” (Ch. 9); “On the Influence of the Snow Cover on the Climate of the Alps” (1893); “Influence of Climate Variability on Harvest and Grain Prices in Europe” (1895); “Weather Prophets” (1896); “An Inquiry about the 35-Year Periods of Climatic Variations” (1902); “On Climate Variability” (1909); “Climate Variability and Mass Migration” (1912); and “The Settlement of the United States as Controlled by Climate and Climatic Oscillations” (1915). Brückner’s interests in glaciers, glacial ages, geomorphology, polar research, and cartography are not represented here.

The editors, Nico Stehr and Hans von Storch, provide a brief introduction, including an outline of Brückner’s influence on his contemporaries, notably Julius Hann, and a plea that current researchers in the human dimensions of global change take Brückner seriously because of what they believe is an “analogy to the present state of affairs” (p. 18), particularly the political and economic consequences of climate variations on human time scales (decades to centuries). The book concludes with a thirteen-page bibliography of over 200 of Brückner’s publications. Scattered typographical and other errors do not seriously detract from the utility of the book or the graceful translations by Barbara Stehr and Gordon Gamlin. This tantalizing peek into a neglected body of literature on climate variations in historical times should serve to keep Brückner’s legacy alive within the English-speaking global change community and may entice scholars to reappraise his influence.

JAMES RODGER FLEMING

Sherry L. Smith. *Reimagining Indians: Native Americans through Anglo Eyes, 1880–1940.* xii + 273 pp., illus., index. Oxford/New York: Oxford University Press, 2000. \$35.

The notion of the exotic Other gives writers something against which to define themselves. Sherry Smith deals with that process of self-definition in her study of a group of writers whose subjects were American Indians. The group includes Charles Erskine Scott Wood, a military officer involved in the pursuit of the Nez Perce; George Bird Grinnell, Walter McClintock, and Mary Roberts Rinehart, who studied northern Plains tribes; Frank Bird Linderman, biographer of the Crows Plenty-Coup and Pretty Shield; Charles Fletcher Lummis, founder of the Southwest Museum in Los Angeles; George Wharton James, a self-taught authority on southwestern Indian cultures; and Mary Austin, Anna Ickes, and Mabel Dodge Luhan, who romanticized Pueblo cultures. Smith argues that all of these authors, although from different backgrounds and holding divergent views about Indians, presented Indians as individual human beings whose cultures and beliefs were worthy of acceptance and even emulation. In a time when federal policy was assimilationist and designed to suppress Indian cultures, the works of these authors delivered a different message.

The message was often prompted as much by the fear of the effects of modernism and rampant individualism on American society as it was by respect for Indians. It was also prompted by sometimes deep-seated yearnings to find new sources of personal identity. Mabel Dodge went so far as to marry a Taos Indian, while Walter McClintock claimed to have been adopted by the Blackfeet.

Most of these individuals became political activists, either directly (Linderman ran unsuccessfully for Congress; Ickes was a member of the Illinois state legislature and was an active participant in her husband's political career as secretary of the interior) or indirectly (Austin shared her outspoken opinions with Commissioner of Indian Affairs John Collier). Certainly in their writings they promoted positive images of Indians and were advocates for the preservation of Indian cultures.

Of the group, only Ickes had any formal training in ethnography. The others were self-taught experts whose personal associations with Indians informed their work. Participation in aspects of Indian life undoubtedly influenced their presentation of Indians as human beings. Grinnell's work on Cheyenne culture is the most systematic and detailed of any of the group.

This is not a book about Indians. Indeed, the only Indian individual about whose life we hear any detail is Tony Luhan, the Taos man who married Mabel Dodge. Smith's deft character sketches of a group of writers whom she characterizes as "middlebrow purveyors of Indian-ness" do show, however, the roots of their fascination with Indians and their attempts to counter the harsh federal policy of assimilation. Their works, uneven in quality and sometimes contradictory of each other, were often poorly reviewed by eastern critics and sold poorly, but some, like McClintock and Grinnell, through publication and public lectures, reached fairly wide audiences. As Smith notes in her conclusion, most of these works have been reissued in new paperback editions, available to influence a new generation of people who are interested in the cultures of American Indian tribes. In many cases, members of some tribes can salvage elements of their own cultures through these works.

Thoroughly researched and gracefully written, Smith's book is a strong contribution to a body of literature that includes Philip Deloria's *Playing Indian* (New Haven: Yale University Press, 1998), Margaret Jacobs's *Engendered Encounters: Feminism and Pueblo Cultures* (Lincoln: University of Nebraska Press, 1999), and Leah Dilworth's *Imagining Indians in the Southwest: Persistent Visions of a Primitive Past* (Washington, D.C.: Smithsonian Institution Press, 1996), books that tell us not about Indians but how responses to Indians reveal aspects of American popular culture.

CLARA SUE KIDWELL

Thomas C. Jepsen. *My Sisters Telegraphic: Women in the Telegraph Office, 1846–1950.* xii + 231 pp., illus., tables, bibl., index. Athens: Ohio University Press, 2000. \$49.95 (cloth); \$21.95 (paper).

Thomas C. Jepsen takes his place among the increasing number of historians who have drawn attention to the often overlooked role that women have played in technology-based industries. *My Sisters Telegraphic* documents the work experiences of women telegraph operators, mainly in the second half of the nineteenth century. The book describes the working conditions women encountered in telegraph offices and the ways in which they were represented in popular culture. While he devotes most of his attention to events in the United States, the author also provides useful comparative data on women telegraphers in Canada, Europe, and South America.

Jepsen vividly depicts daily life in the telegraph industry, drawing on trade journals, diaries, newspapers, corporate records, and popular literature. There are chapters on the tasks and routines of the telegraph office, the social background of female operators, and representations of women telegraphers in fiction and cinema. Working conditions could be grueling and dangerous; women who operated the telegraph in railroad depots, for example, had to hand instructions up to the train crew as the trains went speeding by. Jepsen considers “women’s issues,” especially the question of equal pay, as well as women’s participation in the labor movement. The chapter on popular culture discusses films, novels, and stories (including one by Henry James) that were based on the adventures and romantic entanglements of telegraph women.

Telegraph work demanded considerable technical skill, since the operator had to master Morse code, transmit messages at high speed, and often maintain the telegraph equipment in working condition. Women with these skills were able to achieve independence in many ways: high wages gave them (relative) financial independence, the distribution of telegraph offices throughout the country offered geographic mobility, and operators had a long-distance communications medium at their disposal. Women who worked in small towns or railway stations usually ran the office by themselves, while women in large urban offices had the freedom of the city in addition to the possibility of promotion. Women thus benefited greatly from their association with this new technology, a point Jepsen underscores by comparing telegraph operators with modern computer programmers, who have also been able to translate technical competence into rewarding employment. At the same time, women faced discrimination from employers and unions, and their skilled status was undermined by the introduction around 1915 of the Teletype machine, which replaced Morse code with typewritten input and output.

Jepsen argues that telegraph operators embodied a “modern” outlook because of their independence and embrace of new technology. “It is [their] ability to step in and out of the social bounds of their time that makes them seem so contemporary to us” (p. 116). This point is not entirely convincing: the women may seem to us to have had a “modern” lifestyle, but the book offers little evidence that *they* saw themselves as being outside the mainstream. Indeed, Jepsen notes that most female operators stayed in the business for only a few years before leaving to get married (p. 60).

This book will be most useful to scholars interested in the intersection of technology and labor history. There is relatively little technical detail; instead, the author focuses on the social role that science and technology play as symbols of modernity and sources of economic power. Jepsen makes excellent use of his sources to provide a wealth of detail about the work practices of operators, much of it in the words of the women themselves. *My Sisters Telegraphic* offers a highly readable social history of women’s participation in what was once a high-tech industry.

JANET ABBATE

Daniel R. Headrick. *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700–1850.* x + 246 pp., figs., bibl., index. Oxford/New York: Oxford University Press, 2000. \$29.95.

The agenda informing this compact book has the transparency of crystal. Against the widely repeated claim that the so-called Information Age began with the invention of the transistor in 1947, a claim trumpeted both by the knowledgeable (Michael Riordan and Lillian Hoddeson) and the ignorant (Bill Gates), Daniel Headrick seeks a more distant source for the information-saturated environment in which we now live. He sensibly points out that human demand for information is as old as humanity itself, and consequently we should not look to name any single moment as the “dawn” of the Information Age. Instead we should be attentive to historical periods during which the availability of information accelerates sharply. Often such moments are associated with particular technical innovations, such as the appearance of double-entry book-keeping, printing, the telegraph, and, yes, the computer. But Headrick wants to direct attention away from particular machines and technologies as accelerators of information and toward the eighteenth and early nineteenth centuries as a period during which a host of novel information systems were introduced.

On this basis the book discusses a series of developments in information systems under five headings. The first, “Organizing Information,” describes how Linnaeus and Lavoisier and Guyton de Morveau created new languages to process and communicate scientific information. The creation of the metric system finds a niche in this chapter as well. Headrick’s second heading, “Transforming Information,” discusses the attempt by governments to collect statistics about populations, culminating in the specification of a decennial census in the American Con-

stitution and the repeated attempts by French revolutionary regimes to conduct a census during the 1790s. The third heading, "Displaying Information," turns to innovations in mapmaking during the eighteenth century and the invention of graphical representation. Under the fourth heading, "Storing Information," Headrick describes eighteenth-century encyclopedias and dictionaries, an overview that thankfully ranges considerably more widely than Diderot's *Encyclopédie*. Finally, the heading "Communicating Information" discusses the development of postal systems in various European countries and North America, as well as the invention of telegraphy. Of particular interest here is the extensive network of visual telegraphs established in France during the 1790s and then elsewhere in Europe.

This breadth of coverage is impressive and suggests the comprehensiveness and significance of Headrick's story, but it also betrays certain weaknesses. First, the treatment of topics is highly uneven. The discussion of encyclopedias and dictionaries, for example, is deep and well informed by the primary sources. The treatment of Linnaeus's taxonomy, Lavoisier's chemical nomenclature, and the metric system is far more superficial, as is the analysis of postal systems. Second, this same breadth causes one to wonder just what the phenomenon is that Headrick means to describe. Such concerns are certainly not diminished by the wholly unsatisfactory definition provided for the book's central concept, information. As the book defines it, information is "the patterns of energy and matter that humans understand" (p. 4). That somewhat underdetermines the object, I should say.

Disappointing too was the book's failure to engage very deeply with an explanation of why these changes occurred. Leaving aside the question of whether all of the changes described really constitute changes in information systems (whatever those might be), and also the question of whether all of these eighteenth-century novelties could not be traced farther back in time, as several surely could, we can still ask what brought such developments together. A book of such synthetic reach ought to be ideal for such ruminations. As one might expect, Headrick does attribute the rising demand for information to the attempt by enlightened absolutist governments and later revolutionary regimes to develop policies to stimulate economic growth, along with the needs of actors in an increasingly complex and robust economic system. But all too often the book simply asserts that because this was the Age of Reason, the innovations occurred

because they were inherently more rational. Linnaeus's nomenclature appealed to the "orderly minds of mid-eighteenth-century rationalists" (p. 25), while the physician William Farr's statistical compilation of disease data for the English General Register Office gave "a more scientific basis to the classification of diseases" (p. 88), and so on.

THOMAS BROMAN

Randall A. Dodgen. *Controlling the Dragon: Confucian Engineers and the Yellow River in Late Imperial China*. x + 245 pp., illus., apps., bibl., index. Honolulu: University of Hawaii Press, 2001. \$29.95 (paper).

Because of its extremely heavy silt load and variable regime, control of the Yellow River's course over the alluvial, densely populated North China Plain has been an intractable problem for many centuries. In the thirteenth century the Mongol dynasty used part of the river's downstream section to create a transport route, "the Grand Canal," from the Yangtze River to the capital of Beijing. The main solution to Yellow River floods used to be diversion into flood channels of smaller rivers, but from the sixteenth century onward the Yellow River was confined to a single channel. The steady rise of its river bed created problems of drainage and dike maintenance. Its dual function as a floodway and a canal became increasingly difficult and costly to maintain, and the system became more and more complex and elaborate: some 800 kilometers of dikes, spillways, floodgates, and locks. Because of the Grand Canal's vital function in supplying the capital and garrisons in the north with tax rice and commercial rice from the south, the Ming and Qing dynasties were prepared to allocate great sums of money to keep the system going. It finally broke down in the 1850s.

In a 1991 article in *Late Imperial China*, Randall Dodgen concluded that the eventual breakdown of the system was an inevitable consequence of its ever-increasing complexity and not due to dynastic decline and bureaucratic failure, as most historians would have it. In *Controlling the Dragon* he has modified this position. Although in the 1820s and 1830s few disruptions occurred, the government suffered from a serious fiscal crisis. Local communities became less able and willing to pay. The Daoguang Emperor showed distrust of skilled engineering officials and finally made some bad appointments. The Board of Works did not support the river officials, and tensions between national and local officials intensified. Thus, "fiscal, bu-

reaucratic and technological problems weakened the state's commitment to Yellow River control." The main focus of this charming and thoroughly researched book is on the role of the "Confucian engineer" in the early nineteenth century. By that seemingly contradictory term, Dodgen refers to high officials of the provincial Yellow River Conservancy, "hybrid literati-technologists with no formal training in engineering." He discusses their organizational, administrative, and financial concerns at length, because these were their main tasks and historical sources concentrate on them. Much less attention is paid to the purely technical and hydraulic aspects of their work. In the absence of proper sources, the question of these officials' relationship with and reliance on technical staff (whether their own or attached to local officials) remains largely unanswered. Dodgen discusses one of the "statecraft school" officials of the early nineteenth century, the well-known compiler of the textbook for officials *An Illustrated Guide to River Engineering Tools* Lin Qing, but without going into his qualities as an author or engineer. Lin Qing advocated more hydrological training for officials in general, so that they could become better judges of and more directly involved in the planning and implementation of repair projects.

The story of the introduction of brick as a building material in dike repairs (replacing stalks and stone) by the high provincial river official Li Yumei in 1835 gives a good insight into the difficulties of innovation. When Li pushed for universal adoption of this new material and the Court agreed to the establishment of state-operated brick kilns, the vested interests of suppliers of traditional materials were threatened. Other officials stressed the technical, social, and economic risks of a change from proven practices, and after due investigation Li's proposal was killed, though brick remained on the list of allowed materials. The larger question of the relative utility of bricks vis-à-vis other repair materials was neither tested nor resolved; their use remained at the discretion of local authorities.

Two concrete examples are used to illustrate the concerns and actions of national and local river officials. The 1841 flood and siege of the city of Kaifeng is a story of relief efforts and the organizational and technical difficulties of repairs. The Zhongmou debacle depicts how delays, ineffectiveness, and cost cutting led to new dike breaks and much higher repair costs than initially foreseen. Dodgen concludes that the Daoguang Emperor's record of concern for the Yellow River administration is mixed. His con-

stant admonitions to keep costs down reduced the level of preparedness against floods. The imperial state was committed to a minimal bureaucracy of generalists, and technical specialists did not command much influence. Overseeing hydraulic construction work might bring one temporary glory and great financial reward (because of handling very large budgets; without much evidence, Dodgen states that corruption was not a significant factor in this field) but equally great risks of punishment if dike breaks occurred or projects failed.

This book could have profited from more maps and drawings. It shows little concern for quantitative aspects of river control—for instance, the costs of materials and labor. Technical and practical aspects—such as tools, techniques, the organization of manpower, and the transport of material—are discussed little if at all. In a sense, Dodgen has himself adopted the Confucian "generalist" approach to engineering. Although this limits the scope of *Controlling the Dragon*, it nevertheless remains a highly interesting and readable account of the administrative concerns of late Qing river officials. Moreover, Dodgen's cogent analysis enriches our understanding of the limitations of the traditional Chinese bureaucracy and its eventual inability to maintain the Yellow River transport system.

EDUARD B. VERMEER

Emily Abel. *Hearts of Wisdom: American Women Caring for Kin, 1840–1940.* x + 326 pp., index. Cambridge, Mass./London: Harvard University Press, 2000.

It is virtually a cliché that care-giving was (is) one of woman's primary duties. However, we often have little appreciation of the actual experience. Emily Abel induces a visceral understanding of this critical role, starting from the first chapter of *Hearts of Wisdom*, with the life of Emily Hawley Gillespie, a farmwoman in the Midwest in the nineteenth century. Gillespie assisted neighbors and friends during childbirth and sickness. She was herself recipient of such help when ill and for the birth of her children. Moreover, despite tense relationships with her father and her sister, Gillespie cared for them when the need arose. There was tension between her and her daughter, Sarah. Despite the fact that Sarah had a teaching position in another community, she returned to her mother's house in times of medical crises. As Emily's health failed, Sarah resigned in order to nurse her mother. This story documents how care-giving dominated many women's lives. Emily, Sarah, and other

women of the nineteenth century considered care-giving a labor of love and, at the same, took pride in their accomplishments.

Slowly, though, from the turn of the century onward, physicians increasingly sought to assert their growing professional status. They chafed at lay care-givers who sometimes undercut and even contradicted medical advice. The balance of power between care-giving mothers and physicians shifted in the twentieth century for several reasons, not solely because of enhanced medical authority built on new medical knowledge in areas such as bacteriology and new medical practice, especially surgery. Changes in domestic technology, developments in transportation and communications, and the spread of hospitals, for example, all combined to affect women's family care-giving. In another extensive and telling vignette, Abel traces more than thirty years of Martha Shaw Farnsworth's life, dramatically illustrating how care-giving and medicine changed between 1890 and 1924. True, as medical care moved from the home into the hospital, women spent less time in direct care. However, they did not relinquish their control over medical situations, instead insisting on participating in medical decision-making for themselves and for others. In effect, their care-giving role was redefined from one of personal care to one of mediator between the patient and the health-care provider.

The bulk of this study centers on the lives of literate white women coping with physical illness. Recognizing this limitation, Abel investigates the lives of other women in other situations that involve care-giving. One particularly fascinating chapter highlights immigrant women caring for family members diagnosed in the early twentieth century with tuberculosis. They often clashed with medical and charity workers. In another chapter, Abel shows the influence of the Depression, using letters written to Eleanor and Franklin D. Roosevelt by poor mothers negotiating health care for their families. Two other chapters cogently discuss the mothers of children labeled feeble-minded and epileptic and the mothers of deaf children.

Emily Abel's *Hearts of Wisdom* is a carefully crafted study interweaving the history of American women and the history of medicine. The richness of the sources she uses—the diaries and the letters especially—adds a sense of immediacy and power to her analysis. Attuned to racial and ethnic differences as well as regional and socioeconomic distinctions, *Hearts of Wisdom* demonstrates that female care-giving was both a reflection of contemporary medical develop-

ments and independent of them. Women caring for their families found (and still find) themselves balancing confidence in their own empathic knowledge with the authoritative knowledge of health-care professionals. By focusing on the role of female care-giver, Abel has drawn an insightful and evocative picture of women's changing roles during a period of dramatic transformations in medical care and the medical profession.

RIMA D. APPLE

Peter Lewis Allen. *The Wages of Sin: Sex and Disease, Past and Present*. xxiii + 202 pp., figs., table, bibl., index. Chicago: University of Chicago Press, 2000. \$25.

In six chapters of uneven length, Peter Lewis Allen, a former literature professor and public policy activist, offers a highly readable romp through two millennia of beliefs and attitudes regarding sin, sex, and disease. In particular, Allen draws on religious, medical, and popular literature from different eras in order to exemplify how particular "diseases"—lovesickness, leprosy, syphilis, bubonic plague, and masturbation—were causally connected with thoughts of punishment for sinful behavior. He then extends this theme into a lengthy chapter describing how the same belief contributed to the chasm between conservative and activist perspectives on AIDS in the United States over the past two decades.

Allen, who is admittedly not a historian, picks and chooses a "series of portraits of disease," offering little contextualization as he creates a "tableau" of perspectives drawn from European and American discourse throughout Christianity. He flavors his chronological narrative with personal experiences drawn from his work in gay health groups. The most significant personal experiences he intersperses stem from thoughts about his one-time lover, now dead from complications associated with AIDS. He interjects key episodes from this relationship into the book to affirm that "in its fight about how to respond to AIDS," American society has reenacted a "drama that had been written centuries before" (p. xv).

Allen's engaging writing stands much more firmly as chronologically arranged comparative literature than as historical scholarship. His greatest historiographical faux pas lies in his anachronistic writing about disease. For example, he introduces his chapter on medieval leprosy with a description of the pathological destruction caused by the leprosy bacterium. Then, in selecting situations drawn from Herodotus

through the sixteenth-century “contagionist” Girolamo Fracastoro, he erroneously assumes that “leprosy” implied a singular, consistent disorder throughout this long period. Similar concerns arise regarding his coverage of syphilis. Such errors may have originated from his drawing too exclusively from pre-1990 historical writings. Works like Charles E. Rosenberg and Janet Golden’s *Framing Disease: Studies in Cultural History* (Rutgers, 1992) and Linda Merian’s edited volume *The Secret Malady: Venereal Disease in Eighteenth-Century Britain and France* (Kentucky, 1996), and the voluminous literature on the history of the body, would have provided contextual concepts within which to place more concrete views about the intersections between diseases and culture. The author’s desire to flash forward from particular historical periods to AIDS in our society too often leads to weakly substantiated connections between time periods.

Allen’s strengths lie in his ability to draw on works of literature, especially popular literature. His particular emphasis on French works reflects his own background in medieval French literature. His arguments are also strong when comparing church and society in the medieval period. For example, his chapter on lovesickness clearly delineates the persistent position of the Church Fathers (and Hildegard, too) against medics who regularly prescribed a “coital cure” for the disorder, without specifying what partners to select, instead of welcoming disease as a divine corrective.

Allen’s writing on plague, the shortest chapter of the book, clearly depicts the once-common view that this epidemic disaster was inflicted by God as a punishment for mankind’s sinful nature. However, the omission of any discussion of sex in a chapter of a work subtitled “Sex and Disease, Past and Present,” is somewhat puzzling. Even more conspicuous is the author’s failure to expand upon the 1530 poem regarding the plight of the impious shepherd, Syphilis, from whom the disease in question received its name. Why would a literary scholar prone to draw on popular writings not give more than a single-sentence mention to this historically relevant poem?

Of the works Allen has drawn upon, he offers a pleasant mix of primary and secondary accounts that, like all good literary criticism, gives original sources a clear voice. Any work so selectively focused on a few diseases will leave some readers wondering about others that might have been perceived in terms of sex and sin. Were such associations discussed in regard to madness in the eighteenth century, tuberculosis

in the nineteenth century, or the wide range of twentieth-century STDs prior to AIDS? Why was no mention made of leprosy in the twentieth-century context? Its AIDS-like stigma has been historically contextualized in several works, including Stephanie J. Castillo’s award-winning 1992 documentary *Simple Courage*. Similarly, one wonders why the author chose not to draw on standard medical history accounts on AIDS, including Elizabeth Fee and Daniel M. Fox’s edited volume *AIDS: The Burden of History* (California, 1988) and, perhaps more important for the Francophile Allen, Mirko D. Grmek’s *Histoire du SIDA: Début et origine d’une pandémie actuelle* (Payot, 1989).

Apart from my historiographical criticisms, *The Wages of Sin* is a most delightful popular rendering of key relations between disease and Christianity. Works like this are extremely useful in reminding the reading public in an articulate, informative, and entertaining manner that they are part of humanity’s continuum that has long sought connections between physical health and moral living. Indeed, Allen’s apt description of the underlying usefulness of history underscores the importance of his own writing: “We value history because, whatever its distortions and inaccuracies, it is a way of understanding and giving value to our collective human experience and collective human memory” (p. 158).

PHILIP K. WILSON

R. Ian McCallum. *Antimony in Medical History: An Account of the Medical Uses of Antimony and Its Compounds Since Early Times to the Present.* xviii + 125 pp., illus., figs., apps., bibl., index. Edinburgh/Cambridge: Pentland Press, 1999. £15.

Alchemists and medical practitioners were drawn to antimony for roughly the same reason—its ability to expel impurities from metals or human bodies. Long before the sixteenth century, when Agricola described the process, metallurgists employed compounds of the brittle, flaky metal to separate silver and impurities from gold. Alchemical allegory depicted antimony as a gray wolf that devoured the king that he might be resurrected, rising—purified—from the flames of the wolf’s funeral pyre. This nearly supernatural ability to remove impurities made antimony crucial for alchemists. Medical theorists inferred a similar purifying power from the dramatic physiological effects of antimonial compounds, making antimony a staple in the pharmacopoeia for centuries.

No mere emetic—antimony opens the sluices

at both ends—antimony seemed to its staunchest supporters a near-panacea. Sixteenth-century instructions for brewing an antimonial elixir promised that it “cures the plague, cancers, dullness of wit . . . breaks the force of every poison; if one drinks it once a week, it cures epilepsy” (pp. 65–66). By the eighteenth century, R. Ian McCallum finds, “there were more compounds of antimony than any other modern element in the medical chemists’ repertoire” (p. 15). In 1750 the British physician John Huxham praised the flexibility of antimony in wine, claiming that “the dose can be varied so that, in the treatment of pleurisies, you may puke, you may purge, and you may sweat with it” (p. 74). In the twentieth century antimonials have been employed in experimental HIV/AIDS treatments and continue to be used in tropical medicine, notably in the treatment of leishmaniasis.

McCallum has produced a perplexing though interesting little book. Some books are brief because their authors have very little to say, others because they present essays that are simply too long to be mere journal articles but too focused and succinct to fill a full-length monograph. McCallum’s slim volume—at under 90 pages of text—is neither. He has plenty to say: the book is brimming with erudition, jammed with information about what has been written about medicinal antimony since the early modern period. Some will no doubt welcome the table and appendix in the back of the book listing known antimony preparations and the various antimony-bearing ores around the world.

On the other hand, the book has no clear organizing principle, no central thesis. Late in the book, McCallum wonders at the “semi-religious obsession” physicians have demonstrated regarding antimony and judges this obsession worthy of “further enquiry” (p. 97). Indeed, this would have been a good starting point from which to build a very valuable book. Instead, McCallum leads his readers on what is essentially a guided tour of the interesting facts and citations he has collected. This style is most notable in his chapter on antimony cups, which at points reads like an auction catalogue. Many passages rise above this sort of historian-as-docent narrative, notably his discussion of the seventeenth-century “antimony war” between conservative Galenists of Paris and their “forward looking” rivals at Montpellier, who advocated better iatrochemistry through antimony (pp. 18–20). By and large, however, the book provides little in the way of historical context or analysis.

Although McCallum discusses antimony from

antiquity to the present, he devotes little attention to the fate of antimony in the “therapeutic revolutions” of the nineteenth and twentieth centuries, when medicine’s “semi-religious obsession” with depletives of all sorts was thrown into high relief. It is also regrettable that McCallum, who has had a long career as a specialist in occupational medicine, gives so little attention to the occupational hazards of work with antimony. These, of course, are complaints about what is missing from the book. What is there makes for a very readable introduction to an important subject.

CHRISTIAN WARREN

W. Michael Byrd; Linda A. Clayton. *An American Health Dilemma: A Medical History of African Americans and the Problem of Race: Beginnings to 1900.* Foreword by **Robert J. Blendon.** xxviii + 588 pp., illus., tables, bibl., index. New York/London: Routledge, 2000. \$35.

This work is the first volume of a projected two-volume examination of the black experience with the practices and institutions of Western medicine from its earliest beginnings to the end of the twentieth century. As a reference source, W. Michael Byrd and Linda Clayton’s history is certainly valuable: its thirty-page bibliography and nearly one hundred pages of notes offer a rich field of information for anyone who wants to know the “what” and “how” of the intersection of black history and Western medicine.

Still, after having read the book, I have more questions—about the work itself: its purpose, its intended audience, and the apparent lack of editing (the narrative is very repetitious, the authors often saying the same thing in several different ways). Further, in a quest for completeness Byrd and Clayton tend to introduce material that, for me, slows their story more than it advances what I believe is their central argument: that difference has a way of becoming deviance, which then produces long-term consequences for those not a party to the original decision; that it becomes institutional racism.

In their preface Byrd and Clayton explain how the book came to be; in the introduction they describe what it is intended to accomplish. Their principal objective, they say, was “to perform a history-based descriptive and structured analysis of the U.S. health system from an African American perspective,” a point they will repeat elsewhere in a slightly different guise. Such an analysis is necessary, they argue, because although the American public has become more aware of

the national crisis in health care and of the need for major reform of the health system, too many commentators appear to have overlooked the “older, more ominous, culturally driven health crisis afflicting African American and other poor populations” (p. xxiv). To some extent this crisis “can be explained on the basis of a medical-social culture hundreds of years old that is heavily laden and burdened by race and class problems compounding continued social and economic deprivation.” This contention is followed by a list of assumptions, beginning with “Poor health status and outcomes for Blacks and the poor are ‘normal’ and acceptable” and ending with “Racially and ethnically divided health professions have factions that are often contentious, conflicting, and contemptuous of each other.”

In the introduction, too, Byrd and Clayton describe both the topics the book will cover and the many sources they consulted (some “new to the health care literature,” some “compiled, analyzed, and reinterpreted in an unprecedented manner”) to substantiate their historical and structured analysis. The materials included and the need for close editing of the entire text leave one wondering who will read this book and what they might derive from it. Still, it is a thorough effort from start to finish.

The book first undertakes “a history-based examination and evaluation of the U.S. health delivery system from an African American perspective.” Second, it reassesses “the relationship between the medical profession and issues of race and racism in Western culture and the United States.” Third, it evaluates the impact of race and racism as key variables that must be factored into the complex equation necessary to resolve the “American health dilemma.” Fourth, the book offers “a series of explanatory hypotheses that clarify and help explain the results of the ongoing relationships between race, the biomedical and other life sciences, health, and healthcare delivery in the United States from their ancient Afro-European beginnings” to 1900. (A forthcoming second volume is intended to cover the period from 1900 to the present day.) The remainder of the book is divided into three sections: background, “Race, Medicine, and Health in the North American Colonies and the Early U.S. Republic,” and “Race, Medicine, and Health in the United States from 1812 to 1900.”

The background section provides a reassessment of the relationship between race, biology, and health in the United States and establishes the groundwork for the remainder of the book—though the information on the evolution of race, science, and medicine in Western culture is per-

haps more than the average reader can comfortably digest and assimilate. Part 2 and a portion of Part 3 track the health-care experiences of Blacks under slavery and their importance in the evolution of a dual health system that will become more rigid with time. The balance of Part 3 reviews black health care and the evolution of health policy and practice alongside the maturation of the medical profession after the collapse of the peculiar institution to the end of the nineteenth century.

Although health care for black people did improve after the Civil War and Reconstruction, African Americans and the poor in general still experience a kind of differential access that has been exacerbated by the fee-for-service system—that the system is not equal and is still bedeviled by prejudicial attitudes and discriminatory behavior left over from days gone by is a given. The question that remains is, How do we improve it? Clearly this book, despite its flaws, is a step in the right direction. By providing a historical overview of how things evolved to be the way they are, the authors also provide insight into how to correct existing conditions.

BILL KING

Randal L. Hall. *William Louis Poteat: A Leader of the Progressive-Era South.* x + 262 pp., illus., bibl., index. Lexington: University Press of Kentucky, 2000. \$34.95.

William Louis Poteat (1856–1938), a North Carolina intellectual of the Progressive Era, gained a reputation as a leading liberal in southern higher education. This book, which was recognized by a prestigious National Endowment for the Humanities publication grant, is useful for historians of science because it illustrates how scientific ideas, particularly Darwinism, were diffused into a rural and isolated society.

From his student years to the end of his life, Poteat was intimately connected with a Southern Baptist college, Wake Forest. He matriculated at Wake Forest and became a tutor there in 1878. Although almost entirely self-taught in the sciences, he became a popular and respected professor of biology. As his knowledge of science came from reading contemporary papers and monographs rather than from traditional study, he developed a perspective more modern than that of most of his peers. He rose through the ranks, ultimately becoming president of Wake Forest in 1905.

Relatively early in his career, Poteat began the work that earned him a place in southern history by writing articles and giving lectures on the

ways in which science and religion were related. By the end of his first decade as a faculty member, he had become convinced of the importance of Darwin's theory of evolution and had decided that it posed no threat to traditional Christianity. In supporting this view, Poteat followed the lead of mainstream European and Northern American churches, which had no problem reconciling evolution with the Book of Genesis and its description of creation occurring in seven days. After all, who knew what a day meant in the mind of God? Many Southern Protestants, however, rejected this position.

Randal Hall sees Poteat as an advocate of a liberal social philosophy fully in accord with the social gospel of the Progressive age. As a leading proponent for change in his state, Poteat "personified North Carolina Progressivism" (p. 60), and his defense of Darwin was of a piece with his philosophy. But it is unclear whether Poteat's admiration for Darwin stemmed from an understanding of science or an obsession with eugenics, an obsession that in time came to dominate his thinking.

Poteat vigorously used his position as president of the Southern Baptist Education Association to promote theories of eugenics. Although Darwin did not actively promote racism, followers of his thought such as Poteat could easily educe racist ideas from it. They could argue, for example, that individuals should speed up the process of producing superior humans by helping nature along through the process of selective breeding. Concerned with the large number of Americans who were institutionalized, and the even greater number who were barely educated, Poteat maintained that the government should control the right to reproduce and sterilize the unfit, including the "self-centered, the coarse-fibered, and the discourteous" (p. 186). He thought that civilization would crumble unless such procedures were put in place, because there would be an "overproduction of under-men" (p. 101). Indeed, following this same line of thought, he opposed war because it foolishly wasted "our best blood" (p. 185). He called for federal legislation to govern marriage and divorce, requiring applicants to meet his moral requirements and to pass a rigorous medical examination. Even in conservative North Carolina, these ideas provoked astonishment. A leading Raleigh newspaper accused Poteat of wanting to be the "boss of a human stock farm" (p. 186).

Although Randal Hall's book is primarily a biography of William Louis Poteat—and secondarily a history of Wake Forest as it evolved from a tiny Baptist school into a major college—

it is also a study of the split personalities of Southern Progressives. On the one hand, they rejected rule by educated leaders; on the other, they wanted government to control the most intimate aspects of life, such as reproduction. Poteat thought that all these things should be overseen by a "genteel Christian community led by a liberal elite" (p. 167). The complexity and cognitive dissonance of Southern Progressives are well illustrated in this book.

RUTH J. HAUG

Richard F. Wetzell. *Inventing the Criminal: A History of German Criminology, 1880–1945.* (Studies in Legal History.) xvi + 348 pp., bibl., index. Chapel Hill/London: University of North Carolina Press, 2000. \$39.95.

Some two decades ago Robert Nye began investigating the emergence of criminology as a discipline. At first he wanted to write a book about it, but he eventually thought better of the idea. "It was soon evident to me, as it has been to everyone else who has looked through the older criminological literature," he explained, "that crime was seldom treated as an isolated phenomenon, even by those who were most eager to establish scientific criminology as an isolated discipline" (*Crime, Madness, and Politics in Modern France* [Princeton: Princeton University Press, 1984], p. xi). Undaunted by Nye's words of warning, Richard Wetzell has produced a sweeping history of German criminology, one that approaches "the history of crime and criminal justice from the perspective of intellectual history and the history of science, rather than social, legal-institutional, or political history" (p. 2). Wetzell, that is, attempts largely to isolate the discourse of German criminology from its social, institutional, and political contexts. Readers of *Isis* may consider this an odd conception of this discipline. Moreover, those seeking insight into the questions and debates that preoccupy most historians of science these days will search in vain, because *Inventing the Criminal* generally treats "science" itself as a given, as self-evident, as *explanans* rather than *explanandum*.

That said, *Inventing the Criminal* represents an undeniable contribution to the history of criminology. Wetzell has marshaled an impressive array of primary source material in order to tell his story, which stretches from the 1880s through the Nazi regime. His approach, which combines close readings of journal articles and books with doses of archival material, tends to center on prominent individuals. Anyone looking for a careful analysis of criminological dis-

course, of individual thinkers and their writings, will find it here.

Wetzell has picked through an astounding array of seemingly disparate source material and shaped it into the coherent history of a “recognized scientific field” (p. 28). That history begins during the last quarter of the nineteenth century, with the German reception of Cesare Lombroso’s theory of the “born criminal.” During this “early” period (that is, before WWI), Wetzell shows how German research on crime was dominated by psychiatrists, who favored a criminal-biological approach. Wetzell, who finds a trend of increasing methodological sophistication in criminal-biological research between 1918 and 1945, argues that German jurists and psychiatrists, confronted with an increasingly sophisticated and complex scientific field, were forced to check some of their more extreme impulses. He is at pains to show that “normal” criminological science persisted even under the Nazi regime and that crude racist explanations of crime “did not predominate in mainstream criminal biology and criminology” (p. 230). The claim that the sophistication of criminological research actually prompted serious objections to sterilization in Nazi Germany may be Wetzell’s single most interesting point.

Of course it is precisely here, at the most compelling moments of the book, at the moments where politics and science fuse, that the limitations of Wetzell’s stated approach become most evident. Historians of criminology simply cannot, and should not try to, separate out the “scientific” from the “social, legal-institutional, or political.” It is a mission impossible.

ANDRE WAKEFIELD

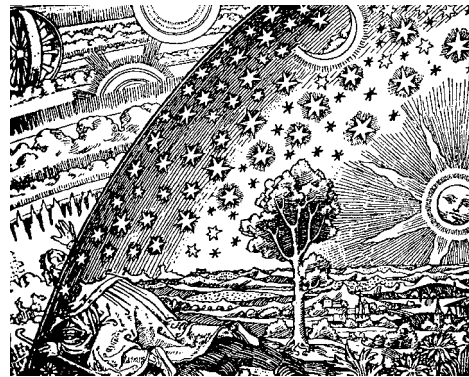
Roger Hennessey. *Worlds without End: The Historic Search for Extraterrestrial Life.* 160 pp., illus., bibl., index. Stroud, England: Tempus Publishing Ltd., 1999. \$29.99, £18.99.

As Roger Hennessey reminds us, “One of the most famous openings in English literature informs readers that ‘in the last years of the nineteenth century . . . human affairs were being watched keenly and closely by intelligences greater than man’s yet as mortal as his own’” (p. 90). So began H. G. Wells’s famous *War of the Worlds* (1897), in which Martians invade the Earth.

The general public seems scarcely aware that discussions of extraterrestrial intelligent beings began to appear centuries before 1897, not just in fiction but also in serious writings by leading scientists, philosophers, and religious authors.

Well before 1970 such scholars as Pierre Duhem, Arthur Lovejoy, and Marjorie Hope Nicolson had shown that mainline intellectuals for centuries have been writing about extraterrestrials. Between 1982 and 1996, three scholars published detailed and fully referenced books documenting in detail the history of ideas of extraterrestrial life from antiquity to the late twentieth century (Steven Dick, *Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant* [Cambridge, England: Cambridge Univ. Press, 1982]; Michael J. Crowe, *The Extraterrestrial Life Debate, 1750–1900: The Idea of a Plurality of Worlds from Kant to Lowell* [Cambridge, England: Cambridge Univ. Press, 1986]; Karl S. Guthke *The Last Frontier: Imagining Other Worlds from the Copernican Revolution to Modern Science Fiction* [Ithaca, N.Y.: Cornell Univ. Press, 1990]; Steven Dick, *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* [Cambridge, England: Cambridge Univ. Press, 1996]). In the last few years at least a half-dozen authors have sought to repackage this exciting message for the literate public. The most successful of these popularizations is *Worlds without End: The Historic Search for Extraterrestrial Life*, the most recent book by Roger Hennessey, a retired British schoolteacher and administrator with strong interests in the history of science and technology.

The strengths of Hennessey’s volume are numerous. He has read and understood both the most authoritative scholarly work in this area and also a significant portion of the vast primary literature. He has surveyed in an engaging, ju-



The “traditional” view of the medieval cosmos—perhaps invented in the nineteenth century? (from Hennessey, *Worlds without End*, p. 22).

icious, and balanced manner materials from antiquity to the present and embellished his narrative with seventy-two well-chosen illustrations. He has avoided sensationalism even when writing about sensational controversies and eschewed partisanship even while describing individuals who in many cases were nothing if not passionate in their convictions. He has shown sensitivity to the complexities and to the range of issues that arose in the history of this long and continuing debate, which, although focused on distant locales and on possibly nonexistent beings, is capable of revealing much about the nature of terrestrials. He has traced through more than twenty centuries a debate that involved not just scientific but also key religious and philosophical issues, presenting the debate in its full cultural richness. The level of informational accuracy in his book is high (despite misdating the so-called Great Moon Hoax to 1836 rather than 1835). Although his references are significantly fewer in number and less specific than many scholars might prefer, they are at least adequate to assure specialists that he is not presenting as his own the hard-won research results of others. The overall format of the book is appealing, its bibliography adequate, its index better than one expects in popularizations.

Historians of science wishing to enhance a survey course in the history of science with an attractive text that will reveal to students a history filled with striking controversies and colorful figures as well as little-known facets of the thought of many scientists of distinction may wish to consider using this book.

MICHAEL CROWE

■ Antiquity

Serafina Cuomo. *Pappus of Alexandria and the Mathematics of Late Antiquity.* (Cambridge Classical Studies.) x + 234 pp., figs., bibl., indexes. Cambridge: Cambridge University Press, 2000. \$59.95.

Greek mathematics is usually seen as having reached its height in a "golden age" around 300 B.C., after which it declined, reaching a rather sad stage in late antiquity. In this latter period Pappus of Alexandria (ca. A.D. 300) stands out as one of the last competent mathematicians, although even his *Mathematical Collection* has been valued by historians mainly for its wealth of information on earlier mathematical achievements. In her readable book, Serafina Cuomo sets out to correct the conventional view of mathematics in late antiquity: her general goal

is "to show that the mathematics of late antiquity deserves a place both in the history of science and in the history of antiquity" (p. 3). To that end she focuses on (parts of) Pappus's *Collection*, for which she attempts "to produce a historical analysis . . . and at the same time to explore its wider cultural contexts" (p. 3). Thus her text is not intended primarily as a discussion of the mathematics contained in the *Collection*; instead Cuomo looks into the historical circumstances in which Pappus produced this work and the image he wanted to convey both of mathematics and of himself.

The first chapter presents some general background on the public's perception of mathematics and its practitioners in late antiquity. Emphasizing evidence "apart from what we find in the books of the famous mathematicians" (p. 9), Cuomo looks at astrological treatises such as the *Mathesis* by Julius Firmicus Maternus and considers the social and fiscal status of various "technical" professions, such as those of land surveyor, architect, and public administrator. She uses Diocletian's edict on wages and salaries and examines the role of mathematics in education to show that, "far from being invisible or confined to ivory towers" (p. 56), mathematics was perceived as an integral part of life and regarded positively. All this material is very interesting, but how relevant is it? Cuomo's broadening of the perspective to include more than just the works of famous mathematicians is certainly commendable. But should one equate the mere skill of calculating with numbers, or even that of applying some "higher" mathematics, with theoretical, philosophical, mathematical thought? Of course, Cuomo is aware of this problem. Taking it to be irrelevant for her purpose, she makes a good point: claiming affiliation with mathematics to enhance one's status, as those professional practitioners would do, presupposes a positive image of mathematics among the public (p. 10). Nevertheless, such evidence would probably not have swayed previous historians' opinion of the decline of mathematics in late antiquity.

Chapters 2–4 are devoted to Book 5 of the *Collection*, which covers isoperimetric problems and Platonic solids; Book 8, on mechanics; Book 3, on cube duplication; and Book 4, on special curves and their classification. In Chapter 2 Cuomo argues that Pappus used the widely known problems discussed in Book 5 to address a general audience so as to promote mathematics and show that "mathematicians are better qualified than philosophers . . . to talk about isoperimetry and the five Platonic bodies" (p. 58). At the same time, pointing out the complementarity of

mathematics and mechanics (in Book 8), Pappus stresses the usefulness of mathematics in educational and material matters. In Chapter 4 Cuomo examines how Pappus, addressing experts, “marks out his territory within the mathematical field itself” (p. 127).

In the final chapter Cuomo tries “to get a clearer grasp of Pappus’ mathematical agenda” (p. 169). She concludes that Pappus is not just a compiler admiring the past; rather, he selected his subjects and manipulated the mathematical tradition to serve his own immediate goals in the present.

This book contains an abundance of interesting historical material, although, regrettably, the mathematical examples are only roughly sketched. Cuomo shows that we can learn much from looking at Pappus’s *Collection* in its own right. Her book deserves careful study.

ALI BEHBOUD

John F. Healy. *Pliny the Elder on Science and Technology*. xvi + 467 pp., bibl., indexes. New York/Oxford: Oxford University Press, 1999. \$110.

In the last twenty years or so there has been a renewed interest in Pliny the Elder, once an immensely popular author whose reputation began to suffer after Renaissance scholars challenged the accuracy of his work. The recent interest has been interdisciplinary, producing contributions from classical scholars, historians, scientists, and technologists, sometimes working as a team. What “interdisciplinary” has meant in practice is a collaboration rather than a blend of disciplines. What you see in Pliny is what your training makes obvious.

John Healy’s book is a robust defense, indeed promulgation, of the thesis that Pliny practiced “science.” This thesis implies not only that science was a recognizable, and recognized, activity in antiquity but that “science” can tell us more clearly than any other rubric what Pliny was up to. Science can certainly tell us about Pliny’s natural world, because it was very much like our own, but it does not tell us anything about Pliny’s enterprise. We may feel a sense of intellectual satisfaction in knowing the formula for the acetic acid in vinegar and the chemical equation that represents its attack on calcareous rocks, but Pliny’s story is about something else.

In this study Healy, a distinguished classical scholar, has taken aboard a lot of science. He provides us with valuable information about the suitability of the Latin language for the development of technical terms and about its borrow-

ings from Greek and other languages. After Healy the classicist considers Pliny as a writer and describes his life, sources, mode of work, language, and style, Healy the scientist addresses the topic of ancient science. Chapter 10 (a page and a half) lays down the program, taken from a modern (Canberra, 1993) classification of fields of research. Healy takes the ten subdivisions of the “natural sciences, technologies and engineering” as a structure for his investigation into Pliny and for the format of the book. He thus looks at Pliny’s thought in relation to chemistry, physics, earth sciences, engineering (including mines and metal), applied sciences, biology, and agriculture. A footnote tells us that he has omitted any reference to medicine, pharmacology, and astronomy—a pity, as these subjects, with their own identities and practitioners, come closer to science than most of what either Pliny or Healy discusses. In the style of a modern scientific textbook, Healy’s text is broken down into numerous subsections to accommodate modern categories. The chapters on minerals and gems are alphabetical lists.

The combination of classical learning and scientific knowledge looks formidable and is certainly unusual. But the book is more an exercise in applying science to classical studies than an example of science illuminating history. The confidence his scientific material gives Healy leads to a certain historical insensitivity. I declare an interest here, for he badly misreads what I have argued about “science” in antiquity. His rigid use of modern—*our*—categories inevitably leads to instances in which he finds Pliny confusing them or failing to separate them. Our categories take on a life of their own in this exposition: the section on “electricity,” for example, is largely independent of Pliny. Its subsection 12.2.1c is on piezoelectricity, of which “neither Pliny, nor other ancient authorities, appear to have been aware.” Gravity has to be there, because it is part of modern physics, but Pliny does not mention it.

There is no reason why classical scholars and scientists should not be interested in Pliny and find each other’s disciplines enlightening. But the claim that Pliny was, as Healy says, making “contributions” to our science is a historical one and relates to Pliny’s purposes. No amount of modern mathematical or chemical formulas will tell us what was in Pliny’s mind, and he was fairly clear, after all, on his purposes in writing the *Natural History*. It’s back to “Science in Antiquity?” again.

ROGER FRENCH

Malcolm Wilson. *Aristotle's Theory of the Unity of Science.* (Phoenix [Journal of the Classical Association of Canada], Suppl. 38.) x + 271 pp., fig., bibl., index. Toronto/Buffalo/London: University of Toronto Press, 2000. \$75, £55.

The title of this book is a bit misleading. Although Malcolm Wilson does argue that Aristotle's theory of science is more unified than is usually thought to be the case, he also examines Aristotle's actual practice of science, particularly biology but also physics, ethics, politics, and the science of being qua being. Hence the central problem of this book is how in practice as well as in theory science is unified in the Aristotelian corpus.

Wilson casts Aristotle's theory of science against the Platonic search for universal definitions, which leads to a suppression of differences or ambiguities both among things and their definitions. "Aristotle," Wilson observes, "sought to redress the imbalance apparent in the Academic prejudice towards the universal" (p. 7). He does so by restricting the demonstrative syllogism, which forms the core of any scientific argument in two ways: terms must be related through their definitions, and predicates must attach to a subject directly and universally (p. 8). Consequently, each science has a subject, what it is about, and "is the sum of the demonstrative syllogisms that concern the same subject" (p. 9).

But defining science in this way creates the problem that the sciences become too particularized, too isolated from one another. Here is Wilson's larger question: How can the project of science defined in the *Posterior Analytics* produce systematic knowledge in which the parts, themselves identified with the various sciences, are sufficiently integrated with one another to form a unified whole? Wilson claims that "abstraction" can serve as a "stepping-stone" to identifying three ways in which the sciences can be seen as forming a (sufficiently) unified whole (p. 10). In the process of abstraction, a more abstract science, usually a brand of mathematics, "supplied principles and explanations for a fact or conclusion found in a distinct and subordinate natural science" (p. 9). Understanding abstraction allows us to identify three forms of "semi-abstraction"—analogy, focality, and cumulation—that allow Aristotle to connect the arguments and subjects of different sciences (p. 10).

A brief analysis of abstraction (pp. 14–39) sets the stage for Wilson's larger project, a full treatment of analogy, particularly in the writings

on biology (pp. 53–115), focality, first in the biological works and then in the *Metaphysics* (pp. 116–174)—this portion of the analysis is followed by a brief consideration of, in the words of the section title, "Mixed Uses of Analogy and Focality" (pp. 175–206)—and finally cumulation, in a discussion that deals mainly with the sciences of psychology and ethics (pp. 207–235). The book concludes with two short commentaries, one entitled "The Place of Theology in the Science of Being" (pp. 235–239), the other "Conclusion: Analogy, Focality, and Cumulation" (pp. 239–242).

Wilson's treatment of the practice of science is sometimes surprisingly brief. The important problem of speed of change (*Physics* 8.4), for example, is analyzed in less than two pages (pp. 39–41). Further, Wilson, observing that the technique of establishing superordinate and subordinate science "and its place in the *APo* [have] been well studied by the secondary literature," states that he will not "treat it in the same depth as the three other techniques" (pp. 9–10). Given its foundational role in his analysis, this technique requires a full examination here. But there is a more serious problem: subordination among sciences also appears in the *Nicomachean Ethics* 1.1, a text Wilson never mentions. Here subordination rests not on mathematical abstraction but on ends among things in the real world. Thus Wilson does not provide a foundation strong enough to support his argument.

HELEN LANG

Dennis Des Chene. *Life's Form: Late Aristotelian Conceptions of the Soul.* viii + 220 pp., bibl., index. Ithaca, N.Y./London: Cornell University Press, 2000. \$45.

Life's Form is that rarest of books: an important contribution to advanced scholarship on its subject that is thoroughly accessible to nonspecialists. It immerses its readers in the world of the sixteenth- to seventeenth-century *scientia de anima*, within which, and out of which, emerges Descartes's decidedly non-Aristotelian conception of the body-soul relation that has haunted us ever since. We are treated to lengthy, elegant translations of the Latin texts of the leading Jesuit philosophers of the period, principally Toletus, Sudrez, Fonseca, Arriaga, and the Coimbrans, but always accompanied in footnotes by the full Latin text. These authors are portrayed as both intimately familiar with their source text, Aristotle's *De Anima*, but also highly sensitive to its key problems: Aristotle's insistence that the concept of soul is applicable to those beings that partake

only of the capacities of nutrition, and generation reproduction, i.e. plants; his equivocal pronouncements on the relationship between life and soul; the problems that emerge from his definition of soul as form and first actuality of a living body with organs; and his simultaneous insistence that the soul is a unity and has parts. All of the authors examined take these problems seriously and have sustained arguments about how to resolve them. When reading this volume one truly feels the importance of answering these problems for these thinkers and the power of the intellects that are grappling with them.

One of the most interesting features of Des Chene's narrative is his ability to put these "in house" disagreements within a wider context. René Descartes's reaction to these debates is shown persuasively to shape those decisive departures from orthodoxy that created a body/soul dualism that was inconceivable to these Aristotelians. There were, of course, serious problems in reconciling the text of Aristotle with Christian doctrine (cf. Chapter 2, "Propositions to Be Held by Faith") but even here the reconciliations are widely varying and often startlingly unorthodox. The volume is organized into four parts. The first, "Data for the Study of Souls," provides the reader with a background in both the Aristotelian texts and the chief concerns of the commentators to be discussed. The second, "Defining the Soul," traces the disputes around Aristotle's definition of the soul canvassed above. "Powers and Parts," the book's third part, sees these authors facing the problem of how one "counts" the soul's capacities and how, in the end, one prevents the soul from simply being a name for this set of capacities. This leads inevitably to the questions dealt with in Des Chene's final section, entitled "Unity." How does one preserve the unity of the soul in the face of the radical differences between its various capacities? This becomes especially pressing for a Jesuit commentator, who must allow for the potential immortality of the human soul within an Aristotelian framework that defines it as "substance qua form of a natural body." Without emphasizing it, there are constant reminders in every chapter that the debate in the philosophy of mind over the past century is decisively shaped by the argument between these Christian Aristotelians and their foes, especially Descartes.

JAMES G. LENNOX

Georges Declercq. *Anno Domini: The Origins of the Christian Era.* 206 pp., app., bibl. Turnhout, Belgium: Brepols Publishers, 2000. \$35, €20.

The use of the Christian (A.D.) or common (C.E.) era is today taken for granted, but recent "millennium" celebrations have focused attention on how we measure time. The starting point of the era was not established without difficulty. Georges Declercq has produced a timely exposition, starting with the scriptural evidence for the events on which the dating is based and continuing to the eleventh century when the Christian Era as propounded by Dionysius Exiguus was accepted throughout Western Europe.

The study is described as an "essay." The scope of the book has led to occasional generalization and simplification. Despite the claim on the cover, specialists may find some of the author's statements insufficiently substantiated, while for nonspecialists the text may be intimidatingly dense.

Interest in chronology as a way of emphasizing the historicity of Christ grew as expectation of his imminent return faded. It involved reconciling Christian chronology with Roman history and establishing the lunar and solar parameters for the Passion and Resurrection of Christ. The book is particularly useful in that it deals in detail with calendar developments in the Eastern Church. Here the traditional date of the Resurrection was 25 March, not 27 March, as in the West—something that had important repercussions in later calendar reform. Declercq gives a succinct explanation of the different reckonings.

Particularly important for historians of science is the adaptation of the world chronicle to computistical principles. Anianus ("Anianus" in Declercq) appears to have produced the first 532-year cycle. The Christian Era was known in the East in the fifth century. In the West the Dionysian tables were innovatory because their starting point was the Incarnation, not the Passion.

Declercq gives a useful summary of the paschal controversy, ground already well covered by earlier writers. He describes in detail the Christian Era that was the legacy of Dionysius to the Western Church and ultimately to the world. Declercq's thesis, preceded by a lengthy discussion of previous theories, is that the choice of 532 as the beginning of what became known as the Dionysian cycle was historical rather than computistical, adducing this from Felix of Gillinganus. Dionysius must have been familiar with the 532-year cycle of Victorius but did not understand the 28-year solar cycle. The Irish knew the principles of the cycle, but Bede constructed the first cycle on Dionysian lines.

Recent work has thrown doubt on the traditional dating of early Irish annals. A survey of

the dissemination of the Dionysian reckoning throughout the Christian West until its general acceptance in the eleventh century will be useful to those studying similar documents.

Establishing the date of the Incarnation was of less practical value than finding a workable calendar. Problems with the Dionysian calculation that were known from Bede's time provoked the first truly scientific writing of the Middle Ages. A full discussion of the Dionysian "error" is beyond the book's scope and, indeed, must await Faith Wallis's forthcoming edition of Gerland's treatise.

Some difficulties with this useful survey involve style rather than content and presumably are due to the publisher rather than the author. There is no index, and quotations are translated and not backed by the original text. It is difficult to refer back from the notes to the text, and the bibliography is not entirely alphabetical. The book appears to have been written originally in French, but there is no reference to a translator: the English is occasionally unidiomatic, but to the point of irritation rather than incomprehensibility.

JENNIFER MORETON

Wolfhart Westendorf. *Handbuch der altägyptischen Medizin.* (Handbook of Oriental Studies, Pt. 1: The Near and Middle East, 36.) xviii + 853 pp., apps., bibls., indexes. 2 volumes. Leiden/Boston/Cologne: Brill, 1999. \$188.

Of the many kinds of documents to have survived from ancient Egypt, only those concerning mathematical problems or medicine have usually been considered in studies of the history of science—probably because, unlike other Egyptian texts, they deal with their subject in relatively objective terms, an approach that has traditionally defined what is meant by "science." Medical texts are more numerous than the mathematical documents. They are preserved on papyri and ostraca dating from the Middle Kingdom (ca. 1900 B.C.) to the Roman Period (ca. A.D. 200); the most extensive and important of them were written during the New Kingdom and Ramesside Period, about 1550 to 1250 B.C.

This corpus was published as a whole and extensively analyzed in a nine-volume series entitled *Grundriß der Medizin der Alten Ägypter* (Berlin: Akademie-Verlag, 1954–1973). This series, the work of three successive authors, Hermann Grapow, Hildegard von Deines, and Wolfhart Westendorf, includes a hieroglyphic transcription of the texts together with translations, dictionaries, and a grammar, as well as studies

of the documents themselves and what they reveal of ancient Egyptian medical knowledge and practice. Westendorf's recent publication is essentially a summary of this series. As such, it is a valuable resource for Egyptologists and historians of science alike, both because the original series is no longer generally available and because it incorporates advances in our knowledge of the Egyptian language and culture over the past quarter century.

A short discussion of the character of Egyptian medicine ("Between Religion, Magic, and Science") serves as the introduction to the work, the body of which is divided into seven parts. Part 1 (pp. 4–79) deals with the sources themselves and describes the history, contents, and publication of each document; a translation is also provided for some of the briefer texts. Although this section is essentially a catalogue, it contains one of the rare instances in which Westendorf's unparalleled knowledge of the genre can be questioned. Westendorf describes Papyrus Edwin Smith as containing "numerous" instances of Old Egyptian forms and spellings (p. 16), thus perpetuating the notion that the document was originally composed during the Old Kingdom. In fact, the grammar of the text is that of early Middle Egyptian. Accordingly, although it is the oldest of the surviving medical texts, it is certainly no older than the very end of the Old Kingdom and probably at least a century younger.

In Part 2 (pp. 80–100) Westendorf examines the genre of medical documents as a whole. He divides the texts into several different categories: instructions, prognoses, prescriptions, magic, and miscellany. The third part (pp. 101–471) contains an exhaustive analysis of the various ailments discussed in the medical texts, and the fourth (pp. 472–535) deals both with the role of the physician in Egyptian society and, more extensively, with the methods and medicaments used in the treatment of illnesses and injuries. These two parts will be of particular interest to physicians and scholars of the history of medicine, along with Part 5 (pp. 536–546), in which Westendorf describes survivals of Egyptian medicine in the Christian (Coptic) period and its influence on Greek medicine.

Parts 6 and 7 are presented in the second volume, paginated sequentially with the first. Part 6 (pp. 547–748) contains a full translation of the two most important medical texts, Papyrus Ebers and Papyrus Edwin Smith. The final part is devoted to references and includes a bibliography, lists of abbreviations and citations, and several extensive indexes.

Westendorf's "handbook" is not only the latest contribution to the study of ancient Egyptian medicine but also the most valuable to appear since the publication of the series on which it is based—and to which Westendorf himself contributed in no small part. As such it deserves a place in the libraries of Egyptologists and historians of science alike.

JAMES P. ALLEN

David L. Lentz (Editor). *Imperfect Balance: Landscape Transformations in the Pre-Columbian Americas*. (Historical Ecology Series.) Foreword by **William M. Denevan**. xxiv + 547 pp., illus., figs., apps., bibls., index. New York: Columbia University Press, 2000. \$65, £41.50 (cloth); \$30, £19.50 (paper).

This substantial volume is dedicated to furthering an "ecological understanding of the pre-Columbian New World by creating evaluations of prehuman vegetation and then offering discussions as to how humans became involved in local ecosystems" (p. 3). These topics are timely, since the last decade has seen a flowering of debate and reconsideration of previously held views of pre-Columbian human environmental impacts in the Americas. The book contributes to those discussions by assembling examples of the current state of knowledge of pre-Columbian ecologies and of their human uses and modifications for a number of selected areas in the Americas.

This somewhat eclectic book, edited by David Lentz, presents empirical evidence of human use of and change to local and regional ecologies in ten chapters. Additional chapters are devoted to useful inventories of pre-Columbian vegetation patterns in North and Middle America and in the lowland tropics and tropical Andes, although the vegetation pattern theme is not uniformly addressed in the case studies. One chapter is devoted to climate change in the northern neotropics since the last Ice Age, yet this discussion applies to only a small part of the hemisphere discussed in the case studies.

The case study chapters mostly address agricultural modifications. These include entries on pre-Columbian anthropocentric food webs that are both general and specific to Mesoamerica; late precontact agricultural landscapes in the Valley of Mexico; the ancient water management systems for agriculture in central and southern Mexico and Venezuela; environmental impacts of ancient Maya deforestation and agricultural intensification in lowland areas of northern Guatemala, Belize, and the southern

Yucatán peninsula; pre-Columbian silviculture and management of neotropical forests; pre-Columbian farming systems of the Mississippi River Valley; environmental impacts of ancient Hohokam irrigation and agriculture in the Sonoran desert; the built landscape in the Lake Titicaca basin; agricultural systems, modified landscapes, and cultural values in the pre-Inca and Inca-era central Andes and Peruvian coast; and impacts of pre-Columbian agriculture and other land uses in riverine areas near the mouth of the Amazon River.

Given its somewhat uneven case study approach and despite broader chapters on climate change and prehuman vegetation patterns, this book is not a systematic approach to or a comprehensive statement on pre-Columbian landscape (or even vegetation) transformation. It does not address large regions of the Americas or all time frames; nor does it address all forms of modification (e.g., changes wrought by hunting-gathering societies or for other nonagricultural purposes are little considered). Nevertheless, this book's virtues outweigh its shortcomings, and



Raised field platforms planted alongside potatoes in Peru (from Lentz, ed., Imperfect Balance, p. 335).

themes emerging from these studies address major ongoing debates over the nature and scale of pre-Columbian environmental impacts. The first is that large regions of the pre-Columbian Americas were transformed in some way before European contact—thus these regions, encompassing much of the most populated New World, cannot be thought of as “pristine.” The second is that the nature of changes wrought to these regions are varied. Some were profound and easily seen, others subtle and visible only to expert eyes; some represented long-term, relatively “sustainable” modifications, while others may have triggered degradation. Lastly, these transformations occurred over a very long time frame and regions that were heavily modified at some time may not have appeared so on the eve of European contact.

THOMAS M. WHITMORE

■ Middle Ages & Renaissance

Simon A. Gilson. *Medieval Optics and Theories of Light in the Works of Dante.* (Studies in Italian Literature, 8.) xiv + 301 pp., app., bibl., indexes. Lewiston, N.Y./Queenston, Ont.: Edwin Mellen Press, 2000. \$99.95.

The somewhat deflating conclusion of Simon A. Gilson’s meticulous examination of Dante’s incorporation of the science of optics and theories of light is that the poet was considerably less well read than we have been giving him credit for.

Gilson’s book is divided into two parts: the first, dealing with the science of optics, contains four chapters; the second, dealing with theories of light, contains three. Each of these parts is devoted to debunking a tendency in Dante scholarship to attribute to a particular scientific or philosophical movement a marked influence on his work. In the first part Gilson maintains that Dante’s use of the science of optics does not—as others, most forcefully and influentially Alessandro Parronchi, have argued—rely specifically on knowledge of the authors of the *perspectivae*—detailed treatises on optics that placed the influence of light rays at the origin of terrestrial phenomena—that is, on such thinkers as Alhazen, Roger Bacon, and Robert Grosseteste. Rather, Gilson contends that Dante could easily have come by the requisite expertise concerning this science through contact with the more popular and widely known doctrines of such Arab interpreters of Aristotle as Avicenna and Averroës and the commentaries of Albert the Great and Thomas Aquinas. He demonstrates the plausibility of this contention by way of a com-

parative analysis of the doctrines of the perspectivists and the Arab interpreters. This analysis is followed by a chapter devoted to optics and vision in Dante’s earlier poetry.

The two following chapters cover, respectively, topics such as blinding, optical illusions, and visual error in Dante’s *Commedia* and the themes of reflection, mirrors, and meteorological optics, also in the *Commedia*, a work that Gilson specifies as having nevertheless gone beyond the more limited sources of the earlier poetry. In the third chapter Gilson’s analysis achieves a welcome degree of insight into the poet’s originality: here Gilson shows how Dante incorporates the scientific knowledge of his day in order to establish a set of limits that circumscribe human action in the physical world but that must be overcome in the course of the pilgrim’s journey through his imaginative world. Such moments provide a refreshing alternative to an otherwise rather positivistic view of scientific knowledge as a compendium of facts and sources one either has or has not read. One cannot help but think that researchers in the field of the history of science might be most interested in the imaginative contributions of a specifically poetic knowledge, especially in an age in which the distinction between “hard” and “soft” science was not accorded the kind of unquestioned respect it currently receives.

In the second part Gilson, continuing his debunking analysis, argues that the scholarship on Dante and his use of theories of light has remained captivated by the notion of “the metaphysics of light.” This term, Gilson claims, has been used to unify and oversimplify a rather diverse group of doctrines concerning the nature of light and its relation to knowledge, vision, God, and being. Against the grain of the traditional critical trend, Gilson maintains that Dante’s thought has nothing in common with the proper metaphysics of light of a Grosseteste—who identifies light as the primary element of being—and that Dante would have had relatively little contact with Neoplatonic theories of emanation. Again, according to Gilson, in applying the imagery of light to his poetic themes, Dante would have had readily available models in the popular theological light imagery of his time; his use of light in the description of the Empyrean is, Gilson states, perhaps the best example of Dante’s relative independence from any limited set of sources.

Whether Gilson’s informative examination of Dante’s relative dependence on sources should be understood as liberating the poet from the anxiety of scientific influence remains, however,

an open question. Whatever the extent or depth of any enumeration of those sources, it is the moment of creation that astonishes.

WILLIAM EGGINTON

Yung Sik Kim. *The Natural Philosophy of Chu Hsi, 1130–1200.* (Memoirs of the American Philosophical Society, 235.) xii + 380 pp., figs., tables, app., bibl., index. Philadelphia: American Philosophical Society, 2000. \$30.

Yung Sik Kim's new book is a welcome addition to the large number of studies of the thought of Chu Hsi, arguably the most important literati thinker (i.e., *Ru*, often translated as "Confucian") in China since the Southern Song dynasty (1127–1280). Chu's ideas became orthodox empire-wide during the early Ming dynasty (1368–1644), and during the Ming and Qing (1644–1911) dynasties millions of candidates for the imperial civil service examinations mastered the "Learning of the Way" (*Daoxue*, often translated as "Neo-Confucianism") associated with Chu and his followers. With the exception of the pioneering study by Yamada Keiji in 1978, nearly all previous accounts of Chu's ideas written by students of Chinese philosophy have emphasized the metaphysical, moral, and epistemological concerns in Chu's writings. Those more concerned with imperial dogma and state power in China since 1400 have tended to paint Chu Hsi's "Learning of the Way" as a monolithic, authoritarian ideology that legitimated the Ming and Qing dynasty rulers politically, socially, and culturally among gentry elites.

Kim acknowledges that the core of Chu Hsi's grand intellectual synthesis was focused on moral and social philosophy, but in this book Kim provides compelling information that Chu was also concerned with natural knowledge about the three levels of reality: heaven and earth, the myriad things in the world, and the human realm. Humans thus formed a triad with heaven and earth as the most numinous living thing because they were endowed with the psycho-physical stuff of *ch'i* that was most clear and complete. Recognizing no boundary between the physical and the spiritual, Chu Hsi equated human nature with the universe. The basic concepts that informed Chu's natural world were yin-yang, the five evolutive phases, and the dualism of *li* (universal and individuated rules) and *ch'i* (embodied and concrete materiality).

Chu Hsi advocated a scholarly agenda that would explain why things and events were as they were. Through the "investigation of things," the heavenly principle that inscribed the *ch'i* of

each object and event could be discovered. Normally historians of Chinese philosophy stress the place of universal heavenly *li* in Chu's thought, but Kim makes a concerted effort not to overlook the important place of *ch'i* as the aggregated collection of stuff in the universe, some dense and falling like the earth, some airy and rising like heaven. Indeed, as important as *li* was for Chu Hsi's moral philosophy, *ch'i* was the most important concept he employed to explain natural phenomena, material changes, and earthly events. With no discontinuity between matter and life, or between materiality and mind, Chu's philosophy made no allowance for the Western distinctions between the material and spiritual spheres or between the physical and mental realms.

It was precisely such views that troubled the Jesuits such as Matteo Ricci who came to China in the late sixteenth century. Ricci and his European cohort would be condemned in the early eighteenth century by French Jansenists and Spanish Franciscans for their overly accommodational compromises with traditional Chinese religious practices such as ancestor worship, which Ricci interpreted as a civil rite. Nonetheless, when Ricci studied Chu Hsi's moral philosophy and natural thought, he was appalled at its materialism and atheism, which he considered the fault of Buddhism ("sect of idols") and its impact on Song literati such as Chu Hsi.

The "noninertness" of *ch'i* carried over from the dynamic materiality of all things, including the human mind, to the formless and unfathomable spirits and ghosts that existed in a border area outside the natural realm between heaven and human beings. The dispersion of *ch'i* upon death could take many forms but, according to Chu Hsi, in the end all such *ch'i* disaggregated, leaving no ongoing or abiding spiritual form for humans, plants, or animals. The *ch'i* of the ancestors could be prayed to because the materiality of their descendants was the same *ch'i*, but even this continuity could not survive more than a few generations. Again, the Jesuits were shocked at this atheistic view of the human soul and its eventual demise materially with no possible eternal life after death.

Accordingly, Kim's careful study of what Chu Hsi thought about the natural world makes it evident that most modern studies have elided an essential aspect of traditional Chinese thought, particularly the centrality of *ch'i* in the dynamic processes of collection and dispersion that produce all things, whether living or inanimate. Students of Chinese philosophy have tended to prioritize those aspects of Chu Hsi's views on

universal *li* and its instantiated forms that are more amenable to a Western, Judeo-Christian-Islamic reading drawn ultimately from the debate between Plato and Aristotle over the universal forms of particular things.

Modern presentations, in other words, have failed to grasp why a generation of Jesuit scholars who spent their adulthood in China during the seventeenth century found Chu Hsi's views alien and dangerous. Kim deserves credit for going against the tide of twentieth-century scholarly interpretation and restoring to Chu Hsi those aspects of his natural philosophy that have been conveniently repressed to make his views more palatable. Rather than just the builder of the orthodox brick wall of traditional Chinese moralism, we can see that Chu Hsi's natural philosophy challenged any view of the world that assumed theological differences between life and death, mind and body, or the spiritual and physical.

BENJAMIN A. ELMAN

Steven P. Marrone. *The Light of Thy Countenance: Science and Knowledge of God in the Thirteenth Century.* Volume 1: *A Doctrine of Divine Illumination*; Volume 2: *God at the Core of Cognition*. (Studies in the History of Christian Thought, 98.) [xii + vi] + 250 + 611 pp., bibl., indexes. Leiden/Boston: Brill Academic Publishers, 2001.

Abbot Suger spoke for a long-standing imaginal tradition when, in 1140, he engraved on the portal of Saint Denis: "The blind soul surges towards truth by means of what is material and, seeing light, resurrects from its earlier submersion." Steven Marrone's new book follows eleven medieval authors as they struggle to adapt such metaphors of divine illumination, inherited largely from Augustine, to an emerging ideal of apodictic science inspired by Aristotle. Some of Marrone's protagonists are well known to historians of science (Grosseteste, Peckham) while others are more obscure (Gilbert of Tournai, William of Ware), some are major philosophical figures (Bonaventure, John Duns Scotus) while others are in every sense *minores* (Matthew of Aquasparta, Vital du Four). The narrative Marrone weaves out of this uneven array of theology masters is rich, dynamic, and rewarding. Taken together, their careers span the period from the early thirteenth century to the early fourteenth, during which a neo-Augustinian school came, saw, and (basically) yielded—forced to adapt to expanding new criteria of scientificity. As Marrone demonstrates, however, core elements of Augustinian illumination are transformed and

preserved. An authentic "Augustinian fire," as he puts it, survives intact through the long journey from Abbot Suger's stone portal to Duns Scotus's ethereal edifice of syllogisms, which in Marrone's view marks the culmination of four stages of progressive intellectual metamorphosis.

The first volume, subtitled *A Doctrine of Divine Illumination*, shows how an initially exploratory map of questions and affinities in the early thirteenth century solidified into a self-conscious Augustinian theory of knowledge under institutional and professional pressures. Marrone in this volume breaks new ground in the historiography of late medieval "schools" by emphasizing the importance of underlying discursive demands. Marrone shows how two opposing attractions—to logic and naturalist explanations on the one hand, to the (dialogic) intimacy between human mind and God on the other—drove the advance toward doctrinal clarity and coherence, thus culminating in a "classic" Augustinian formulation.

Volume 2, subtitled *God at the Core of Cognition*, turns to the fortunes of this newly minted Augustinianism as it transforms in the late eighteenth and early nineteenth centuries under the impact of a new critical temper. The detailed discussions of Henry of Ghent's disciple Vital du Four (nicely introduced on p. 268 as "an inveterate plagiarizer") and of Scotus's immediate predecessor William of Ware give special value to this second volume, as they greatly flesh out the context in which Scotus's *subtilitates* will count as meaningful solutions. Overall, I have just one major reservation: the important move, especially among Franciscans, to substitute divine *infinity* for divine *light* is overlooked. The key, here, lies in the notion of intensity, which belongs simultaneously to measuring light and measuring "perfection." Since this exciting move will bear epistemic fruit well beyond medieval scholasticism—think of Descartes—it might indeed have been cited, even briefly discussed.

Marrone's great contribution, however, is to show convincingly that God remains "at the core of cognition" in Duns Scotus's prodigious balancing act, which thus retains and even enshrines key Augustinian features (Ockham scholars should pay special heed). By exploiting John Murdoch's seminal idea that analytical languages more than doctrine *per se* shaped the epistemic landscape of the scholastic age, Marrone succeeds in stirring up new questions about the medieval roots of modern science. What matters, Marrone argues, is to understand better diachronic evidence of how knowledge is defended

and displayed. In this regard, the gigantic step that separates prescholastic literate discourse from the highly formalized procedures of the late thirteenth century offers a unique window into more fundamental and explosive questions about epistemic transformation and the rise of scientific elites. Philosophers and historians of science will find in these two volumes vital new perspectives based on exceptionally refined scholarship.

ANNE A. DAVENPORT

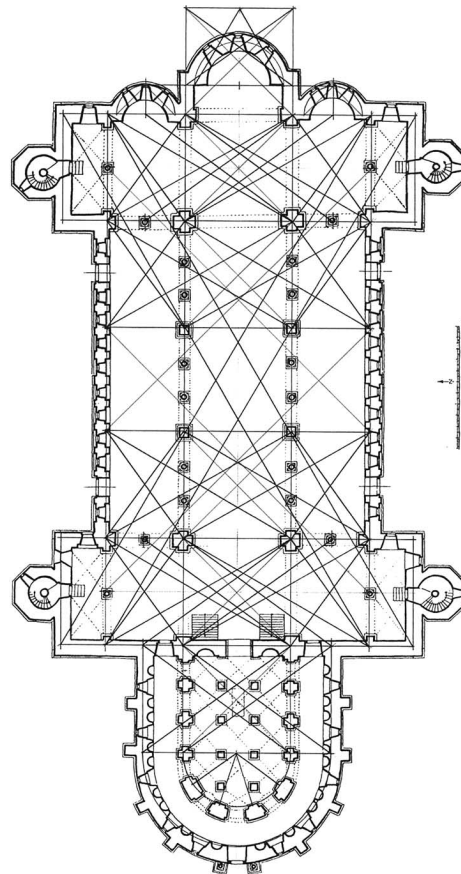
Nigel Hiscock. *The Wise Master Builder: Platonic Geometry in Plans of Medieval Abbeys and Cathedrals.* xviii + 340 + [108] pp., illus., figs., apps., bibl., index. Aldershot, England/Brookfield, Vt.: Ashgate, 2000. \$99.95.

The main conclusion of Nigel Hiscock's important but ill-arranged book is that the ground plans of abbeys and cathedrals of the tenth and eleventh centuries incorporate Platonic wisdom—hence the “wise” in the title catchwords, which come from Paul's first letter to the Corinthians (1 Cor 3:10). There Paul likens himself to a *sapient architectus* who lays the foundations on which others erect the building. In three of the four translations in *The Complete Parallel Bible*, however, Paul does not declare himself wise but, rather, “skilled” or “trained.” The discrepancy makes an emblem for Hiscock's investigation: Did the architects deliberately express geometrical ratios significant in Platonic philosophy in their designs or did they proceed by applying their practical skill and training to the lie of the land and the resources available? A subsidiary question is also symbolized in Paul's verse: Was the designer a wise cleric who set the proportions and left the heavy work to someone else?

Hiscock builds his answers in two ways. For one, he delivers a chrestomathy of Platonic snippets known in the tenth century and a few telling quotations from wise clerics—the latter concern the expression of significant numbers in the church fabric: a baptistery is octagonal because of an association between creation and the number eight, and a church with a half-dozen altars is complete because of the perfection of the number six. But, Hiscock emphasizes, numerology does not account for floor plans, and to test the wisdom of the designers he scrutinizes plans of two dozen churches, especially those associated with monastic reformers. He expresses his results in color-coded lines superposed on the plans, some one hundred of which comprise a valuable appendix.

An example will indicate the interest of the findings and the riskiness of the business. The

crossing of the transept at St. Michael's Abbey, Hildesheim, makes a square ABCD, proceeding clockwise from A in the northeast corner. AD and BC prolonged give the line of nave piers, AB and DC prolonged that of the arms of the transept. Lines drawn from B at angles of 54° and 60° with BC cut CD extended in E and F, respectively, locating the end piers in the side aisles. Now 60° , as the invariable angle of a three-sided figure all of whose parts are equal, carries a cornucopia of Platonic and Christian symbolism. Also 54° , because derivable from a pentagon, has the pregnant significance of the figure five, which is the sum of the first male and first female numbers. Repetition of the transept square fixes the nave piers. Then lines between piers, pillars, and pilasters make the special an-



St. Michael, Hildesheim, cathedral with all alignments shown (from Hiscock, The Wise Master Builder, plate 31).

gles with the north-south and east-west lines of the grid all over the plan.

How much of this construction is mere coincidence? Requiring the intervals between piers in the same line to be equal, we have $DE = FE = FD/2$. And so it is: $(\tan 54^\circ - 1)/(\tan 60^\circ - 1) = 0.51$. Otherwise put, if angle FBC is 60° and E divides FD equally, angle EBC must be 54° without reference to a pentagon. Against such arguments, Hiscock observes that his analysis has uncovered previously unknown relations between churches confirmed by documents and that his technique, when applied to large nineteenth-century buildings with repeated bays such as the Crystal Palace, picks out relatively few structurally significant elements.

Hiscock is senior lecturer on the design, theory, and history of architecture at Oxford Brookes University and a master craftsman. His scrupulously prepared color-coded drawings contain much of interest and pleasure for a geometer. Has he definitively answered the old vexed question whether the *sapiens architectus* intended to express ancient wisdom in his plans? If the architect thus proposed, did his builder faithfully dispose? Paul again may give guidance. "The Lord knows the thoughts of the wise, that they are futile" (1 Cor 3:21).

JOHN L. HEILBRON

Anthony Grafton. *Leon Battista Alberti: Master Builder of the Italian Renaissance.* xii + 417 pp., frontis., illus., index. New York: Hill & Wang, 2000. \$35.

Anthony Grafton, like Jacob Burckhardt before him, begins his appreciation of Leon Battista Alberti by reviewing how the fifteenth-century Italian author created a many-faceted identity through willful self-fashioning. Grafton, however, offers the reader a much richer *Bildungsroman* than the older portrait and exposes many forces undercutting the monolithic character of Burckhardt's Renaissance, the same forces that may provide a key to the contrary and doubt-ridden persona frequenting Alberti's writings. Alberti's ambitions and the leitmotifs of his life from his youthful aspirations to their later glorious fulfillment are laid out in stunning detail.

Moving well beyond the unrelenting brightness of Burckhardt's presentation, Grafton also attempts to fuse what have become for scholars the dramatic polarities of Alberti's enigmatic personality. An ambitious scholar and writer on academic subjects, on the visual and practical arts, Alberti was a lover of nature and a sensitive commentator on aesthetic, familial, and

cultural ideals. He was also given to irony, despair, and bitter isolation. Grafton makes a strong case for Alberti's dependence on an unwavering determination that compelled him to assume many guises and foster numerous strategies to achieve his literary, social, and economic goals. As his friend Cristoforo Landino once noted, Alberti was like a chameleon. In Grafton's hands, however, Alberti remains dazzlingly inventive and radically humanist, and he endures as appropriately leonine and the hero of his own tale.

With a predictable outpouring of references, Grafton evokes Alberti's social, political, and intellectual world and, reprising his earlier writings, develops several themes. These include Alberti's literary erudition and the high price he paid to achieve it; how Alberti applied the lessons of ancient sources to the problems of his own world, and in so doing subverted those lessons to create something new; how the humanist author developed special vocabularies for writing about such novel subjects as the visual arts, instruments of measure, and other current technologies; and, perhaps most surprisingly for a man given to bitterly mocking his contemporaries, how Alberti became involved in the creative energy of early modern life with apparent enthusiasm and accomplished the astonishing feat for a humanist of becoming a practicing architect.

Grafton finds Alberti's confidence in a material culture driven by technology, theoretical knowledge, and careful observation expressed forcefully in the dedicatory letter of his essay *On Painting* addressed to the builder Filippo Brunelleschi. Brunelleschi deserved to be praised not for slavishly drinking from the fountain of the ancients, but for the brilliance of his intelligence and the successful application of his knowledge. Further, by requesting that the architect emend his essay, Alberti, the scholar, is shown to have treated Brunelleschi, the builder, as an equal and thereby to have elevated all technical knowledge. Alberti cleverly places himself within the circle of the ingenious engineers who were masters of practical knowledge based on underlying principles and therefore at the forefront of an intellectual parade led by its most renowned practitioner. One wonders, perhaps, what Brunelleschi at the height of his fame might have desired to learn from the audacious savant.

As Alberti masters how to make his way in Florence and among the elegant courts of his day, he is seen to revisit the themes of his youthful writings with ever-deepening insight. Grafton's reflections on Alberti and Florence, though generally convincing, have been greatly enriched

by Luca Boschetto's recent book devoted to that subject (*Leon Battista Alberti e Firenze* [Olschki, 2000]). In addition, some of Grafton's notions about the influence of *On Painting* as centered in courtly art seem to reach beyond the evidence and the explicit directives found in Alberti's writings.

The reader interested in Alberti's involvement in science and technology will still want to consult Joan Gadol's *Leon Battista Alberti: Universal Man of the Early Renaissance* (University of Chicago Press, 1969), and the lack of a general bibliography will be an irritation to those who like to follow an author's research trail, the trekker in this case having to stumble through a thicket of footnotes. Nonetheless, Grafton has created a richly drawn portrait of Alberti. Scholar and student alike will garner much that is important about this immensely gifted and mercurial man whose writings continue to influence our understanding of the beginnings of early modernity.

JANE ANDREWS AIKEN

George Ripley. *George Ripley's Compound of Alchemy (1591)*. Edited by **Stanton J. Linden**. 1x + 138 pp., illus., index. Aldershot/Burlington, Vt.: Ashgate, 2001. \$59.95.

The fifteenth-century Augustinian canon and alchemist George Ripley is one of the most important figures in early English alchemy. As the chief popularizer of the alchemical principles of the pseudo-Lull, he initiated an influential school of English alchemy that remained resilient to the end of the seventeenth century. John Dee, George Starkey, Robert Boyle, and Isaac Newton all read Ripley carefully, and Michael Maier is said to have learned English just so that he could read Ripley in the original tongue.

But Ripley has encountered the fate of many alchemical writers: reliable biographical data about him is scarce and nearly overwhelmed by the accumulation of rumors and legends, and his *corpus* is a *farrago* of genuine, adulterated, and spurious works springing from several periods and places. Naturally, this messy situation renders solid historical inquiry difficult, and so one of the first tasks must be to produce more reliable biographical and bibliographical foundations for studies of Ripley and his influence.

The current volume, although published by Ashgate, greatly resembles (in layout, content, and intent) a further installment in the Garland English Renaissance Hermeticism Series, of which Stanton Linden was the general editor. The bulk of the book is a reprint of the 1591

London edition of Ripley's *Compound of Alchemy*—his longest and most influential work—a versification in rhyme royal on the making of the philosophers' stone. The reprinted text is preceded by an introduction and followed by explanatory notes, many of them making use of Eirenaeus Philalethes' (i.e., George Starkey's) *Ripley Reviv'd*, a lengthy commentary on the *Compound* published in 1678, and of Elias Ashmole's *Theatrum chemicum britannicum*, in which the *Compound* was published with annotations in 1652.

The historian of science might well question why the 1591 printed edition was chosen as the primary text when there are at least nine fifteenth-century manuscripts of the *Compound* in existence. Linden expresses his belief (p. xxxix) in the superiority of Rabbard's 1591 edition over Ashmole's 1652 edition—though he bases this preference, somewhat curiously, on the modernity of the former's spelling and punctuation—but he does not note explicitly why Rabbard's text should be preferable to manuscripts written during Ripley's lifetime. This decision is presumably due, however, to the apparent connection of this book to the English Renaissance Hermeticism Series, and Linden's greater interest in the late sixteenth-century scene is clear in the detailed account he provides of the production of the 1591 edition. This treatment contrasts with the relatively less critical interest shown toward details on Ripley himself, for the biographical section simply lists items about Ripley's life as summarized around 1900 (predominantly by John Ferguson and the *Dictionary of National Biography*) and includes some points that must be incorrect (e.g., that Ripley was made chamberlain by Pope Innocent VIII in 1477; Innocent VIII did not ascend to the See of Peter until 1484). Given Linden's fine researches published previously, this comes as a bit of a disappointment, although it must be recalled that even Ashmole had trouble getting details on Ripley three hundred years ago.

Students of alchemy should welcome the appearance of a reprint of a primary source. Those who are interested in Renaissance publications of alchemical works and who approach Ripley primarily as an English poet and literary figure will benefit from the book. Questions of course remain, and it is to be hoped that this volume will attract more attention to further aspects of the famous Canon of Bridlington and his work.

LAWRENCE M. PRINCIPE

D. Zecaire. *Opusculé tres-eccellent de la vraye philosophie naturelle des metaulx*. Edited by **Re-**

nan Crouvizier. Foreword by **Jean-Claude Margolin.** (Textes et Travaux de Chrysopaeia, 6.) 208 pp., frontis., illus., bibls., index. Paris/Milan: Arche, 1999. (Paper.)

The *Opuscule* written by Denis Zecaire in 1560 is one of the most famous testimonies to Renaissance alchemy. In addition to assessing the medieval alchemical heritage, the work is especially noteworthy because of the firsthand description of the alchemist's life it contains. As a whole, it offers a lively picture of traditional alchemy, which in the following decades would be deeply transformed by the impact of Paracelsian doctrines.

Zecaire's work went through several editions, in French, Latin, and German, from 1567 until the very end of the eighteenth century (see the list on pp. 183–186), and the French text has been reprinted twice, in 1977 and 1990. Yet the present edition is the first to give the full text from a manuscript probably written by the author himself (Paris, Bibliothèque Nationale de France, fr. 1089). Renan Crouvizier presents a valuable introductory essay that describes the results of his thorough research. Indeed, although an important outcome of Crouvizier's work is the restoration of passages lacking in the earlier editions, the main interest of this book is in the introduction, the careful biographical and sociological assessment of the author, and the overview of the sources and contents of his work.

Despite the display of biographical and historical data in the first part of the *Opuscule*, the author's identity is still unknown. Crouvizier points to some features (the supposed Latin name of Zecaire, Johannes Cerasius; his origin from Guyenne; his social status as a landlord) that might help us to ascertain who "Denis Zecaire" really was. Yet even this well-equipped scholar must at present surrender before the "effacement social de Zecaire" (p. 55), leaving us with only a faint hope that new sources may confirm the name "Johannes de Berle" proposed by the eighteenth-century scholar Nicholas Lenglet-Dufresnoy—or that a different name, confirming the features so carefully outlined, may emerge from archival records.

Analysis of the autobiographical account in the *Opuscule* leads Crouvizier to affirm that Zecaire and his work are to be included in the "dossier des rapports entre protestantisme et alchimie" (p. 43), therefore assigning it to the same intellectual milieu where Paracelsus was to find an audience. This conclusion is strengthened by the connection of the *Opuscule* with another alchemical work linked to French Paracelsianism, the

Traité attributed to Bernard *Le Trévisan*, printed with Zecaire's *Opuscule* in the 1567 edition.

However, the alchemical sources referred to in the second book of the *Opuscule* are clearly those of a pre-Paracelsian alchemist, who accepted the traditional theory of "mercurius solus"—that is, the doctrine according to which metals are formed by one substance, mercury or quicksilver, whose fiery aspect manifests itself as "sulphur" in the formation of metals and in the alchemical opus. Only the transmutation of metals is considered; there is no hint of the alchemical distillation of alcohol. While the main source of the *Opuscule* seems to be Bernard *Le Trévisan*, the most-quoted author is Petrus Bonus, and Zecaire clearly considers the doctrines of the Latin "Geber" and pseudo-Lull—the most important medieval alchemical authors—as mutually consistent.

The third part of the work is a suggestive allegory of the alchemical process, ending with instructions for using the "grant roy" or "divine oeuvre"—that is, the alchemical elixir—to transmute base metals, to make pearls and gems, and to heal the human body. Nothing new is developed from pseudo-Lullian alchemy; but the interest shown by the Paracelsian Gerhard Dorn in Zecaire, whose work he translated into Latin in 1583, confirms that the French author can be placed in the intellectual stream leading from alchemy to "chemical philosophy."

MICHELA PEREIRA

■ Early Modern (Seventeenth and Eighteenth Century)

Jed Z. Buchwald; I. Bernard Cohen (Editors). *Isaac Newton's Natural Philosophy.* (Dibner Institute Studies in the History of Science and Technology.) xx + 354 pp., illus., figs., tables, index. Cambridge, Mass./London: MIT Press, 2001. \$45.

This collection belongs to a distinguished series and contains a number of outstanding essays. Some of the essays, notably those by Alan Shapiro, Michael Nauenberg, and George Smith, expand on work published in *The Foundations of Newtonian Scholarship*, edited by Richard H. Dalitz and Nauenberg (Singapore, 2000), which can be seen as a companion volume.

Jed Buchwald and I. Bernard Cohen identify two strands of contemporary Newtonian research. The first, "Motivations and Methods," opens with an essay by Maurizio Mamiani on the sources for the *Regulae Philosophandi* in Book 3 of Newton's *Principia*. Relying on his previ-

ous critical edition of Newton's *Treatise on the Apocalypse*, Mamiani shows that "Robert Sanderson's [1631] *Logicae Artis Compendium* is the primary source of Newton's rules" (p. 4). Thus circa 1672 Newton adapted Sanderson's laws first to biblical exegesis and later to the investigation of nature. Cohen compares Newton's *Opticks* with Huygens's *Traité de la lumière*, shedding light on the history of their editions. Shapiro's study on diffraction presents a detailed analysis of Newton's experimental investigations, with particular emphasis on quantitative methods. Shapiro argues that not only Robert Hooke's role but also "Newton's inability to conclude the part [of the *Opticks*] on diffraction was a principal reason" for the delay of its publication until 1704 (p. 47). Mordechai Feingold outlines a picture of the Royal Society where, a few years after its foundation, two factions emerge, the naturalists and the mathematicians. His interpretation provides a convincing key for interpreting events at the society in Newton's time and beyond.

The second strand, "Celestial Dynamics and Rational Mechanics," opens with an essay by Bruce Brackenridge on the interplay among Newton's three different ways to represent curves, which he calls the "polygonal, parabolic, and the curvature methods." Essays by Nauenberg and Curtis Wilson provide starkly contrasting perspectives on Newton's investigations on lunar motion in relation to those of later mathematicians. According to Nauenberg, the perturbation method developed by Newton in the Portsmouth papers is remarkable and "corresponds" to later methods developed by Leonhard Euler and George W. Hill: "The evidence presented here indicates that [Newton] could have succeeded in his quest to evaluate correctly higher-order terms to the motion of the lunar apogee had he continued to pursue his method more carefully, particular[ly] in regard to the dependence on the orbit's eccentricity" (p. 215). By contrast, Wilson emphasizes the differences between Newton's and later contributions. A crucial section in his essay addresses the same problem that is at the center of Nauenberg's work but reaches opposite conclusions. The section is titled "Why It Is Unlikely that Newton Would Ever Have Solved the Problem of the Moon's Apsidal Motion Correctly" (p. 168). In his remarkable study, Wilson identifies several important differences between Newton and his successors, such as the shift from geometrical to analytic methods. The problem of the apsidal motion can only be solved in a "blind, iterative" algorithmic fashion, one Newton did not prefer.

Moreover, Wilson argues that whereas the solutions by Leonhard and Johann Albrecht Euler and by Hill "started from differential equations that stated exactly the conditions of the problem" and allowed a close check of the approximations adopted, "Newton's calculative procedure . . . provides no internal check on the accuracy of [his] assumptions or of his results" (p. 153). Although both Nauenberg and Wilson employ modern notation, Wilson is more careful in conveying the sense of Newton's style and original way of proceeding. Michel Blay's fine essay identifies the main aim of Newton's *Principia* as determining how one can "achieve mathematical rigor in the transition from the discontinuous to the continuous" (pp. 225–226). Traditionally historians have identified the laws of motion, especially the second law, as the intellectual cornerstone of Newton's masterpiece. Blay's conclusion, however, is that "the real driving force of Newton's dynamics, the coherence of the *Principia*, resides in the lemmas of Section 1" (p. 243).

George Smith's essay on Book 2 of the *Principia* is probably the most original and innovative contribution to this volume and one of the most important studies of Newton's work. It will become a classic in the field. Smith, a philosopher and engineer by profession, has the technical skills and the historicophilosophical sophistication to deal with the complex issues of motion in resisting media and to analyze Newton's problematic experiments and theories. Book 2 has traditionally been little studied and bracketed off as a rather cumbersome and unfortunate aside in Newton's *oeuvre*. Smith's work sheds new light on it and at the same time shows the profound links with better-known aspects of Newton's research. A useful appendix to his essay contains a translation of those passages on fluid resistance from the first edition (1687) that were replaced or removed in the later editions. Finally, an essay by the late Sam Westfall analyzes the background to the mathematization of nature in the sixteenth and seventeenth centuries, focusing on four technologies: water management, military engineering, navigation, and cartography. Westfall's conclusion relates to his interest in patronage and argues that the advances in seventeenth-century mathematics are "perhaps partly" due to a "greater demand for mathematical expertise than any previous society ever had" (p. 336). His article is accompanied by an eulogy by Cohen.

I very much hope that a paperback edition will make this important volume available to a wider audience.

DOMENICO BERTOLONI MELI

Giancarlo Nonnoi. *Saggi Galileiani: Atomi, immagini e ideologia.* (Collana Agorà, 11.) 238 pp., illus., index. Cagliari, Italy: AM&D Edizioni, 2000.

In 1635 a Latin translation was published of Galileo's *Dialogue on the Two Chief World Systems* (1632), which had occasioned his condemnation by the Inquisition in 1633. The Latin translation bore the title *Systema Cosmicum*. It had been organized by Elia Diodati (1576–1661), a Protestant of Italian origin born in Geneva and living in Paris, where he was a Parliament lawyer. Diodati, a confidante of Galileo, had gone into action after receiving a letter that may be regarded as Galileo's intellectual testament, written the same day (15 January 1633) his legal testament was registered and he decided to journey from Florence to Rome to stand trial. Galileo's letter stated that "from reliable sources I hear the Jesuit Fathers have managed to convince some very important persons that my book is execrable and more harmful to the Holy Church than the writings of Luther and Calvin."

The translator was Mathias Bernegger (1582–1640), the Austrian-born Protestant rector of the University of Strasbourg, who taught history and political science but had a background in mathematics. The publisher was the influential Dutch firm of the Elseviers, based in Leiden but with branches in several cities. The place of publication was Strasbourg, which at that time was (as it had been for centuries) a free city within the Holy Roman Empire. The book had two appendices: a five-page selection from Kepler's introduction to his *Astronomia Nova* (1609), arguing that Scripture carries no weight in natural philosophy; and a Latin translation of Paolo Foscarini's 1615 booklet (30 pages) that had been condemned and banned by the Decree of the Index of 5 March 1616 for arguing that the earth's motion is compatible with Scripture. The book's frontispiece reproduced the one from the original edition—that of Aristotle, Ptolemy, and Copernicus engaged in conversation—but with the figure of Copernicus looking much younger than the original. And the title page carried two epigraphs: a Greek quotation from the Platonist philosopher Alcinoüs meaning "One must be mentally free if one wants to become a philosopher" and a Latin quotation from Seneca meaning "It is especially among philosophers that one must have equal liberty."

A year later (1636), there appeared also in Strasbourg with the Elseviers and edited by Bernegger the first publication ever of Galileo's "Letter to the Grand Duchess Christina," which

he had written in 1615. It had both the Italian text and a Latin translation by Diodati and bore the revealing title *Nov-antiqua Sanctissimorum Patrum et Probatorum Theologorum Doctrina de Sacrae Scripturae Testimoniis, in Conclusionibus mere Naturalibus, Quae Sensata Experientia et Necessariis Demonstrationibus Evinci Possunt*. It had a preface in which Diodati praised Galileo's astronomical accomplishments, blamed his trial on jealous rivals, and justified the depth and purity of his piety and religiousness. Diodati used the pseudonym Robertus Robertinus, which corresponded to the name of a Prussian poet named Robert Roberthin (1600–1648).

These are some of the factual details in Nonnoi's book. Other chapters deal, in a similar vein, with the ambiguities of Galileo's atomism; with icons, models, and symbols in Galileo's Copernican propaganda; and with the image of Galileo in the astronomical writings of John Wilkins (1614–1672).

Such details are fascinating and important for understanding Galileo's work and its aftermath, and so Nonnoi's book is useful for contributing such necessary spadework—in particular, the bibliographical documentation is especially valuable and the analysis of the pictures found in the works discussed shows considerable originality. Regrettably, Nonnoi does not integrate such details into an overarching thesis that might elaborate their significance; thus, the work of assimilating them remains to be done.

MAURICE A. FINOCCHIARO

Dennis Des Chene. *Spirits and Clocks: Machine and Organism in Descartes.* xvi + 181 pp., illus., bibl., index. Ithaca, N.Y./London: Cornell University Press, 2001.

Spirits and Clocks is the third in a series of magnificent books in which Dennis Des Chene explores the relationship between late Scholastic (particularly Jesuit) philosophy and Cartesian thought. The other two books are *Physiologia: Natural Philosophy in Late Aristotelian and Cartesian Thought* (Cornell University Press, 1996) and *Life's Form: Late Aristotelian Conceptions of the Soul* (Cornell University Press, 2000). Together, these three books situate Descartes's thinking in one important aspect of the intellectual context within which it developed. The result is a superbly nuanced study of a thinker whose brilliance has often dazzled his modern commentators so much that they have forgotten he was addressing a philosophical tradition out of which many of his own concepts and arguments derived.

In the present book Des Chene considers Descartes's physiological ideas, as presented in *Traité de l'homme*. He argues that Descartes's "rejection of the vegetative and sensitive souls invented by his predecessors was no less momentous for the science of life than the rejection of forms, powers, and ends was for physics. It was of a piece with his program in physics, executed with the same motives and resting on the same principles" (p. xi). *Spirits and Clocks* is a careful, historically informed conceptual analysis of Descartes's notorious doctrine of the *bête machine*. Considering this idea in context highlights both the traditional and innovative features of Descartes's physiological thought. This book makes a significant contribution to the historiography of early modern natural philosophy by demonstrating both the continuities and discontinuities between the mechanical philosophy and Aristotelian natural philosophy.

In the individual chapters Des Chene examines a few detailed examples of physiological questions that he considers particularly significant. These include the explanation of self-motion, where machines come from, and the role of functional and teleological ideas in Descartes's physiology. Other important topics include sensation and perception, intentionality, and the unity of the body. In examining each of these issues, Des Chene first describes the explanations favored by sixteenth- and seventeenth-century Scholastic philosophers. He then provides a detailed analysis of Descartes's position and shows the precise differences and similarities between Descartes's thought and that of his contemporary Aristotelians. Both aspects of his discussion enrich our historical understanding. Des Chene is one of only a handful of scholars who have given serious attention to late Aristotelian natural philosophy in recent years, and his account in *Spirits and Clocks* is both informative and useful. Similarly, *Traité de l'homme* has received less scholarly attention than the *Discourse on Method* and the *Meditations*, so the present study is a welcome addition to the literature.

Des Chene deploys an impressive array of scholarly skills and knowledge of Descartes's intellectual context as well as analytic precision. The result is an important and original reading of an aspect of Cartesianism that has not received as much attention as Descartes's physics, metaphysics, and epistemology. This book not only illuminates Descartes's theories but also delineates the conceptual commitments of the mechanical philosophy and the details of its differences from the late Scholasticism that it re-

placed. It serves as an excellent model for a contextualized history of early modern natural philosophy.

MARGARET J. OSLER

Antonio Clericuzio. *Elements, Principles, and Corpuscles: A Study of Atomism and Chemistry in the Seventeenth Century*. (International Archives of the History of Ideas, 171.) xii + 223 pp., index. Dordrecht/Boston: Kluwer Academic Publishers, 2000. \$89.

This book addresses two related generalizations that persist in the history of seventeenth-century chemistry, both of which are crucial to the canonical narrative of the scientific revolution. The first is that the experimental program of Robert Boyle led him to abandon the Aristotelian and Paracelsian chemical theories of his predecessors and adopt a reductionist, materialist matter theory from the French mechanical philosophers Pierre Gassendi and René Descartes, forever changing the nature of chemical theory and paving the way for the modernization of chemistry during the late eighteenth and nineteenth centuries. The second is that the theories of Gassendi and Descartes were unequivocally "mechanical" and reflect the reemergence and supervision of classical atomism over alchemical and vitalist ontologies. Both of these generalizations have been successfully challenged in the past fifteen years. The present book collects and explicates these findings, while focusing on Robert Boyle and the legacy of his matter theory for late seventeenth-century European chemistry. In the end, Antonio Clericuzio shows that Cartesian mechanical philosophy did not have a decisive impact on the matter theory of the chemists who held onto chemical principles and qualities even as they adopted various forms of Boyle's corpuscular hypothesis.

In an able historiographical overview, Clericuzio shows how Boyle was thrust into the mainstream of revolutionary science by Thomas Kuhn, Marie Boas, and A. R. Hall, who depended on an eighteenth-century construction of Boyle that suited the needs of the experimentalism and materialism of Enlightenment science but hardly reflected the thinking of Boyle and his contemporaries, as is evident in the texts cited here. In fact, Boyle did not rigorously apply mechanical philosophy to his chemistry and medicine, as he did to his physics, and he fashioned his corpuscularist matter theory from the active seminal principles of the Paracelsians and Helmontians as well as the atoms of Epicurean theory and the *minima naturalia* of medieval Ar-

istotelian alchemy. William Newman and Lawrence Principe have recently argued the importance of the medieval alchemists' materialism for seventeenth-century chemistry, and Newman has credited J. B. Van Helmont and Daniel Sennert with forging medieval corpuscular *minima* into the corpuscles adopted by Boyle, but here Clericuzio argues that corpuscles were hardly evident in sixteenth-century alchemy, that Van Helmont's theory was not truly corpuscular, and that Sennert's corpuscles still possessed Aristotelian forms. This matter awaits resolution.

One of the strengths of this book is Clericuzio's treatment of the pre-Boylean developments within chemical theory, documenting that corpuscularism did not emerge from the classical atomism of the French mechanists but evolved from various considerations of alchemical and Paracelsian theory, combined with Aristotelian natural philosophy. In the first place, the idea of *semina*, which Boyle explained as corpuscles endowed with generative power and specific developmental programming, was clearly present in chemical philosophy from Paracelsus and Petrus Severinus to Van Helmont, whose influence on Boyle and his contemporaries is now well established. Moreover, a materialized version of *semina* already existed in the medical theory of Girolamo Fracastoro, who adapted the idea from Lucretius. As well, *semina* were being corpuscularized and materialized in the early part of the century, as reflected in treatises by Nicholas Hill.

One cannot expect a book of such wide-ranging scholarship to reflect all of the recent literature in the field, but the author's failure to engage Barbara Beigun Kaplan's study of Boyle (*Divulging of Useful Truths in Physick: The Medical Agenda of Robert Boyle* [Baltimore: Johns Hopkins Univ. Press, 1993]) is unfortunate, both because her work speaks directly to the perspectives on Boyle that are treated here and because points on which their accounts differ need clarification. In sum, Clericuzio's book presents a much-needed rectification of the entrenched Enlightenment view of Boyle and the development of corpuscular chemistry but is not the last word on Boyle's relationship to his predecessors' ideas on matter.

JOLE SHACKELFORD

Zakiya Hanafi. *The Monster in the Machine: Magic, Medicine, and the Marvelous in the Time of the Scientific Revolution.* xiv + 272 pp., illus., bibl., index. Durham, N.C./London: Duke University Press, 2000. \$59.95 (cloth); \$20.95 (paper).

This book poses an interesting and important question: What happens to the "sacred" version of the monstrous in the "secularized" world of the Scientific Revolution? The "monster" of the title is defined as "what we are not," and its conceptualization is explored in the context of late sixteenth-century to mid-eighteenth-century Italy. Aware that, previous to the period she discusses, the monster was not wholly "sacred," Zakiya Hanafi first delineates three well-known traditions of monsters: those of natural philosophy (the monster as fact of nature), divination (the monster as prodigy), and wonders of nature (the monster as curiosity or miracle). New attitudes toward the monstrous that Hanafi calls the descriptive mode and the manipulative mode are said to emerge from the mid-sixteenth century (Ch. 2). Her discussion of the emergence of the former mode is related to the story of a dissection and description of a double-bodied infant in the private garden of the Rucellai family of Florence in 1556. The manipulative mode is demonstrated with regard to the production of living monsters (by crossbreeding, for example) proposed by Giambattista Della Porta in the second book of his *Magia naturalis* (1589).

Hanafi's third chapter presents the central hypothesis on which the rest of the book will turn: that the monster and the fear and horror associated with it migrated from the sacred (portentous monstrous births, demons, etc.) into the machine. She presents the intriguing idea that one of the continuities of the construction of monstrosities in Western culture is "that which is inanimate yet moves of its own accord" (p. 54). But references to "the machine" and the "Scientific Revolution" in the title of the book are rather misleading, for her examples are drawn from the narrower realm of automatons and organically produced hybrids, speaking statues, and distorting mirrors. She does not deal with the question of whether these mechanical and artificially produced monsters necessarily signified a general belief that the machine itself was monstrous.

Following her assumption that *machine-like* and *monstrous* are synonymous in this period, the fourth chapter argues that the consequence of a machine-like interpretation of the human body was its inhabitation by the monstrous as well. Deviations from the proper shapes and ratios in body parts—once a primary characteristic of the monstrous races—is now a revelation of bestiality and monstrosity in all human beings, according to Della Porta and other writers on physiognomy. Pursuing the medical theme, Chapter 5 explores monstrosity in the body and

the body politic through an examination of the physiological theories of Giambattista Vico. The final chapter shifts the focus onto monstrous language, examining debates on the proper use of literary figures.

Throughout this book Hanafi adopts a methodological principle of “seeing the connections” rather than “making explanations” (p. x) that diffuses the scholarly value of her insights and interesting examples by presenting the material simply as metaphors to meditate on the post-modern condition. Many of the sources brought together in individual chapters (and, indeed, the chapters themselves) seem incompletely related to each other, particularly in the absence of generalizing explanations and a discussion of what is meant by such key terms as “secular,” “sacred,” and “the machine.” Tenuously linked sources are thus placed in unilluminating (because unexplored) relationships, such as the odd conjunction of Marsilio Ficino’s description of talisman making with Della Porta’s of animal crossbreeding, and peculiar omissions occur, for instance, the absence of any consideration of the golem tradition. In short, this book might itself be said to possess the jumbled limbs and motley order of its monstrous subject matter, which unfortunately mitigates against its interest for the specialist and its usefulness for the general reader.

SOPHIE PAGE

Georgius Everhardus Rumphius. *The Amboinese Curiosity Cabinet*. Edited, translated, and annotated by **E. M. Beekman**. cxii + 567 pp., frontis., illus., figs., bibl., index. New Haven, Conn./London: Yale University Press, 1999. \$45.

The Dutch East Indies Company (VOC) was one of the most aggressive and successful trading enterprises in the seventeenth-century world. In the Indian Ocean it elbowed the Portuguese out of major ports, dominated the lucrative spice trade, and ruthlessly punished the natives if they refused to cooperate. Like the English East India Company, which would soon become a fierce rival, the VOC was a formidable commercial, military, and imperial complex in the expanding maritime world. In recent years historians of science have begun to examine how this growing maritime trade in the early modern period contributed to the development of natural history. Specimens and observations brought back from the tropics and other exotic lands had an enormous impact on the European understanding of the natural world. Scientific voyages and explorations were relatively few before the middle of the eighteenth century. It was the network of

maritime trade that supplied most of the scientific data about the rest of the world. More than anyone else, employees of the Dutch and English maritime enterprises collected the specimens and observations that fed the scientific communities in their home countries. Many of these largely forgotten individuals were accomplished naturalists whose experience and knowledge earned them respect among the scientific elite in Europe.

The activities of Georgius Rumphius nicely illustrate the conjunction of science and maritime trade. After a peripatetic military career, Rumphius joined the VOC and in 1652 sailed to the Dutch East Indies, where he would spend the rest of his life. He didn’t go to the East with the purpose of investigating natural history, but the strange creatures in this exotic land caught his attention, and he began studying natural history, collecting specimens, and writing about them. It was a labor of love. Not even blindness could stop his research; in fact, he produced most of his voluminous writings on the natural history of Ambon, or Amboina, a small island northeast of Java, after he lost his eyesight. But it would be an oversimplification to see Rumphius as a lonesome genius marooned in a remote island struggling to produce brilliant work that only posterity would come to appreciate. In the Dutch East Indies during this period, several employees of the VOC were dedicated naturalists, including the noted Hendrik van Reede, and they exchanged ideas and information with him. Rumphius also maintained an active correspondence with the scientific establishment in Europe and was elected to a prestigious scientific academy.

Rumphius’s major work was an illustrated herbal that described about 1,200 plants found in Ambon and the nearby areas. *The Amboinese Curiosity Cabinet*, however, focuses not on plants but on crustaceans, shells, minerals, and other items that are grouped into three categories: “Soft Shellfish,” “Hard Shellfish,” and “Minerals, Stones, and Other Rare Things.” Each of the volume’s 170 chapters examines one or more natural objects, often with accompanying illustrations. The descriptions are usually vivid and convey a sense of wonder at exotic natural objects. The text also contains rich ethnographic records of the maritime world of Southeast Asia. Rumphius drew heavily on the indigenous lore of the natural world and frequently cited information collected from Chinese traders and immigrants. Combing through the text, one comes across many telling examples of how a seventeenth-century naturalist pursued research in the social and cultural environ-

ment of a colonial entrepot. The translator, a distinguished scholar of Dutch colonial literature, has added a long introduction detailing Rumphius's life and work. The text itself is amply annotated.

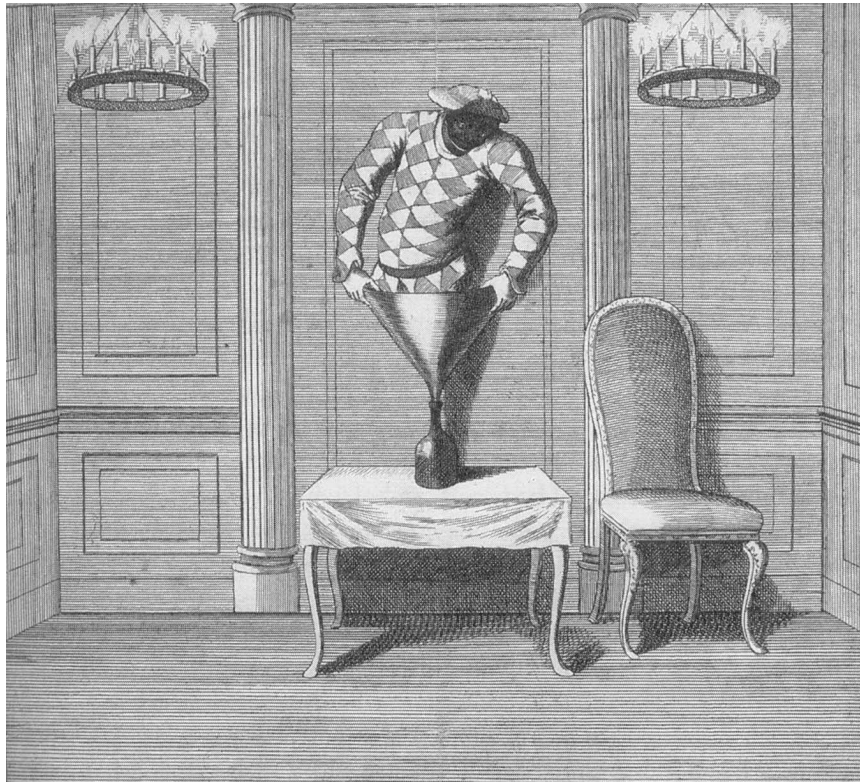
FA-TI FAN

Barbara M. Benedict. *Curiosity: A Cultural History of Early Modern Inquiry.* x + 321 pp., frontis., illus., index. Chicago/London: University of Chicago Press, 2001. \$45.

In recent years historians of science have come to an increasing appreciation of the role played by such moral and affective categories as “trust,” “wonder,” “pedantry,” and “self-discipline” in the knowledge-making enterprises of the early modern period. Barbara Benedict's book on curiosity is a most welcome contribution to the literature devoted to such topics. In a lively and entertaining work, Benedict sets out to “analyse literary representations of the way curious people, including scientists, authors, performers,

and readers, were engaged in practicing and producing curiosity itself” (p. 1). The author modestly states at the outset that the work is not, and does not claim to be, a history of science, and indeed as a whole the essay perhaps falls short of the more ambitious promise of the subtitle—“a cultural history of early modern inquiry.” Yet it deals with a subject that is nonetheless of profound importance for historians of seventeenth- and eighteenth-century science.

Of particular significance is the way in which the book demonstrates how curiosity and its representations served to demarcate the boundaries of legitimate topics of knowledge and modes of enquiry. The discourse about curiosity thus served to inform central epistemological questions of the period: Is it appropriate to seek all knowledge on all topics, and is it to be sought by all people? If there are areas of knowledge that are illicit, what are they and why are they proscribed? What are the proper methods for the various spheres of knowledge? Benedict carefully articulates the role played by the discourse



“The Bottle Conjurer” (from *Benedict, Curiosity*, p. 165).

of curiosity in the sanctioning of some projects and the censuring of others. To take one of the many telling examples found in the book, the protagonist of Thomas Shadwell's *Virtuoso* (1676) is presented as epitomizing the curious impulse, here manifested as a puzzlingly earnest quest for useless knowledge and a strange fascination with base and undignified natural objects. The odd proclivities of this character demonstrate in a forceful way how the new natural philosophy could be regarded as merely an outlet for the intellectual vice of curiosity—and how far the new knowledge-making enterprises fell short of social approval amongst those whose approbation mattered most. The familiar seventeenth-century rhetoric of the “usefulness of natural philosophy” was thus in part a response to accusations of curiosity leveled against experimental philosophers. Benedict observes that “early modern literary culture struggled to mold curiosity into forms that would preserve public values” (p. 68). Apologists for the scientific activities of the Royal Society, in keeping with this goal, sought to depict the quest for natural knowledge as a legitimate expression of a curiosity that had been appropriately disciplined and directed in ways that would contribute to the common good.

The book also traces the varying fortunes of curiosity, nicely delineating the reciprocal relations between subjective and objective, between the curious sensibility and curiosities, between wonder and wonders. At times it might have been helpful for the author to have transgressed the self-imposed limitation of examining literary representations and to have considered some formal accounts of curiosity as they occur in contemporary works of moral psychology in which this human propensity is carefully described and precisely located among the other affections. Without more direct information about the contemporary taxonomy of the affections curiosity too easily shades into wonder, credulity, greed, avarice, and acquisitiveness. In short, the relations of curiosity with its neighboring affections—the subtle transformations of which constituted an integral part of the changing status of curiosity—could perhaps have been more finely drawn. This, however, is a minor issue. Benedict has written a good book on an important topic, not least for historians of science because it clearly shows how the eventual establishment of the social respectability of curious individuals and objects was an essential phase in the legitimation of natural history and natural philosophy.

PETER HARRISON

Claire Richter Sherman. *Writing on Hands: Memory and Knowledge in Early Modern Eu-*

rope. Edited by **Claire Richter Sherman** and **Peter M. Lukehart.** With contributions by **Brian P. Copenhaver, Martin Kemp, Sachiko Kusukawa,** and **Susan Forscher Weiss.** 278 pp., illus., bibl., indexes. Seattle: University of Washington Press, 2001. \$35 (paper).

This book is an expanded catalogue of an exhibit of mid-fifteenth- through seventeenth-century drawings, woodcuts, engravings, and etchings emphasizing hands as objects of study, as teaching tools, and as reflections of the human being. In addition, it contains an extended introduction by the curator of the exhibit, Claire Richter Sherman, and four essays by other contributors on pertinent topics: the hand as an instrument of the intellect, manual reckoning, music, and chiromancy (palmistry). These essays, which precede the catalogue itself, are only loosely connected to the exhibit, but each deals with its subject clearly and crisply.

In his composition on the hand as a means of expression, Martin Kemp traces the legacy of ancient thought as reflected in the various anatomical drawings from Leonardo through the detailed Bidloo prints. Kemp concludes that the hand remains “a prime mechanism for personal expression—for the manifestation of individual character and identity.” In the following essay Sachiko Kusukawa provides a succinct sketch of finger numeration, noting that a system alluded to by ancient authors was fully described by the Venerable Bede in the eighth century. Bede also wrote of a method of using the hand as a mnemonic aid in determining the proper date for Easter and other movable feasts. Finger counting remained popular throughout the Middle Ages but gradually fell into disuse in the West by the sixteenth century and was merely quaint by the eighteenth. Kusukawa does not, unfortunately, suggest a reason for the decline, but the spread of computation with Arabic numerals was surely a major factor.

Next, Susan Forscher Weiss discusses the use of the hand in teaching music theory and scales. Although there are some indications of this practice in antiquity, variations on a system developed in the eleventh century by Guido of Arezzo were used to teach music through the sixteenth century. Finally, Brian P. Copenhaver discusses the history of the pseudoscience chiromancy (palmistry). Already in existence in antiquity, palmistry, and other forms of divination, flourished despite the prohibitions of the church. Copenhaver concludes with a witty discussion of the hard times on which palmistry has fallen recently in California.

As for the catalogue, it consists of eighty-three monochrome illustrations, each with an extensive commentary about the artist, the subject, and the reason the item was included in the exhibit. These descriptions are frequently fascinating short essays in themselves, enticing the reader to investigate further. The organization is thematic rather than chronological, with six divisions (which do not directly correspond to the preceding essays): "Reading the Writing on Hands," "Handiwork of the Creator," "Messengers of the World," "Knowledge on Hand," "Whole World in the Hand," and "Guiding Hands." The faults are minor. Although the themes of the divisions themselves are clearly described in Sherman's introduction, several of the illustrations seem to have only a general association with the stated theme. A few are filled with details too small to be legible in the necessary reduction of plates to fit the book. Most of the illustrations, however, are excellent examples of the main subject of the exhibit and are fascinating studies in their own right.

Generally, this volume is a valuable work for anyone interested in the history of the hand in science and the arts. The four prefatory essays are particularly instructive, and the prints are reproduced clearly, with elaborate descriptions of their historical context and their meaning. Accordingly, this book is much more than merely a catalogue; it is an important work in its own right. Throughout, the substantial references to other works indicate directions for further study. One only regrets that the exhibit itself was shown in only two venues.

RICHARD S. WILLIAMS

Francisco Hernández. *The Mexican Treasury: The Writings of Dr. Francisco Hernández.* Edited by **Simon Varey**. Translated by **Rafael Chabrán**, **Cynthia L. Chamberlain**, and **Simon Varey**. xxii + 281 pp., frontis., illus., index. Stanford, Calif.: Stanford University Press, 2000. \$65.

Simon Varey; Rafael Chabrán; Dora B. Weiner (Editors). *Searching for the Secrets of Nature: The Life and Works of Dr. Francisco Hernández.* xviii + 229 pp., frontis., illus., index. Stanford, Calif.: Stanford University Press, 2000. \$60.

Mauricio Nieto Olarte. *Remedios para el imperio: Historia natural y la apropiación del Nuevo Mondo.* 280 pp., illus. Bogotá: Instituto Colombiano de Antropología e Historia, 2000.

History and historians have not been kind to Francisco Hernández. Hernández was a sixteenth-century physician steeped in classical learning whom Philip II sent to the New World to study new exotic plants for the royal pharmacy. A typical humanist who befriended such luminaries as Benito Arias Montano and Francisco Valles, Hernández went well beyond Philip II's request and put together a mammoth natural history of New Spain that took seven years (from 1570 to 1577) to complete and included descriptions of some 3,000 new species of plants (compared to some 350 inventoried by Theophrastus, 500 by Dioscorides, and 600 by Islamic botanists). The financially strapped Philip II ordered the court physician Nardo Antonio Recchi to come up with a synthesis of Hernández's eleven-volume illustrated natural history. The Academy of Lincei published Recchi's shortened version in Rome some seventy years later, with glosses and commentaries. To make things worse, in 1671 Hernández's eleven volumes burned up in a great fire at the library of El Escorial. Fortunately, however, many copies of Hernández's manuscript had long been circulating in Mexico, Spain, Holland, and Britain, and they surfaced periodically, particularly in works by Gregorio López (ca. 1583/publ. 1678), Juan Barrios (1607), Francisco Ximénez (1615), Johannes de Laet (1625, 1630, 1633), Georg Margraf (1648), Juan Eusebio Nieremberg (1635), Robert Lovell (1659), Henry Stubbe (1662), Hans Sloane (1707–1725), James Newton (1752), and James Petiver (1715). This maddening history of Hernández's manuscripts has not been well understood, nor has the scholarship on his life and works been historically sensitive. Hailed from the eighteenth-century onward as the epitome of modernity in Spain and Mexico, a model for local scientists to emulate, Hernández has systematically been read out of context.

This situation has, fortunately, begun to change. Thanks to the patient work of scholars such as José M. López Piñero, José Pardo Tomás, Rafael Chabrán, Simon Varey, and Jesús Bustamante, we are now beginning to understand the complex history of the dissemination (and survival) of Hernández's manuscripts in Europe and the New World and the humanist culture in Spain that made his work possible. The two handsome volumes published by Stanford go a long way toward making this new scholarship available to English-speaking audiences.

The Mexican Treasury offers readers a thoughtful selection of some of Hernández's writings. It includes pieces drawn from his extant manuscripts as well as selections from several of the authors who in the course of the sev-

enteenth and eighteenth centuries copied his writings. Although the selection privileges Hernández's natural history, it also includes a translation of his correspondence with Philip II and Arias Montano, his will, his *Christian Doctrine* (a pedagogical poem he wrote while in Mexico summarizing the tenets of Catholic theology), and excerpts from his treatise on Mexican antiquities. Although these selections clearly encourage contextual readings of his work, they do not go far enough. We know, for example, that Hernández translated and glossed Aristotle, Pliny the Elder, and Pseudo-Dionysus. He also wrote essays on Stoic philosophy. Samples of these writings should have been included as well.

The accompanying volume, *Searching for the Secrets of Nature*, seeks to put Hernández in his appropriate historical context. Several essays in this collection are particularly insightful. Peter O'Malley Pierson presents Philip II not as an obscurantist monarch but as a patron of natural philosophers whose generosity was always limited by a bankrupt treasury. Rafael Chabrán locates Hernández in the philological and experimental traditions of Spanish humanism that thrived at the Universities of Alcalá de Henares and Valencia. Hernández found in Nahuatl etymologies and taxonomies an alternative to the botanical classifications of Dioscorides. He also sought to confirm the medical virtues of plants through clinical trials. Guenter B. Risse offers an enlightening study of sixteenth-century Mexican hospitals, where local shamans introduced Hernández to Nahua botanical knowledge and where Hernández carried out his clinical research. Essays by Lopez Piñero and Pardo Tomás and by Chabrán and Varey painstakingly reconstruct the history of the dissemination of Hernández's manuscripts in Mexico, Spain, Britain, and the Netherlands. Finally, Jaime Vilchis highlights the importance of understanding Hernández's Neoplatonic and Stoic writings to comprehend why he went to Mexico in the first place. Although Hernández still remains a poorly understood figure, these two volumes help dissipate the fog enveloping his life and work.

The publications on Hernández are a trickle when compared to the numerous new studies on eighteenth-century Spanish botanical expeditions. Mauricio Nieto Olarte's *Remedios para el imperio* is one example of this new literature. Building on the scholarship of Francisco Puerto Sarmiento, Nieto Olarte describes the control exercised by the guild of apothecaries of Madrid over the largest expeditions in eighteenth-century Spanish America, namely, those that went to Mexico, Colombia, and Peru. Unlike the

Swedes, who, as Lisbet Koerner has persuasively shown, sought economic autarchy through a plan spearheaded by Linnaeus and his disciples of import substitution, Spaniards sought to break Dutch and British monopolies of valuable medicinal plants and to keep their own (e.g., the cinchona tree). Drawing on the insights of Bruno Latour, Nieto Olarte also seeks to show how naturalists and apothecaries, using the visual techniques encouraged by the new Linnaean taxonomy, colonized the pharmaceutical knowledge of the indigenous peoples of the Americas, transferring it to their metropolitan headquarters. Creole naturalists of the national period blindly followed the same colonialist strategies of their Spanish predecessors. Nieto Olarte's book, then, is welcome as a good synthesis of recent scholarship on Spanish botanical research in the New World during the Enlightenment.

JORGE CAÑIZARES-ESGUERRA

Molly McClain. *Beaufort: The Duke and His Duchess, 1657–1715*. xviii + 262 pp., illus., bibl., index. New Haven, Conn./London: Yale University Press, 2001. \$35.

In a study based on archival research and imaginative reconstruction, Molly McClain tries to prove that the political and personal activities of Henry Somerset, third marquis of Worcester and first duke of Beaufort (1629–1700), and his wife, Mary Capel Somerset (1630–1715), demonstrate the transformation of the aristocracy in the Restoration period. Her work seems to embrace the thesis of Theodore K. Rabb in *The Struggle for Stability in Early Modern Europe* (Oxford, 1975) about the “crisis of the seventeenth century” and its resolution in confidence and stability later in the century, but in this case, as in many others, McClain fails to present the evidence and analysis necessary for such an assertion.

According to McClain, the duke of Beaufort became a rationalist in his pursuit of certainty, while the duchess turned to empiricism (and religion) for her peace of mind. The Copernican landscape of their estate at Badminton in Gloucestershire was the expression of Beaufort's quest to order the world. His wife collected a vast number of plants and seeds, housed in a greenhouse at Badminton, and patronized some of the most important naturalists and botanists of her age, including Sir Henry Sloane. With their help, she assembled a twelve-volume herbarium, which was used by John Ray in his botanical taxonomy.

Mary Somerset, who suffered from periodic

bouts of depression, found in plants the expression of God's providence and, according to McClain, was led through contemplation of the physical world to the experience of God's grace. Unfortunately, rather than linking this argument with the many modern works that have sought to understand the relationship of science and religion in the late seventeenth century, McClain uses Scripture and unsupported speculation to bolster her argument.

If McClain had developed these themes, contextualized them, supported them with more evidence, and enhanced them with reference to the secondary literature, this book might have proved of interest to historians of science. Instead, it is largely devoted to detailed political and local history. Her discussion is historically anachronistic, echoing an earlier generation of scholars who rarely considered social and cultural questions.

A large part of the problem with the book is its meager footnote citations and an extremely limited bibliography. One can only hope that this is an expression of the writer's lack of experience rather than a dictate of Yale University Press. If the book was intended for a popular audience, these omissions would be understandable; but presumably that is not the expected constituency.

Or perhaps it is. McClain has a curious tendency to introduce the rhetoric of romance novels into her discussion. What are we to make of statements like the following: "Their marriage was held together by a strong sexual passion which their letters hint at, but never reveal. We can only imagine what it must have been like for them to spend their nights in a dark bedchamber hung with tapestries and warmed only by a fire" (p. 27)? Probably most historians would not like to dwell on this question, and they would be better off avoiding the duke and duchess of Beaufort, and their expositor, entirely.

LISA T. SARASOHN

Peter N. Miller. *Peiresc's Europe: Learning and Virtue in the Seventeenth Century*. xv + 234 pp., frontis., illus., fig., index. New Haven, Conn./London: Yale University Press, 2000. \$40.

In his 1641 biography of Nicolaus-Claude Fabri de Peiresc (1580–1637), Pierre Gassendi declared that all learned men acknowledged that the most noble Peiresc "had seized the glory of kings" (*The Mirrour of True Nobility: Being the Life of the Renowned Nicolaus Claudius Fabricius Lord of Peiresc*, trans. W. Rand [Humphrey Moseley, 1657]). For Gassendi and his circle of savants, Peiresc, in his public life a member

of the Parlement of Provence, was the pattern of beneficence and learning, heroic in his virtue, his magnificent mind, and his care for scholars and scholarship. Peter N. Miller, in his profound and riveting study of what might be called the Peirescian moment of European intellectual life, asks why this grand figure, the hero of his age, was subsequently almost entirely forgotten—or at best considered the model pedant.

Peiresc was an antiquarian who investigated the physical remains of the past with delight and perspicacity. He felt that the past offered lessons to the present and that the constitution of the contemporary state could not be understood without a comparative and comprehensive survey of former times and places. Through a far-flung network of correspondents and friends Peiresc collected his observations, although most of his resulting work remained unpublished. Peiresc, Miller observes, was engaged not only in a prodigious intellectual feat but in a moral discipline teaching "the virtues of constancy, conversation, friendship and beneficence" (p. 11).

Among Peiresc's friends were Galileo, Hugo Grotius, Peter Paul Rubens, Marin Mersenne, Italian humanists, Catholic prelates, Protestants, and Jews. He subscribed, according to Miller, to an irenic religiosity in which reason revealed basic religious truths that could be accommodated to all other belief systems. Miller credits neo-Stoicism as the animating force behind this religious minimalism that flourished briefly in the middle of the sectarian excesses of the Wars of Religion. Broadly speaking, Stoicism taught and confirmed the virtues of constancy, duty, generosity, and friendship and provided the moral economy for a learned and tolerant civil society.

Miller uses Peiresc as a touchstone for his time but also as the point of departure for discussing the thought of others, both before and after Peiresc, who held similar beliefs and pursued similar interests. It is only here that Miller's analysis falters. Disembodied minds require some social context, and Miller's traditional intellectual history does not provide enough.

This limited approach is particularly true of his analysis of friendship, gratitude, and ingratitude—terms with important seventeenth-century social meanings as well as Stoic connotations. Peiresc was not simply a disinterested Maecenas of learning; he was also the center of a patronage network bringing him honor and power within the intellectual community.

Neo-Stoicism as a category also needs to be problematized, a fact Miller acknowledges in his footnotes but rarely addresses in the text. Other ancient traditions informed the thought of the

early seventeenth century, most notably skepticism and Epicureanism—which was rehabilitated by Gassendi at the same time he wrote his *Life* of Peiresc. The most recent historiography of these movements is largely absent from Miller's study. Thus his analysis would have benefited from a broader investigation of both the social and the intellectual context of the Peirescian world.

Nevertheless, one can only be awed by Miller's vast if somewhat idiosyncratic erudition. His mastery of the sixteenth- and seventeenth-century neo-Stoic sources is immense and his integration of echoes of these themes into later centuries is provocative. His conclusion that the polymath Peiresc could seem only a pedant to Enlightenment figures who idolized the practitioners of the New Science, or who valued the polite gentleman over the learned scholar, is perhaps too sweeping. Nonetheless, Miller shares the attributes of his seventeenth-century subject: learning, curiosity, and the ability to penetrate and befriend the minds of those both past and present.

LISA T. SARASOHN

Paul Wood (Editor). *The Scottish Enlightenment: Essays in Reinterpretation*. (Rochester Studies in Philosophy, 1.) xii + 399 pp., illus., tables, index. Rochester, N.Y./Woodbridge, U.K.: University of Rochester Press, 2000. \$75.

Ten of the twelve essays in this fine collection treat subjects that are relevant to any reasonably comprehensive understanding of the nature of the history of science. The first four essays are either completely or largely historiographical. Each explores the extent to which the natural sciences have been, or should be, seen as central to the Scottish Enlightenment. As all four provide extended descriptive historiographies, there is extensive repetition here, but as the four also offer radically different answers, they are worth reading.

In the first essay Paul Wood argues that Dugald Stewart created an imaginary picture of the Scottish Enlightenment that has influenced almost all subsequent interpretations of the movement. These interpretations have promoted the idea that there was a coherent "Scottish school" of philosophy of which David Hume and Francis Hutcheson were the cofounders; that the Scottish school emphasized moral philosophy and social theory; and that it included figures from Glasgow, Edinburgh, and Aberdeen. Wood claims that Stewart downplayed the relationship between natural knowledge and social theory, except for some minor methodological commonalities, for several reasons. In part, he desperately

wanted to maintain the mind-body dualism that characterized the Scottish school. In addition, his main statement on the Scottish Enlightenment appeared as an essay on the history of the progress of metaphysics and morals that was paired with John Leslie's essay on the progress of the natural sciences in the supplement to the fourth edition of the *Encyclopaedia Britannica*, and he was simply responding to the limits of his assignment. Regardless of his motives, one major consequence of Stewart's approach has been the exclusion of the natural sciences from a central role in most subsequent interpretations of the Scottish Enlightenment not written by historians of science—an exclusion Wood laments.

The second essay, by John Robertson, seems, on one level, almost designed to prove Wood's main point, for it explicitly denies natural science a significant role. For Robertson, moral philosophy, history, and, above all, political economy are at the core of Scottish concerns. He departs from Stewart, however, by insisting on a fundamental opposition between Hume and Hutcheson and by arguing that the Scottish Enlightenment would be better understood as part of a broader European Enlightenment, with less patriotic fervor about Scots exceptionalism.

Richard Sher's essay on what book history can tell us about science and medicine in the Scottish Enlightenment is remarkably insightful and illuminating; it left me waiting with great anticipation for his book-length study on the subject. Although Sher rejects Roger Emerson's claims that the natural sciences were the driving force for the Enlightenment in Scotland, he insists that science and medicine were important. He then goes on to suggest a series of fascinating ways in which characteristics of the book trade both shaped and can illuminate the place of science.

Among the other essays likely to interest historians of science are those by Anita Guerrini, John Wright, and Fiona MacDonald. These authors explore aspects of medical theory and medical care in very different but very illuminating ways. (MacDonald's empirical analysis of admissions' patient care at the Glasgow Town's Hospital Infirmary from 1733 to 1800 departs most from the traditional history of ideas pattern that dominates many of the other essays.)

One other related set of essays consists of pieces by James Moore, Christopher Berry, and Alexander Broadie, all of which focus on aspects of the theorized relationship between science and religion. Here, the major theme is the difference in emphases between those who followed the ancient materialists in seeing fear as the primary motive in the origins of religion and those who

emphasized some version of the design argument.

This volume provides a good introduction to the current state of interpretations of the Scottish Enlightenment, and its special emphasis on the place of science among eighteenth-century Scottish intellectuals should make it attractive to many readers of *Isis*.

RICHARD OLSON

■ Modern (Nineteenth Century to 1950)

Charles W. Curtis. *Pioneers of Representation Theory: Frobenius, Burnside, Schur, and Brauer.* (History of Mathematics, 15.) xvi + 287 pp., illus., apps., bibl., index. Providence, R.I.: American Mathematical Society, 1999. \$49.

Charles W. Curtis is a prominent mathematician who has made important contributions to the field of representation theory. His textbooks in this field (written in collaboration with the late Irving Reiner, to whose memory the present book is dedicated) have been classics for a long time. In *Pioneers of Representation Theory* he has set out to present the historical development of the main ideas of the discipline, from the work of Georg Ferdinand Frobenius in the 1890s up to 1960. In addition to Frobenius, the book focuses mainly on three other “pioneers”: William Burnside, Issai Schur, and Richard Brauer.

Curtis states that his interest in the history of representation theory arose gradually, and jointly with that of Reiner, in the process of writing their textbooks. Thus, a main aim of the book is to show how the pioneers reached their important results while using only the mathematics then available to them. In order to do so, Curtis presents successive and thorough accounts of the works in which the new and seminal ideas of the pioneers were introduced and then developed. At the same time, however, he simplifies some of the original arguments by translating them into modern terminology.

In an attempt to make the book appealing and accessible to a wider circle of potential readers, some of the necessary mathematics is explained. Thus Chapter 1 presents an introduction to the basic ideas and problems of nineteenth-century algebra and number theory; later on, as the need arises, additional mathematical sections addressed to nonexperts are included. Of course, even this very clear presentation will be accessible only to readers with at least a graduate-level knowledge of algebra.

Curtis also attempts to provide some historical context. He is particularly concerned to clarify the

main problems that the work of each of the mathematicians discussed here was originally meant to resolve. In a book of this kind (i.e., a technically detailed historical overview of a particular mathematical discipline) this is surely one of the major benefits that the reader may expect to obtain.

There are biographical sketches of the major figures involved, as well as additional information about other participants. Some illuminating documents are quoted, and Curtis supplies brief accounts of the mathematical traditions within which each of the pioneers was educated and worked. He acknowledges, however, that *Pioneers of Representation Theory* has only a limited claim as a work of historical research. He thus provides references to more historically oriented work that interested readers can consult. In particular, he mentions several articles by Thomas Hawkins; it should be stressed that much of Hawkins’s work has recently been published in book form: *Emergence of the Theory of Lie Groups: An Essay in the History of Mathematics, 1869–1926* (Springer, 2000). Curtis’s and Hawkins’s books complement each other in many important ways, and each should appeal to readers of the other.

Charles Curtis has written an impressive, authoritative, and well-informed book on a difficult subject. Mathematicians and historians of twentieth-century mathematics with the relevant background will find it difficult but rewarding reading. Along the way, historiographical questions may arise. To what extent is it possible to translate, as Curtis does, the original proofs of the pioneers into more modern terminology and yet remain faithful to the sources? In most cases, however, it will require the technical expertise of the author himself to answer questions like this one properly. We can only hope that the firm starting point this book provides will lead Curtis to further historical research in this and related fields.

LEO CORRY

William Rowan Hamilton. *Mathematical Papers of Sir William Rowan Hamilton.* Volume 4: *Geometry, Analysis, Astronomy, Probability and Finite Differences, Miscellaneous.* Edited by **Brendan Scaife.** (Cunningham Memoir, 16.) x + 842 pp., frontis., figs., bibl., indexes. Cambridge/New York: Cambridge University Press, 2000. \$150.

William Rowan Hamilton was not a tidy mathematician. When he had to host a formal dinner party at the observatory, it took him two days to clean up the dining room, and he achieved that

only by stuffing his papers into bags and baskets and shoving them under the beds. He did try to reform. He kept much of his mathematical work in notebooks of all sizes, which he started from both ends, writing on only the right-hand page so that writing from the other direction appeared upside down on the left page. But then he would relapse and write on any blank spot that he could find. In 1924 the Royal Irish Academy set out to publish Hamilton's mathematical papers in four large volumes, which meant putting them into some kind of order. The first volume, on optics, appeared in 1931; the second, on mechanics, appeared in 1940; the third, on algebra, appeared in 1967; and now, after seventy-five years, we have the fourth and final volume, edited by Brendan Scaife. The academy is to be congratulated on having completed the publication of its most famous member's mathematical works.

This latest volume consists mostly of previously published but hard to find papers, including a few miscellaneous items of biographical interest, but it begins with three important unpublished manuscripts. The first item is *Part Third* of Hamilton's *Theory of Systems of Rays*. *Part First* of the *Systems of Rays*, which he published in 1827 and which first revealed his mathematical genius, contained a table describing the contents of all three parts, but the second two parts never appeared. Instead Hamilton published three lengthy *Supplements*. John L. Synge, one of the editors of the first volume of the *Mathematical Papers*, published *Part Second*, but no one could find *Part Third* because Hamilton never finished it to his satisfaction and therefore left it stirred in among his great mass of loose papers where it was difficult to identify. It is on extraordinary systems, a subject that he developed much further in his *Third Supplement* (1832) where he predicted the phenomenon of conical refraction in biaxial crystals.

The other two manuscripts are three very long "letters," two to Augustus De Morgan on definite integrals and differential equations and one to Andrew Hart on anharmonic coordinates. These three letters written between 1858 and 1860, toward the end of Hamilton's life, make up almost four hundred pages of the printed text! At the time he wrote these letters Hamilton was trying to finish his *Elements of Quaternions*, which kept expanding beyond his control and was causing him serious financial difficulty. His desperate efforts to nail down his legacy caused him to spin out page after page of heavy mathematical calculation, much of which never came to a conclusion. The *Elements of Quaternions* was still

incomplete at his death and was published posthumously in two volumes by his son.

The rest of Volume 4 of the *Mathematical Papers* consists of published articles on geometry, analysis, astronomy, probability, and miscellaneous subjects. The volume closes with a chronological list of Hamilton's works, an index to this fourth volume, and a combined index to all four volumes. Scaife has done a good job of editing. He identifies all persons mentioned and adds helpful notes on the provenance of the manuscripts. He has not, however, attempted to repeat the long introductions and analytical appendices that appear in the previous three volumes. The reader will be on his or her own in what is often a sea of mathematical confusion.

Probably of greatest interest to potential purchasers of this volume is a CD inside the back cover that includes all four volumes, so by buying this one volume one has access to the entire set. The CD is an omen of things to come. This is probably one of the last efforts to publish the collected works of an important mathematician in a beautiful hardcover edition. It is a fitting tribute to an extraordinary man and a great mathematician.

THOMAS L. HANKINS

Bruce Collier; James MacLachlan. *Charles Babbage and the Engines of Perfection*. 123 pp., illus., figs., tables, apps., bibl., index. New York/Oxford: Oxford University Press, 2000. \$11.95 (paper).

Oxford University Press proudly announces: "Now, for the first time, Oxford offers the general public a series of readable accessible biographies of great scientists." Included among the chosen great men (and two women) is Charles Babbage, described on the back cover of this book as "a dazzling genius with vision extending far beyond the limitations of the Victorian age." Well, I'm not quite sure what this means, and unfortunately our understanding of Babbage and his historical context is not greatly illuminated by this short book.

Bruce Collier and James MacLachlan have produced an uncritical biography of Babbage that glorifies him as "the Grandfather of the modern computer" rather than shedding new light on his work within the context of nineteenth-century England. Partly, no doubt, this is due to the remit of this Oxford series and its targeted audience. It is good that history of science and technology is being taken to a wider audience, but unfortunately very little is made of the work many historians have already done. The

book, however, does do a useful and lucid job of describing the aims and workings of both the Difference and Analytical Engines, and it has helpful sidebars describing some of the technical aspects necessary to understanding Babbage's objectives and resources.

Overall, however, historians may find the eulogizing and whiggish approach of this book a little irritating. The authors are prone to a number of ungrounded remarks, such as the allegation that the government was misguided to pay nearly £300,000 for Marc Brunel to build a tunnel under the Thames, in comparison to the "stingy" amount given to Babbage to build his Difference Engine (p. 49). To make judgments about past events from the concerns of the present is not particularly fruitful. It was not at all clear to contemporaries that Babbage's engine was worth investing in or, indeed, was possible within the technological parameters then available. As such, perhaps a more interesting question would be: How did Babbage manage to get as much public money as he did in the first place? The authors would have been far more helpful had they actually related industrial Britain to the work of Babbage.

Throughout this book readers will be constantly reminded of Babbage's prophetic genius. For example, on page 63 we learn that he devised a scheme to replace the transport of mail by road with a system of elevated wires carrying letters in a metal container between London and Bristol. This inspires the authors to remark: "Babbage would certainly have been overjoyed by e-mail, by which electronic symbols are transported all over the world in the blink of an eye." Could it be that Babbage was also the great grandfather of electronic mail? On page 65 we learn that he was also the originator of the idea of having "black boxes" used to record information in case of train or aircraft crashes, while a few pages later the authors reflect: "imagine how much Ada [Lovelace] and Charles would have loved word processing, spreadsheets, and databases!" Some people will no doubt delight in such speculations, and who am I to sour the story? As such this is a useful introduction to twentieth-century Babbage.

WILLIAM J. ASHWORTH

Septimus H. Paul. *Nuclear Rivals: Anglo-American Atomic Relations, 1941–1952.* x + 266 pp., bibl., index. Columbus: Ohio State University Press, 2000. \$42.50.

The United States probably would not have gambled \$2 billion on its Manhattan Project in World

War II without the "MAUD Committee" report by British scientists in the summer of 1941, which concluded that only pounds—not tons—of fissionable material might yield a nuclear explosion. And once the project was under way, friendly but secretive wartime agreements by President Franklin D. Roosevelt and Prime Minister Winston S. Churchill laid plans for the two allies to collaborate on nuclear weapons development and decisions.

Why, then, is Britain best remembered for giving the Manhattan Project its first spy and its first dissenter? In popular history, the British delegation to Los Alamos included Klaus Fuchs, who passed American bomb designs to the Soviet Union, and Joseph Rotblat, who quit when he saw that his work would not be used defensively against Germany but offensively against Japan. (Fuchs confessed to spying in 1950. Rotblat shared the Nobel Peace Prize in 1995.) In fact, there was much more activity in American-British atomic relations, an engaging story explained in rich detail by Septimus H. Paul, a history professor at the College of Lake County in Grayslake, Illinois. Paul blends exhaustive and wide-ranging research in a clear, coherent style, punctuating his account with dry wit and historical insight.

Unfortunately for historians of science, there is little technical detail in Paul's account of these fateful years. We never learn just what scientific contributions Britain's MAUD Committee members and Los Alamos visitors made, nor do we appreciate the independent allied research by the British and French in Canada during the war. Paul does note that by withholding information the United States left its allies with no choice but to develop different nuclear reactors: Canada's heavy-water and Britain's gas-cooled designs. But Paul's admirable achievement is to untangle the many complex diplomatic, bureaucratic, and political intrigues that shaped atomic science.

Paul explains how the personal bond between Roosevelt and Churchill yielded secret agreements at Quebec in 1943 and at Hyde Park in 1944, yet neither of their successors (Harry S. Truman or Clement Attlee) learned about those pacts until months after taking office in 1945. Equally fascinating is Paul's account of the bureaucratic intrigues behind the president and prime minister—engineered in Great Britain by Lord Cherwell, Churchill's science advisor, and in the United States by science administrators Vannevar Bush and James Conant, by the Manhattan Project's military leader, General Leslie R. Groves, and by Lewis L. Strauss, an aggressively anti-Soviet member of the Atomic Energy Commission. Legislative politics also played a

fractious role. In London, Churchill (as opposition leader against Attlee) strained to reassert British influence; in Washington, Senator Brien McMahon created and dominated the joint committee on atomic energy, striving with Senators Bourke Hickenlooper and Arthur Vandenberg to protect U.S. nuclear secrets from all foreigners.

Still, incentives to cooperate persisted throughout the 1940s and 1950s, with the United States coveting Britain's uranium stockpile as if it were an "atomic colony" (p. 147) and Britain craving technical information and international prestige. But it was the spies who ultimately doomed real collaboration, making the U.K. an untrustworthy ally until there were no more secrets to protect. In 1950–1951, scandals surrounded Fuchs's arrest and Bruno Pontecorvo's defection to Moscow. Paul argues that while U.S. and U.K. cooperation barely survived these ruptures, trust was lost finally when Guy Burgess from the British Embassy in Washington and Donald Maclean, head of the American Department at the Foreign Office, also defected to Moscow. Only after the United States, the USSR, and the United Kingdom all had independently developed nuclear and thermonuclear weapons did the U.S. Congress amend the Atomic Energy Act in 1958 to grant the president legal authority to exchange information on atomic and hydrogen bombs, at last allowing full Anglo-American atomic cooperation.

WILLIAM LANOUILLE

Ruth H. Howes; Caroline L. Herzenberg. *Their Day in the Sun: Women of the Manhattan Project.* (Labor and Social Change.) Foreword by **Ellen C. Weaver.** viii + 264 pp., illus., apps., bibl., index. Philadelphia: Temple University Press, 1999. \$34.50.

This book reminds us in yet another context that women's contributions to science can be rendered invisible by "the historical record." The Manhattan Project, the supersecret midcentury United States research, development, and production enterprise that produced the nuclear bomb, was a massive undertaking, at one time employing 130,000 persons. About 10 percent were women, yet official histories made no mention of female scientists or engineers.

Sleuthing by the physicists Ruth Howes and Caroline Herzenberg has documented Manhattan Project contributions by more than three hundred women. Howes and Herzenberg begin with a few well-known European women pioneers in nuclear science ("The Founding Mothers": Marie Curie, Mileva Marić, Irène Joliot-Curie, Ida Nod-

dack, and Lise Meitner), none Americans and none available for the U.S. bomb effort. They then recount the history of the Manhattan Project via biographical vignettes of women, organized in chapters: "The Physicists," "The Chemists," "Mathematicians and Calculators," "Biologists and Medical Scientists," "The Technicians," and "Other Women of the Manhattan Project."

It appears that few of these women knew each other. In her foreword, Ellen Weaver writes: "When I read the personal reminiscences of the men who were nuclear pioneers, I'm struck by the importance they place on their friends and associates, and on the often intense interaction among them, which could lead to major insights in both theory and practice of science. And I'm a bit jealous. By and large, women did not share in that give-and-take."

Not only was there little networking among women scientists and technicians in the early 1940s while the bomb was being developed, but there was little opportunity for them to share their experiences later. Only a very small percentage of these women were able to continue their professional careers. The many barriers to women as professional scientists and engineers, temporarily lowered owing to the manpower shortages of wartime, were raised after the war. There did not develop a community of women, engaged in teaching and research, with roots in the Manhattan Project.

A web page is being developed to gather and provide further information about the women scientific workers of the Manhattan Project. Howes and Herzenberg are setting up an on-line archive there, hoping that others who have information about the women scientific workers of the Manhattan Project will contact them via the web page (www.geocities.com/CapeCanaveral/Lab/9137/Manhattan_Project_women.html) or by email (rhowes@bsu.edu or herzenbc@anl.gov).

The magnitude of their endeavor to learn about these women was illustrated vividly to me while writing this review. I attended the memorial service for my aunt, Mary Matilda Morrison Pendleton (1908–2000), and heard in her eulogy that "she worked as a nurse at the Hanford project, near Richland, Washington, where the government was secretly making atomic bombs. She would work shift work, two weeks of day shift, two weeks of swing shift, two weeks of graveyard shift, then she would get seven days off. She wore a badge every day that was checked after each day's work to see how much she had been radiated." Although I thought that I knew her well, my aunt's role in the Manhattan Project had been unknown to me.

The women of the Manhattan Project are finally gaining visibility. For example, Nancy Cook Steeper's book-length biography of Dorothy Scarritt McKibbin ("the gatekeeper to Los Alamos") is being published by the Los Alamos Historical Society. Howes and Herzenberg have provided ideas and starting points for many additional biographical projects. Perhaps the greatest long-term value of their book is the impetus that it will give to further research.

The book is well written, easy to read, and attractively printed. An appendix, listing the women and their roles, and a thorough index combine to make this an easily used reference work. There is also an informative sixteen-page chronology that focuses on the crucial period from 1938 through 1945.

GEORGE FLECK

Patricia S. Whitesell. *A Creation of His Own: Tappan's Detroit Observatory*. xx + 236 pp., frontis., illus., figs., apps., bibl., index. Ann Arbor: University of Michigan Press, 1998. \$48, £37.50 (cloth); \$24.95, £18.95 (paper).

Histories of observatories are generally celebratory and narrowly focused, useful primarily for the data they include, such as staff lists, and of limited interest. There are exceptions, where the authors have used the history of the observatory to illuminate larger themes in the history of science and place the observatory's history in a larger context. For American astronomy, the work of Mary Ann James on the Dudley Observatory and Donald Osterbrock on Yerkes and Lick comes immediately to mind. In addition, the authors of this second type of observatory history bring unequaled knowledge of the archival records to bear in their analysis.

The Detroit Observatory of the University of Michigan was one of the most important American astronomical observatories during the third quarter of the nineteenth century. Under its first two directors, Franz F. E. Brünnow and James Craig Watson, the observatory was an essential conduit in the transfer of German astronomical techniques to the United States. After Watson's departure in 1879, it was quickly eclipsed by a new generation of observatories. In 1980 Howard Plotkin discussed the role of Brünnow and Henry Philip Tappan, the first president of the University of Michigan (1852–1863), in this transfer in an article in *Annals of Science*. Patricia Whitesell, the director of the observatory and a specialist in historic preservation, has written a celebratory volume that both expands upon Plotkin's work by providing additional details

and commemorates the recent physical restoration of the building. Written in anticipation of the sesquicentennial of the completion of the observatory in 2004, *A Creation of His Own* is a celebration of the vision of Tappan, who was truly the father of the observatory. Whitesell, like Plotkin, places the transfer of German astronomical techniques to the United States within a larger context of increasing American intellectual appreciation for things German, especially Tappan's desire to model American higher education after that of Prussia.

Whitesell's contributions are those typical of the celebratory history of an observatory. She provides very useful appendixes, uncovers details, and corrects earlier errors regarding the history of the observatory. Of particular interest are the photographs she has included. Some of them are historical, while others document the restoration of the observatory. Many are published for the first time. Very few observatory histories can boast photographs of this quality and quantity.

On the negative side, Whitesell has included more detail than most readers will want about such individuals as the artist who produced an 1855 painting of the observatory, the architect of the observatory, and the maker of the telescope. Readers should also be aware that Whitesell has made errors in describing historical events outside the campus of the University of Michigan. They are minor, but annoying. For example, on page 150, in discussing the Dudley Observatory, she confuses the board of trustees, who opposed B. A. Gould, with the Scientific Council, which supported him.

I am not a fan of the book's organization. Whitesell has ordered the chapters in a way that makes following the story rather difficult. For example, the chapter on the contributions of Watson, the second director of the Detroit Observatory, precedes the two chapters that discuss the departures of Brünnow, the first director and Watson's teacher, and Tappan from the university (Brünnow resigned shortly after Tappan's firing). The chapter on the physical renovations of the observatory and attempts to relocate it is also out of place, preceding the chapter on Watson. The chronology that Whitesell includes as an appendix is absolutely necessary to follow the history of the observatory.

All in all, despite some problems, this is a useful book.

MARC ROTHENBERG

Tom Standage. *The Neptune File: A Story of Astronomical Rivalry and the Pioneers of Planet*

Hunting. xiv + 240 pp., illus., figs., bibl., index. New York: Walker & Company, 2000. \$24.

In 1995 Walker & Company published a small book authored by the professional writer Dava Sobel entitled *Longitude: The Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*. Not only did the book sell exceptionally well; it also spawned a three-hour film, *Longitude*, starring Jeremy Irons and Michael Gambon, and a new, lavishly illustrated work, *The Illustrated Longitude*, by Sobel and Harvard's William J. H. Andrewes. It is difficult to think of another book in the history of science that has attained comparable success. Yet it seems that history of science journals have taken scant notice of the book; my efforts to locate reviews of Sobel's volume in history of science journals have turned up only a single review, that being in Italian. This is all the more distressing because the book and film present a very controversial view of Astronomer Royal Nevil Maskelyne. This is not the place to examine Sobel's recipe for success, but it seems relevant background in reviewing a book also written by a professional journalist, also published by Walker, and fairly comparable in format to Sobel's.

The history of science is rich in fascinating stories that could delight a variety of readers. The story of the search for longitude in the eighteenth century is certainly one of these; the dramatic quest to discover Neptune in the mid nineteenth century is another. Put overly briefly, the latter is the story of the frustrated efforts of a young, personally diffident but intellectually bold Cambridge graduate, John Couch Adams, to convince either the director of the Cambridge Observatory or England's Astronomer Royal to look for a planet that Adams's calculations had told him must be located at a specific position. It is also the story of the brilliant and arrogant Urbain J. J. Leverrier, who had independently completed comparable calculations and who beat Adams to the discovery by persuading not one of his French colleagues but an astronomer at the Berlin Observatory to launch a search, which within a few hours had located Neptune. It is also the story of the immense controversy that followed and that has in the last few years been given a new twist with the recovery of key documents carried off to Chile from the Royal Greenwich Observatory.

Tom Standage, science correspondent for the *Economist* and author of *The Victorian Internet*, has taken up the challenge of retelling the Neptune story, which had previously been treated in

dozens of articles and in book-length studies by John Pringle Nichol, Albert Glodin, Morton Grosser, and Patrick Moore. Moreover, Standage presents the Neptune narrative as the centerpiece in a story that stretches from William Herschel's discovery of Uranus to the discovery of Pluto in 1930 and even to the spectroscopic detection in the last few years of dozens of extra-solar system planets. Standage's clear and engaging prose is based on extensive reading in English and French sources, some manuscript work, and interviews with a number of the discoverers of extra-solar system planets. Although the book is bereft of footnotes, an annotated bibliography at its end partially fulfills their function. Numerous illustrations appear, but these tend to be rather dark and small.

Although the book is generally reliable, some significant errors appear. For example, whereas Standage reports (p. 6) that William Herschel did not see Uranus alter in size, Herschel observed its diameter nearly double in the two months after his first observation of it. It is John, not William, Herschel (p. 171) who is buried in Westminster Abbey. Benjamin Peirce's last name is misspelled (p. 157), as is Christiaan Huygens's first name (p. 182), and it is incorrect to say that Huygens "considered it was unlikely that there was life elsewhere in the solar system" (p. 183). Also, because Lowell Observatory director Vesto Slipher played such a major (arguably the key) role in the discovery of the planet Pluto by creating and directing the research program that enabled a recent high school graduate, Clyde Tombaugh, to be the first to recognize the planet on a photographic plate, it seems inappropriate that Standage makes no mention of Slipher in recounting (pp. 175–182) the discovery of Pluto.

Overall this is a highly engaging story, well told and based on good sources. One would hope that it may follow *Longitude* into film, at least a documentary, and that other authors and publishers will recognize the market for such exciting stories from the history of science.

MICHAEL J. CROWE

John E. Lesch (Editor). *The German Chemical Industry in the Twentieth Century*. (Chemists and Chemistry, 18.) viii + 472 pp., illus., figs., tables, index. Dordrecht: Kluwer Academic Publishers, 2000. \$176, £109, NLG 30.

"Farben Made Plans Prior to Sudeten Grab"; "Farben Aid to Nazis Listed; 53 U.S. Associates Named"; "Double-faced Men: Remarks on the Trial of I. G. Farben"; "Farben Forced Standard

Oil to Help Nazis' War Machine"; "Farben Called Vital Adjunct of World War"; "I. G. Farben Industrie: Dissolving the German Chemical Combine"—thus ran headlines in major British and American newspapers during 1947 as the behemoth I. G. Farben stood accused of complicity in war crimes and of waging Hitler's war. Yet only three decades earlier, in the midst of World War I, Farben's principal constituents—AGFA, BASF, Bayer, and Hoechst—were the foremost international exemplars of high-tech industry, held up by Allied scientists as models to be emulated in both war and peace. And from the 1950s on, the reincarnated firms once again occupied leading positions in the league of international manufacturers of chemicals.

The modern German chemical industry emerged in the 1860s with the creation of companies devoted to the production of coal-tar dye-stuffs; by the 1880s these companies had established industrial research laboratories and international marketing organizations. This much, at least, is known to generations of students of history of science from John J. Beer's seminal study *The Emergence of the German Dye Industry* (1959). Other scholars will be familiar with the industry through Joseph Borkin's *Crime and Punishment of I. G. Farben* (1978). These studies, however, present just two of the many facets of one of the most remarkable of science-based industries. Since 1990 or so, new material has become available: we now have a fairly complete history of nineteenth-century events, as well as a number of fine studies dealing with the I. G. Farben era and the aftermath in Germany. *The German Chemical Industry in the Twentieth Century*, a collection of papers presented at a conference of the same name held at the University of California, Berkeley, in 1997, represents the first attempt to provide an overview of how the German chemical industry operated throughout the twentieth century. The contributions focus in particular on the connections between academics and industrialists, Farben's influence in foreign, and especially non-European countries, and how the company came to terms with the Nazi era. The book is divided into three parts: the first deals with research and technological innovation, the second with international connections and comparative perspectives, and the third with the industry since 1945. The two introductory chapters provide a context for the thirteen essays by the scholars in science, technology, and business who participated in the conference.

The essays do not in any way pretend to constitute a broad or comprehensive history. In-

stead, they examine, often in great detail and taking advantage of recently available sources, some of the many complex issues connected with the history of the chemical industry in Germany. Among these issues are the relationships between leading academic and industrial chemists, industrial subsidies for academic chemistry, the place of "free scientific research" in industry, synthetic fuels, the impact upon and within the important U.S. and Japanese markets, the influence on the organization of British and other German industries, the decline in East Germany under Soviet domination, the technological gap that had to be filled as a result of the slow changeover from coal to oil, and the place of the present-day German chemical industry in the world arena. Foremost, however, is the connection between state and industry. Although two chapters examine the relations between Jews and non-Jews, none of the papers discusses what the expulsion of non-Aryans in the 1930s meant to the chemical industry. In closing, Raymond Stokes suggests further topics for research, including the effect of the industry on the environment, and draws attention to the fact that, as shown elsewhere by Peter J. T. Morris, even during the Nazi era the German firms remained highly innovative.

ANTHONY S. TRAVIS

Christine Hertler. *Morphologische Methoden in der Evolutionsforschung*. (Studien zur Theorie der Biologie, 5.) 364 pp., illus., figs., tables, bibl., index. Berlin: Verlag für Wissenschaft und Bildung, 2001. DM 48.

Christine Hertler has produced an extended work on the role of morphology in evolutionary thinking. Her book was originally her dissertation at the University of Frankfurt am Main, Germany. German dissertations have a tendency to be extremely detailed and systematized works, and Hertler's book is no exception. The whole book is divided into sections, subsections, and sub-subsections, thus cumulating letters and numbers that are a little overwhelming, more confusing than helpful, and quite difficult to follow with all those B.4.2.1s, etc.

Hertler starts with a lengthy introduction that considers "the methods of morphology" and "morphology and evolution." Then we find a section dedicated to "materials and methods" (with several subsections). Then Hertler moves to "results of systematic and historical reconstructions," a very lengthy part with the customary subdivisions that deals with all possible aspects of morphology and evolutionary theories,

including such diverse elements as Archaeopteryx, drosophila, and skeletal models. The next section, "Comparative Anatomy and Evolution," introduces Darwin and some of the major figures in the history of morphology and evolution. Thus we have first the contemporary developments of evolutionary morphology and then its historical origins.

This order of things is followed within this very section, so that Darwin is discussed before Georges Cuvier and Etienne Geoffroy St. Hilaire, something rather unsettling for historians. Luckily enough, Carl Gegenbaur, the key figure in evolutionary morphology, and Anton Dohrn come after Darwin. Ernst Haeckel is there as well but is rather peripheral and mainly relevant for his collaboration with Gegenbaur. The final section, "Discussion," restores historical order and starts with Darwin and *Darwinismus* and ends with modern morphology leading to an interpretation of evolutionary morphology.

Hertler is a biologist and it shows—her main concern is the status of today's morphology, and she approaches the morphologists of the past analytically rather than historically. The best result of her professional approach is her constant use of precise examples to illustrate the general problems treated in her book, as scientists are not content with general statements.

Hertler's knowledge of morphology is undoubtedly phenomenal, to say the least, but it is doubtful how profitable her book can be to historians of science except for the mass of details and specific information. Rather than a book on the history of science, her work is an example of "theoretical biology." From a historical perspective, one notices that she focuses on German morphology as if morphology were a uniquely German methodology; thus Richard Owen and T. H. Huxley are not there, but Owen was essential for Darwin's view of morphology and Huxley central in the debates around evolutionary morphology. Also Edwin Ray Lankester is overlooked.

The bibliography is good but far from being as exhaustive as one would expect of such a work. William Coleman's classic article on Gegenbaur's evolutionary revision of the type concept is not quoted, and Garland Allen's and Jane Maienschein's publications on the history of morphology are absent. Dietrich Starck, somehow an intellectual heir of Gegenbaur, is duly cited but only for some of his scientific production, while there is no mention of his masterly papers in the history of morphology. There is a subject index but no name index.

MARIO A. DI GREGORIO

Franklin W. Stahl (Editor). *We Can Sleep Later: Alfred D. Hershey and the Origins of Molecular Biology*. xii + 359 pp., illus., figs., tables, indexes. Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory Press, 2000.

We Can Sleep Later celebrates Alfred Hershey's personality, friendships, and scientific accomplishments. Hershey, a molecular biologist and ten-year director of the genetics research unit of the Cold Spring Harbor Laboratories, died in 1997; the essays in this book are adapted from a commemorative service held shortly after his death. Twenty-two of Hershey's scientific colleagues, including Franklin Stahl (the editor), James D. Watson, Gunther Stent, John Cairns, and Seymour Benzer, present their memories of Hershey as a collaborator, mentor, and editor. The final third of the book reproduces several of Hershey's articles on bacteriophage genetics, including his report on the "Waring blender" experiment (1952) that confirmed DNA's role as the material substance of heredity. Readers will also find Hershey's yearly reports from the genetics unit and a few philosophical essays on the nature of viruses.

Scientists remember Hershey for his role in the "phage group," a research community consisting of Hershey, Salvador Luria, Max Delbrück, and their followers and defined by their shared interests in bacteriophage λ as an experimental tool. The three leaders (unfortunately referred to by the essayists as the "saint," the "priest," and the "pope") shared the Nobel Prize in 1969 for their insights into genetic replication and the structure of viruses. Although the phage group's achievements have attracted much attention among historians of biology, Hershey initially received the least fanfare. Never a fan of scientific conferences or self-promotion, Hershey found his "Hershey heaven" by establishing consistent, reproducible experimental systems. Bacteriophage λ , once known among molecular geneticists as "naked DNA," became just such a system in his capable hands. Hershey's role in editing the first book-length guide to phage in 1971 ensured the model's continued usefulness and spread Hershey's reputation as a talented editor. His guidelines to authors, reprinted in the text, confirm his dedication to the clear, concise expression of ideas.

The essays depict a quiet man, fascinated by experimental method, whose wide-ranging interests seem to have escaped some of his well-meaning friends. When Hershey retired in 1972 at the age of 63, his decision to focus on gardening, music, computers, and sailing baffled

some of his colleagues. Sadly, many of the essayists—whose recollections generally end in 1971, or worse, with unanswered invitations to discuss phage in the garden—still lack an appreciation for Hershey's desire to live outside the laboratory. Rather than a tribute to the complete man, *We Can Sleep Later* is a testament to the staying power of the "phage school" in practitioners' origin stories of molecular biology. It is no coincidence that the book's subtitle, *Alfred D. Hershey and the Origins of Molecular Biology*, echoes that of the *Festschrift* for Max Delbrück, *Phage and the Origins of Molecular Biology*, edited by Cairns, Stent, and Watson (Cold Spring Harbor, 1966). Biochemists such as Arthur Kornberg have blamed their supposed declining status on that book's portrayal of phage geneticists as the central figures of early molecular biology. They will undoubtedly lodge similar complaints against *We Can Sleep Later*. But practitioners perhaps ask too much if they expect good history to come from memorial works. *We Can Sleep Later* is not good history, but historians will find it useful nonetheless for its first-person accounts and as an illustration of commemorative practices. Molecular biologists will enjoy the fond memories of one of their own.

AUDRA J. WOLFE

Jonathan Gathorne-Hardy. *Sex the Measure of All Things: A Life of Alfred C. Kinsey.* xiv + 513 pp., illus., apps., bibl., index. Bloomington: Indiana University Press, 2000. \$39.95.

The role of Alfred Kinsey, America's most influential sexologist, in the cultural revolution of sex and gender during the past fifty years remains as unquestionable as it has been controversial. This admiring biography argues that Kinsey also qualifies as an authentic great man of science in the tradition of Darwin. Kinsey's expert authority was recently challenged by James Jones, who claimed in his 1997 biography that Kinsey's terrible personal secrets—homosexuality and masochism—plagued his life and ruined his science. Jonathan Gathorne-Hardy sets out to repair Kinsey's reputation by defending him against this "Kenneth Starr school of biography" (p. viii). The author seeks to rescue Kinsey's achievement from the stigmatizing charge that it was flawed because it subordinated science to subjectivity.

Gathorne-Hardy emphasizes Kinsey's methodological creativity and his interviewing genius. During his early career, when he worked on gall wasps, Kinsey's science developed as a practice of scrupulous collection, observation,

and documentation. Even in graduate school, he was dubbed "get a million Kinsey," and his belief in sheer quantity—as well as quantification—was just as apparent when he turned his attention to human sexuality. In 1938 Kinsey taught a course on marriage at Indiana University, where he spent his entire working life. Limited to married or engaged students and faculty, the course covered reproductive physiology, contraception, and a host of other sexual topics in explicit detail. Kinsey also used the course to gather data about his students' sex lives. The thousands of sexual histories collected at the Institute for Sex Research in later years—7,985 by Kinsey alone—attest to his scientific commitment to behavior as the only legitimate basis for a science of sex.

The behavioral unit of analysis chosen by Kinsey was the orgasm—or "outlet," as Kinsey called it. Because it was countable, the theory went, it was objective. Kinsey's ethic of measurement resulted in interviews involving at least 350 standard questions, whose answers were recorded in a custom code designed to fit on a single sheet of paper divided into 287 squares. Among the ironies of Kinsey's method was the fact that his sex histories measured linguistic rather than sexual behavior. What Kinsey actually compiled was a huge cache of stories, not direct observations of sexual behavior. (Kinsey did try to approach sexual behavior directly through film and photography, but self-reported histories remained his primary data base.) Kinsey, who gathered more sexual stories than any other person alive, systematically aimed to eradicate all quirks and complexities in order to produce a statistical portrait of population-wide behavior. Meanings might be historically important, but numbers, not narratives, would yield truth. The easy use of "human males" and "human females" in the titles of Kinsey's famous reports suggests how universal his scientific claims were—and also how devoid of temporal and cultural particularity.

The resulting conception of human sexual nature is probably best represented in Kinsey's six-point scale, where behavioral possibilities ranged from exclusively homosexual at one pole to exclusively heterosexual at the other. Diversity emerged as the premier fact about sexual behavior. While this placed men and women uncomfortably close to their primate cousins on an evolutionary map, making human sexual exceptionalism objectively unsustainable, it also produced a reformist sensibility that rooted its demand for toleration in the powerful evidence of natural facts. It is difficult to overstate how

shocking Kinsey's picture of polymorphous sexuality was in a culture devoted to either/or binaries and prone to harsh judgments about deviation from norms. Kinsey's contribution was to point out the gap between ideology (sexual culture) and behavior (sexual nature). That lots of people did lots of things at odds with professed sexual morality was, for some, a welcome relief and call to revolution. For others, it was a reason to hate Kinsey and blame him for changes in the realm of gender and sexuality already well under way by midcentury.

No biographies can save scientific heroes from the fatal charge that their methods and findings were bound up in their lives, or they would not be biographies worth reading. This attests to the stubborn endurance of the psychoanalytic paradigm. Kinsey despised Freud for passing off philosophy (a term of derision in Kinsey's vocabulary) as science. Yet because of the conventions of post-Freudian biography, Gathorne-Hardy must explore exactly those dimensions of Kinsey's life and character that Freud embraced but that Kinsey himself would never have admitted into the precincts of science. His childhood illnesses and struggles with an overbearing father, his rage against religion, fondness for music, charismatic yet autocratic style, and his own anguished sexuality are keys to puzzling out not only a life in science, but a life.

Gathorne-Hardy can hardly ignore evidence that Kinsey's own sexual appetites were diverse—"bisexual" is this author's preferred designation—or that his enterprise in sex research involved experimentation: the mostly married male members of Kinsey's team were expected to engage in sexual activities with one another and one another's wives. Kinsey's wife Clara ("Mac") was a confidant and supporter from the start. Their loving marriage was also an open marriage. Mac was a participant-observer in the world of sex research. She had a series of affairs with Kinsey's colleagues and even changed the bedsheets during energetic sessions of sexual cinematography that took place in the attic of their home. Yet the Kinseys also shielded their children from their own unorthodox sexual practices.

This biography concludes by suggesting that Kinsey died tragically in 1957, convinced that his enemies had the upper hand. Kinsey was wrong. The diversity he championed has become a theoretical staple in the human and life sciences as well as a practical goal in social policies related to gender, race, and sexuality. However unfinished it may be, it is difficult to imagine

Kinsey's revolution being reversed in either science or society.

ELLEN HERMAN

Cathy Boeckmann. *A Question of Character: Scientific Racism and the Genres of American Fiction, 1892–1912.* viii + 238 pp., bibl., index. Tuscaloosa/London: University of Alabama Press, 2000. \$39.95.

During the late nineteenth century, science and fiction intertwined in complex ways well beyond Jules Verne's voyages and H. G. Wells's tales of time travel and a war between worlds. Developing in the United States after the Civil War, literary realism directly reflected the scientific temperament of the times—the Enlightenment belief that science was leading the inevitable way to a secular millennium. Founded on admiration for science and scientific method, realism was the artistic parallel to the careful observation and recording of data that the new social scientists saw as the way to "Truth" about human nature and behavior. In a famous essay entitled "The Experimental Novel" (1880), Émile Zola argued that "the novelist is equally [with the scientist] an observer and an experimentalist" dedicated to uncovering the deterministic laws governing human life. Focusing on this fundamental interrelationship between nineteenth-century science and nineteenth-century fiction, *A Question of Character* explores in thoughtful and complex ways the interaction between late nineteenth-century scientific theories of race and American fiction of the time.

In the first section of her book, Cathy Boeckmann traces scientific theories about race from their emergence as part of the "American School" of physical anthropology based on Samuel G. Morton's *Crania Americana* (1839), which argued for polygenesis rather than monogenesis of races, through Josiah Nott and G. R. Gliddon's *The Types of Mankind* (1854), which strongly supported the theory of a hierarchy of separate races, to the later, post-Darwinian arguments that racial inferiority corresponded to different stages of evolution rather than to separate origins. Especially influential was the neo-Lamarckian concept of acquired cultural traits forming identified developmental stages along a continuum from "savagery" to "barbarism" to "civilization," as explained by Lewis Henry Morgan in *Ancient Society* (1877). Philip A. Bruce's *The Plantation Negro as a Freeman* (1889), for example, insisted that under the uplifting influences of slavery African Americans had been experiencing a slow cultural evolution

but that in the postwar era of freedom they were devolving rapidly back into savagery. As the arguments over racial difference grew more complex and the problem of the mixed-race character loomed larger, there was an interesting shift away from emphasis on simple physical markers of difference to essentialist markers that endure despite any racial mixing that may blur physical differences. These essential markers are traits of character that differ from race to race, often with each group of different national origin considered to be a distinct "race." Thus the individual Irishman's or German's—as well as the individual African's—mental and moral character was seen simply as the manifestation of an inherent and unchanging racial character. By the late nineteenth century, it was generally believed that various racial characters had now been scientifically established, thus providing "a positive basis for legislation, politics and education, as applied to a given ethnic group," according to Daniel Brinton in an 1895 article quoted by Boeckmann.

In the second section of her book Boeckmann examines six novels published between 1892 and 1912 by Thomas Dixon, Jr., Mark Twain, William Dean Howells, Charles Waddell Chesnut, and James Weldon Johnson. Dixon's novels *The Leopard's Spots* (1902) and *The Clansman* (1905) are examples of sentimental romantic fiction dominant in the first half of nineteenth-century America, a style of writing that uses the physical appearance of characters in a novel to represent their inner mental and moral worth—in short, appearance reveals "character." Dixon relies on the physical description of black characters to reveal their dangerous, bestial, inherently racial "character," thus embodying that basic scientific belief of the time in his best-selling novels and projecting it into the American cultural consciousness, an accomplishment greatly enhanced by D. W. Griffith's *The Birth of a Nation*, the 1915 film version of *The Clansman*. (The one factual error I noted in Boeckmann's otherwise well-documented work is her statement that Griffith's film was based on *The Leopard's Spots*). The other four writers, following the conventions of the newer realist fiction, complicate the simple equation of outer appearance and inner character, especially in the intricate representation of the emerging nature/nurture argument in Twain's *Pudd'nhead Wilson* (1896).

Given the belief in scientifically determined racial "character" as a basis for political, legislative, and educational action, these novels can be seen as sites of struggle over the issue of race

at that time. Boeckmann's analyses of these works are subtle and theoretically sophisticated and help us see the complex interaction between science, artistic expression, and social policy.

JAMES KINNEY

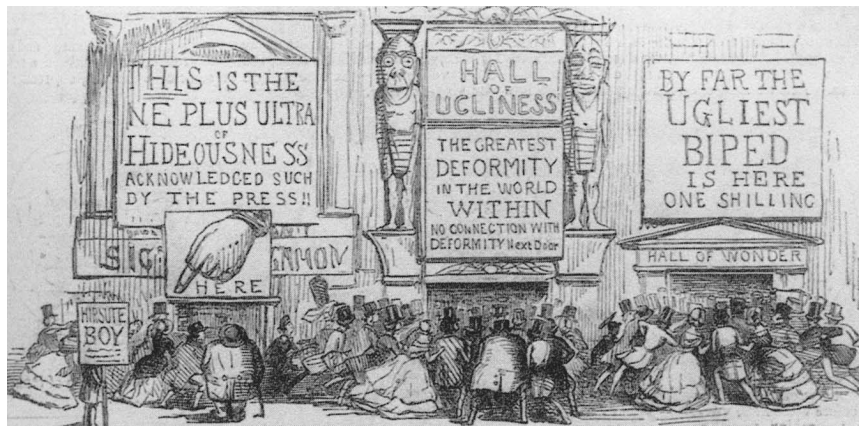
Goldie Morgentaler. *Dickens and Heredity: When Like Begets Like*. xvi + 221 pp., index. New York: St. Martin's Press/London: MacMillan Press, 2000.

The opening chapter of this work is a comprehensive "Historical Overview of the Hereditary Puzzle." Goldie Morgentaler's analysis of theories of heredity before Mendel will interest students of biological science. She admits that "resurrecting such theories without contamination from subsequent knowledge often requires an imaginative leap." Very true. There have been such profound advances in the science of genetics since that time, with the avalanche of discoveries during the past half century, that much of the previous thought now falls in the realm of philosophical fantasy.

These early concepts were those to which Charles Dickens was exposed for most of his life. His literary reaction to them is exhaustively analyzed in the subsequent two parts of the book. The first of these is entitled "Heredity and the Individual," and the second is "The Public Face of Heredity." The latter includes interesting discussion of class and race, with analyses of the last three novels. These indicate that Dickens's views on heredity changed during his later life, perhaps influenced by Darwin, whose work he had read . . . and vice versa.

The author is to be admired for her detailed knowledge of Dickens's works and his characters. For a reviewer who has been steeped in evidence-based medicine and science for most of his career, it seems that much of the speculation regarding heredity in the nineteenth century is tenuous and far-fetched. While Dickens engaged the topic of heredity many times, he appears to have followed the general trend of that era by showing little consistency in his views. This is not surprising in light of the paucity of scientific evidence at that time.

While the title implies a study of Dickens and heredity, the substance covers a much wider field, with ventures into ethics, morality, religion, psychology, philosophy, sociology, and more. The appended notes tell of assiduous research and concentration. To the pragmatic reader it sometimes appears that Morgentaler makes observations and draws conclusions that are more profound than Dickens himself might



The "Deformito-mania" from *Punch*, 1848 (from O'Connor, *Raw Material*, p. 149).

have achieved, or admitted. This is, of course, a common diversion in revisionist studies of well-known authors and other celebrities.

It is inevitable that the perennial question of the relative strength of nature and nurture must have prominence in this study. In his earlier novels Dickens implied support for the notion that goodness and virtue were heritable traits allied to beauty and good physical appearance. Morgentaler returns repeatedly to this question in many aspects. In her final chapter she points out that Dickens's views changed, paradoxically, after *The Origin of Species* was published, toward the end of his life. He then gave less weight to the influence of heredity. She has, perhaps, missed an opportunity of recording that Dickens noticed hereditary factors in alcoholism and longevity. In the case of Jenny Wren's family, Mr. Cleaver was "like his own father, a weak wretched trembling creature, falling to pieces, never sober" (*Our Mutual Friend*). The Wardle family in *Pickwick Papers* showed familial longevity in that "only one member hasn't lived to eighty-five, and he was beheaded by one of the Henrys."

The relationship of some of the discussion to heredity is profound, often remote, even cryptic. To those who are hybrids of a scientific historian and an obsessive Dickens aficionado, this work will be absorbing. Unfortunately for the author and the publisher, such hybrids are probably rare—but I hope not extinct. To the pure scientist this work might be an uphill exercise. The production of the book is faultless.

J. E. COSNETT

Erin O'Connor. *Raw Material: Producing Pathology in Victorian Culture.* (Body, Commod-

ity, Text: Studies of Objectifying Practice.) xi + 273 pp., illus., bibl., index. Durham, N.C./London: Duke University Press, 2000. \$54.95 (cloth); \$18.95 (paper).

Readers expecting a history of nineteenth-century pathology are in for a surprise. They will find instead a self-conscious example of cultural studies, critical of some assumptions made in this field and of some feminist writing, but containing some alarming sentences like "My goal has been to give shape to the accidental palimpsests of an inveterately verbal, and increasingly visual, culture; to assemble a particular series of hermeneutic loose ends into a coherent account of how an extraordinarily bizarre system of signification came into being" (p. 18). With learned English like that, who needs Latin? But once we get into the main part of the book, things get much better. We are confronted with a study of the fringes of science, in popular writings, in literature, and in raree-shows, one working from sources that the more austere scientifics of the Victorian period despised and that historians of science are prone to ignore. Metaphor and analogy are everywhere, and sensitive stomachs will be churned by vivid accounts of disease, deformity, and surgery.

The first chapter is concerned with the cholera morbus, the plague of the nineteenth century, and with the way it could be perceived as an indicator of social ills. John Ruskin's word "illth" as an opposite of health is revived, and the terrible blackness of the shriveled and dehydrated victims of this disease imported from the East is linked with colonial and racist notions. The theme that a healthy body is like a

well-run state leads into the next chapter, on breast cancer. Surgery was not only agonizing but ineffective in the first half of the nineteenth century, but then the survival rate after three years rose gradually from 4.7 percent to 45 percent by 1900. O'Connor asks whether this saga, with cancer seen as cellular overproduction, reveals close connections with gender construction and the symbolic importance of breasts, concluding that it does not and that the language used really was neutral rather than sexual.

She then looks at amputations and artificial limbs, seeing amputation as a threat to the whole masculine body (there appear to be no women involved here) that could be countered by prostheses almost undetectable to the observer. This allows reflection on illustration, where curiously disembodied hands are shown carrying out amputations; on dissembling and artificiality; on materialism; and on metaphors of wholeness and replacement and of extending senses and capacities. We see some extraordinary advertisements where men with artificial legs climb ladders (back into ordinary life) and skate, perhaps on thin ice. The final chapter examines deformity, with monsters and freaks (a word that took on its current sense in this period). P. T. Barnum is prominent here, but interesting links are also made to the Great Exhibition at the Crystal Palace (1851) and its successors and the numerous museums that were such a feature of the Victorian period. They are strikingly placed in a continuum, rather than opposed, in a discussion of chaos and order, capitalism and health, deformity and degeneration. Wonder is presented as the key to modern sensibility, and there is a nice quotation on page 152: "If *Beauty and the Beast* should be brought into competition in London at the present day, *Beauty* would stand no chance against the *Beast* in the race for popularity." Readers will have been led into a fascinating world at the periphery of the respectable science that most of us study and will rejoice in the extraordinary sights they see.

DAVID KNIGHT

Malcolm Macmillan. *An Odd Kind of Fame: Stories of Phineas Gage*. xiv + 562 pp., frontis., illus., figs., apps., bibl., index. Cambridge, Mass./London: MIT Press, 2000. \$39.95.

In the neurosciences, and indeed beyond, Phineas Gage is an icon. It is impossible to see reproductions of his life mask, his skull, and above all the tamping iron driven into his head by an explosion without wanting to know more about the man and his reason for fame. Malcolm Mac-

millan's extraordinary book *An Odd Kind of Fame: Stories of Phineas Gage* is the definitive word on this fascinating subject and a labor of love. The book's appearance is extraordinary, because on page 1 Macmillan quotes David Ferrier writing to Henry Pickering Bowditch about Gage (12 October 1877): "In investigating the reports on diseases and injuries of the brain I am constantly being amazed at the inexactitude and distortion to which they are subject by men who have some pet theory to support." Macmillan has been scathing over the years in his attacks on previous authors who have been imprecise in their treatment of the facts in relation to Phineas Gage's story. He has been vigilant in pointing out confabulatory accounts and has repeatedly steered the interested reader to the original reports of Dr. John Martyn Harlow (*Passage of an Iron Rod Through the Head* [1848] and *Passage of an Iron Bar Through the Head* [1868]). He cites these reports as containing the only true account of what happened on 13 September 1848 and the consequences. As if to reinforce this message, he crucially reproduces a facsimile of these source papers in an appendix to the text. The reader has the story at first hand. It is also interesting to note that on the very last page of his book Macmillan summarizes the importance of Phineas Gage one hundred fifty years on: "his was the first case to point to a relation between brain and personality functions."

Having discharged his duty in relation to the sparse facts known about Phineas Gage and the lasting importance of the event, Macmillan could have left it there. We are fortunate that he didn't. In what began as part of a set of historically based lectures to introduce students to various problems in psychology, Macmillan has, from painstaking research, taken us on a fascinating journey through nearly two hundred years of neuroscientific thinking on the functions of the frontal lobes of the brain. I would strongly recommend this book to those interested in the history of medicine, to the clinical neuroscientist, and to the nonspecialist with an interest in the bizarre.

KIERAN O'DRISCOLL

Julyan G. Peard. *Race, Place, and Medicine: The Idea of the Tropics in Nineteenth-Century Brazilian Medicine*. x + 315 pp., bibl., index. Durham, N.C./London: Duke University Press, 1999. \$54.95 (cloth); \$17.95 (paper).

This timely, well-written book illuminates an aspect of Brazilian science that has long been neglected, for two major reasons. The first is that

it is only in the past two decades that the scientific past of Latin America, including Brazil, seemed to merit systematic academic investigation, and only with this change have scholars discovered, or rediscovered, several important, but forgotten, developments, such as the one Julian Peard analyzes in this study. The second reason is that, although there is a substantial literature on late nineteenth- to early twentieth-century colonial science and medicine—which is considered almost synonymous with tropical medicine—none of it treats Brazil or any of the other Latin American countries because, even though they fall within the tropical zone, they were formally independent nations from the early 1800s onward.

Peard rejects this adherence to the old criterion for defining “tropical.” Drawing on a respectable collection of both primary and secondary sources, she tells the story of the Escola Tropicalista Bahiana (the Tropical School of Bahia), which was founded before the revolution in bacteriological knowledge and the great European colonial expansion. The idea for the school originated, Peard says, with “a group of nineteenth-century doctors in Brazil who, in attempting to adapt Western medicine to more fully engage with the problems of their tropical country, sought novel answers to the age-old question of whether diseases of warm climates were distinct from those of temperate Europe. In their search, they used the tools of Western medicine to confront European ideas about the fatalism of the tropics and its people, and to argue in favor of Brazilian expertise.”

The text is organized into five chapters, whose titles clearly describe both the structure of the narrative and Peard’s main points, as well as part of her conclusions: “The Escola Tropicalista Bahiana: A Creative Response in Adversity”; “The Politics of Disease”; “Race, Climate, Medicine: Framing Tropical Disorders”; “Physicians and Women in Bahia”; and “Moving into Mainstream.” In her introduction Peard presents a useful discussion of the earlier literature on her topic, pointing out her (original) contribution to several relevant fields. Throughout, the text is structured to highlight the tension between the *Tropicalistas* and European science: “although they [the *Tropicalistas*] resisted aspects of European cultural authority that harped on Brazilian, and Latin American, inferiority, they wanted to gain the mantle of legitimacy that they believed only European science, as the leader in universal science, could bestow on them.” Peard shows, chapter by chapter, the *Tropicalistas*’ sometimes conscious, sometimes intuitive strat-

egies to build up an innovative scientific field, a project that entailed issues of national identity and the regional (Bahian) response to the centralized imperial authority of Rio de Janeiro. Almost half the volume is devoted to supplementary material: three useful appendixes, notes to all the chapters, a list of primary sources, the bibliography, and a well-elaborated index—all of which testify to the quality of both Peard’s research and her book as a whole.

It is important to stress here that Peard relies on what one could call the “new” Brazilian history and sociology of science, particularly in the fields of medicine and public health. Despite its vigorous growth, both quantitatively and qualitatively, this historiography still remains more or less confined to Latin America, its wider dissemination impeded by language barriers. In using and commenting on the bibliography of this new historiography, Peard respects the local intellectual production while helping to enrich the traditional set of references. Nevertheless, and although I warmly recommend the book, I regret that she did not fully incorporate the conclusions reached by this recent historiography, preferring instead to present essentially the same picture drawn in previous works, a picture based on the view that “in the few instances of research work being carried out in Brazil before 1900 such work was sporadic, isolated . . . or incapable of being self-sustaining.”

SILVIA FIGUEIRÔA

Michael Dunnill. *The Plato of Praed Street: The Life and Times of Almroth Wright.* xiv + 269 pp., illus., tables, index. London: Royal Society of Medicine Press, 2001. £17.50.

If ever a prize is to be given for the most cantankerous figure in the history of science and medicine, Almroth Wright will surely be on the short list. With the exception of himself, Wright was a man who did not tolerate fools lightly. Even the author of this biography, who tries very hard to see Wright’s point of view, becomes exasperated with him at times. More commonly known today as Sir Colenso Ridgeon in George Bernard Shaw’s *The Doctor’s Dilemma*, Wright was born of stern, fanatical Irish Protestant parents in 1861. Extremely gifted, Wright graduated first in modern languages at Trinity College, Dublin. After switching to and qualifying in medicine, a gadfly postgraduate career followed. His first permanent job was as pathologist at the army’s medical headquarters at Netley near Southampton, where Wright developed the agent for which his name remains inscribed on the bac-

teriologists' roll of honor: prophylactic typhoid vaccine. Its passage into common use, however, was far from easy. Statisticians, clinicians, and military authorities lined up against him. Wright's belief in the vaccine's value was vindicated in World War I. The controversy over its efficacy has been analyzed by J. Rosser Matthews in his *Quantification and the Quest for Medical Certainty* (Princeton University Press, 1995). Dunnill does not refer to this, but, there again, scarcely any modern secondary source is recognized in this book. This is not that sort of a biography, which is not to decry its great merits. Dunnill is a pathologist who sticks very close to the primary sources, including large amounts of hitherto-unpublished manuscript material. His approach is very evaluative of what Wright got scientifically right and wrong by today's criteria, but the judgments are made in a subdued and relatively unobtrusive way. This is a great virtue in dealing with any aspect of the volatile Wright. His views on woman's place in the world and her claim for the right to vote would drive any intolerant feminist historian to apoplexy. Dunnill, however, takes great pains to situate Wright's views in context.

A man like Wright was never going to be happy at Netley since the military hierarchy weighed on him, crushing his individualism. Only the dictatorial control of an autonomous empire would suit him, and this is what he eventually got. Wright became the head of the pathology department at St. Mary's Hospital, London, and there he was effectively responsible to nobody. This was possible because he turned his laboratory into a vaccine-producing factory and used the drug company Parke Davies to market his products. These included not only prophylactic agents but now-discredited ones for the treatment of the then-common bacterial diseases such as pneumonia. The Great War saw Wright in France struggling to introduce another innovation that was finally accepted. "Listerian antiseptics" was a hallowed phrase among surgeons, and the more infected war wounds became the more intense became their antiseptic applications—sadly, to little effect. Wright campaigned for simple saline washing of wounds, a practice eventually adopted with much better results. After the war, separated from his wife, at odds with the Medical Research Council, and estranged from some of his colleagues (although Alexander Fleming stuck it out), Wright turned to the consolations of philosophy—unfortunately writing rather than just reading it. His otiose productions solving the riddle of the universe now lie unread. This conventional but highly readable

biography offers no new insights into the science of the period, but it does merit attention as a study of the relations of personality and empire building.

CHRISTOPHER LAWRENCE

Michael Worboys. *Spreading Germs: Disease Theories and Medical Practice in Britain, 1865–1900.* (Cambridge History of Medicine.) xvi + 327 pp., illus., tables, bibl., index. Cambridge/New York: Cambridge University Press, 2000. \$59.95.

While visiting relatives in northern England in October 1865 the London chemist William Crookes witnessed firsthand the economic devastation of farming communities blighted by the cattle plague (rinderpest) that had been sweeping Britain since June. Crookes delayed his return to London for several months and obtained official permission to begin experimenting on eradicating the disease with a new disinfectant, carbolic acid. In his report to the British government in 1866, Crookes was explicit that his experiments had been based on a germ or contagion theory of the disease. Germs were considered to be airborne particles that might either be "living" material that "germinated" in the soil of animal flesh and blood or (as Justus von Liebig had taught) chemical poisons that decomposed flesh and blood.

In the opening chapter of this fine study of the construction of British germ theories between the 1860s and 1900, Michael Worboys makes it clear that the cattle plague was a keystone in the long process of germ theory construction. Rinderpest was readily accepted by veterinary surgeons as a contagious disease to be controlled by wholesale culling with the poleax. On the other hand, they ignored or actively opposed the practical implications of a germ theory—disinfection (as Crookes recommended), vaccination, and laboratory research—because these procedures posed a threat to the power and control of the veterinary profession. *Plus ça change?* In Britain, we are currently witnessing a similar example of party interest as a powerful Farmers' Union culls millions of cattle and sheep but prevents the use of vaccination in fighting a foot (hoof) and mouth epidemic.

Although a number of studies have celebrated the germ theory as the key development in producing scientific medicine in the late nineteenth century, this is the first critical book-length study of its diffusion. The separate professional communities of veterinary practitioners, surgeons, and sanitarians are disarmingly shown to have

developed different germ theories and differed over the practical consequences of their commitments. The closed subcultures inhabited by these groups meant that it took several decades before the germs of sanitarians were linked with those of surgeons and with the bacteria of microbiologists. Anyone who made a connection, such as the physicist John Tyndall, was dismissed as an inexpert interloper. Clearly, the singular specific disease germ theory (as it eventually became) was evolutionary in construction, not revolutionary.

Worboys's ambitious monograph offers many fresh insights, including a finely tuned account of Joseph Lister's vacillating ideas and practices concerning wound management, and a splendid analysis of the problematic identification of specific germs causing cholera, smallpox, tuberculosis, diphtheria, typhoid fever, and scarlet fever. His meticulous survey of the contemporary literature (both periodicals and textbooks) unravels the deep uncertainty over whether "germs" were living organisms or chemicals, spontaneously generated or ancestral, causes or concomitants of disease. The fact that unpleasant wounds and the sick sometimes recovered spontaneously made sense only if patients constitutionally differed as an appropriate or inappropriate "soil" for "germ seeds" to blossom or perish. In this way ontological germ theories complemented the traditional medical concepts of constitutional strength and weakness and the healing power of nature. This insight underlines one of the strengths of the book, namely, its recognition of continuities in the construction of disease concepts and practices.

Worboys successfully challenges the view that the British medical communities (who were often "part-timers") acted largely as onlookers while French and German practitioners honed a laboratory-based medicine for the twentieth century. Overall, Worboys's monograph is a challenging and extremely readable medical history of germs. It will be essential reading for students taking history of medicine programs.

WILLIAM H. BROCK

Bert Theunissen. *"Nut en nog eens nut": Wetenschapsbeelden van Nederlandse natuuronderzoekers, 1800–1900.* 220 pp., illus., bibl., index. Hilversum: Uitgeverij Verloren, 2000. Dfl 49.70.

The central theme of this book is the question, Why do scientists pursue scientific investigation? Of course, Bert Theunissen begins by pointing out that the answers scientists offer will

be socially acceptable answers. Even so, Theunissen asserts, the historian may infer from the answers what motivated the persons questioned. Moreover, insights may be gleaned concerning science, society, and the relations between the two in the period the scientists lived.

In this book the author discusses the notions of the objective of science endorsed, respectively, by Jan Hendrik van Swinden (physics, Utrecht University), Jan van der Hoeven (zoology, Leiden University), Pieter Harting (zoology, Utrecht University), Gerrit Jan Moll (chemistry, Utrecht University), Franciscus C. Donders (ophthalmology, Utrecht University), Hugo de Vries (botany, Amsterdam University), Martinus W. Beijerinck (microbiology, Delft Technical University), and Hendrik Antoon Lorentz (physics, Leiden University).

From this list of names it appears that Theunissen has focused his study on the nineteenth century. That period is especially interesting with respect to the changing images of science, as the ideas of the main goal of the university altered completely during that period. At the beginning of the century providing an academic education was seen as the prime task. Research was not seen as part of the duties of a professor at all. Those that did any experimentation chose to do so for their own sake, not because it was an element of the curriculum. That had changed completely by the end of the century. By then scientific investigation was considered a regular—in fact the most important—task of the university. This change in focus went hand in hand with the establishment of a number of new laboratories for most Dutch universities.

In the accounts of the above-mentioned men the content and development of their ideas about the pursuit of science are examined. From this analysis the common element that emerges in their images of science is gain for society, as expressed in the title, which translates into English as something like "Profit and more profit." In the view of these men the pursuit of science is profitable for society; it is not pursued just for its own sake, let alone for the pleasure of the pursuer. In the beginning of the century the well-trained minds of an intellectual elite that had completed academic training was regarded as the prime benefit for society. By the end of the century the profit was understood to come from scientific investigation of nature: science was seen as an instrument to further human welfare.

Initially, I found it surprising that each and every one of the leading persons confidently asserts that the pursuit of science is for the benefit of society at large. Yet, on closer inspection, that

was not so surprising, as Theunissen has studied and quotes almost exclusively from published sources, from treatises written for fellow scholars, for administrators, and for the lay public. The author seems not to have studied correspondence or other private papers in which a man may have voiced less elevated purposes for the pursuit of science.

One thing amazed me: in the whole of this work, covering over a hundred years of discussion and the ideas of some 300 Dutch scholars on the subject at hand, there is not one woman (apart from present-day scholars) mentioned. Admittedly, by the time the present story finishes, in the early twentieth century, only a few women had been appointed to academic positions in Dutch universities, so there is presumably not much material to draw on. However, one argument in the debate raging in the last quarter of the nineteenth century about the admission of women to the universities was the view that women, like men, should have the benefit of a higher education so as to fully develop their minds.

Most of the contents of this book have appeared in print already in the form of separate articles in various journals, some in English but mostly in the Dutch language. Presumably that explains why the author has chosen to publish his treatise in Dutch rather than English. Even though the author has stressed the national character of his exposé by discussing at length some controversies among Dutch historians of science on points he addresses, the issues considered in this book and the scope of the inquiry warrant international notice and discussion.

This book has a pleasantly unpretentious layout and typography and is, moreover, very carefully produced: I have seen but one printing error—which I leave it to you to discover.

MARIAN FOURNIER

John Bellamy Foster. *Marx's Ecology: Materialism and Nature.* x + 310 pp., index. New York: Monthly Review Press, 2000. \$48 (cloth); \$18 (paper).

Karl Marx has often been described as anti-ecological, concerned about the exploitation of humanity, not of nature. But, conducting a careful review of Marx's writings and a survey of the intellectual context in which Marx lived and worked, John Bellamy Foster argues that, in fact, Marx had a deeply and systematically ecological view of the world.

To make this argument, Foster traces the development of Marx's ideas. He finds in the ma-

terialist, antiteleological philosophy of Epicurus (the subject of Marx's doctoral thesis) the partial origins of an ecological perspective. Other elements of Marx's ecology emerged from his critique of Thomas Malthus's view that population would inevitably outstrip agricultural production—a conclusion that could justify social inequality. From this subject, Marx turned to a study of the agricultural chemist Justus von Liebig, drawing from him to formulate the notion of a "metabolic rift" in the human relation with nature. Armed with such ideas, Marx contributed to debates over soil "exhaustion," the problems of agriculture, and the division between town and country. Ultimately, under Liebig's influence, Marx arrived at an ecological critique of capitalist agriculture and what he saw as its inevitable depletion of the natural fertility of the soil. Both he and Friedrich Engels would argue that ecological problems could be addressed only if human beings regarded nature rationally, through an understanding of nature's laws, and then organized production accordingly.

Thus, engaged in nineteenth-century discussions about science and nature, including those relating to Darwinism, Marx linked social transformation with the transformation of the human relation with nature: the alienation of human labor paralleled the alienation of human beings from nature. In other words, the domination of nature resulting from unequal ownership of land paralleled the domination of humans through economic power. Foster traces these ideas across each stage in the development of Marx's thought: in relation to agriculture, Darwinism, and, in his last years, ethnology, geology, and paleontology. Foster follows the course of Marx's ecological views even after Marx's death. For a time, Marx and Engel's ecological critiques influenced Marxist thought in the Soviet Union. Nikolai Bukharin, August Bebel, and other Marxist scholars built on the original foundation, and by the 1920s Soviet ecology was highly advanced—only to be crushed, in the 1930s, by Stalin.

Seeking to place Marx within his context, Foster ranges widely, from Epicurus to the influence of Epicureanism in the seventeenth and eighteenth centuries to Julien Offray de La Mettrie, Baron d'Holbach, Denis Diderot, and Darwin, and on to Hegel, political economy, and French socialism. He covers thinkers who influenced Marx as well as those whom Marx reacted against, including William Paley and, especially, Malthus, who represented for Marx the intrusion of natural theology into political economy. In attempting to reconstruct Marx's world, Foster

largely follows the methods of traditional intellectual history, often interpreting ideas apart from their contexts. In his analysis of Darwin's ideas, for example, he considers Marx's debts to other scholars but not Marx's own research and observations of nature. Foster, however, does review in some detail society and politics in Marx's day, remarking on the social discontent and the perception of materialism as a threat to the established order, associated with both atheism and revolutionary France.

Foster's ambition goes beyond illuminating Marx's thought to situating ecology within materialism and science. Foster thus takes issue, persuasively, with the idea, often encountered in Green thought, that modern science justifies exploitative attitudes toward nature. This view, according to Foster, is a misinterpretation of modern science and reflects a reduction of ecological questions to questions of values, obscuring the material interrelations (Marx's "metabolic relations") between humans and nature. In fact, he finds no necessary contradiction between sustainability and the mastery of nature, noting that in the seventeenth century John Evelyn, among others, remained an advocate of modern science even as he defended trees and criticized London's air pollution. And he notes that in the nineteenth century ecological thought, in the work of Darwin and others, was grounded in materialist conceptions of nature.

Foster's analysis is valuable both as a critique of the conventional wisdom about Marx's views of nature and as a thorough effort to place Marx within the context of his time. Scholars and readers interested in nineteenth-century intellectual history will find Foster's account of an ecological revolutionary worth the study.

STEPHEN BOCKING

Charles Boewe. *Mantissa: A Supplement to Fitzpatrick's Rafinesque*. xii + 105 pp., bibls. Providence, R.I.: M&S Press, 2001. \$15 (paper).

This addition—hence the title *Mantissa*—to the rich vein of information about Constantine Samuel Rafinesque (1783–1840) is in fact a supplement to Charles Boewe's own revised and enlarged edition (1982) of Thomas J. Fitzpatrick's book *Rafinesque* (1911).

The details of the peripatetic life of Rafinesque, one of America's most original yet undisciplined naturalists, are too well known to bear repeating here. Suffice it to say that because of the vicissitudes of his life—his perpetual wandering between and within Europe and frontier America, his impecunious circumstances

that forced him to find different ways of making a living—finding and identifying his publications is a bibliographer's nightmare. Even now, more than 160 years after his death and with the benefit of serious studies by Fitzpatrick and Boewe, as well as by Richard E. Call and Elmer D. Merrill, among others, we can only approximate the number of his publications, including both original titles and republications. Probably we will never have a complete list of Rafinesque's publications because he published regularly in newspapers, broadsides, sales catalogues, privately printed journals, and other ephemera that are infrequently archived. Even his own references to "published" works cannot be trusted as, to him, this term included papers that he sent to journals but were never published. On the other hand, Rafinesque complained to one correspondent that he never *knew* whether some of these manuscripts were ever published or he learned only years later that they had been. The total number has been estimated at about a thousand, but, as Boewe points out, this number is based on Fitzpatrick's faulty numbering system in which each version of a paper or volume of a multivolume work was given a number. Thus Fitzpatrick's system, continued by Boewe, represents *serial* numbers, not individual titles. Rafinesque's own estimate was 220, a number Boewe now thinks is a reasonable guess.

The *Mantissa* is an important addition to Rafinesquiana. It lists twenty hitherto-unrecorded publications by Rafinesque, thirty-three new translations or reprints, and more than two hundred newly listed secondary references. For the first time we have a list of every manuscript letter written by Rafinesque that is known to exist, and Boewe provides a documented discussion of Rafinesque publications still remaining to be discovered. Several titles known to me, however, are missing from *Mantissa*, but Boewe's book represents a learned guide for the next scholar willing to take up the challenge and carry on the search. The newly listed manuscript letters will doubtless be particularly helpful in providing leads to undiscovered publications and other facets of Rafinesque's still not completely understood life. Among his correspondents were fellow naturalists such as John James Audubon, Joseph Banks, Benjamin Barton, Charles Bonaparte, Alexandre Brongniart, Augustin de Candolle, Georges Cuvier, Amos Eaton, Asa Gray, William Jackson Hooker, Muhlenberg, Ord, Paolo Savi, James Edward Smith, William Swainson, and John Torrey, as well as prominent leaders of the day, including John Adams, De Witt Clinton, Eleuthère Irénée du Pont, George IV,

Thomas Jefferson, and Joel Roberts Poinsett. A total of 346 letters are listed.

More important, Boewe has given us the benefit of his many years of scholarly searching and thinking about Rafinesque in his discussions entitled "Hints about Unlisted Titles," "Letters as a Source of Leads," and "Hints in Publications." We learn, for example, that Rafinesque signed some of his papers simply as "Constantine" or "Linneus." The *Mantissa* makes it abundantly clear why arriving at a complete account of Rafinesque's writings is an elusive goal, but Boewe shows us that the attempt still offers an exciting trail to follow.

KRAIG ADLER

Bettina von Briskorn. *Zur Sammlungsgeschichte afrikanischer Ethnographica im Übersee-Museum Bremen 1841–1945.* (Tendenzen, Suppl. 2000.) 336 pp., illus., figs. Bremen: Übersee-Museum Bremen, 2000. (Paper.)

Bettina von Briskorn's book on Bremen's Übersee-Museum (or overseas museum) takes on the fascinating topic of the history of ethnographic collections. Briskorn follows recent scholarship on the topic in regarding the museum's collections as artifacts not only of the societies from which they were gathered but also of the societies that gathered them. Briskorn thus proposes using the ethnographic collections of the Bremen Übersee-Museum to shed light on the history of ethnology itself.

Briskorn finds that the directors of the Bremen museum pursued a "mimetic" exhibition style in their African sections, in which they sought to reproduce the scenes of daily life in Africa. Many displays included groups of life-sized figures to show the artifacts as they were used, because the curators believed such a display would better instruct the general public. Briskorn points out that this sort of display differed sharply from that of the larger Berlin museum of ethnology and had more in common with popular ethnographic displays of the period. While this mimetic strategy in the museum gave directors a preference for groups of objects that would give a sense of the daily life of a group, it is unclear, Briskorn asserts, to what extent this preference shaped the actual collections. More than a third of the book is devoted to short entries on the individuals and institutions who donated or sold ethnographic objects to the Bremen museum. The entries also include serial numbers of each object given by an individual or institution. Briskorn has used these data to provide statistical tables related to the collection of ethnographic

artifacts, including the total number of objects entering the museum, the proportion that were gifts, and the proportion that were purchased. Perhaps the most significant statistics are those relating to the profession of the donor: whether colonial military personnel, professional scientists, colonial merchants, or missionaries. Briskorn suggests that the predilections and range of expertise of these various groups affected the quality and reliability of their collections. Given the painstaking work of processing this information for a statistical database program, I would have liked to see further interpretation of the statistics, which are surely a rich source of wider historical correlations.

Briskorn illustrates suggestively the practical role played by colonialism in the Bremen museum. She finds that 33 percent of the museum's pre-1945 holdings—and 20 percent of its current holdings—were acquired directly in the course of colonial rule and that colonial interests shaped the museum's presentations, especially its interest in the Herero during Germany's genocidal war against that group. Briskorn hauntingly juxtaposes two 1905 photographs: one of a group of starving and emaciated Herero taken during the war and a second depicting an idyllic museum diorama of Herero. Ironically, the very genocidal war that stimulated Bremen's interest in the Herero also severely reduced the availability of artifacts that might satisfy this interest.

The topic of anthropological collecting is of utmost interest to the history of anthropology and to the history of science generally. I would have been delighted had Briskorn more thoroughly assisted the reader in drawing connections between her very detailed account and the wider intellectual and political world in which the Bremen Übersee-Museum accumulated its collections. As it is, the book will be primarily of interest to scholars interested in the history of anthropological collecting in the Bremen museum and, indeed, to those scholars using the collections themselves.

ANDREW ZIMMERMAN

Lynda Nead. *Victorian Babylon: People, Streets, and Images in Nineteenth-Century London.* x + 251 pp., frontis., illus., bibl., index. New Haven, Conn./London: Yale University Press, 2000. \$35.

In examining the visual culture of Victorian London during the years 1855–1870, Lynda Nead in her book *Victorian Babylon* explores the difficult and restless narrative of modernization that any of us who have read D. G. Rossetti's "The



"Effects of the Gas Strike in London," *Illustrated London News*, 1872 (from Nead, *Victorian Babylon*, p. 91).

Burden of Nineveh” will recognize as crucial to the Victorian imagination. As Nead promptly establishes, Babylon for the Victorians was a trope evoking gain and loss, triumph and hubris, future and past ruination. Taking this ancient city as her titular image, then, Nead aims to rearticulate urbanism and modernity, indeed challenging us to reconceive what we mean by “modernity.” Positioning her own arguments against the influential architectonics of Marshall Berman’s *All That Is Solid Melts into Air* (London: Verso, 1983) and favoring instead the writings of Michel Foucault, Walter Benjamin, and Michel de Certeau, Nead recasts modernity as an “untidy experience,” a “constant struggle with history” (p. 10). Near her book’s end, Nead provocatively claims: “Ruin is the resolution of the contradictory impulses of modernity” (p. 214).

Victorian Babylon explores the spaces of mid-Victorian London and, more important, the experience of inhabiting those very spaces. This textual tour is divided tidily into three sections: a first on mapping and water, a second devoted to gas and light, and a third on obscenity, which Nead calls “improvement’s other” (p. 8). As Nead herself claims about the metropolitan travel literature she examines, her book speaks well to the eye. *Victorian Babylon* is a vicarious tour of London thanks to Nead’s deft and abundant use of fresh images, which she has culled assiduously from private collections, archives, and especially illustrated nineteenth-century periodicals. Her study thus takes us to fascinating places: readers travel along with John Hollingshead on his journey down to London’s sewers; we are invited into Joseph Paxton’s dreamscape of the Great Victorian Way; and we play for a night at Cremorne Pleasure Gardens, witnessing Madame Poitevin’s balloon ride. We hesitantly enter the haunted and obscene Holywell Street.

The catalogic abundance of *Victorian Babylon* works both to Nead’s advantage and disadvantage. Surely the sheer range of Nead’s material proves her points about the frenzy and incomprehensibility of modernity and the promiscuity of Victorian commercial culture. But invariably the variety of topics results in too much cursory analysis—a paragraph on photography followed by a paragraph on the International Health Exhibition; brief excursions into the realms of advertising, illustrated sheet music, and music halls. Subsequently, a reader might grow eager instead for book-length studies of these issues. Yet the most egregious omission of an adequate treatment is the two-page cursory overview of the picturesque. Here, Nead misses an opportunity to offer a more extended, theoretical treat-

ment of the “metropolitan picturesque” and how this aesthetic category relates—or not—to the other psycho-aesthetic touchstones for her work, which are the sublime and the urban uncanny. One might also rue the absence of an extended treatment of the relic versus the ruin at the book’s close.

The analysis of the book does grow stronger as it unfolds. The Cremorne Gardens in the second section make for interesting reading, and Nead is best at discussing London at night, the uncanny, and what she calls a poetics of gas. The final section on obscenity is most promising, for here the Babylonian polyphony of Victorian London—what Nead calls the twin mission, to build and destroy—hits the reader with full force. One might wish that Nead had spent a bit more time on obscenity (Where is Soho? Or Henry Mayhew’s prostitutes?) before extending her treatment to the more symbolic, architectural expression of obscenity-cum-obsolence, the Temple Bar. However, the fate of the Temple Bar is nicely evocative of the ruin and, thus, takes the reader full circle back to the ambiguities of modernity.

BARBARA J. BLACK

Cherry Lewis. *The Dating Game: One Man’s Search for the Age of the Earth.* x + 253 pp., illus., figs., bibl. Cambridge/New York: Cambridge University Press, 2000. \$24.95.

Arthur Holmes was the founder of the modern geological timescale. His slim book, *The Age of the Earth*, first published in 1913 when he was twenty-three, is a minor classic in the history of geology. In it Holmes succinctly summed up the state of geochronological knowledge at the beginning of the twentieth century, the problems involved in the various methods previously proposed for quantitatively measuring geological time, and the promise of the newly developed methods of radioactive dating. For the next three decades, he was the foremost advocate for developing the techniques for radioactive dating and using them to determine the age of the earth and to establish an accurate quantitative geological timescale. He was also an early proponent of Wegener’s theory of continental drift, and his text *Principles of Physical Geology*, published in 1944, set a new standard for geological textbooks. But for much of his life Holmes was something of an outsider in the British geological establishment, not from choice but from circumstance.

Cherry Lewis’s book is an episodic account of Holmes’s life and contribution to geochronology

intended more for the general reader than for historians or geologists. Her approach alternates biographical narrative with nontechnical accounts of scientific issues, but at times her stream-of-consciousness presentation leaves the connection between the two unclear—at least to me. Nearly one-fourth of the book, for example, is devoted to accounts of Holmes's ill-fated excursions to Mozambique in 1911–1912 and Burma in 1920–1923. While these and other biographical episodes illustrate the financial circumstances and personal decisions that kept Holmes on the fringe of the geological community, they are rarely balanced by biographical information that might illuminate his development as a scientist or explain what drove his passionate and, at times, almost solitary commitment to formulating a quantitative geochronology based on radioactive dating. Lewis's discussion of the scientific issues involved in geochronology are generally as clear and accurate as the constraints of simplification permit, but her choice of the contexts in which these problems are discussed strikes me as again highly selective. We are given little indication, for example, as to why the majority of geologists were so unreceptive to radioactive dating even as late as 1930. Even more to the point, we are given only brief glimpses of Holmes's own researches.

Lewis writes fluently and with great enthusiasm for her subject. General readers will find this enthusiasm appealing and the book a quick and pleasant introduction to a fascinating geological problem and to an important twentieth-century geologist. Historians interested in a more sophisticated analysis of this important episode in the history of geology and the complex scientist who was its major protagonist will have to wait a while longer.

The book contains a short selective bibliography but neither notes nor an index.

JOE D. BURCHFIELD

Paula Rebert. *La Gran Linea: Mapping the United States–Mexico Boundary, 1849–1857.* xx + 259 pp., illus., figs., bibl., index. Austin: University of Texas Press, 2001. \$45 (cloth); \$22.95 (paper).

The boundary between the United States and Mexico extends over almost two thousand miles of challenging terrain between the Gulf of Mexico and the Pacific Ocean. About 1,300 miles of the border follow the Rio Grande and nearly seven hundred miles run overland from the river near El Paso westward across New Mexico, Arizona, and California to the sea. The cartographic

historian Paula Rebert relates the progress of the survey of this boundary in meticulous detail, covering the field work between 1849 and 1855 and the office work from 1850 to completion in 1857.

The need for the survey originated with the war between Mexico and the United States in 1846–1848 and the subsequent treaty of Guadalupe-Hidalgo. Mexico ceded huge parcels of territory to the United States, and the boundary survey defined the extent of the transfer. The survey was designed to be carried out independently by two national commissions in ways that were agreeable to both. Generally, the two sides met to compare data, consult, and form agreements. They usually managed to cooperate, with each side showing enough flexibility to reach consensus.

The commissions used different methodologies. The Mexicans tended to favor triangulation while the Americans emphasized actual measurement. There were other differences. American instruments were better and more plentiful, and the map-drawing techniques of the commissions diverged. Other problems included the political pressures under which both worked, frequent turnover of commissioners, harsh field conditions along the borderlands, and changes in the course of the Rio Grande. The main point of contention involved the location of the point at which the boundary went west from the river above El Paso, an issue that soured overall relations between members of the commissions. Given these difficulties, precise agreement was impossible.

Despite the many problems, the resultant maps, consisting of two separate series of fifty-four sheets, were very similar in content. They each showed part of the boundary and the surrounding country, physical and cultural features of the area, boundary monuments, and annotations. Rebert's book includes photographs of many of these maps. As she notes, "The final maps were a great accomplishment" (p. 58).

Nevertheless, imperfections remained. The shifting of the Rio Grande, unaddressed in the treaty and impossible to anticipate, forced a resurvey in 1891–1896. The issue was not completely resolved until the treaty of 1970, which codified the reality of the fluid boundary and placed it in the middle of the channel that in normal flow had the greatest average width. Despite the lingering problems that took more than a century to resolve, Rebert views the survey, which set a good precedent of engineers working together in an environment of mutual respect, to have been a success.

The boundary survey was a complex enterprise. The commissioners, surveyors, and assistants included fascinating and distinguished figures, most notably, on the American side, William H. Emory, a seasoned officer of the Army's Corps of Topographical Engineers whom Rebert identifies as the dominant personality on the survey. In addition to making maps, Emory and his colleagues collected data on natural resources, made many drawings, amassed valuable collections of plants and animals for the Smithsonian Institution, and studied the lives of borderlands peoples. His fellow Army topographer Amiel W. Whipple even compiled a vocabulary of the Yuma Indian language while surveying the mouth of the Gila River. Rebert does not devote much attention to these aspects of the enterprise. Her primary contribution is in her detailed narration of the surveys and the cartography, a story she covers well. This book will interest all who specialize in the history of cartography and the boundary between the United States and Mexico.

FRANK N. SCHUBERT

Randal S. Beeman; James A. Pritchard. *A Green and Permanent Land: Ecology and Agriculture in the Twentieth Century.* (Development of Western Resources.) x + 219 pp., bibls., index. Lawrence: University Press of Kansas, 2001. \$29.95.

Randal Beeman and James Pritchard offer us three reasons why we should care deeply about agriculture: we all require food and even in the seeming cornucopia of American farmland we have the ever-present danger of food shortages, the health of our families is intimately tied to the quality of our food supply, and farming and farm families are an important and inspirational part of American society. This book attempts to "foster a better understanding of the centrality of food production in the history of American civilization" (p. 6) by exploring the intersection of ecology and agriculture. The premise of this book is that ecological ideas have provided the scientific guidelines and philosophical animus for a different kind of farming that is gentler on the land and people than is traditional agriculture. Accounts of the intersection of ecology and agriculture have been scarce, and so the premise is appealing.

Beeman and Pritchard support their thesis by exploring the development of two extraordinary agrarian reform movements in American history. The short-lived permanent agriculture movement starting in the late nineteenth century

gained momentum with the crises of the Great Depression and Dust Bowl. It promoted soil conservation and planning as an alternative to traditional farming practices. Similarly, the sustainable agriculture movement today, though subdivided into agroecology, organic farming, permaculture, and polyculture, can share underlying ethical principles that recognize the fragility and interconnectedness of living systems. It was spurred in part by rapidly expanding pesticide use and economic upheaval. Agrarian reform, promoted by charismatic individuals such as Edward Faulkner, Hugh Bennett, Louis Bromfield, Paul Sears, and Wes Jackson, called for nothing short of revolution in farming. Proponents were just as much concerned with preserving social resources as with natural resources because a crisis of human spirit mirrored the crisis of the soil. The authors argue that both permanent and sustainable agriculture were founded on ecological principles and a reaction to what was perceived as a failure of traditional farming practices to provide quality farm products, healthy soils, and desirable livelihoods.

Beeman and Pritchard subtitle their book "Ecology and Agriculture" in part because for Sears and Faulkner "permanent agriculture was far more than conservation, requiring an ecological worldview that required reverence for life and respect for nature" (p. 75). Nevertheless, this book would be better subtitled "Conservation and Agriculture" because little of the intellectual content of the science of ecology appears in it and even less of its application to agriculture. The work of Alfred Lotka, Vito Volterra, Georgii Gause, G. Evelyn Hutchinson, Robert MacArthur, and Carl Huffaker certainly influenced traditional agriculture, but their connection to alternative agriculture is unclear. Although Beeman and Pritchard describe some early ecological models of vegetation change in both theoretical and philosophical terms, they provide little evidence of farmers actually using the science of ecology as it was used in range science. They write of agrarian reformers using ecological holism and techniques to create a new environmental ethics and a "new devotion to ecological stewardship and responsibility" (p. 101). In effect they conflate environmental and ecological tenets, equating ecology with ethical and spiritual outlooks on nature because "ecology based itself on then-prevailing currents such as interdependence, balance, and harmony" (p. 35). They suggest that the eclipse of permanent agriculture was due in part to "divisions within the guiding force of ecology" (p. 77), though they do not say what that guiding force was or who

represented it. Because they never clearly lay out when they are using “ecology” to refer to a budding science or when they are borrowing a layman’s use of “ecology” that refers to the interconnectedness of all organisms and a sense of holism, they obscure their very important treatment of agrarian reform movements.

This book is less a history of the impact of ecological science on agriculture and agrarian reform than it is an analysis of the role of environmental philosophy in spurring changes in farming practices. Nevertheless, it is a valuable account of extraordinary events in the history of American farming. Beeman and Pritchard present fascinating stories of agricultural visionaries striving to better the world around them. This combination of environmental history and prescriptive remedy for our agricultural ills provides thought-provoking reading.

SARA TJSSEM

Donald MacMillan. *Smoke Wars: Anaconda Copper, Montana Air Pollution, and the Courts, 1890–1924.* xviii + 296 pp., illus., index. Helena: Montana Historical Press, 2000. \$40 (cloth); \$18.95 (paper).

Butte, Montana, lies at the headwaters of the nation’s largest Superfund site. Donald MacMillan’s book is a morality tale about this environmental travesty—a story of damaged health and environment, futile efforts by citizens and government to halt that damage, and demoralization resulting from those failed efforts.

MacMillan’s story covers the period from the 1880s to the 1930s. In the first phase, he describes the struggle between the young city of Butte and negligent smelter owners. In the second, the smelter owners shifted the problem to a nearby town and surrounding farmers. In the third, the federal government attempted to enforce conservation policy.

When miners first settled Butte in the 1860s, they found a lush valley high amid the peaks of the Continental Divide. By 1890 Butte was a major source of copper for a growing nation. Ore was roasted in open heaps a city block long. Sulfur and arsenic fumes killed vegetation for miles around. When winter inversions trapped smoke, residents suffered nosebleeds and vomited in the streets. Up to eighty people a month died in this town of just 40,000.

The city sent abatement notices. Mine owners ignored them, arguing, “No smoke, no wages for workingmen.” Though open heap roasting ended because it was inefficient, new roasting furnaces did little to ease the problem. The growth of the



L. O. Evans, counsel for the Amalgamated Copper Company in the Bliss case (from MacMillan, *Smoke Wars*, p. 121).

Anaconda Copper Mining Company (ACM) did end the problem—at least for Butte residents. By 1906 nearly all of Butte’s ore was shipped twenty-six miles down the valley to ACM’s Anaconda smelter. Each day it belched thirty tons of arsenic and 2,500 tons of sulfur into the air. Whole herds of horses, cattle, and sheep lay wasted in the fields. ACM paid \$330,000 for damages within five miles of the Washoe but refused compensation to more distant farmers.

Afflicted farmers filed a lawsuit, offering to settle for a \$1,175,000 buyout of their 60,525 acres. ACM declared their land not worth \$500,000 and then spent nearly \$1 million to prove it. Farmers lost when the judge—who socialized with ACM executives—found against the farmers in 1909. ACM had utilized “best known methods” and therefore should not be liable for any damages.

Smoke poisoned national forest lands as well as farmers’ fields. Trees within twenty-five miles of Anaconda were dead or damaged. President Theodore Roosevelt and Chief Forester Gifford Pinchot initiated an investigation through the U.S. attorney general’s office that eventually sought \$4 million in damages from ACM. The company stalled, hoping for a more tolerant administration following the elections of 1908. In 1911 President William Howard Taft, trusting industry to do the right thing, created the “An-

aconda smoke commission”—a group of industry and government advisors—to oversee ACM’s implementation of pollution controls. In 1916 ACM’s smelter still emitted sixty-two tons of arsenic and 1,700 tons of sulfur each day.

In 1924 ACM finally took effective steps to remove most of the arsenic from its emissions. Because of high demand for arsenic insecticides to fight boll weevils, ACM made considerable profit on arsenic recovery. Problems with farmers ended when the farmers, financially bankrupt from their lawsuit, sold “smoke rights” or easements to ACM. Problems with the federal government ended after 1928 when President Herbert Hoover, who promoted government-industrial partnership, approved the swap of healthy ACM timberlands for damaged national forest.

As a resident of Butte, it is hard for me to keep in mind that this is a historical account. Although ACM’s smelting operations ended in 1974, the legacy of cultural and environmental damage lingers on. The morning newspaper reported forty-six homes in Butte contaminated with lead and arsenic: “The federal Agency for Toxic Substances and Disease Registry is conducting an investigation, and encourages all children to be tested.”

PAT MUNDAY

George S. Levit. *Biogeochemistry–Biosphere–Noosphere: The Growth of the Theoretical System of Vladimir Ivanovich Vernadsky.* (Studien zur Theorie der Biologie, 4.) 116 pp., bibl. Berlin: Verlag für Wissenschaft und Bildung, 2001. DM 28.

V. I. Vernadsky (1863–1945) was a star of Soviet science. Applying a mineralogist’s perspective to the phenomena of life, he founded the sciences of geochemistry and biogeochemistry and developed the concepts of “living matter,” “biosphere,” and “noosphere.” George Levit claims that Vernadsky’s work has not been thoroughly organized or interpreted even by Russians. Accordingly, he devotes over half of this book to a “reconstruction and analysis” of Vernadsky’s theoretical system, beginning with his notions of space and time as they apply to organisms. Vernadsky observed that living bodies escape entropy, that they are “dissymmetrical,” and that all their processes, including evolution, are irreversible.

Levit contends that Vernadsky’s views on the logic and methodology of science are vague and sporadic. He declares his philosophy of science to be a version of “radical empiricism,” which

holds that scientific theories are merely forms of the description of one’s sensations. He was a phenomenalist and a positivist. However, his notion of the noosphere was metaphysical and not empirical.

Most significantly, Vernadsky claimed that the biosphere is a geological envelope that has determined the geochemical history of almost all of the elements of the earth’s crust. Levit shows that Vernadsky viewed life as one of the general manifestations of reality alongside matter, energy, space, and time. Its properties are determined by such cosmic phenomena as gravitation and solar radiation. And so, Vernadsky believed, it must be cosmic in its scope. Once it comes into existence, it cannot die out.

In the 1920s Vernadsky became convinced that the development of thought similarly was a natural phenomenon rooted in the very structure of the biosphere. He developed the notion of the noosphere in Paris in the company of Henri Bergson, Edouard Le Roy, and Teilhard de Chardin. Since the seventeenth century, he argued, the growth of scientific knowledge has been the main force influencing the geochemistry of the earth.

In the latter third of his book, Levit compares Vernadsky’s theoretical system to three related ones. With Teilhard, Vernadsky shared a basic terminology, methodological principles, and an implicit teleology. Unlike Vernadsky, however, Teilhard believed that eventually the noosphere would be replaced by a super-mind that would release thought from its material matrix. In the 1960s James Lovelock introduced the Gaia hypothesis, which holds that the earth itself is a kind of homeostatic self-regulating organism. Although Vernadsky would likely have been dubious, Levit discerns no fundamental differences between his biosphere and Gaia.

Finally, V. N. Beklemishev, a Russian zoologist, also concluded that life controls the processing of matter in the biosphere. However, while Vernadsky interpreted the phenomena biogeochemically, as a flow of chemical elements, Beklemishev viewed it morphologically. There is, he argued, neither life nor death, simply more or less material organization. Most approaches to the biosphere, writes Levit, are located within the Beklemishev–Vernadsky spectrum of opinion.

Levit admires Vernadsky’s attempt to include biological, geological, social, and cultural processes as parts of a single planetary process. Nevertheless, he concludes that Vernadsky failed to show convincingly that the empirical basis of his biosphere theory supports his claims

about the inevitable transition from biosphere to noosphere.

This terse and dense book reads like a reworked thesis. It badly needs editing by someone whose first language is English. There is a substantial bibliography but no index. Instead of endnotes or footnotes, there are maddening references in parentheses. At least twice, I found that a reference had no corresponding bibliographic entry. It all makes for an ineffably tedious treatment of what is potentially a truly intriguing subject.

ELIZABETH HAIGH

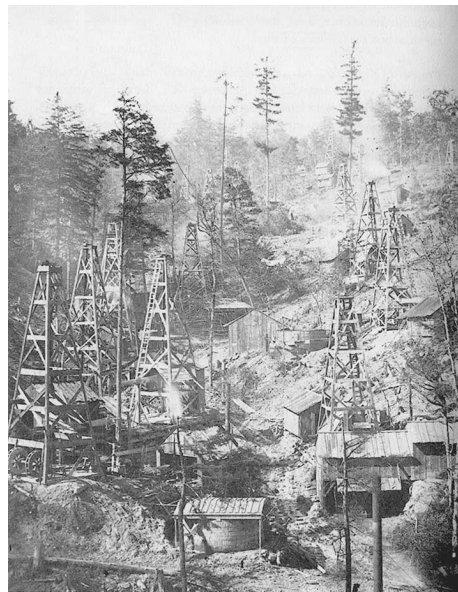
Brian Black. *Petrolia: The Landscape of America's First Oil Boom.* xiv + 236 pp., illus., tables, app., index. Baltimore: Johns Hopkins University Press, 2000. \$42.50.

The history of the modern oil industry begins along Oil Creek in August 1859 when Edwin Drake and Billy Smith found petroleum at the bottom of their well. Over the next decade and a half, Petrolia, the name given to this region in northwest Pennsylvania, produced more oil than anywhere else on earth. In the process, Petrolia became a massive industrial site and a vivid cultural image. Understanding this profound dual transformation is the object of Brian Black's sensitively drawn portrait of the landscape of America's first oil boom.

A landscape, according to Black, is a place where culture and nature meet, and in the 1860s a devastating crash occurred when the natural oil of Oil Creek met the commercial demand for lamp and machine oil. Oil Creek had been a quiet, lightly populated agricultural region whose sense of place was entirely self-constructed by the local farmers. After Drake's discovery, the area became a place of unprecedented exploitation whose identity was hastily assembled by the thousands of outsiders that flooded the area looking for work, riches, or an exciting newspaper story. Petrolia soon became a mythic boom, a mania, a craze. Distant capitalists and recently arrived entrepreneurs painted fantastic pictures of endless and easy wealth. Oil became a prized commodity, and everything else—animals, plants, people, and even the creek itself—became expendable in a single-minded market designed to pump as much oil as fast as possible. There seemed no legal, economic, or natural limitation to the exploitation—or to the boom mentality. Petrolia became the very embodiment of greed and speculation, instantaneous wealth and sudden failure. Its mores were as ephemeral as its transient population.

All this is grist for Black's ethical mill, and he grinds it well, perhaps too relentlessly. There is no doubt that looking at the exploitation of oil from the obliteration of the wooded valleys, or the filth of boomtown streets, or the emptiness of ghost towns (as Black does with startling effect when studying contemporary photographs of Petrolia) reveals a sacrificial landscape—an environment abused, wasted, ruined, and despoiled in pursuit of profit. Certainly Black is on firm ground when he ties what happened in Petrolia to what happened in Gilded Age America as a whole, but he may overstate the case when he argues that "industrial rationalization would never allow . . . humanitarianism to penetrate the utilitarian logic of Petrolia" (p. 167).

Was the logic of oil so ruthless and the motives of the Petrolians so shortsighted as to miss what was happening around them and what they were doing to themselves? They took photographs, after all. They criticized and complained endlessly about the mud, the floods, and the fires. Certain towns curbed land speculation, restricted development, and preserved a sense of community. And capitalists, by definition investors who try to reduce risk, worked to bring stability to petroleum production and prices. Black describes (but nevertheless discounts) these valiant if sometimes vain efforts to restrain the oil rush.



Landscape of Petrolia (from Black, *Petrolia*, p. 177).

But taken together, they seem to suggest more of a struggle—communities versus companies, humanitarianism versus utilitarianism—than Black acknowledges.

Many of those involved in the seeming chaos that was Petrolia wanted the oil industry to become a permanent, predictable branch of mining. This was especially true for the engineers, scientists, and other petroleum experts. To this end, Black provides a useful sketch of the technology of oil production (how to sink a well) along with a brief explanation of petroleum geology. He concludes, however, that none of these experts had much effect on the problems. “Science and technology were clearly tools of industry in Petrolia” (p. 72).

To an extent. In Black’s account, the oil “industry” was a collective evil. Equal parts cultural and economic, it acts like a numberless, faceless mob, gripped by “oil on the brain” and motivated by an all-pervasive ethic of progress and an insatiable drive to make money. It reduces to the sharp end of a rod used to bore through the earth for oil—environmentally insensitive and destructive. As an analytical device, however, “industry” is a blunt tool. Not all wells struck oil, not all companies manipulated knowledge and technique to their own purpose. Experts (independent and trustworthy) learned quite a bit and quite quickly about the habits of oil. The divining rod was *not* the most acceptable method of exploration (cf. p. 46). Again, there was more of a struggle—sci-tech versus random wildcatting—than Black allows.

The suggestion of situated struggles, however, does not detract from Black’s larger theme. Petrolia was environmental hell. Black has rendered this nightmarish landscape into a powerful and at times passionate story about the physical changes to the land and its meaning (how Americans then and now view, value, and understand the place). If there is a lesson to be found in Petrolia, it is that the modern oil industry is truly an American creation.

PAUL LUCIER

Harry Von Kroge. *Gema: Birthplace of German Radar and Sonar.* Translated by **Louis Brown.** Foreword by **Louis Brown.** x + 206 pp., illus., bibl., index. Bristol/Philadelphia: Institute of Physics Publishing, 2000. \$73, £45.

This book by Harry Von Kroge provides a short yet detailed technical and business history of Gema, the firm most prominent in the development of radar and sonar in Germany during

World War II. Along with the technical detail, this case study is valuable because of the light it shines on the ambivalent relationships between armament contractors and the various branches of the German armed forces, the difficulties inherent in developing, testing, and manufacturing new technology in Germany during World War II, and the cooperation and competition between different firms.

This book has limitations for the historian. References to sources are minimal and sometimes incomplete—no location for the documents is given. No attempt is made to compare the German work with its Allied counterpart, with the result that the reader cannot really judge Gema’s achievement. Finally, with very few exceptions, this book reads as if national socialism did not exist and Gema was merely a firm located in a country at war.

MARK WALKER

Hugh R. Slotten. *Radio and Television Regulation: Broadcast Technology in the United States, 1920–1960.* xviii + 308 pp., illus., bibl., index. Baltimore/London: Johns Hopkins University Press, 2000. \$45.

This well-researched book will be of immense value to the person who will someday write the full story of broadcast regulation in the United States. That story still needs to be written; although in this book the facts are all presented, the story behind the facts is not.

Well, actually, not quite all the facts are here either. For example, similar problems tackled in other countries such as Canada, even before the United States began looking into them, aren’t even mentioned. (The Canadian government began regulating radio in 1905, fifteen years before the U.S. regulations considered here.) True, the title of the book specifies that it is limited to the United States, but to understand the regulations presented we should certainly have some knowledge of how others had attacked the same problem.

More important, Hugh Slotten totally ignores the personalities of the people involved. This is a tremendously important consideration, for to understand what happened we must know something about the motives of the people who made the decisions, and since many of the motives were hidden under layers of varying complexity and political beliefs we would like to know something about the personalities of the players. (This would also make the book easier to read, which was clearly not the main concern of the author, but it couldn’t hurt.) Someone at the

Johns Hopkins Press evidently noticed the problem, but the only attempt at fixing it was to lie blatantly on the bookjacket: "His [Sloten's] discussion of the early years of radio examines powerful personalities—including navy secretary Josephus Daniels and commerce secretary Herbert Hoover." But there is no discussion at all of the personalities of these men. Daniels is mentioned in only two sentences, neither of which touches on him as a person, and although Hoover occurs in several more, nothing of his "personality" is thrown in.

Lee De Forest is another example. On page 4 he is identified as the inventor of the audion (or triode vacuum tube). On page 61 we read of his "invention" [*sic*] of that device. Why the quotation marks around "invention"? Did he or didn't he invent it? Actually, there is a good story to be told about that, but you won't read it here. De Forest played an active role in the regulation controversies, and this role is made clear in the book. But precisely because of this, wouldn't it be interesting to know that De Forest was arrested and went to trial for crooked stock manipulation in connection with the audion? The only hint at such activities is Sloten's statement that De Forest was a "maverick." Wouldn't that one word make you want to know more about him, if only to evaluate his quoted remarks on governmental interference and regulations?

Other matters of interest are passed by, as when on page 48 we read: "Decisions about who should receive licenses . . . could . . . be based on such qualitative issues as the character of broadcasts . . . and the educational benefits." What a can of worms this opens up! Or should open up. Is the government going to censor broadcasting by denying licenses to stations that publicize alternative methods of government, such as communism? How about religious or ethnic controversies: will these be deemed "educational" or subversive? Is the government, through its licensing powers, going to let the public hear only what it wants it to hear, à la Goebbels and Germany? Well, we'll never know, for this particular can is not opened by the author; after this one mention, the subject is never broached again.

In summary, if you are actively researching this field, Sloten's book is a must for you. But the full story of radio and television regulation in the United States is still to be written.

DAVID E. FISHER

David A. Kirsch. *The Electric Vehicle and the Burden of History.* xiv + 291 pp., illus., figs., tables, bibl., index. New Brunswick, N.J./Lon-

don: Rutgers University Press, 2000. \$52 (cloth); \$20 (paper).

Recent energy problems in California, combined with gyrating U.S. gasoline prices, have brought renewed attention to the energy efficiency of American automobiles. But this timely study by David Kirsch examines a set of historical questions related to electric vehicles. A century ago electric-powered vehicles seriously contended in the emerging market for automobiles. The internal combustion engine soon won out, but Kirsch shows that the explanation does not lie in common assumptions about a supposed technical superiority of gasoline engines. In line with the best recent scholarship in the history of technology, this volume demonstrates the complicated web of social, business, and environmental issues that, interwoven with technical factors, produce a more nuanced story of technical change, namely, the market failure of the electric vehicle. Specifically, Kirsch demolishes as simplistic the efforts to pin the failure of the electric car on its battery.

Kirsch's history begins with the formation and activities of the Electric Vehicle Company (EVC), the leading maker of electric cars. In 1897, EVC emerged in the context of early experiments with electric cars and grew into a large enterprise pursuing a marketing strategy of providing taxi services in large cities. Most automobile pioneers assumed that each power plant would prove best suited for certain activities. Electric-vehicle promoters embraced this logic of separate spheres, envisioning electric cars as best suited for short urban trips (taxis and electric delivery trucks) and for women drivers. Unfortunately, drivers of gasoline cars did not respect these boundaries. So even as EVC pioneered ideas such as interchangeable battery racks for cabs, their vehicles slowly lost in the competition. The demise of the company in 1912 was as much organizational as technical, however, for the various branches of the company's operations failed to follow standard practices designed to produce good service, not to mention profits.

Kirsch tells similar stories about other efforts to promote and sell electric vehicles. Thus attempts to link electric cars and central power generating stations went nowhere, despite a seemingly obvious fit. Utilities were attempting to build load, and battery charging at night promised to smooth load curves. Once again, however, Kirsch traces a pattern of missed business opportunities and organizational failures that amplified the technical challenges posed by bat-

tery power. In the end, utilities and electric vehicles never developed a suitable working relationship. A similar fate befell electric delivery trucks, even though they survived in a few East Coast cities for a longer time. Finally, efforts to develop an infrastructural base analogous to gasoline filling stations also went nowhere. Taken together, these sections of Kirsch's book are designed to show "might have been" elements to this complicated story.

Kirsch offers a number of original ideas as he follows this story along the path of history. He devotes a chapter to the idea, for example, that the electric vehicle actually survives within the internal combustion car, which he sees as a gasoline-electric hybrid. Beginning with the adoption of the electric starter as a standard element of the "normal" automobile, this hybrid nature was reinforced by the introduction of electric lighting, radios, and other electrically powered accessories. Kirsch also discusses the environmental impact of automobiles and closes with a chapter suggesting that the approaches of industrial ecology offer a promising way of thinking about the technology/environment interface. Overall, he makes an important contribution to the scholarly literature on technical failures, a topic that several historians have recently examined in order to highlight the importance of attention to alternative pathways—successful and otherwise. As has been the case in other such studies, the result is a much more complex, but also much more compelling and plausible, historical account. Kirsch's study is a model of the current work in the history of technology.

BRUCE E. SEELY

Ann Hibner Koblitz. *Science, Women, and Revolution in Russia*. xv + 211 pp., glossary, bibl., index. Amsterdam: Harwood Academic Publishers, 2000. \$45.

The 1860s—the epoch of great reforms—brought to Russia a remarkable assortment of official actions that emancipated the serfs, liberalized the judicial system, created *zemstva* as experiments in limited local self-government, granted universities an unprecedented scope of academic autonomy, and dramatically enlarged the number of young Russians enrolled in the leading Western universities in search of higher degrees in the sciences. These and similar reforms created an atmosphere favoring women's access to professional positions and contributing to the removal of the harshest aspects of the lingering patriarchal system.

Ann Hibner Koblitz's book offers a richly

documented and judiciously analyzed portrayal of the widening scope of Russian women's active participation in the professional life of the nation. The book's analysis operates on two levels: the general dynamics of the rising social pressure to expand the range of professions open to women, and the personal experiences of individual women selected for special analysis. Koblitz is fully aware that the process of the emancipation and professional advancement of women was occasionally disrupted by adverse shifts in government policies. Concentrating primarily on the 1860s, this book makes many references to subsequent developments and provides enough documented information to create an adequate picture of the state of women's emancipation and professional employment during the waning decades of the nineteenth century.

As might have been expected, Koblitz devotes the most interesting and penetrating analysis to the life and work of the mathematician Sofia Kovalevskaja, the brightest star in the emancipation movement and a most respected model of high professional aspiration and achievement. Inspired by the philosophy and ideology of the Nihilist movement of the 1860s, Kovalevskaja decided to enter the challenging world of science, specializing in mathematics, the queen in the world of scientific thought. The Nihilists made the idea of close interdependence of science and democracy a pivotal point of their ideology. Encouraged and guided by the well-known German mathematician Karl Weierstrass of Göttingen University, Kovalevskaja published a series of mathematical papers that attracted wide professional attention. Henri Poincaré, a leading mathematical physicist, referred to the paper that brought her the Prix Bordin from the Paris Academy of Sciences as a "celebrated memoir." The Petersburg Academy of Sciences elected Kovalevskaja an honorary member, the first woman to receive such a high honor—she was not, however, allowed to work for a magisterial degree in Russia, a requirement for university employment.

Koblitz shows that despite compounded obstructions on the path to professional achievement, women's gains in Russia were equal to those in the West. Her study provides solid information and cogent comments on the historical background and the educational role of the higher courses for women established in all major cities. Women, however, had less difficulty in acquiring higher education than in finding employment commensurate with their professional qualifications. Their employment by institutions

devoted to scientific research was almost always at the level of auxiliary personnel. I. P. Pavlov's main laboratory showed that even at this level there were women who not only manifested originality in experimental work but also published advanced scientific papers. In his classic volume on the development of the theory of conditioned reflexes, Pavlov referred to the publications of eleven women.

This book is welcome as the first solid effort to draw a general picture of the multiple ramifications of the ascent of Russian women to professional positions in science. It also contributes to a better understanding of the growing movement in favor of broader participation by women in the full spectrum of professional activities. This book is a rich source of topics for special studies.

ALEXANDER VUCINICH

C. Wright Mills. *Letters and Autobiographical Writings*. Edited by **Kathryn Mills** and **Pamela Mills**. Introduction by **Dan Wakefield**. xxviii + 378 pp., illus., apps., bibl., index. Berkeley/Los Angeles/London: University of California Press, 2000. \$34.95.

C. Wright Mills's daughters have selected 150 of 600 of their father's letters to family, friends, and colleagues covering successive phases of his career: student rebellion in the Texas years, collaboration with the Wisconsin sociologist Hans Gerth on the translations in *From Max Weber* (1946), his major sociological works, foreign travel, and the antinuclear and pro-Castro advocacy that made him a New Left icon even before his death from a heart attack in 1962. The editors delete references to "purely private" (p. xiv) matters, omit comments that might offend the living, and note that the record is less than complete since much of Mills's correspondence did not survive. The result is nonetheless an interesting if skewed portrait of America's most famous academic radical, supplementing but not replacing Irving Louis Horowitz's masterful *C. Wright Mills: An American Utopian* (Free Press, 1983).

Silences and omissions, although sometimes revealing, leave many questions unanswered. The letters tell more about professional quarrels and the politics of publishing than cross-fertilization within Mills's intellectual circle. Only one letter represents his longtime friendship with the historian Richard Hofstadter—already soured by the time Mills commented on a draft of the *Age of Reform* (1955): "god it is thin stuff" (p. 189). Numerous letters chronicle Mills's troubled part-

nership with Gerth, although less harshly than in Guy Oakes and Arthur Vidich's *Collaboration, Reputation, and Ethics in American Academic Life: Hans H. Gerth and C. Wright Mills* (University of Illinois Press, 1999). Useful editorial notes describe Mills's habit of breaking with former allies, notably Daniel Bell, Irving Howe, and Dwight MacDonald. But the letters shed little additional light on these relationships. No letters represent his colleague Robert Lynd, one of several Columbia influences on the anti-Columbia manifesto *The Sociological Imagination* (1959). All in all, Mills appears to have suffered little from the 1950s Red Scare. He condemns McCarthyism retrospectively but dismisses early reports that the FBI is watching him (a story detailed in Mike Forrest Keen's *Stalking the Sociological Imagination: J. Edgar Hoover's FBI Surveillance of American Sociology* [Greenwood Press, 1999]). A product of his time, Mills ignored issues of gender and race. "A woman, any woman, looks best at her prayers," he noted during his first trip to Europe in 1956 (p. 211). Although women figure in the letters as wives (three), lovers (two), and sociological collaborators, the correspondence is essentially silent regarding what he termed "my women and all of that . . . a tale of monstrous tragedies" (p. 254). He also was not much interested in the "Negro problem," even though he personally condemned racism.

On balance, these letters present a more complex and conflicted figure than the Mills of legend, New Left or otherwise. An academic bad boy, he nonetheless played the professor game with consummate skill, creating alliances, outflanking rivals, and cultivating references for foundation grants and visiting lectureships. Although a critic of capitalism, he was increasingly both creature and captive of the literary marketplace, measuring success in terms of sales and publishers' advances. Denouncing the rich, he talked constantly of money and things, planned his country homes and their furnishings down to the smallest detail, loved foreign travel, and worshiped his BMW motorcycle (the "roar of an R-69 being bench-tested," he wrote, was preferable to the world's "finest cathedral" [p. 197]). Despite a surface bravado, he was also deeply sensitive to criticism.

As "Charlie" of Texas becomes "C. Wright" of New York, it is tempting to view Mills as a self-invented, self-promoting outsider in the tradition of the Great Gatsby, a likeness noted by friends and critics. But the deeper truth is that Mills apparently saw the tragedy of this role even as he played it. "[It] saddened me horribly,"

he wrote Gerth after reading Fitzgerald's novel, adding that his "personal reaction" made it impossible to discuss the book in a letter (p. 64). Mills's turbulent, too-short life deserves attention not only for what he taught about society and sociology but what he teaches about ourselves.

ROBERT C. BANNISTER

■ **Recent (1950–)**

C. J. Mozzochi. *The Fermat Diary*. xii + 196 pp., frontis., illus., apps., bibl., index. Providence, R.I.: American Mathematical Society, 2000. \$29.

This is the diary of an observant mathematician who documented the drama of the resolution of Fermat's Last Theorem (FLT) as it unfolded around him from 1993 to 1995. Pierre Fermat claimed around 1637, in the most famous marginalia in the history of mathematics, to have a proof of the theorem that $x^n + y^n = z^n$ has no whole number solutions for n greater than 2. The other principal figure is the British mathematician Andrew Wiles, who emigrated to Princeton University in the 1980s and who in 1993, at what for mathematicians is the relatively advanced age of forty, announced a proof of FLT. In the course of Wiles's initial exposition to mathematicians, before a full-fledged proof could be published, a gap was discovered. This was too late to forestall announcements in the world press of an imminent proof. What had been an almost secretive devotion to the task by Wiles now became a rather more public and pressurized effort over the course of nearly a year. Wiles wondered at times if success could be achieved, but with the help of other mathematicians the gap was filled in and the full formal proof published in 1995.

The statement of the theorem is likely to be the only part of the 1990s story that a nonspecialist can immediately appreciate, and the author has not especially addressed his book to the nonspecialist. Rather, this account is analogous to a well-illustrated exhibition guidebook that serves as a memento and record to those who visited in person but that is not intended fully to inform those who did not experience it. For a broader account of the historical and mathematical background a reader can consult the three principal books published previously on the same topic by Amir Aczel, Simon Singh, and Alfred J. van der Poorten. The author knew many of the main players, attended most of the key talks, took notes, made recordings, and pho-

tographed. A major part of the book is a selection of sixty-two photographs from the total of three thousand made by the author. He asked questions of Wiles and others and recorded both formal and informal reactions that he observed around him during the many public and non-public presentations that were made. Also, in keeping with the journal nature of his work, he has recorded his own reactions. Appendixes include an excerpt from Wiles's 1995 *Annals of Mathematics* publication and a synopsis by Ram Murty of the key results by Gerhard Frey, Jean-Pierre Serre, and Kenneth Ribet that formed a basis for Wiles's work.

It may interest historians and archivists to learn of the extent to which the primary sources for this story include e-mail, web pages, photographs, and newspaper and television interviews. Though we recognize this reality of contemporary science, a diary account probably brings the issue home more directly than would studies by professional historians, who might feel obligated to do more of their own interviews, for example, rather than rely on the media. Mathematics has rarely had such a public spotlight turned on it—the proof of the four-color theorem in 1976 is the only comparable event that comes to mind. Consequently, it has opened an unusual window into how mathematicians do mathematics.

ALBERT C. LEWIS

David H. Levy. *Shoemaker by Levy: The Man Who Made an Impact*. xvi + 303 pp., illus., tables, bibl., index. Princeton, N.J./Oxford: Princeton University Press, 2000. \$27.50, £15.95.

This book, written by a close friend, recounts episodes in the life and career of Eugene M. Shoemaker (1928–1997), an ever-youthful geologist with a passionate interest in applying geological principles to the moon and planets. In the early 1960s Shoemaker persuaded the U.S. Geological Survey to found an Astrogeology Branch, of which he served as the first director, to search for impact scars on the earth and to map the moon and other planetary bodies. He also played a leadership role in persuading NASA to include scientific investigations in its plans for the Apollo missions. In the 1970s, when images from spacecraft revealed the presence of impact craters on all the rocky planets and satellites, he declared that the impact of solid bodies was the most fundamental process to have taken place on the terrestrial planets. Acting on this insight, he helped to transform geology from an earth-centered to a planetary science. Eugene

Shoemaker was, indeed, a man who made an impact.

Details of Shoemaker's career and his many accomplishments have been documented elsewhere, including the numerous citations for honors bestowed upon him and, sadly, his recent obituaries. In this book David Levy, an amateur astronomer and a collaborator with Gene Shoemaker and his wife, Carolyn, gives us personal reminiscences that are available nowhere else. Levy writes in a relaxed, anecdotal style that adds new information and a great sense of fun to this story.

Levy tells us, for example, that as a young member of the U.S. Geological Survey, Gene broke with a stern tradition by bringing his wife and children to live with him in his field camps, arguing that their presence made him more rather than less efficient in conducting his work. It was perfectly natural, then, for Gene and Carolyn, decades later, to work together in the Australian outback, where they discovered ten previously unknown impact scars and confirmed several more suspected ones.

From 1948 onward Gene harbored a fervent desire to go to the moon, a wish Levy ascribes to his view of a spectacular moonrise over the Colorado Plateau. Back then, such ideas were pure science fiction; but years later, when a real possibility arose, Gene was overcome by a mystifying loss of energy. When his doctor found nothing wrong, Gene and Carolyn took a river trip, hoping to restore his strength and spirits. But his condition worsened until he found a doctor who recognized, on sight, that Gene was a victim of Addison's disease, a formerly fatal illness that could be controlled by cortisone. On taking his second dose, Gene felt his energy returning, but he—like his contemporary President John Kennedy—was obliged to take cortisone every day for the rest of his life. This dashed Gene's hopes of going to the moon himself, but he redoubled his efforts to provide geological training to the fighter-pilot astronauts who did go there.

Beginning in the 1970s, Gene and Carolyn performed systematic searches of the night skies for comets and Near Earth Objects—bodies in orbits that might cause collisions with the earth. Levy joined in many of their searches, and the three of them shared the ultimate triumph of discovering their ninth comet together—Shoemaker-Levy 9—and watching more than twenty luminous fragments of it plunge one by one into the atmosphere of Jupiter. Several of the pieces sent up dark plumes that lasted more than a year and would have been large enough to envelope

the entire earth. No doubt remained that impacts could cause global damage to earth's lithosphere and biosphere were such impactors to strike our own planet. Levy tells us that as the last few pieces disappeared Carolyn lamented the loss of "her string of pearls"; as a consolation, Gene surprised her with the gift of a string of pearls.

This book is not, nor was it intended to be, a serious biography based on extensive interviews and archival research. Regrettably, its excellence as a personal account is somewhat marred by the lack of attention from a good fact checker and editor, who would have fixed the slips that appear here and there. For example, on page 41 Levy describes Meteor Crater as being 1.2 kilometers across, and on page 43 as being 1.3 kilometers across—a small but needless discrepancy (the "official" diameter is 1.18 km). On page 144 we read that when Gene brought a carload of students to the Grand Canyon, "a steady snow was falling as they made their way into the canyon. Gene showed a lot of enthusiasm—after all it was his crater!" Clearly, several sentences are missing from between these two sentences. Such lapses are minor, but they are sufficiently common to make the book unreliable as a source of facts. Nevertheless, it is a delightful book that can be strongly recommended to general readers and also to specialists, both for their enjoyment and for the personal details it will add to their knowledge of Eugene Shoemaker's contributions to science.

URSULA B. MARVIN

Tony Jones. *Splitting the Second: The Story of Atomic Time.* x + 199 pp., illus., figs., tables, app., index. Bristol/Philadelphia: Institute of Physics Publishing, 2000. \$19.99, £14.99 (paper).

Science writer Tony Jones, a research astronomer by training, has given us a lucid history of timekeeping and time distribution, one that emphasizes the last fifty years of developments. These five decades are among the most significant in the long history of advances in the accuracy of time measurement. Indeed, during the period our fundamental unit of time—the second—was redefined in terms of an invariant property of the cesium atom, thereby abandoning its longtime astronomical basis.

Writing in a popular style, Jones begins at an elementary level, describing how time was based on the rotation of the Earth. He details the nature of the corrections that were applied to the passage of the Sun's center over the observer's meridian in order to produce a uniform time system,

one in which all days had the same duration, within small fractions of a second. He highlights improvements in the precision of timekeepers and how they led to a better understanding of the Earth's motion and, eventually, to the need for a more uniform time scale. Jones provides easy-to-understand examples of various phenomena affecting modern timekeeping, giving readers an appreciation of the technologies as well as the exciting physics associated with the myriad advances. In addition, he describes a number of uses of precise time to demonstrate the linkage between laboratory devices and the complementary distribution of very precise time signals. The most important application today is probably the global positioning system (GPS) of satellites, whose onboard atomic clocks have revolutionized air and sea navigation and which give us the means to know time accurately anywhere in the world.

An author writing a summary history necessarily draws upon the works of others, and apparently Jones used the late Derek Howse's history of nineteenth-century timekeeping as given in *Greenwich Time and the Discovery of the Longitude*, published in 1980 and revised in 1997. The later edition is more properly a reissue, for its text does not reflect current understanding of the history of timekeeping and astronomy—despite the fact that the sources are listed in Howse's bibliography and notes. Thus we have Jones repeating Howse's erroneous statement that the Greenwich time ball was the "world's first regular public time signal" and writing that "in 1884 an international conference in Washington set up a system of time zones for the whole world"—common misstatements, but a bit disheartening to see them once more. Moreover, because of the focus on astronomy at Greenwich, studies of timekeeping and time distribution by the Astronomer Royal for Scotland Robert A. Sampson have been slighted: Sampson's results were critical in the subsequent selection of technical work undertaken by the time committees of the International Astronomical Union after World War I. Of course, the historical errors do not detract from the central thrust of the work.

Jones's book is a most welcome addition to the literature. With the exception of James Jespersen and Jane Fitz-Randolph's *From Sundials to Atomic Clocks*, now in its second edition, there is nothing available for technically oriented nonspecialists who need an introduction to current practices in timekeeping. Specialists also will find *Splitting the Second* a useful resource. Both groups will look forward to the next edition,

whose appearance will serve to document further advances in the science and technology of time. Considering that standards working groups are already studying the ramifications of dropping the Leap Second, another correction that Jones describes, we will not have long to wait.

IAN R. BARTKY

Alfred K. Mann. *For Better or for Worse: The Marriage of Science and Government in the United States.* xviii + 240 pp., illus., bibl., index. New York/Chichester: Columbia University Press, 2000.

In the preface to *For Better or for Worse*, Alfred Mann cautions, "This book is not a scholarly history with any claim to completeness." This is fair warning. The book is a somewhat idiosyncratic discussion of the development of what Mann terms "the science establishment" in the United States from World War II to the present. The establishment is defined rather loosely as the complex of federal agencies, universities, industrial firms, and researchers that support and conduct the nation's basic and applied research.

Within this "establishment," the book's focus is almost exclusively on the four agencies that fund most of federal research: the National Science Foundation (NSF), the National Institutes of Health (NIH), the Department of Energy (DOE) and its organizational antecedents, mainly the Atomic Energy Commission (AEC), and the National Aeronautics and Space Administration (NASA). Defense is treated very briefly. Industry (except the nuclear industry) is virtually absent. The universities are seen mainly in relation to the funding agencies. And Congress, with only a couple of exceptions, is a black box.

Mann, an emeritus professor of physics at the University of Pennsylvania, has had a distinguished research career in elementary particle physics and astrophysics. He was associate director of the Princeton-Penn Accelerator in the 1960s, served on the boards of trustees of two university consortia that manage major scientific facilities, and was a member of the Department of Energy's High Energy Physics Advisory Panel (HEPAP).

His treatment of government-science relations reflects this background. Physics and atomic energy and their patron agencies (first AEC, more recently DOE) receive the most attention. Events and personalities in the nuclear power industry, for example, are discussed in detail, while NSF, NIH, and NASA affairs are painted with a broader brush. The White House Office of Science and Technology Policy and other presiden-

tial advisory bodies appear only at the periphery. Chapter 7 does include a table listing presidential science advisors from 1939 to 1999, but, oddly, it is not cited in the text. Indeed, the chapter makes no reference at all to presidential science advice.

There are many errors in the book, some serious: NIH is said to have grown to seven institutes by 1995 (p. 198). In fact, it had seventeen (twenty-one if one counts the National Library of Medicine, the Fogarty International Center, and similar bodies). Discretionary funding makes up about 34 percent of the federal budget, not 16 percent as stated on page 206. The Supersonic Transport (SST) program did not produce a Mach 3 airliner (p. 148). It was killed by Congress in 1971. NASA's aeronautics program did produce the XB-70, an experimental bomber that flew at Mach 3. The book's most significant shortcoming, however, from the standpoint of history of science, is its lack of documentation. Mann provides only forty-four footnotes, citing a total of ten sources. A more extensive set of references is included, but without specific citations.

Despite these limitations, patient readers will find some reward in the book. Researchers who have heard NIH described as "the crown jewel of the federal research enterprise" and seen it granted huge budget increases in recent years will find it sobering to read about how the agency struggled through bureaucratic battles over its management and peer review procedures as well as the political hostility of the Nixon administration in the 1960s and 1970s. And Mann's descriptions of NSF's travails over Project Mohole and its social science curriculum project, "Man: A Course of Study" (MACOS), though well-documented elsewhere, are useful reminders that NSF's congressional honeymoon is also a relatively recent phenomenon. In all, however, the book's contributions to the literature on postwar science-government relations are modest.

ALBERT H. TEICH

Gordon R. Mitchell. *Strategic Deception: Rhetoric, Science, and Politics in Missile Defense Advocacy.* (Rhetoric and Public Affairs Series.) xx + 390 + [9] pp., illus., fig., bibl., index. East Lansing: Michigan State University Press, 2000. \$55.

Gordon Mitchell mixes scholarship and polemics in a deliberate attempt to intervene "in present-day missile defense controversies" (p. 21). His book operates on three levels. First, he presents three case studies of recent missile defense

activities in which the United States government has misled the American public. The failed promise of President Reagan's Strategic Defense Initiative, or "Star Wars," has lured countless industry representatives and government officials into rigging tests, falsifying results, and withholding information. The government used secrecy and intimidation, trying to suppress the assertion of MIT professor Ted Postol that claims for the Patriot missile's success rate in the Gulf War vastly exceeded the evidence. Similar techniques were employed in the mid 1990s to discredit a study done by Postol and other colleagues suggesting that the government's proposed Theater High Altitude Air Defense (THAAD) might violate the Anti-Ballistic Missile Treaty. Mitchell relies primarily on secondary sources to document these accounts; readers familiar with the issues will find little that is new in his treatment.

The second level at which his book operates is more original. He subjects statements by government officials to rhetorical analysis. He hopes, thereby, both to reveal the misinformation and to create something of a taxonomy of dissimulation. He notes, for example, that President Reagan's rhetoric in proposing strategic defense was to equate it with disarmament. Volume 7 of the so-called Fletcher report on ballistic missile defense revealed the system's vulnerability to countermeasures; the volume was withheld from publication. The Rumsfeld report, which purported to establish that rogue states posed a ballistic-missile threat to the United States, was used instead to validate the claim that existing missile defense technology could work. When Ted Postol succeeded in demonstrating that a government-sponsored rebuttal of the study he coauthored on THAAD was fatally flawed, the head of Ballistic Missile Defense, who sponsored the study, chose to represent the difference as a "healthy scholarly debate." When the government is on the rhetorical offensive, it polarizes debate: to oppose Star Wars was to oppose disarmament. When the government is on the rhetorical defensive, it obfuscates: refutation of evidence is simply scholarly disagreement. In the end, Mitchell's exploration of rhetorical techniques provides some illuminating insights, though it does not seem to add up to a model that one might apply in other cases. Nor is it clear that these rhetorical strategies are anything more than ad hoc responses to the politics of the issue at hand.

On the third level, epistemology, the inherent conflict between scholarship and polemics becomes manifest. Though Mitchell promises to fo-

cus on “the interpretation of controversy” (p. 22), in practice he places “strategic deception at the center of attention” (p. 11). He is less interested in locating “the stages of the dispute” than in demonstrating that the critics were right and the government was lying. Even his title, *Strategic Deception*, confuses his focus. This term usually refers to counterintelligence designed to deceive the enemy, not polemics designed to persuade the public. Most of the deceit he describes is ad hoc and banal; only the special claims of secrecy and national security distinguish it from the practices of other government agencies and programs. One can see most of them, for example, in the controversy surrounding the creation of energy policy within the current Bush administration.

Those who do not know the details of his case studies will find this a useful, if somewhat wordy and redundant, introduction. Those who want to understand how government officials and contractors cross over the line from rhetorical flourish to abuse of power and blatant misrepresentation will be disappointed. The value that might have been added to this familiar material by a scholarly analysis is compromised by the polemics.

ALEX ROLAND

Raymond G. Stokes. *Constructing Socialism: Technology and Change in East Germany, 1945–1990.* (John Hopkins Studies in the History of Technology.) xii + 260 pp., illus., bibl., index. Baltimore: Johns Hopkins University Press, 2000. \$42.50.

This book outlines the evolution of some fields of technology and science in East Germany that were significant for industrial production during the existence of the German Democratic Republic (GDR). A description of political and economic conditions creates a lively picture of efforts, achievements, and misadventures on the basis of a particularly large number of newly exploited sources.

During the last decade numerous papers on the history of the GDR have appeared in print. *Constructing Socialism* has distinctive features, however. Giving some examples of high technology, Raymond Stokes follows up documented successes, their causes and their fates, as well their dependency on the entire political and economic milieu. There are no glorifications or nostalgic excuses for the social system of the GDR, but there is a remarkable approximation of realistically historical conditions in the country.

Originally the economy in East Germany was very industrialized and technologically highly developed in crucial areas such as mechanical engineering, machine tools, office machinery, chemistry, optics, and precision mechanics, along with the camera industry and motor industry. Immediately after the war, this capacity was weakened by dismantling, reparations, and the evacuation or internment of experts by the victorious powers. In the 1950s, every effort was made to develop modern technologies in the GDR. This is verified in full detail by the analysis of the transition from coal-based to petroleum-based technology for production of organic chemicals (pp. 80–93) and the evolution of semiconductor technology (pp. 93–109).

Although the GDR with its efforts wasn't far behind other industrialized countries at that time, the East German evolution of technology fell back in the early years of the GDR's existence. The causes were the weak research and development work in the GDR, the limited support of Soviet help, especially on semiconductor technology, the chronic lack of foreign currency reserves, the COCOM restrictions, and the migration of scientists and engineers to the West. Despite these serious defects, work on a digital computer began at the Technical University of Dresden under the direction of Nicolaus Joachim Lehmann in 1950. In 1953–1954 Herbert Kortum and Wilhelm Kämmerer in the VEB Carl Zeiss began work on an optical calculating machine, a working model of which was available in December 1954.

From the viewpoint of technology development in the GDR, different elements of socialism are introduced and analyzed, such as the role of group technology developed by the Soviet inventor Sergei Mitrafanow, the problem of standards in industrial production, and the new economic system. In 1961 the construction of the Berlin Wall was a deep break in the realization of all these political, economic, and technological initiatives and plans. Actually there was a relative stabilization of conditions in the GDR, but relations with the West became more complicated and the Sovietization increased perceptibly.

For the 1970s and 1980s the author introduces the program of secondary raw materials system (Sero) and the Stasi's (governmental security) role in GDR technological development. During these two decades the GDR was incapable of producing world-class technology without the Stasi and outside the area of the recycling system. With supreme effort, the government tried to develop the electronics and computing indus-

try, in terms of both research and development and production. Notably, the efforts for the development and production of the one-mega chip as well as the ambitious project of the 32-bit microprocessor are described in this section. Although huge sums were invested in these fields, leading to distortion in the entire development of the country, the results remained unsatisfactory and the gap relative to other industrialized countries increased (pp. 177–194). Even grandiose targets weren't able to hide the fact that by the end of the 1980s the system of the GDR was in the throes of political death and the GDR lacked the economic power to carry out such technical peak performance.

Unfortunately, the author takes less notice of the developments and products that were effective in the GDR, such as Mikroelektronik Erfurt, Carl Zeiss Jena, or Robotron Dresden Computers from the ROBOTRON 300 (circa 325 were built by 1972) to the EC 1056 (1985–1989) or the personal computer PC 1715. These devices did play a noticeable part in the economy and science of the country and expressed a high competitiveness of the GDR in the framework of COMECON as well.

The book presents a convincing outline of the development of some fields of high technology in the GDR based on essential and numerous researches; it is clearly laid out and will stimulate further studies. The explanatory statements are founded on fact and convincing, especially because of the close integration of technological, economic, and political arguments. Moreover, the bibliographic essay on the evolution of technology in the GDR (pp. 243–251) is of great value. Taken as a whole, this book is a benefit, and everybody who deals with the history of technology in East Germany during the second part of the twentieth century will gain a great deal from it.

MARTIN GUNTAU

J. Samuel Walker. *Permissible Dose: A History of Radiation Protection in the Twentieth Century.* xii + 168 pp., illus., index. Berkeley/Los Angeles/London: University of California Press, 2000. \$35, £22.

J. Samuel Walker, in his first two volumes on the setting of radiation limits, set the standard for writing about federal radiation protection policies. His *Controlling the Atom: The Beginnings of Nuclear Regulation, 1946–62* (Berkeley: University of California Press, 1985), written with George Mazuzan, and *Containing the Atom: Nuclear Regulation in a Changing Envi-*

ronment (Berkeley: University of California Press, 1992) contain a wealth of information about policies of the Atomic Energy Commission and its successor agencies the Department of Energy and the Nuclear Regulatory Commission. Walker, although a federal employee, always has been evenhanded in his treatment of radiation controversies, and no one writing in the field would be without his works as a reference.

Walker's new book is billed in the introduction as more than simply the final volume of the *Controlling* and *Containing* trilogy. Instead, its title and subtitle point to a larger story of radiation in the twentieth century, rather than just picking up in the 1970s where *Containing* left off. The book, however, falls short of that goal. The first sixty years of the century are summarized in the first 28 pages, with the remaining 128 pages covering the period from 1960 to the present. This editorial decision does not serve the book well, as Walker's descriptions of policy debates of the 1960s and 1970s are simply not gripping enough to justify the space allotted, while his sections on earlier history are so compact as to be lifeless.

What this book does well is summarize the major policy debates surrounding the "permissible" dose for radiation in the twentieth century, mostly from the perspective of federal agencies and scientists in charge of setting those standards. Walker takes pains to point out the problems surrounding the setting of radiation standards, including lack of knowledge of long-term and genetic effects, the difficulty of creating standards for medical personnel, workers, patients and the general public, and the difficulties of reconciling the American environmental movement and the need for nuclear power.

Despite its strengths, however, *Permissible Dose* sometimes reads more like an executive summary than a book. Controversies and political conflicts are disposed of in a paragraph or two, with little in-depth description of why nuclear issues received so much attention in the 1970s–1990s. Three Mile Island, Chernobyl, and the human radiation experiments scandal are all summarized in a few pages, if not paragraphs, without tying them to a larger argument or narrative. Significant events are decontextualized or simply left out. For example, the "Green run," Hanford's 1949 radiation releases, is mentioned in the section on the federal government's publicity problems in the 1980s, not in its proper cold war context. Another problem with the book is the lack of attention to occupational exposure to radiation—Karen Silkwood goes unmentioned, as does treatment of controversies

over radiation standards for workers in the Oak Ridge, Hanford, and Paducah atomic production facilities. Readers looking for historical background on the federal program to compensate workers at these facilities for their occupational diseases will find next to nothing of relevance.

While this book will prove a handy one-volume reference on complex debates involving the number of rems per year that were considered the permissible dose for radiation exposure, it does little to shed light on the human lives behind that number—either the lives of those who set radiation exposure standards or those who suffered the consequences of working under those standards.

RUSSELL OLWELL

Evelyn Fox Keller. *The Century of the Gene*. ii + 186 pp., illus., figs., bibl., index. Cambridge, Mass./London: Harvard University Press, 2000. \$22.95.

“*Evolvability*,” writes Evelyn Fox Keller, “refers to the capacity to generate any kind of heritable phenotypic variation upon which selection can act” (p. 39). Whether one considers genes or organisms, the potential to adapt and evolve, to respond flexibly to a changing environment, is now recognized by many biologists as itself a trait actively favored by natural selection. Keller correctly presents this idea as an antidote to an old notion of genetic stability. She seems not to appreciate how well it applies to her own subject.

The Century of the Gene is Keller’s latest collection of linked essays, six tidy, intelligent shovelfuls from her ongoing effort to undermine the claims of mainstream molecular biology and to substitute from the scientific margins an alternative interpretation. This project stems from her philosophical biography of the geneticist Barbara McClintock, published in 1983. In her Nobel speech, also from 1983, McClintock wrote of the genome as a dynamic “sensitive organ of the cell,” responsive, flexible, and interacting with the environment. For half a century, McClintock had railed at biologists that genes must be studied not as autonomous, independently acting units but rather as parts of an exquisite whole, acting in concert. Keller celebrated this in McClintock’s work, though many have read Keller as applying to this view of nature a gloss of feminism that McClintock rejected. More recently, among other projects, Keller has criticized the “master molecule” concept in biology, examined the use of metaphor in science, and celebrated Christiane Nüsslein-Vollhard’s studies in developmental biology.

Through it all, she maintains a fascination with gender and with language as shapers of scientific thought.

Here Keller explores what she sees as the divergent histories of studies of genes and use of the term “gene.” While scientists continue to talk of genes much as they have done for a century now—as stable, discrete units directing the activities of the cell and the development of the organism—the molecular biology of the last forty years has seen a breaking down of the boundaries of the gene, physically, chemically, and physiologically. Keller begins by attacking the notion of genetic stability—whence the introductory quotation about *evolvability*. Next she explores the idea of genetic regulation, the fact that genes do not *make* anything, nor do they literally control anything. The molecular biologist’s version of the chicken-and-egg problem is: Which comes first—proteins or genes? Proteins read the DNA that provides the instructions to make more proteins. Keller argues for chickens.

The most important idea in the book is Keller’s distinction between a developmental program and a genetic program. The former is a sequence of ontological steps in the life of an organism; it does not presuppose that all steps in the program are encoded in genes or that all steps are determined prior to the beginning of development. Developmental programs may be derived empirically, independently of genetic analysis. In contrast, the genetic program is a more recent idea that does locate the program instructions in the nucleus in the fertilized egg. For Keller, genetic programs carry implications of determinism, a restriction of vision in our attempts to understand nature.

The term “gene,” Keller concludes, has outlived its utility. Molecular biologists no longer work with anything so discrete as genes. Their own data, she argues, show that genes and genomes are flexible, modular, and interactive. Keller wishes for, but does not offer, a new term or set of terms that would better reflect current understanding of genetics and development.

If biologists have shown that the gene concept is outmoded, why don’t they know it? Keller’s answer is that the biologists have not yet recognized the implications of their own results; their language lags behind their knowledge. Eventually, she believes, either they will drop the term “gene” or biology must suffocate in its shell. Yet the changes she describes have been under way for decades and biology shows no signs of slowing. Keller recognizes this, and in the conclusion she briefly acknowledges the obvious solution to the conundrum: that biology

continues to grow *because of*, not despite, this linguistic flexibility. This important idea deserves fuller treatment.

As with the gene in nature, so with the word “gene” in the scientific lexicon: its very evolvability is selected for, a crucial trait that ensures its survival.

NATHANIEL C. COMFORT

Christopher Wills; Jeffrey Bada. *The Spark of Life: Darwin and the Primeval Soup*. xx + 291 pp., illus., figs., index. Cambridge, Mass.: Perseus Publishing, 2000. \$17 (paper).

Where is the line between successful popular science writing informed by scientists’ own recollections and truly reliable history? This is a book of the first kind that dallies with history but clearly remains a problematic source. As popular science writing about work since 1953 *The Spark of Life* is very successful and conveys a great deal of information about origin of life research and exobiology in highly readable form. Christopher Wills and Jeffrey Bada are, respectively, an evolutionary biologist and an organic chemist/biochemist oriented toward origin of life studies. Their strength lies in clear, simple writing about sometimes complex research. Their chief weakness as historians is that they have strong opinions about the field of research they are describing. They are friends and admirers of Stanley Miller (Miller was Bada’s Ph.D. advisor), and they fundamentally share his research orientation. They thus also share his enemies. Approached with this in view, the book can be a very useful source about the Miller “school” and its point of view in origin of life debates since 1953. But it certainly should not be mistaken for a neutral source just because it appears to be an introductory text.

Let us choose a single example to see how this plays out: the case of Sidney Fox, the protein chemist and longstanding Miller antagonist. While the development of Miller’s ideas is laid out in much fascinating detail and sympathetically given many pages of text, Fox’s equally long career is summed up in less than five pages as a “false start” in understanding evolution of the first organic molecules into more complex proto-living systems. Fox’s career did indeed take some odd turns, and his publicity seeking became something quite out of the norm after he was marginalized in the research community. But the initial differences in approach between Fox and Miller are here passed over quickly, leaving the impression that Fox never really had any answers to Miller’s criticisms of his work

on proteinoid microspheres (though Fox did). And Fox’s ability to carry on research at all is attributed to his character as “an excellent self-promoter,” with the veiled implication that he was thus able to dupe early NASA Life Sciences administrators into giving him funding. Whether one thinks that Fox’s research program actually brought out any useful, important insights or not (and some think so), this is surely an oversimplification of a complex story of the institutional environment that exobiology operated in during its early years. NASA administrators saw genuinely promising things in Fox’s work, and even if most of those have not panned out, there is surely a story here worth telling about changing ideas within the research community and within the NASA patronage system. The competition from the mid 1950s until at least the late 1970s between Fox’s “school” and the opponents, including Miller and Norman Horowitz, is a story full of historical interest, both in research journals and behind the scenes.

Regarding historical material before 1953, the first forty pages of the book, this work is whiggish to the point of being completely unreliable. Again, a single example will have to suffice. John Tyndall is credited with coining the term “panspermia.” Then William Thomson is touted as a proponent in 1871 of the altered meaning, that life could be present throughout space—for example, carried on meteors yet still remaining viable. We are left with a sense that both Tyndall and Thomson, being “scientific giants” of the time (i.e., heroes of the authors and “forerunners” of views they advocate), both basically agreed on this subject and that only the popular press ridiculed Thomson for this idea. But Tyndall and the Darwinians all ridiculed Thomson’s idea at the time. And Thomson himself proposed the idea as part of a unified campaign against Darwinian evolution and against modern ideas on the origin of life supported by Tyndall and Huxley, a covert way of holding out against the banishing of a divine Creator by abiogenesis. But we learn none of this: the ideas are bereft of their historical context, and even their scientific context, in the same old way that the simplistic “historical sections” of science textbooks have long distorted the stories they tell. Wills and Bada’s treatment of Pasteur, Pouchet, and Bastian similarly repeat many misstatements from past internalist histories. This is the case despite the fact that the authors show in their footnotes that they are aware of much of the recent work of professional historians on these subjects.

This book, then, is a source to be handled with some caution but useful on the period from 1953

to the present. On the period before 1953 it should not be considered useful history.

JAMES STRICK

Brian J. Ford (Editor). *Institute of Biology: The First Fifty Years*. iv + 135 pp., illus., apps. London: Institute of Biology, 2000. £10.

After five years of consultation, the Institute of Biology formally organized in early 1950. Its goals were twofold: first, to watch relevant legislation and provide the voice of British biologists on international issues; second, to serve the labor and community needs of British biology in both academic and industrial sectors. Years later the institute expanded to incorporate other roles: consultant accreditation, biology education, degree regulation, and history of biology.

This anthology celebrates the institute's fiftieth anniversary. Short papers written by members of the institute's history of biology network focus on particular decades. These are interspersed with brief recollections from select participants in institute activities. Appendixes list institute officers, symposia titles, publications, and details on the organization and events of institute branches.

These authors practice history as chronology and fact-collecting. They ask limited questions of past events. No effort is made to connect institute activities to larger issues. No effort is made to understand why these events took place, what enabled them, or how their character came to be defined. No effort is made to compare what happened here with what happened along similar lines elsewhere in British science, British labor, or the life sciences abroad. No effort is made to justify claims of impact and influence. This book is simply a celebration of activity written for insiders who are celebrating their own achievements. Although they can be proud of their accomplishments, this book fails to offer much meaningful explanation.

Edited by Brian J. Ford, this book has two values for analytical historians. First, some reminiscences offer interesting suggestions for future study, such as Sam Berry's tale about proposing a Royal Society of Biology. Second, the simple collecting of facts makes this book useful for reference, though an index would have been helpful. For more than this, historians must look elsewhere.

JOE CAIN

■ Sociology & Philosophy of Science

Donna J. Haraway; Thyrza Nichols Goodeve. *How Like a Leaf: An Interview with Donna J.*

Haraway. x + 197 pp., index. New York/London: Routledge, 1999. \$17.95, Can \$26.95 (paper).

Donna Haraway, one of the premier feminist science theorists of our generation, is a trained biologist who has used a menagerie of creatures—the cyborg, the vampire, OncoMouse[®], and primates—as markers to analyze the intersections among nature, culture, gender, and science. Her writing about these creatures is unique: dense, circling around, doubling back to move forward. This book, a conversation with Thyrza Nichols Goodeve, uses a more informal voice to discuss the intellectual, professional, geographical, and personal influences that shaped Haraway's singular vision.

A most surprising influence is the Catholicism of her upbringing—she was schooled by nuns and considered becoming a medical missionary. Although she no longer adheres to the tenets of the religion, Haraway attributes her linking of the figurative and the material to an indelible impression of the Eucharist. Place has also been defining: Denver, where she grew up, as a borderland; California, as a blend of agriculture and technology, populated by “Californios” (p. 42), as the location of the history of consciousness program of the University of California at Santa Cruz, where she was appointed to the first position in feminist theory in the United States and where she has trained multitudes of students, both graduates and undergraduates.

Haraway's background in the life sciences permeates this conversation. Architecture and its emergence in embryonic development stimulated her initial interest in biology, and the title *How Like a Leaf* stems from Haraway's attempt to compare her own structure to that of a leaf. Biology, with all of its subdisciplines, is the foundation for her analysis of nature-culture, using one to inform the other. “We live intimately ‘as’ and ‘in’ a biological world” (p. 25, italics in original), but it is a world that is historically contingent on and tied to culture. Her theory is relational, seeking to challenge boundaries, requiring responsibility for their construction, and taking in all views, simultaneously. The multiple perspectives occur horizontally and vertically, from miniatures to aggregates, zooming between them.

A large portion of this slim book discusses Haraway's adult personal ties, which, like her writing, also are unique. Goodeve claims that these relationships show how Haraway “lives the theory she writes and teaches” (p. 63), but Haraway does not explicitly endorse this idea, say-

ing that the relationships were only possible at a particular point in time. Without linking them to the body of work, the assertions run the risk of resembling gossip. The conversation is stilted at times, the flow interrupted when Goodeve quotes material from other writers (e.g., Martin Heidegger) whom Haraway does not immediately acknowledge as influential. A complete bibliography of Haraway's writings, easily accessible citations for works discussed during the talks, and more careful copyediting (e.g., Wenner-Gren Institute, not Wenner Grey Institute) would have been helpful. Readers of this book will also find worthwhile dialogue between Haraway and Constance Penley and Andrew Ross (Constance Penley and Andrew Ross, "Cyborgs at Large: Interview with Donna Haraway," in *Technoculture*, ed. Penley and Ross. [Minneapolis: University of Minnesota Press, 1991]).

Those who come to this book looking for the canvas on which Haraway has painted an uncommon picture of our world will be enlightened. Those who come looking for clues to unravel the density of the words in her texts may be disappointed. But who would want directions for reading Haraway? Part of the joy is finding something new each time we read an essay "with passion and irony, where passion is as important as irony" (p. 172).

MURIEL LEDERMAN

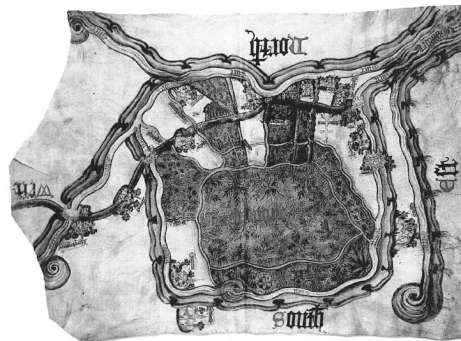
David Turnbull. *Masons, Tricksters, and Cartographers: Comparative Studies in the Sociology of Scientific and Indigenous Knowledge.* x + 263 pp., illus., bibl., index. Amsterdam: Harwood Academic Publishers, 2000. \$24, £14.99.

Although these essays derive from much previously published material, the whole is greater than its parts. The collection allows a comparative view of a variety of local knowledge systems, from that of the medieval masons who built the cathedral of Chartres to early modern cartography, and from the complex navigation system of Micronesia to present-day research on malaria and on turbulence. David Turnbull marshals local systems of knowledge to substantiate his thesis that "there is not just one universal form of knowledge (Western science) but a variety of knowledge" (p. 1).

Turnbull aims to show that knowledge is motley—that it is assembled out of heterogeneous components. It is a product of social labor. Its contents are pertinent to the locality in which it was produced. As such, contrary to the claims of modernist Western science, it is not rational, au-

tonomous, and objective. Knowledge is performative and historically contingent. It is both various and able to be compared across diverse cultures. Against the claim of science to represent universal, objective knowledge, Turnbull points to the conclusions of philosophers such as Richard Rorty who have examined the indeterminacies of modern scientific and technical ways of knowing. Using an eclectic variety of studies in philosophy and the sociology of knowledge, Turnbull reiterates Wittgenstein's point that meaning consists of embodied performance and usage.

For me the most illuminating part of this book is its comparison of the development of Western cartographic techniques in the "age of discovery" with the profoundly different navigational system that was developed in the Pacific by Polynesians. Turnbull shows the difficulties that early Europeans had in assembling the multitude of local knowledges about place and distance into a systematic cartographic knowledge in the interest of the state. He then discusses the profoundly different but also highly sophisticated navigational system of the Polynesians. They developed what he calls "a dynamic cognitive map," a map based on a star compass and *etak*, a system of mental representation in which the canoe was conceived as stationary and a reference island as moving backward against the rising and setting points of the stars. It was a complex system of navigation that Polynesian navigators learned by long years of study from childhood; it allowed an accurate estimation of the distance traveled. Pacific oceanic navigation was based on this system of mapping and on a key, highly sophisticated technology, the sea-



Late fifteenth-century local estate map, Yorkshire (from Turnbull, *Masons, Tricksters, and Cartographers*, p. 102).

worthy canoe. Turnbull here undermines the “great divide” between so-called traditional knowledge systems and modern scientific ones. He effectively questions assumptions such as the one that contrasts deliberate European discoveries of the Americas with accidental Polynesian discoveries of the Pacific islands.

He takes a similar approach in his discussion of the building of Gothic cathedrals, which he conceives as sites of experimental practice, as “laboratories.” He describes the cathedrals as sites of local knowledge, built with talk, tradition, and templates (patterns that the stonemason uses to cut the stone). Pointing to the evolution of the master mason into the architect in the fifteenth and sixteenth centuries, he suggests that thereby “theory became divorced from practice and skill became expertise” (p. 79). Here Turnbull oversimplifies the later development. History itself becomes a template cut for the purposes of his own theoretical structure, rather than the complex, locally contingent, messy, and inherently interpretive entity that it is. Calling cathedrals “laboratories” and the process of their construction “technoscience” places modern categories onto the past in a procedure that can only create a distorting lens.

This criticism can be directed at many social studies of science that use historical examples and is not meant to detract from the great value of this collection of interrelated studies. For modern science, Turnbull emphasizes both the motley assemblage and indeterminacy of scientific practices (his case studies of malaria research and turbulence provide concrete evidence). Rather than modern science being superior to other knowledge systems, both are based on local practices. The question then becomes not how scientific methodology achieves universal, objective truth, but how technoscientific knowledge spaces achieves apparent universality and connectedness. Turnbull’s answer includes technical devices and social strategies that treat various instances of knowledge/practice as equivalent and that make connections through ordering. He also shows the legitimacy and sophistication of knowledge systems that developed before or outside of modern technoscientific knowledge, and he creates a legitimizing space for both kinds, emphasizing the value of comparison and reciprocity. Rejecting the extremes of both the modern and the postmodern, he aims to create a middle ground that he calls the transmodern, a ground in that reciprocal dialogue between scientific and other kinds of knowledge systems can create both new insights

and concrete human progress. This book is a valuable contribution toward such a goal.

PAMELA O. LONG

Fritz Ringer. *Toward a Social History of Knowledge: Collected Essays.* 239 pp., frontis., figs., tables, index. New York/Oxford: Berghahn Books, 2001. \$49.95.

Fritz Ringer is best known to historians of science for his book *The Decline of the German Mandarins: The German Academic Community, 1890–1933* (Harvard, 1969), a work that has informed so much scholarship on the history of German science. But Ringer has also written major books on the social history of European education systems in the nineteenth and twentieth centuries, as well as on French academic culture in the decades around 1900. This volume of collected essays makes available in English a number of pieces he published during the 1980s and 1990s, often in journals or volumes unfamiliar to most historians of science.

The essays fall into three categories. Some illustrate Ringer’s long-standing interest in the historical sociology of the German academic community. One of them locates the origins of Karl Mannheim’s sociology of knowledge in the context of the social crisis of 1920s Germany. “Bildung and Its Implications in the German Tradition, 1890–1930” traces the impact of this educational concept on the political behavior (and to some extent the scholarly predilections) of academics. And “A Sociography of German Academics, 1863–1938” is a preliminary analysis of what can be learned from survey data collected in the 1950s by Helmut Plessner and his colleagues at Göttingen (now available, thanks to Ringer and collaborators, as an electronic database).

A second group of essays is concerned with the social history of European secondary and higher education systems. “Education, Economy, and Society in Germany, 1800–1960” summarizes parts of Ringer’s *Education and Society in Modern Europe* (Indiana, 1979). For historians of science its most important finding is probably the “segmentation” of secondary education from the late nineteenth century on: that is, pupils from different class backgrounds and social statuses tended to go to schools with different curricula (“classical” versus “modern”). Having internalized different kinds of educational, and more generally cognitive, values, the different “segments” then tended to opt for different kinds of higher education and even to study different disciplines. “Education and the

Middle Classes in Modern France” is actually a comparative analysis of French and German systems of secondary and higher education, ca. 1800 to the 1960s. In neither France nor Germany, Ringer argues, was the structure of the educational system primarily driven by the needs of the economy. Moreover, throughout this period both national systems tended to reinforce existing hierarchies of social status rather than to promote social mobility or open the doors of higher education to more people.

Finally, two essays illustrate Ringer’s comparative and sociological approach to intellectual history (and would be useful for teaching). “The Intellectual field, Intellectual History, and the Sociology of Knowledge” draws on Pierre Bourdieu’s concepts of field, habitus, and capital and outlines the analytical framework that Ringer used in *Fields of Knowledge: French Academic Culture in Comparative Perspective, 1890–1920* (Cambridge, 1992). “Ideas of Education and of Systematic Knowledge” is a comparative analysis of ideologies of secondary education in France and Germany that gave rise to particular intellectual orientations and conceptual preferences. As such it provides a nice example of the concept of habitus.

Historians of French and German science around 1900 will obviously find these essays of value, as will anyone interested in styles of science (or medicine or technology), whether these are conceived as national traditions or much more local ones associated with particular institutions or schools. Ringer’s work demonstrates how the basic cognitive predispositions that characterize such styles often originate in the structure of schooling and higher education.

JONATHAN HARWOOD

Michael Ruse. *Can a Darwinian Be a Christian? The Relationship between Science and Religion.* xii + 242 pp., illus., figs., bibl., index. Cambridge/New York: Cambridge University Press, 2001. \$24.95.

Who was it, when asked whether or not he believed in infant baptism, that replied, “Believe in it? Hell, I’ve seen it done!”? One might anticipate a kindred reply to the question “Can a Darwinian be a Christian?” from the irreverent pen of the philosopher Michael Ruse: “Can one be both a Darwinian and Christian? Well, one ought not be,” we might imagine his reply, “but I’ve actually encountered them . . . so evidently a Darwinian CAN be a Christian.”

The rationale behind Ruse’s affirmative answer is not so simple, although affirmative it

most certainly is. *Can a Darwinian Be a Christian?* provides an energetic, balanced, and thoughtful consideration of the issues populating contemporary discussion about Darwinian evolution and the Christian religion. Historians of “The Evolution Wars”—the title, by the way, of Ruse’s second-most-recent book (ABC-CLIO, 2000)—will remember Richard Dawkins’s 1986 boast that “Darwin made it possible to be an intellectually fulfilled atheist” (*The Blind Watchmaker* [Norton, 1986], p. 6). *Can a Darwinian Be a Christian?* stands as the most objective objection to Dawkins’s claim from one who, like Dawkins, insists that “Darwinism rules triumphant” (p. ix). This is the first way in which the book is praiseworthy: Ruse takes both Darwinism and Christianity seriously. While writing with zeal, good humor, and punch, Ruse, for the most part, eschews caricature, condescension, and patronizing remarks about the Christianity that he personally rejects.

The result is a very rewarding book, especially for those seeking a survey of the issues and points for fruitful conversation. Following two very nicely done introductory chapters on “Darwinism” and “Christianity,” respectively, the book ambitiously (but successfully) devotes a chapter to each of ten subjects—every one a fitting book topic in its own right—relevant to assessing the compatibility of Christianity with Darwinian evolution: “Origins,” “Humans,” “Naturalism,” “Design,” “Pain,” “Extraterrestrials,” “Christian Ethics,” “Social Darwinism,” “Sociobiology,” and “Freedom and Determinism.” Following each focused investigation of the hurdles Christianity and Darwinism present to each other, Ruse offers some variety of this conclusion: “There is no reason now to cast aside your Christian faith” (p. 156). In some cases his appreciation of Christianity is especially keen: “If you are a Darwinian looking for religious meaning, then Christianity is a religion which speaks to you. Right at its center there is a suffering god, Jesus on the Cross. This is not some contingent part of the faith, but the very core of everything. . . . Darwinism, a science which so stresses physical suffering, looks to Christianity, a religion which so stresses physical suffering and the divine urge to master it” (p. 134).

Ruse’s unwillingness to cast Christianity and Darwinism into the roles of embattled irreconcilable foes requires him to oppose both Christians and Darwinists who believe their views are mutually exclusive. By insisting that Darwinism need not be embraced as “a secular religion for a new age” (p. 186), Ruse places himself in opposition to such Darwinists as E. O. Wilson,

Julian Huxley, Richard Dawkins, and Richard Lewontin, folks with whom he also shares much common ground. Of course Christian anti-Darwinians, from the philosopher Alvin Plantinga to the adherents of the new Intelligent Design movement, like Phillip Johnson, Michael Behe, and William Dembski, come in for a good thrashing. In short, by suggesting the compatibility of Christianity with Darwinism, Ruse will irritate his vigorous opponents who see such peacemaking efforts as a mistaken compromise.

Whether or not it is a mistaken compromise, Ruse's conclusion still stands: "If there is a unifying conclusion to this book it is that while the comparison of Darwinism and Christianity may be challenging and difficult, it is also stimulating and fruitful. . . . Time and again what might seem to be firm barriers to the Darwinian and the Christian existing in one and the same person prove, on examination, to be precisely the points where advances can be made and understandings can be achieved" (p. 218).

This book would be very difficult for a young scholar to write. It successfully covers much ground quickly. This is a testimony to Ruse's writing ability and his devotion of decades to studying and writing about the history and philosophy of evolution. Even so not all the details are on mark. For example, Ruse misidentifies the Seventh-Day Adventist prophetess Ellen G. White as "Mary Ellen White" (p. 57) and overstates the case for hopefulness in origin-of-life studies (pp. 62–64). These problems and others of Ruse's debatable contentions, however, do not detract from the book's value within its most promising venue: the college classroom. It succeeded most admirably for a course I taught in science and Christianity this past academic year. Students read it, engaged with it, even claimed that it challenged them as they enjoyed it. For anyone seeking a guide to the issues upon which further study and conversation can be fruitfully built, Ruse has provided a valuable source.

MARK A. KALTHOFF

Shirley C. Strum; Linda M. Fedigan (Editors). *Primate Encounters: Models of Science, Gender, and Society*. xvi + 635 pp., figs., tables, apps., bibl., index. Chicago/London: University of Chicago Press, 2000. \$35.

Primates have been studied by more people, from more angles, for longer periods of time than any other vertebrates. Primate studies have existed for over fifty years and have attracted leagues of students from diverse backgrounds to studies of primate behavior, ecology, and evo-

lution. The nature of the primates and their students has insured that the field has enjoyed considerable public exposure. Most people with access to a television have watched programs in which the lives of baboons, chimps, or gorillas have been interpreted by a primatologist, either on screen or behind the scenes. Shirley Strum and Linda Fedigan's marvelous edited volume examines the totality of this phenomenon—the motivation behind the studies, the students, the media, and the practitioners of science studies who provide contemporary commentary on the whole mess.

In the Wenner-Gren Foundation-sponsored conference that led to their book, Strum and Fedigan's goal was to investigate how and why ideas about primate society have changed in the short lifespan of the discipline. The book does this and more. It is an all-encompassing examination of the adaptations and survival of a discipline through fifty years of changing intellectual fashions, increasing publicity, and an ever-changing backdrop of "general knowledge" and public expectations about science. The book's four major sections deal, in turn, with the perspectives of the pioneers of primatology, the diversity of national traditions involved in primate studies, intellectual currents in the related fields of cultural anthropology, archaeology, and psychology, and models of science and society through the lens of primate studies. Thanks to this well-conceived framework, the reader steps through an experiential history of primate studies that is vivid, lively, and filled with significant scientific and social insights. Each section is concluded with a printed exchange of e-mails among the contributors, modern versions of the texts of discussions featured in symposium volumes from decades past. These exchanges are the soul of the book, for it is in these that the personal motivations, grudges, and agendas of the participants emerge.

One of the most important themes explored in the book is that of gender and, specifically, to what extent the gender of primatologists has influenced their science and the way it is portrayed. Not only does this involve a complete exploration of Jane Goodall and Dian Fossey hagiography but also examinations of the impact that women have had in elucidating the roles of female primates in their societies and, thereby, in achieving comprehensive views of primate social dynamics. This theme, in turn, is closely tied to the most interesting set of interactions played out in the book, between the primatologists and the practitioners of science studies. One doesn't quite know here who is watching whom, but the

result is a balanced examination of what science in general means to people who don't identify themselves as scientists and how scientific knowledge is translated into public knowledge. In this age of growing "antiscience" sensibilities in the humanities and the public sphere, this contribution alone makes the book essential reading.

The shortcomings of the book are few: the chapters providing commentary on related disciplines do not make consistent comparisons with primatology, and at least a few of the authors don't seem to know or care about the entire premise of the book. But this is a very small problem in a book that is otherwise outstanding. The editors have produced a multifaceted, retrospective volume that is neither self-congratulatory nor self-pitying. It is an insightful treatment of how science really works, how it is portrayed, and how it becomes the fodder for its own science. I don't know any biologist or historian of science who would not benefit immensely from reading this book.

NINA JABLONSKI

Andrew Abbott. *Department and Discipline: Chicago Sociology at One Hundred.* xii + 249 pp., tables, apps., bibl., index. Chicago: University of Chicago Press, 1999. \$45, £31.50 (cloth); \$17, £12 (paper).

Andrew Abbott's *Department and Discipline* calls to mind an exchange I once had with an economist—prompted by my characterization of a recent work of urban sociology as part of the "Chicago-school tradition"—who reminded me that in his profession "Chicago school" was associated with Milton Friedman, free market ideology, and a world made up of rational, self-interest-maximizing actors. What I had in mind could hardly be further from that: the highly contextual, neighborhood-based mode of analysis that became a hallmark of the University of Chicago Department of Sociology from the late 1910s through the 1930s and that explained such phenomena as juvenile delinquency, race relations, poverty, and urban ennui as the products of complex, historically rooted social processes, ecologies, and group interactions.

The essays that make up *Department and Discipline* ask that we rethink "conventional" notions of "Chicago-school" sociology as a body of work produced by a particular group of faculty and students in a bygone era. Instead, in an engaging, unapologetically polemical, and ultimately prescriptive blend of historical analysis and disciplinary critique, Abbott conceptualizes the Chicago school as a tradition that was in-

vented and reinvented over time, and within the ever-changing relationship between the department and the broader discipline over the first half of the twentieth century. With this as his central theme, Abbott contemplates the—highly contested—meaning of the Chicago school in historiography and departmental history; the historical transformation of the Chicago-based *American Journal of Sociology* (*AJS*) from early, shaping influence to a mere organ of an increasingly narrow, professionalized discipline; and the capacity of the discipline to transcend what Abbott believes to be its contemporary state of professional and intellectual exhaustion.

Even within sociology, "Chicago school" has had varying connotations over the years. Some associate it with Robert Park and his cyclical, assimilationist vision of race relations; others with the organic, ecological view of urban growth and mobility patterns captured in such still-ubiquitous concepts as ethnic "succession"; still others with symbolic interactionism, the social psychological study of how people engage with, give meaning to, and ultimately act within the object world around them. More recently there has been talk of a "second Chicago school," a post-World War II generation of qualitative and interactionist scholars who kept those traditions alive even as the discipline was headed in more quantitative, grand theoretical directions. Complicating matters still further, members of the initial, now-legendary founding generation did not think of themselves as engaged in a single intellectual project or "school" of thought. Indeed, Abbott tells us that it was not until the 1970s, decades after Chicago lost its dominance in the discipline, that "the loose tangle of maxims and practices that had sustained the department in its glory years" was actually presented as "*the* Chicago school" (pp. 63, 18, emphasis in original).

So does it make sense to talk about *a* or *the* Chicago school of sociology? Abbott argues that it does, albeit not as something that exists in the ideas, the body of research, or the considerable institutional apparatus that characterized the department during its interwar "glory years." Rather, it existed in the interactions among a methodologically diverse, often deeply conflicted department faculty, out of which emerged an eclectic tradition of inquiry dedicated to understanding social processes in the context of time and place. Ironically, it took a moment of crisis—a year-long self-study in 1951–1952 prompted by administrative pressure and foundation efforts to define sociology as a bona fide science—to bring this vision of the Chicago-

school tradition into full view. By then, the tradition was on the way out: its practitioners retiring or moving elsewhere; its sensibilities displaced by a type of analysis C. Wright Mills would scornfully refer to as abstracted empiricism, dedicated to the construction and manipulation of variables outside of time and place.

Though not a book for the uninitiated—Abbott's detailed rendering of behind-the-scenes personalities and squabbles requires some knowledge of the department and its landmark works—*Department and Discipline* makes an important contribution to social science history as well as to the literature on the Chicago school. Informed by extensive archival research, the book is animated by a powerful argument that is likely to resonate with historians, if not with the *AJS* editors who declined to publish the essay they had commissioned from Abbott for the journal's centenary: that sociology must reconnect with and reinvigorate the tradition of contextual analysis. While intriguing, Abbott's argument that the Chicago (or any) "school" exists in departmental processes and faculty relationships is less fully realized—occasional references to the Chicago-school tradition in its 1920–1930s "heyday" sound awfully like the conventional view. It also makes for a book that gives short shrift to the actual ideas and body of research associated with Chicago sociology—and to their extraordinarily enduring influence among social practitioners and analysts alike. Still, when Abbott does turn to the work, the discussion is, like the rest of the book, original, thought provoking, and rewarding to read.

ALICE O'CONNOR

■ Reference Tools

Marilyn Ogilvie; Joy Harvey (Editors). *The Biographical Dictionary of Women in Science: Pioneering Lives from Ancient Times to the Mid-Twentieth Century*. Foreword by **Margaret W. Rossiter**. 2 volumes. xxxviii + xxvii + 1,499 pp., indexes. New York/London: Routledge, 2000. \$250, Can \$375.

Throughout the years, books on the history of science have featured only scattered references to the contributions of women in scientific fields. Published biographical dictionaries of scientists have contained relatively few entries devoted to women. Within the last century, sparked by the emerging interest in the feminist movement, isolated volumes have appeared dealing with women in medicine, in mathematics, in chemistry and physics, and in the biological sciences.

Marilyn Ogilvie and Joy Harvey, with the aid of over twenty contributors, have amassed a two-volume collection of essays on women who have worked in the sciences. No other work of such massive scope has been published; it contains information on the works and lives of approximately 2,500 women scientists culled from many sources. The fields of science covered include astronomy, biology, chemistry, engineering, mathematics, medicine, and psychology. The women cited are from around the world and are either deceased or were born before 1910.

Individual entries vary in length, not necessarily reflecting the importance of the individual's achievements. In cases where sources and detailed biographies are readily available, the entry included may be briefer. Each entry consists of a data section summarizing personal information, a biographical essay, and a bibliography containing selected works by and works about each woman.

Also included are various summary lists. Using these, the reader can derive perspectives on such questions as: What disciplines have attracted women through the ages? What time periods were most conducive to women's work? What countries and cultures encouraged women achievers?

Greater care could have been taken in proof-reading and editing the manuscript to minimize various technical flaws in the presentation. For instance, the ordering of entries in the "Alphabetical List of Entries" in the main body of entries and in the subject index is not always consistent.

With any work of this nature and magnitude, questions can always be raised as to omissions. There is no entry, for instance, for the mathematician and computer scientist Gertrude Blanch (1897–1996), who received the Federal Woman's Award from President Lyndon Johnson in 1964. Given today's widespread use of the computer, it is also surprising that no mention is given to pertinent reference sources available on the Internet.

This work is extremely valuable as a reference tool. It provides a springboard for further study on specific women as well as on the past, present, and future role of women in the sciences. It can also serve as a source of inspiration and encouragement to young women to seek careers in the sciences.

LOUISE S. GRINSTEIN

Sophie Riché; Sylvain Riquier. *Des hôpitaux à Paris: Etat des fonds des Archives de l'AP-HP XIIème–XXème siècles*. 864 pp., illus., tables.

Paris: Assistance Publique-Hôpitaux de Paris, 2000.

Sophie Riché, directed by Sylvain Riquier, the former *conservateur*, has inventoried every document in the Public Health Archives of Paris at 7 rue des Minimes to create an impressive, comprehensive guidebook. This volume of almost 900 pages now takes its place among the *Etats des fonds* that have long guided researchers through the thousands of boxes and bundles deposited in the Archives de France.

The authors confronted five idiosyncratic reference systems that, in the end, they decided to maintain. These inventory Léon Brièle's lists of old regime documents; hospital registers covering hundreds of years; the archives' library and rich card catalogues; recent acquisitions; and, most important, the so-called Fosseyeux catalogue, a "marvellous grab bag" according to a former *conservateur*, Valérie Poinssotte. It lists 136 items, many of them bundles held together by a piece of string (*liasses*). Untying a *liasse* initiates a treasure hunt—the researcher's delight, the bibliographer's nightmare.

To use this guide, one must understand the editorial decisions fundamental to its layout. The Assistance Publique de Paris was created in 1849. This leads the editors to focus on the past 150 years. A "policy of collecting and publishing" has replaced a "policy of documentation" (p. 3). The editors created an alphabetic list of 144 "hospital structures" (two-thirds of the book) since they wish to "privilege the producer" (p. 7). Each entry consists of most of the following (Bicêtre is here used as an example): a brief historic description, a bibliography, and a guide to archival documents with sections on administration, personnel, finances, architecture, gifts, inmates, inquiries, medical archives, plans, and images. An up-to-date supplement (*Suivi des hôpitaux*) is forthcoming. Footnotes act as links and dispense good advice. Researchers who are curious about a contemporary institution will be well served.

Less favored are scholars interested in historic developments. Events corresponding to the old regime are inserted into the alphabetical list of contemporary institutions. A glance backward reveals their past activities. Thus under *Charité-Gifts* we find "List of donors, 1601–1797" and under *Charité-Inmates (administrés)*, "Register of admissions, 1702–1935"—two of the rare lists that extend far into the past. As for tables of information regarding patients at Bicêtre, the Hôtel-Dieu, or Salpêtrière, they begin in 1810 (pp. 318, 543, 776)!

The other epoch that falls victim to this inventory's present-mindedness is the Revolution and Empire, when the French government attempted to transform Christian charity into secular welfare (*bienfaisance*), the citizen-patient's entitlement. Three reports document this momentous effort: those of the Duc de la Rochefoucauld-Liancourt to the Poverty Committee of the Constituent Assembly in 1791 and those of the Hospital and Public Health Councils of the Seine Department in 1803 and 1816. These reports appear only as bibliographic snippets for each concerned institution. This approach contravenes the spirit in which the treasures of this archive were collected by past *conservateurs* such as Marcel Fosseyeux (1903–1919) and Marcel Candille (1950–1973). A future inventory of the Assistance Publique before 1849 should also heed the legacy of that great scholar and friend of our field, the late dean Jean Imbert, whose work underlines the interrelationships of past, present, and future.

The authors freely acknowledge the lacunae with a list of "topics not dealt with" (pp. 861–862). Here we find groups such as the mentally ill and the blind, but also topics such as secularization. One looks in vain for information about the Sisters of Charity, the Brothers of Charity, or the Augustinians of the Hôtel-Dieu. Only one page deals with modern nursing (p. 106). "Pharmacy" is more explicit (pp. 146–151). A general index would be helpful. The main desideratum, in my opinion, is a complementary guide to public assistance from the perspective of the old regime and the Revolution and Empire. It is regrettable that an editorial decision appears to have excluded foreign-language works (that the archives own) from the secondary literature of this inventory.

These archives are open Monday to Friday from 9:00 to 5:30 without the usual annual closing. Photocopying is by permission, and some documents must be requested 48 hours before they can be viewed. Researchers have long been welcomed and guided here in an exceptionally friendly and helpful manner, and the new *conservateur*, Agnès Masson, and her staff continue this tradition.

DORA B. WEINER

Paul Dijstelberge; Leo Noordegraaf (Compilers). *Plague and Print in the Netherlands: A Short-Title Catalogue of Publications in the University Library of Amsterdam*. 360 pp., illus., bibl., indexes. Rotterdam: Erasmus, 1997. Dfl 120 (cloth).

This catalogue arose from a project to document material concerning the plague and the history of disease in the Netherlands. Rather than serving as a comprehensive bibliography, it is limited to texts held by the University of Amsterdam Library and published from 1512 through 1796. It contains over eight hundred entries and is augmented by twenty-two plates of illustrations. The catalogue itself also contains two indexes. The first links the entries to the authors' last names, and the second ties them to printers, publishers, and places.

The preface outlines the intended scope of the catalogue—a partial listing of the primary source material from the compilers' research into the plague in the Netherlands. This outline is complicated by the restrictions they place on what is entered into the catalogue. It "is confined to the works held in the Library of the University of Amsterdam, in particular to works in the collection of the Koninklijke Nederlandse Maatschappij tot Bevordering der Geneeskunst (KNMG)." The intent in assembling the catalogue was not to prepare a list of every work containing a passing mention of or paragraph referring to the plague; rather, it is limited to works that devote a substantial amount of attention to the plague. It is further restricted to authors and printers from the Low Countries, as well as works written by Dutch authors but produced in other countries.

This unfortunately prevents the catalogue from serving as a complete listing of the pertinent subject work contained in the KNMG collection. One looks forward to what the editors describe as their intention to expand the catalogue into a full-fledged bibliography without geographic restrictions—an effort that will potentially render this work obsolete.

Following the introduction is a detailed explanation of the structure and contents of each bibliographic entry. The entries are arranged in chronological order, then alphabetically by the author's last name within each year. When available, the main heading includes the author's birth and death dates. The elements of description contained in each entry include a short title (which adheres to the rules of the Short-title Catalogue—Netherlands [STCN] and uses modern Dutch spelling); the bibliographical format and collational formula; the STCN fingerprint; a brief statement of contents; the shelf mark; references, which correspond to the catalogues and bibliographies listed; and a list of all of the editions of the same text contained in the catalogue.

The editors make allowances for those new to the study of analytical bibliography and make an

effort to educate readers in this area. The volume's format is identified, as is its collational formula, which details the number of gatherings within the work and the presence or absence of introductory material. The STCN fingerprint further describes each entry and gives readers a chance to compare their holdings to this standard. The editors take readers step-by-step through the production of the fingerprint, which is based on the positioning of letters over the signature and is intended to distinguish between different editions of a text. As the editors conclude, "the usefulness of the STCN fingerprint lies in the unambiguous identification of any given edition."

The supplemental bibliography covers the period from 1800 to 1993 (but is not limited to the University of Amsterdam Collection). It is not comprehensive, containing only those items included at the compilers' discretion. They have chosen to omit modern publications unless they deal exclusively with the plague.

In general, the editors met their goal of creating a bibliography that would be useful and of interest to medical historians, bibliographers, and historians of the book. One can look forward to the next phase of this project with confident expectation.

LOIS FISCHER BLACK

Robert E. Krebs. *Scientific Laws, Principles, and Theories: A Reference Guide.* [viii] + 403 pp., illus., figs., bibl., index. Westport, Conn./London: Greenwood Press, 2001. \$65.

This book is intended as a reference source of "universal scientific laws, physical principles, viable theories, and testable hypotheses" from ancient times to the present. Robert Krebs states that he includes only the physical and biological sciences, including geology, but in fact there are also several mathematical and logical entries ranging from the Greeks to Gödel. The book contains over four hundred entries, in alphabetical order, averaging less than a page each, plus a glossary of nearly four hundred technical terms. Evidently, it is intended as a library reference for a general audience. It does not seem to be directed toward professional historians of science. The author is a retired university science administrator in the health sciences field.

Opening the book at random, I find four entries on the facing pages: "Carnot's Theories of Thermodynamics," "Caspersson's Theory of Protein Synthesis," "Cassini's Hypothesis for Size of the Solar System," and "Cavendish's Theories and Hypothesis." It is hard to know

what the principle of selection is, other than comprehensive coverage. But although it is impressive, the coverage is spotty. The famous story of Adams, Leverrier, and Neptune is not included, for example—perhaps because no new law is involved.

To a historical scholar, such a project has obvious pitfalls; I will list some of them. First, it is whiggish in selecting and evaluating the entries from our standpoint and in often omitting now-discredited content. For example, the entry on Carnot does not mention caloric, although it does mention the model of water flowing over a waterwheel. The book encourages the idea that discoveries and other major results are more or less punctiform, the achievements of particular individuals at particular times. To be fair, in his introduction Krebs does describe science as an ongoing, self-correcting process in which “laws” sometimes turn out to be false or to need correction. The book is historically uncritical, since it accepts at face value that eponymous results (a category that includes most of the entries) were actually achieved by the person celebrated in the name. The entries are necessarily too brief to indicate much of the wider historical context, or even the technical context, in which the law or theory under discussion was developed. Krebs’s statement of his intent, in the introduction to the volume, is theory centered and seems to take physics (indeed, Stephen Weinberg’s conception of physics) as a model, although in fact there are many entries from the biomedical sciences that do not neatly fit this model. The author’s attempt to characterize his subject matter—scientific laws—is philosophically naïve. Finally, even if we leave aside the difficulty of making complex technical results accessible to a general audience in a very limited space, no single author can be expert enough to maintain a high standard throughout a volume of such scope. Krebs identifies no panel of expert consultants enlisted to check his entries.

The entries that I sampled sometimes contained less-than-sharp formulations, inaccuracies, and even contradictions. For example, Krebs describes Aristotle, in cliché fashion, as a “philosopher” rather than as a “scientist concerned with observations and evidence” (p. 23), but two paragraphs later it turns out that Aristotle based his account of spontaneous generation on observations! Krebs says that motion was self-explanatory for Aristotle because things strive to reach their natural places. The entry on Euler mislabels his work on bodies moving with multiple degrees of freedom as the three-body problem. Fermat’s last theorem is said to remain un-

solved, yet Krebs obviously prides himself on being up to date. The entry on Planck is historically inaccurate and physically misleading. And so on.

For all that, I found the book rather interesting and useful. No reader leafing through it will fail to find this entry or that intriguing. (“Ah. I always wondered what that was!”) Since the entries are short and discrete, the book makes good bedtime reading. And, given that the laws, principles, and effects *are* commonly called by these names, the book can serve as a source of general knowledge—but only as a starting point. Given the uneven quality, *caveat lector!*

THOMAS NICKLES

■ Collections

Peter Becker; William Clark (Editors). *Little Tools of Knowledge: Historical Essays on Academic and Bureaucratic Practices*. Ann Arbor: University of Michigan Press, 2001.

Peter Becker and William Clark: Introduction. **Martin Gierl:** “The Triumph of Truth and Innocence”: The Rules & Practice of Theological Polemics. **David Warren Sabean:** Peasant Voices and Bureaucratic Texts: Narrative Structure in Early Modern German Protocols. **William Clark:** On the Ministerial Registers of Academic Visitations. **Wolf Feuerhahn:** A Theologian’s List and an Anthropologist’s Prose: Michaelis, Niebuhr, and the Expedition to *Flex Arabia*. **Hans Erich Bödeker:** On the Origins of the “Statistical Gaze”: Modes of Perception, Forms of Knowledge, and Ways of Writing in the Early Social Sciences. **Peter Becker:** Objective Distance and Intimate Knowledge: On the Structure of Criminalistic Observation and Description. **Martin Schaffner:** The Figure of the Questions versus the Prose of the Answers: Lord Devon’s Inquiry in Skibbereen, 10 September 1844. **Lorraine Daston:** Scientific Objectivity with and without Words. **Heidrum Friese:** Thresholds in the Ambit of Discourse: On the Establishment of Authority at Academic Conferences. **Rudolf Vierhaus:** Instead of an Epilogue: On the Production of Knowledge in History.

John M. Logsdon (Editor). *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program*. Volume 5. Washington, D.C.: NASA History Series, 2001.

John E. Naugle and John M. Logsdon: Space Science: Origins, Evolution, and Organization. **Amy Paige Snyder:** NASA and Planetary Exploration. **Nancy Grace Roman:** Exploring the Universe: Space-Based Astronomy and Astrophysics.

Wolfgang Lefèvre (Editor). *Between Leibniz, Newton, and Kant: Philosophy and Science in the Eighteenth Century*. Dordrecht/Boston/London: Kluwer Academic Publishers, 2001.

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