BOOK REVIEWS

From Caveman to Chemist: Circumstances and Achievements. Hugh W. Salzberg, American Chemical Society, Washington DC, 1991, xix + 263 pp.

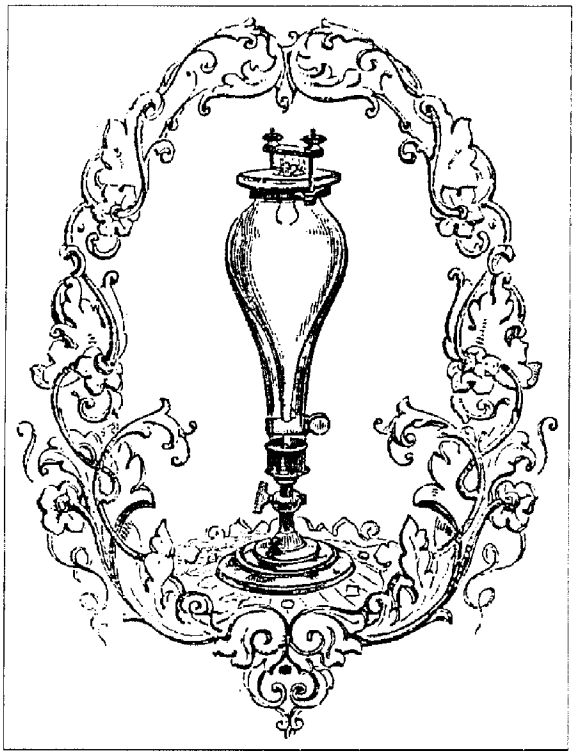
Among the many one-volume histories of chemistry that have appeared during the past decade, only a few have aimed at being "popular" histories of the subject, that is works designed not specifically for historians and chemists but also for a wider audience. Perhaps the best-known example of that genre is Bernard Jaffe's *Crucibles*, first published more than a half century ago and still in print. To quote from the preface of the work under review, "This book is not a detailed, comprehensive history. It is a narrative designed to give chemists and interested bystanders some insight into the profession." It clearly falls into the class of popular histories.

The 25 chapters of *From Caveman to Chemist* proceed from ancient technology to the divisible atom. A page count will give an idea of the relative importance given to various periods in this extended time line. The text encompasses 260 pages. The first 52 of these bring us to the end of the Hellenistic and Roman eras. A short (18 pp.) chapter on Islamic Alchemy is followed by 51 pages in three chapters on medieval and renaissance contributions to chemistry; 16 pages on the impact of printing and books; 10 pages on some of the architects of the scientific revolution—Copernicus, Kepler, and Galileo among others; and 23 pages on Sala, Van Helmont, and Boyle, who are dubbed the first chemists. The phlogiston theory (11 pp.) is followed by Lavoisier and the chemical revolution (21 pp.). Nineteenth-century chemistry occupies most of the rest of the book, with 18 pages on the atom and molecular formulas and 25 pages on organic chemistry up to stereoisomerism. Twentieth-century chemistry is limited to a few pages in the final chapter (10 pp.) on the divisible atom. The book includes a number of illustrations, among them one in full color showing the earliest known depiction of a wearer of spectacles, emphasizing the importance of artisanship in early chemical technology. Each chapter has a short list of references, and there is a four-and-a-half-page additional reading list and a detailed index.

Hugh Salzberg has an easy style and his book is readily comprehensible to a wide readership. It stresses the contributions of individual scientists and is very much an internalist history of the subject. While there are connections to medicine, other sciences, and technology, there are few to any broader historical context. However, the task of presenting in a relatively concise way the major outlines of the development of chemistry from prehistoric times to the beginning of the twentieth chemistry is one that this book does accomplish well. *Harold Goldwhite, Department of Chemistry, California State University, Los Angeles 90032.*

Cavendish. Christa Jungnickel and Russell McCormmach, Amercian Philosophical Society, Philadelphia, PA, 1996. xi + 414 pp. Cloth (Typeset), $32.00.

Henry Cavendish (1731-1810), the well-known 18th-century British chemist and natural philosopher, has been the subject of three book-length biographies. The first, by the British chemist George Wilson, was published in 1851 and was commissioned by the Cavendish Society. One of several early 19th-century subscription printing clubs, the society was best known for issuing massive multi-volume English translations of Gmelin's well-known *Handbuch der Chemie*. Not only was the society named in honor of Cavendish, it also adopted a woodcut of Cavendish's famous glass eudiometer as its logo.



Logo of the Cavendish Society: Henry Cavendish's glass eudiometer for sparking gas mixtures

Wilson's biography, set in small type, was 478 pages long, of which roughly 190 pages, or about 40%, were strictly biographical, with another 104 pages or 22% devoted to a summary of Cavendish's work in chemistry and natural philosophy. The remaining 184 pages, sandwiched between the descriptions of Cavendish's chemical and physical researches, dealt with the vindication of Cavendish's reputation relative to the so-called "water controversy."

Since the end of the 18th century there had been rival claims as to who—Lavoisier, Monge, Watt, or Cavendish—most deserved the credit for having first discovered that water was a compound of hydrogen and oxygen. Matters had been brought to a head by the publication in 1846 of James Patrick Muirhead's book on *The Correspondence of the Late James Watt on his Discovery of the Theory of the Composition of Water*, and by an article published two years later by Lord Jeffrey in the *Edinburgh Review*. Both authors were enthusiastic supporters of Watt's claim and essentially accused Cavendish of out and out plagiarism or, at best, of highly questionable ethics. Wilson, and doubtless the directors of the Cavendish Society as well, felt that these accusations had to be answered and the result was Wilson's long digression on the history of the water controversy. Though Wilson realized that this digression produced an imbalance by underrating Cavendish's work in natural philosophy relative to his work in chemistry, he felt that it was nevertheless justified. Since the attacks concerned Cavendish's chemical activities, it was only right that chemists should come to his defense.

Wilson was no amateur when it came to history of chemistry. More than one modern historian of chemistry made his reputation in the early 1960s in the debates over the true origins of Dalton's atomic theory by rediscovering what Wilson had already said about Dalton's theory a century earlier in one of his historical essays. Besides his teaching position as Professor of Technology at the University of Edinburgh, Wilson also became the first Director of the Industrial Museum of Scotland and was largely responsible for establishing the Playfair Collection of Historical Chemical Apparatus.

Not only do we owe most of our existing anecdotes of Cavendish to Wilson's zeal in interviewing the older members of the Royal Society, he also left us with an unforgettable summary of Cavendish's life and character - a summary which at times borders on the brilliant:

> Morally [the life of Cavendish] was a blank and can only be described by a series of negations. He did not love, he did not hate, he did not hope, he did not fear, he did not worship as others do. He separated himself from his fellow men, and apparently from God. There was nothing earnest, enthusiastic, heroic, or chivalrous in his nature, and as little was there anything mean, groveling, or ignoble. He was almost passionless. All that needed for its apprehension more than the pure intellect, or required the exercise of fancy, imagination, affection, or faith, was distasteful to Cavendish. An intellectual head thinking, a pair of wonderfully acute eyes observing, and a pair of very skillful hands experimenting or recording, are all that I realize in reading his memorials.

Over a century would pass before a second book-length biography of Cavendish appeared in 1960. Like Wilson before him, its author, the Cambridge chemist A. J. Berry, was no stranger to historical writing and is perhaps best known for his two earlier volumes of essays dealing with selected topics in the history of chemistry (*Modern Chemistry: Some Sketches of Its Historical Development*, 1948, and *From Classical to Modern Chemistry: Some Historical Sketches*, 1954). Berry made no pretense that he had uncovered important new information concerning Cavendish. His goal was rather to produce a concise and balanced summary of Cavendish's life and work. The resulting book was less than half the length of Wilson's and was devoted almost totally to a description of Cavendish's scientific researches, with his life being compressed into a single 15-page chapter. Unlike most recent scientific biographies, which tend to focus on a scientist's hobbies, political and social activities, or personal sexual peculiarities, Berry realized that it is the scientific work of scientists which alone makes them worthy subjects of book-length biographies, and that any account which fails to address this work in detail is seriously defective.

The third book-length biography of Cavendish, and the subject of this review, was published by the American Philosophical Society in 1996 and is coauthored by the team of Christa Jungnickel and Russell McCormmach, perhaps best known for their two-volume social history of the 19th- and early 20th-century German physics community (*Intellectual Mastery of Nature: Theoretical Physics from Ohm to Einstein*, 1986). Beautifully produced in a large 8.5 x 11 inch page format with double print columns, the book logs in at 425 pages. Despite the differences in font size, its use of the larger page size and double columns probably means that it is longer than even Wilson's early volume. This 28-fold expansion of Berry's concise 15-page summary of Cavendish's life would suggest that the authors have uncovered a vast reservoir of previously unknown material concerning Cavendish, but in fact most of this size increase is a simple result of how the authors have chosen to define their subject.

In less than a paragraph, Berry pointed out that Henry Cavendish's father, Lord Charles Cavendish, was the single most important influence in Henry's life. Charles was something of a scientist in his own right, though hardly as distinguished as his son, and Henry received his scientific education by acting as his father's assistant. He also lived and worked in his father's house until the latter's death in 1783, during which he performed most of his electrical researches. It is primarily this father-son connection that Jungnickel and McCormmach have sought to explore in detail and which accounts for both the title of their book (*Cavendish* rather than *Henry Cavendish*) and for the fact that the portrait on the front cover is that of Charles Cavendish rather than of Henry Cavendish.

The book is divided into four parts. Part 1 provides a brief introductory history of the Cavendish family; Part 2 deals with the life and career of Charles Cavendish, Part 3 with the education of Henry Cavendish during his father's lifetime, and Part 4 with Henry's career after his father's death. As with their earlier book, the authors spend a great deal of time exploring the social and political context of their subject. If Berry's biography errs on the side of too little context, this volume comes close to erring in the opposite direction - but not quite, since the authors do an admirable job of tying all of their pieces together and in documenting their subject.

As is the case with most modern literature in the history of science, the authors are not kind to their predecessors. Wilson's biography is described as an eccentric work which violates the fundamental rules of good biography and his brilliant analysis of Cavendish's character, quoted above, is dismissed as an unfair projection onto Cavendish of Wilson's own personal depression and obsession with religion. Likewise, Berry's biography is characterized as being little more than the kind of introductory essay that one might expect of someone who was assembling an edition of Cavendish's collected works. I think these comments are much too severe. Though the biography by Jungnickel and McCormmach is an invaluable addition to the secondary literature on Cavendish, it in no way displaces the earlier volumes by Wilson and Berry for the simple reason that each of these three volumes serves very difference audiences.

Because it is the source of most of our knowledge of Cavendish, the Wilson biography will always be of interest and, with the passage of time, it has become almost as valuable for what it tells us about the water controversy and the views of early 19th-century chemists concerning the nature of Lavoisier's chemical revolution, as for what it tells us about Cavendish. On the other hand, students of the history of science, who are interested in a case study of the larger issues of the relations between science, politics, scientific organizations and class structure in 18th-century England, will find the Jungnickel - McCormmach biography of most interest, whereas chemists and teachers, who lack a pro-

fessional interest in the history of science but who are looking for a concise overview of Cavendish, will still find Berry's modest, but balanced, account the most manageable starting point. *William B. Jensen, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221 - 0172*

Episodes from the History of the Rare Earth Elements. C. H. Evans, Ed., Kluwer Academic Publishers, Dordrecht, Hingham, MA, 1996. xxv + 240 pp.

The story of the discovery of the rare earth elements is probably the most confused and complex of any group of the elements. The history of the rare earths also illuminates more areas of chemical progress than any other group of elements. It stretches from the discovery of the first rare earth mineral in 1787 by Carl Axel Arrhenius to the unequivocal identification of the last in 1947 by Marinsky and Glendennin. The story involves the discovery of emission spectroscopy by Kirchhoff and Bunsen, the development of the periodic chart by Mendeleev, the discovery of X-rays by Röntgen, the discovery of atomic numbers by Moseley and atomic structure by Bohr and Rutherford, and, finally, work on the atomic bomb during World War II.

The book is divided into two main sections: *Discovery* and *Applications*, which, the editor states, concentrate more on historiography and contextual interpretations, rather than the highly technical. *Discovery* consists of six chapters; each authored by an experienced scholar in the field, in which are described the discovery and identification of the 17 rare earth or lanthanide elements. In chronological order, the chapters are: "What did Johann Gadolin Actually Do" by Pekka Pykko and Olli Orama; "The Discovery of Cerium—A Fascinating Story" by Jan Trofast; "Carl Gustaf Mosander and his Research on Rare Earths" by Levi Tansjö; "The Fifty Years Following Mosander" by F. Szabadvary and C. H. Evans; "Elements No. 70, 71, and 72: Discoveries and Controversies" by Helge Kragh; and "The Search for Element 61" by Jacob Marinsky.

The first three chapters are most useful because they provide access to the earliest days of research on the rare earths through the Scandinavian literature, which is inaccessible to most because of language. The most outstanding figures of this early period were the Swedes Jacob Berzelius and his younger colleague, Carl Gustav Mosander, successively professor of chemistry and pharmacology at the Karolinska Institute. Tansjö notes that Berzelius retired from the professorship at 53 in favor of Mosander, as his wedding present to Mosander. He remarks "..that such generosity was then—and is still—not very common." In another of those strange historical connections, he notes that Mosander's great granddaughter, Carin Fock, was married to Herman Goering, and that Adolf Hitler liked her Swedish pea soup. Despite heavy academic and governmental responsibilities, Mosander expanded the rare earth family from two—cerium and yttrium—to six, the additional four being lanthanum, didymium, terbium, and erbium. This work was done without benefit of any unifying principles and by the traditional methods of fractional precipitation and crystallization. Following Mosander, very little was accomplished in the next thirty years because further progress required the development of new techniques and new concepts.

In the last quarter of the 19th century spectral analysis introduced by Kirchhoff and Bunsen and the development of the periodic table led to a new interest in identifying rare earth elements. This work resulted in the identification of all of the remaining elements, except for two: lutetium and promethium. It also led to the industrial production of rare earths by Carl Auer von Welsbach, who developed the incandescent gas mantle, using a mixture of thorium and cerium, and the automatic gas lighter, with a pyrophoric alloy of iron and mixed rare earths.

The chapter by Helge Kragh on the discovery of elements 70, 71, and 72 is a case study of contentious

priority and nationalistic disputes between the French chemist Georges Urbain and the Austrian Auer von Welsbach and their followers. Both were highly regarded by their colleagues. Auer von Welsbach was nominated ten times by Austrians and Germans for the Nobel Prize between 1918 and 1929. Urbain, on the other hand, received fifty-six nominations, almost all by French, between 1912 and 1936. Their disputes apparently led the Swedish Academy to award a Nobel Prize to neither. This period also brought physicists into the field, with the discovery by Moseley of atomic numbers from X-ray spectroscopy. This, in turn, led to disputes between the old-line chemists, such as Bohuslav Brauner, and the Copenhagen school of physicists. The chemists resented the easy solution found by the physicists to determine the number of rare earth elements.

The chapter on the search for and discovery of element 61 by one of its discoverers, Jacob Marinsky, is especially welcome and important. In the late 1950s Professor Marinsky was a member of my doctoral committee at what was then the University of Buffalo. It was he who, in part, whetted my interest in the history of the long search for 61. In this chapter he clearly describes hi involvement in the research at Oak ride on separating uranium fission products during work on the atomic bomb in World War II. He also describes the interactions between himself, Lawrence Glendenin, Charles Coryell, and other colleagues in their use of ion exchange chromatography for the separation of the rare earth fission products and their discovery of element 61 in those products. He also explains their reasons for their claim of the discovery of 61 and the source of the name, promethium.

Part II: *Applications* consists of five chapters: "Carl Auer von Welsbach, A Pioneer in the Industrial Application of Rare Earths" by E. Baumgartner; "The History of China's Rare Earth Industry" by Wang Minggin and Dou Xuehong; "Rare Earth Elements in the Geological Sciences" by Edward Lidiak and Wayne Jolly; "Use of Lanthanum as a Tool to Delineate Calcium Mobilization Patterns in Smooth Muscle" by George Weiss; and "Medical Uses of the Rare Earths" by C. H. Evans. These entail descriptions of various practical aspects of rare earth chemistry. Probably of most interest to chemical historians is Baumgartner's chapter on Auer von Welsbach and the industrial application of rare earths. This author treats much of the same material covered earlier by Kragh from a somewhat different viewpoint, decidedly more favorable to his fellow Austrian.

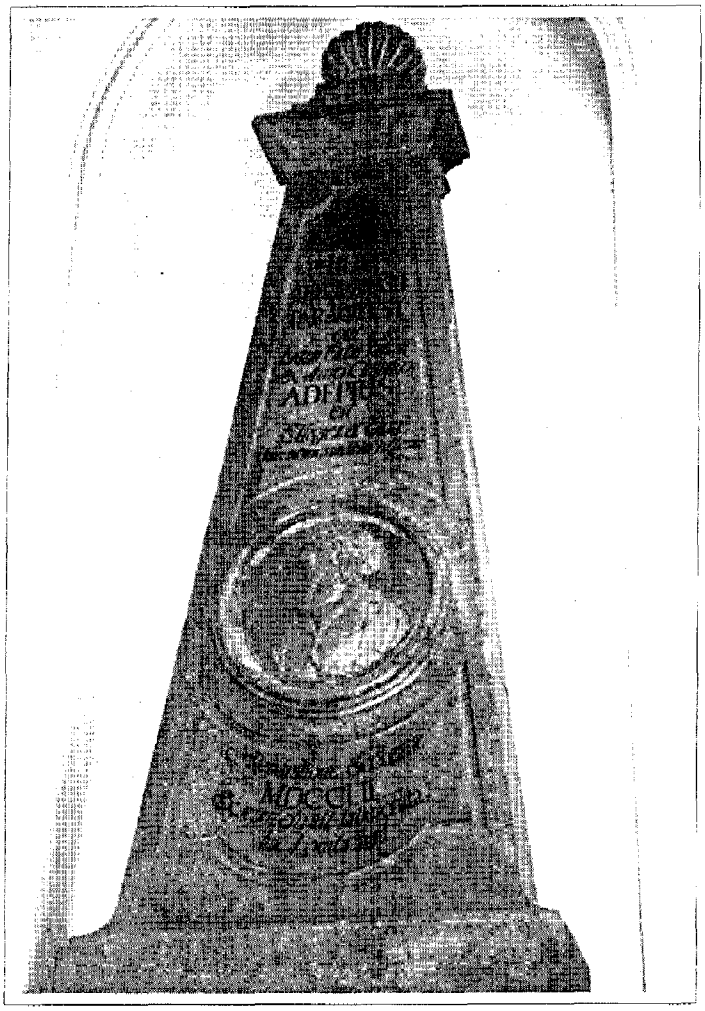
The editor states that he imposed minimal stylists restrictions on the authors. Unfortunately, this has resulted in some interesting nongrammatical language by some of the authors whose native tongue is something other than English. There are also a number of typographical errors, which bring into question editorial and proof-reading care. A random sample of the index also disclosed a troubling number of errors. For example, a search for work by the American chemist Charles James under the eight index listings of his name led to two for Charles James, one each for James Spencer, H. L. James, A. E. James, and James Prescott Joule.

In conclusion, *Episodes from the History of the Rare Earth Elements* is a welcome and valuable contribution to this subject in the history of chemistry. In many ways it describes what science really is: a noncontinuous path, with many false turns, to the solution of a problem. The close connections between advancements in science and in instrumentation and theory are also well documented.

Episodes is an excellent source of information on the discovery of a group of elements intimately connected with the development and understanding of atomic structure and of the periodic table. The search was an integral part of the development of science and technology in the late 19th and early 20th centuries which served as the basis for the atomic bomb. *Clarence J. Murphy, East Stroudsburg University, East Stroudsburg, PA 18301-2999.*

Paracelsus: Das Werk - die Rezeption. Volker Zimmermann, Ed. Franz Steiner Verlag, Stuttgart, 1995. 227 pp. DM 76-.

This book in German is a collection of sixteen articles celebrating the 500th birthday of Paracelsus. The birthday symposium preceding its publication was convened in Basel in 1993 with support from the Ciba Foundation. The book covers a diverse set of topics. Some are oriented toward what is medical and scientific. Others are spiritual or theological in nature. Still others focus on modern representations of Paracelsus in 20th-century literature and in the movies. All of the articles are scholarly, and the book is a must-read for any Paracelsus enthusiast. It was, however, a very difficult task for this reviewer with intermediate skills in German because of its specialized vocabulary and the liberal use of untranslated phrases in Latin, Greek, medieval German, and modern Swiss dialect. Like an American in a Berlin cabaret, I understood that the audience was laughing, but I missed many of the punch lines. The historian unprepared for the nuances of German philology might want to wait for an English translation, but that could involve a long delay.



Tomb of Paracelsus, St. Sebastian, Salzburg, Austria

Perhaps the best way to review this book is to emphasize that the title, *Das Werk - die Rezeption*, really states what the book is about: (1) what Paracelsus did and wrote and (2) what perceptions later generations had of his life. About half the articles deal with Paracelsus the balneologist (therapeutic user of baths), the practitioner of homeopathic medicine (syphilis and mercurials), the military field surgeon, the wandering healer, the "Luther of Medicine," and the cantankerous rebel in the medical establishment of Basel. The other half of the articles deals with the fictionalized or rediscovered Paracelsus of later periods. To the extent that there exists a single theme and that the book is not just a compilation of unique thoughts occurring to euphoric party-goers, it is a summary of the peaks and valleys of Paracelsus' esteem. In this sense the approach is similar to that of Jaroslav Pelikan in *Jesus through the Centuries: His Place in the History of Culture (1985)*, which illustrates how widely posterity can range in its characterization of a single historical personality when given several millennia in which to reformulate. In the case of Paracelsus, we have had only five centuries for reformulation. There was a lifetime of "bombast" followed by repudiation and eclipse. A nadir was reached in 1777 when the Swiss writer and naturalist Albrecht von Haller declared, "The theories of this man are so insignificant that they scarcely deserve discussion." A resurrection attributable to the fastidious archaeology of Karl Sudhoff took place in 1911 with the assembly of 17,773 Paracelsus artifacts for exhibit in Leipzig. This painstaking historical effort was followed (unfortunately) by Erwin Guido Kolbenheyer's three-part novel (*The Youth of Paracelsus, The Constellation of Paracelsus*, and *The Third Reich of Paracelsus*), which promoted a politically correct (for that time), popular—if historically inaccurate—conception of Paracelsus the "*Ingenium Teutonicum*." The trilogy published from 1917 to 1926 paved the way for the film "Paracelsus" (Script, Kurt Heuser; Direction, Georg Pabst) in 1943, which found in Paracelsus the Faust of National Socialism as magnificent in fantasy as was Paracelsus dwarfish in reality (Paracelsus was very short).

Highlights from the book include the reincarnation of Paracelsus (in the voice of Werner Rihm - *Paracelsus Basileae redivivus*) and a lament about Basel in the age of Golden Arches (McDonald's), two articles on the appropriateness of the epithet "Luther of Medicine," two articles on medical ethics of the 15th-century, and a review of German literature dealing with Paracelsus fictions.

The historian of science will find no coherent examination of what Paracelsus contributed to the basic sciences, although the book is filled with insights. In the opinion of Gundolf Keil, Paracelsus differed little from his contemporaries in the practice of medicine and regularly "cured his patients to death." Hartmut Böhme explains that Paracelsus specialized in treating the terminally ill and sought to understand a netherworld between the last flickers of life and death. This fits well with the thesis of Jolande Jacobi, that in the reading of Paracelsus science cannot be separated from theology [Jolande Jacobi, *Paracelsus: Selected Writings*, Bollingen Series XXVIII, Princeton University Press, Princeton, NJ, 1951.] Renewed appreciation for this side of Paracelsus comes with the completion of Part II: Paracelsus Complete Works - Theological and Religious Writings by Goldammer [Kurt Goldammer, Ed., *Theophrast von Hohenheim, gennant Paracelsus. Sämtliche Werke. Zweite Abteilung: Theologische und religionsphilosophische Schriften*. Franz Steiner Verlag, Stuttgart. 7 volumes plus index, ca. 1955-1995.]

Contrary to the hope of editor Volker Zimmermann that this volume might rehabilitate Paracelsus, Gundolf Keil, who contributed three of the sixteen articles (two as *additamenta*), concludes that "Paracelsus never saw the Light of Nature." He remained entrapped in medieval thinking, and thus he strikes the modern reader as arcane and obscure. Although Paracelsus may not have led the way as a scientist, he may well be considered the founder of alternative medicine as we know it today. The light that he saw was the same one that shines in the work of Deepak Chopra, M.D., and the spiritualists of the Harvard Medical School. Physicians are not always judged by the diseases they cure. Sometimes they are judged by the spirits they lift. *Thomas W. Orme, 14001 Harpers Ferry Road, Purcellville, VA 20132-1729.*

John Dalton, 1766-1844: A Bibliography of Works By and About Him, with an Annotated List of his Surviving Apparatus and Personal Effects. A. L. Smyth, Ashgate Publ. Co., Brookfield, VT, 2nd ed., 1997, 192 pp., $72.95.

John Dalton is a character well-known to chemists, particularly for his influential version of chemical atomism. The present volume is a revised and much expanded version of a Dalton bibliography produced by the same author in 1966. It begins with a brief overview of the long saga—both miraculous and tragic—of the Dalton archive. He recounts the archive's fate from its rediscovery bit-by-bit in the library of the Manchester Literary and Philosophical Society, through the disaster of Christmas Eve, 1940, when a German bomb set the Society's quarters alight, destroying three-quarters of Dalton's papers, to the 1979 sale of the remainder to the University of Manchester.

The majority of the book consists of well-organized and classified lists of primary and secondary Dalton materials. In the former category are classed his published works, manuscripts, notebooks, and letters. The second part lists the letters to and about Dalton, various "Daltoniana" (such as handbills and "laments" over his death), portraits, and scholarly books and articles dealing with Dalton. The third and final section catalogues surviving objects relating to Dalton: his apparatus and personal effects, medals, and so forth. The book concludes with indices of letters, names, and subjects. It is well illustrated throughout. Scholars interested in writing on Dalton, atomic theory, and related topics of the early nineteenth century will find this a valuable reference catalogue. *Lawrence M. Principe, Department of Chemistry and Department of the History of Science, Medicine, and Technology, The Johns Hopkins University, Baltimore, MD, 21218-2685.*