BOOK REVIEWS

Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry. J. B. Lambert, Addison-Wesley, Reading, MA, 1997, xiii + 319 pp. Cloth, $30.

Chemistry enjoys a uniquely utilitarian tradition among the scientific disciplines; long before the emergence of the modern atomistic paradigm and associated principles that established this new science during the nineteenth century, artisans had developed a wealth of empirical methods for the molecular transformation of natural materials into metals, glass, and ceramics. In *Traces of the Past: Unraveling the Secrets of Archaeology through Chemistry*, Joseph B. Lambert tells the engaging story of how chemical analysis of such artifacts provides insights into the cultures that created objects of practicality and beauty.

Traces of the Past assumes no technical knowledge on the part of its readers, and essential chemical concepts (from isotopes to infrared spectroscopy) are briefly described in the text. An extensive glossary of specialized terms makes it a useful reference for the novice, but Lambert does not shrink from the inclusion of representative data, in the form of tables and graphs reproduced from the primary literature. While the author offers succinct explanations, an individual who has never seen a ternary composition plot, for example, may have difficulty learning its interpretation here (p. 84). Each figure contains appropriate references, and over 18 pages of suggested "Further Reading" propel the student into the monographs and research articles of archaeological chemistry.

The eight chapters and epilogue are organized into a hierarchy of increasingly complex manipulation, from stone carving to the dyeing of cloth, to the production of "foods" such as chocolate and beer. A final chapter chronicles the history of early humans, including diet and lead poisoning, as revealed in relic stools and bones. A common theme is the interdisciplinary nature of archaeological research, and Lambert devotes as much space to anthropology as to chemistry.

The author, who holds the Clare Hamilton Hall Chair in Chemistry at Northwestern University, is well qualified for his task. He has carried out extensive research in collaboration with archaeologists for three decades; he received the Society for American Archaeology's Fryxell Award in Scientific Archaeology for 1989. He is also highly regarded as a teacher and has served as Director of Northwestern's Integrated Science Program. Lambert is an individual with wide-ranging interests, who in addition has made fundamental contributions to the study of structure and bonding in organosilicon chemistry, being recently recognized by the Kipping Award of the American Chemical Society (1998).

Traces of the Past relates intriguing instances of how chemists have uncovered apparent forgeries, as in the 1936 discovery of a brass plate bearing an arcane inscription with a date of 1579 and the name of navigator Francis Drake. Controversy ensued because the artifact was found in northern California, a site not known to have been visited by Sir Francis; elemental analysis confirmed that the alloy contained too much zinc (35%) and was suspiciously homogeneous to have been smelted before the nineteenth century.

Chemical analysis often supplies critical evidence to identify the provenance, or origin, of a particular artifact. Archaeological excavations in Mexico have yielded many examples of majolica, a lead-glazed pottery, originally brought by Spanish explorers and traders at the outset of the sixteenth century. However, levels of trace elements (cerium lanthanum, and thorium)

as well as isotopic ratios for lead have definitely shown that such technology was indigenous to Mexico about 1550.

In conclusion, this book constitutes a valuable resource for a course in archaeological chemistry (as a textbook), and it may also provide the analytical chemistry teacher with novel applications to enliven the classroom. More generally, *Traces of the Past* is a well written introduction that will be enjoyed both by nonscientists and professional chemists with an interest in the deep past. *William J. Hagan, Jr., School of Mathematics and Sciences, College of St. Rose, Albany, NY 12203-1490.*

Justus von Liebig: The Chemical Gatekeeper. William H. Brock, Cambridge University Press, Cambridge, 1997.

It is remarkable that Justus von Liebig, a central figure in the development of nineteenth-century chemistry, has escaped a full biographical treatment since Jakob Volhard's two volume biography published in 1909. Brock's biography is the first to appear in 25 years, the first English language biography in almost 100 years, and the first ever full biography by a professional historian of science. Historians of chemistry have long had to rely on Volhard's *Justus von Liebig* (Leipzig, 1909) and the fragmentary pictures of Liebig's career provided by Frederic Holmes' introductory essay to the facsimile edition of Liebig's *Animal Chemistry* (1964) and his biography in the *Dictionary of Scientific Biography* (1973), Margaret Rossiter's *The Emergence of Agricultural Science: Justus Liebig and the Americans, 1840-1880,* and Morell's seminal 1972 *Ambix* article on Liebig and Thomas Thomson as "The Chemist Breeders." Brock's biography is therefore a very welcome contribution to the literature on nineteenth-century chemistry and complements the recent full biographies of Edward Frankland, Hermann Kolbe, and Eilhard Mitscherlich.

Fortunately for his biographers, Liebig left an enormous literary trail consisting of letters, books, and articles. Much of his correspondence has been published and many unpublished letters remain in his *Nachlaß* at the Bayerische Staatsbibliothek. Despite these rich sources, however, Liebig's life has remained practically unexamined relative to other nineteenth century figures of his stature, and Brock is one of the first scholars to make extensive use of these and other archival sources. He also incorporates much of the existing secondary literature on Liebig, including two insightful, but previously unpublished dissertations on Liebig by Bernard Gustin (*The Emergence of the German Chemical Profession*, 1975) and Pat Munday (*Sturm und Dung: Justus von Liebig and the Chemistry of Agriculture,* 1990). The book contains a comprehensive index and two appendices. The former includes a translation of an 1840 report by Carl Wilhelm Bergemann to the Prussian minister on Liebig's laboratory in Giessen, complete with a floor plan of the laboratory. The second appendix contains a list of Liebig's British and American students.

In the first three chapters, Brock details Liebig's educational development from his childhood in Darmstadt to the 1830s, when his laboratory in Giessen was reaching its peak of activity. Much of the success in Liebig's early life can be attributed to the guidance of his first teacher at Bonn and Erlangen, Karl W. G. Kastner. Kastner appears to have engineered Liebig's matriculation (and arranged a small stipend) into the University of Bonn, for Liebig did not have the *Abitur* necessary for admittance. He also personally appealed to the Grand Duke of Darmstadt to support financially Liebig's crucial period of study in Paris with Guy-Lussac. When Liebig wished to be appointed to the University at Giessen, Kastner also arranged the awarding of an essentially honorary (without a dissertation) doctoral degree from the University of Erlangen. The most fascinating portion of Liebig's student years is his little known homosexual affair with a poet of aristocratic background, August Graf von Platen (1796-1835). Using extracts from Platen's diaries and the correspondence

between Platen and Liebig (from a 1990 biography of Platen), Brock recounts the passionate, but short-lived affair between the two men.

Of course, Liebig's most famous contribution to chemistry was the creation of the instructional laboratory at Giessen. If Kastner had proved essential in guiding Liebig's education and appointment, Liebig's success at Giessen was due to his own intelligence, hard work and his political savvy with the university. Brock raises a few interesting suggestions about the formation and administration of the laboratory. He argues that it was the emerging friendship with Friedrich Wöhler, combined with his duty to train pharmacists for the state, that ultimately caused Liebig to focus his efforts on organic chemistry during the late 1820s. In 1825 Liebig became the *Ordinarius* of chemistry at Giessen, and his primary duty was to teach chemistry to matriculated students in the medicine and philosophy faculties. His laboratory, however, began as a private institute, unaffiliated with the university because the philosophical faculty did not wish to train "apothecaries, soap-makers, beer-brewers, dyers, and vinegar-distillers" at a university dedicated to producing civil servants. Liebig's success at Giessen can be attributed to a number of factors: the ability to attract nonmatriculated students (and their fees) to increase his class size, the modest support from the state, a focused research program determining the composition of organic compounds, and a new efficient piece of apparatus (the *Kaliapparat*) to determine that composition. Liebig's appointment as editor of the *Annalen für Chemie und Pharmacie* in 1836 also created the vehicle with which he could and did express his views to the international chemical community.

Brock treats Liebig's life after 1840 thematically rather than in a strict chronological narrative. There are chapters devoted to Liebig's ties to Britain, commerce, agriculture, physiology, food, and sewage. Immediately striking in these chapters is the number of Liebig's attempted commercial ventures, driven equally by his love for chemistry and the search for additional income (perhaps to compensate for his own modest background). Some projects, such as his formation of a meat extract company, today a portion of the multinational Unilever company, were successful ventures. Others, such as bread made from baking powder and coffee extract, were not at all successful. What tied all the ventures together was Liebig's consistent belief, derived from his mentor Kastner, that knowledge of chemistry could improve the commercial prospects for all of these seemingly unrelated areas. All could become "scientific" with the proper application of chemical principles. Even if many of his attempts to transform the ancillary disciplines of medicine, agriculture, and pharmacy were not entirely successful, many of his ideas concerning the recycling of sewage and replenishment of the soil have a distinctly modern sound to them, and the fact that these disciplines today have a large chemical component to them is due to Liebig. He also effected a profound change on how chemists viewed their own profession, transforming it from a pure science concerning the composition of materials to the "central science" that could be applied to many diverse areas.

Brock is at his best describing Liebig's life before 1840. Although he provides an excellent overview of Liebig's enormously varied interests, the thematic approach does tend to weaken the overall picture of Liebig's life. Because Brock abandons a strict chronological narrative (he mentions Liebig's appointment to Munich many times before he gets to the specifics), it is difficult to see how Liebig's various interests might have interacted with each other aside from the central importance of chemistry. Brock also includes little about Liebig's family life until the last chapter. Finally, there are a few claims that are not followed up completely. For example, Brock makes the intriguing remark that "it has been plausibly suggested that the vehemence of Liebig's attack on *Naturphilosophie* in 1840 may have been a mask for his feelings of repugnance for homosexuality after his marriage (page 26)." I awaited eagerly, but in vain, for him to draw out the possible connection between homosexuality and *Naturphilosophie*, or give a reference to the plausible suggestion.

These are, however, minor problems with Brock's account. Constructing a full biography of a scientist has long presented problems for historians in how to meld the science with the life without ignoring one at the expense of the other, or without making an artificial division between them. Brock has balanced these needs well, creating a picture of Liebig and his influence that can be enthusiastically recommended to chemists and historians alike. *Peter J. Ramberg, Department of Chemistry, Johns Hopkins University, Baltimore, MD 21218.*

A History of Metallurgy. Fathi Habashi, Métallurgie Extractive Québec, Sainte Foy, Québec, 1994, 307 pp, 123 illustrations. Distributed by Librairie des Presses de l'Université Laval, Cité Universitaire, Sainte Foy, Québec, Canada, G1K 7P4.

Dr. Habashi has undertaken the ambitious project of preparing a comprehensive review of metallurgy from 5000 BC to the early 1900's. By compiling and editing previously published articles, he has produced a valuable undergraduate textbook that will also be a useful reference for practicing metallurgists, physical scientists, engineers, and historians of science. Archaeologists, conservators, and curators will also find this a valuable reference work. Unfortunately, many readers outside of this book's target audience, undergraduate metallurgists, may find the book somewhat disappointing.

The author has selected the nine most pertinent articles from the multi-volume *History of Technology* series, which was published by Oxford University between 1954 and 1958. His approach allows excellent coverage of a 7,000-year time span. The book begins with the earliest extraction and processing of gold, silver, lead, copper, antimony, tin, and bronze in central Asia and closes with the electrolytic refining and powder metallurgy of the late 1800's to early 1900's. The main advantage of this approach is that it allows a balanced coverage. No section of the book is skewed towards a single author's area of expertise or academic prejudices. This reviewer was particularly impressed by the inclusion of many non-ferrous and non-precious metals. There were also excellent sections dealing with such ancillary technologies as assaying, coal mining, and coke production. The disadvantage of Habashi's approach is that some of the articles seem very dated and should at least have been annotated to incorporate more of the current research in the field. The absence of experimental re-creations of historic processes and of recent archaeological research is particularly noticeable.

Before using the *History of Metallurgy* as a college textbook, the instructor will have to consider carefully the academic majors of the students. Chemists, engineers, and metallurgists will have little difficulty. Nonscience majors attracted to such a course to help fill a science requirement may need assistance with the terminology and some of the chemical concepts. This should not discourage anyone from adopting the book, however. Students planning careers in archaeology, history, conservation, or museum studies will find the book an excellent reference and will use it for years to come.

This work features a number of excellent, high-quality illustrations, which are well chosen to convey concepts discussed in the text. Despite its limitations, the *History of Metallurgy* is an impressive contribution to the historiography of science. *Kevin K. Olsen, Wyeth-Ayerst, Pearl River, NY 10965.*

Instruments of Science: An Historical Encyclopedia. R. Bud, D. J. Warner, and S. Johnston, Ed., The Science Museum, London, and National Museum of American History, Smithsonian Institution, Washington, in association with Garland Publishers, Inc., New York, 1998. xxv + 709 pp.

Over 230 contributors world wide have participated in providing information on hundreds of instruments. Included are fairly simple to highly complex and ancient to modern examples. Some examples: abacus, chromatograph, compass, cosmic ray detector, eudiometer, melting point apparatus, planimeter, protein sequencer, seismograph, slide rule, string galvanometer, thermopile, Wheatstone bridge, and X-ray apparatus. The narrative portion includes information about discovery, function, development, and uses of each item. Most are depicted by photographs, which have been provided by individuals, academic institutions, archives, industries, learned and professional societies, and museums, and all of which are acknowledged. The somewhat oversize book is sturdily bound for continual use; it will surely serve as an invaluable reference source for scientists and nonscientists. An extensive index of 36 pages greatly enhances its utility. The editors of this impressive tome have been recognized by the awarding of the 1998 Paul Bunge Prize for an outstanding publication in the field of history of scientific instruments. This award of the Hans R. Jenemann Foundation is administered by the Gesellschaft Deutscher Chemiker and the Deutsche Bunsen-Gesellschaft für Physikalishe Chemie. *Paul R. Jones, Department of Chemistry, University of Michigan, Ann Arbor, MI 48109-1055.*

Chemistry and the Chemical Industry in the 19th Century: The Henrys of Manchester and other Studies. Wilfred Vernon Farrar. Richard L. Hills and W. H. Brock, Ed., Variorum, Aldershot, Hampshire, Great Britain, 1997. xii +334 pp. Cloth (Typeset), $94.95.

The lives and works of ordinary and not so ordinary British chemists whose contributions are long forgotten, and sometimes led to nowhere in particular, might seem unworthy of extensive study, let alone of a full length monograph. But every rule has its exceptions, as the late W.V. Farrar (1920-1977), research chemist turned historian of chemistry, found through diligent and painstaking research undertaken around three decades ago. Now we have the opportunity to rediscover the fruits of his work most conveniently bound between two covers. It is abundantly clear that the stories of Farrar's heroes sometimes tell us as much about the development of chemical sciences as do many accounts of more famous personalities.

Farrar spent most of his adult years in Manchester, once the center of British applied chemistry, so it is entirely appropriate that his principal focus was on Mancunian life, particularly during the vibrant period 1760-1860 that encompassed the heyday of the Manchester Literary and Philosophical Society, the spread of Unitarianism, and the rise of the chemical-based textile industry and gas lighting. Manchester and surroundings also witnessed the ascent from quite inauspicious backgrounds of men such as John Dalton and the emergence of severe environmental problems.

Farrar, jointly with his wife Kathleen and Leonard Scott, made a special study of the Henry family and its interaction with science, education, medicine, and industry. This resulted in a series of outstanding papers published in *Ambix*. Here, for the first time, they appear together, as the authors originally intended, comprising the first part of *Chemistry and Chemical Industry in the Nineteenth Century*. The Henry family fortune derived from a milk of magnesia factory that actually survived until the end of the 1920s. The family activities led, through the Lunar Society, to contacts with the Watts, and, through geographical closeness, to a connection with John Dalton and theories of the existence of atoms. Indeed, William Henry's law of partial pressures contributed towards atomic theory.

The second part of the book covers an equally fascinating range of activities, not all directly related to greater Manchester. From the hallowed towers of 1860s Oxford, Sir Benjamin Collins Brodie applied the work of the mathematical logician George Boole to theories of fundamental chemistry that, although they ran counter to received opinion, do reveal much about how consensus was reached over novel concepts. By contrast, the much traveled Richard Laming, at one time partner in an east London gas works, suggested the existence of sub-atomic electrical particles in the 1840s, long before others predicted and then provided evidence for the electron. At a more practical level, Lewis Thompson's early work on the capture of atmospheric nitrogen led to the discovery of cyanides as byproducts of iron smelting in blast furnaces. Laming and Thompson, incidentally, worked together in Paris during the 1840s. In Scotland, the roguish Andrew Ure contributed to the development of gas lighting, lobbied successfully for his own promotion as head of an observatory near Glasgow (although he was not the best candidate), and is best known to historians of chemistry for his highly useful, but not always reliable, *Dictionary of Arts, Mines, and Manufactures* (1839). As an interlude, we have Farrar successfully tackling science and the German university system during 1790-1850, using the example of Liebig's laboratory to mirror the changes taking place during the later years.

Of Robert Angus Smith, expatriate Scotsman in Manchester, Farrar concludes that he "was not a great scientist...he was a half-trained amateur...His theories were often wrong and his quantitative results unreliable...It is for his example rather than his results that he is remembered." (Chapter XII, pp. 255-257). Smith brought credit to his profession for his work as the first Alkali Inspector (1863); by demonstrating great diplomacy in his dealings with polluting manufacturers, he showed them how to profit from the conversion of harmful waste into useful products. That was far from an ordinary achievement.

Farrar's expertise as an organic chemist was put to excellent use in his survey of the manufacture of artificial dyes (including guano-derived murexide and picric acid, both made in Manchester) before William Henry Perkin (in London) discovered mauve in 1856, and in his account of the life of (Henry) Edward Schunck, of Manchester. Schunck earned a doctorate at Giessen under Liebig in 1841, and, benefiting from the availability of products used in the family textile printing business, subsequently embarked on a life of private study into natural dyes. This came in useful when he was asked to analyze samples of byproducts from the synthetic alizarin process worked out by Perkin. Schunck's research into anthraquinone derivatives and related products was of the highest order, as chemical investigation of his surviving samples by Farrar dem-

onstrated, although he suffered from a lack of input by younger colleagues.

This book is a welcome addition to the Variorum Collected Studies Series and serves as a timely reminder of the great debt that we owe to a historian of chemistry who pioneered the study of regional themes and lesser events and individuals. *Anthony S. Travis, Sidney M. Edelstein Center for the History and Philosophy of Science, Technology and Medicine, The Hebrew University, Givat Ram Campus, Jerusalem 91904, ISRAEL.*

A NEW BIBLIOGRAPHY OF GERMAN DISSERTATIONS IN CHEMISTRY

Dr. Günther Beer, Museum der Chemie, Göttingen, has just completed the compilation of a bibliography of chemistry dissertations from Universität Göttingen, 1734-1900. The 216-page book, *Die chemischen Dissertationen der Universität Göttingen*, Verlag Museum der Chemie, Göttingen, (ISBN 3-932427-00-9), can be purchased at a cost of DM 34. Send orders to:

Verlag Museum der Chemie. Dr. Günther Beer
Tammannstraße 4
D-37077 Göttingen
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This should be a must for all major libraries; recommend it to your acquisitions librarian.

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CHMC is a newly formed Commission of the International Union of History and Philosophy of Science / Division of History of Science. The aim is to focus interest on, and to create a framework for, research on the history of modern chemistry with particular emphasis on twentieth-century chemistry in its relationship to the biomedical sciences, physics, instrumentation, and technology. Officers are: Christoph Meinel (University of Regensburg), President; Tony Travis (Edelstein Center, Hebrew University), Joint Secretary; Peter Morris (Science Museum, London), Joint Secretary.

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