BOOK REVIEWS

Chymists and Chymistry. Studies in the History of Alchemy and Early Chemistry. Lawrence M. Principe, Ed., Science History Publications, Sagamore Beach, MA, 2007, xiii + 274 pp, ISBN 0-88135-396-5, $45.

George Sarton was largely responsible for the establishment of the history of science as an academic discipline. He founded the journal *Isis* in 1912 and continued crusading for the subject until his death in 1956, the year I entered the graduate program at Harvard University. For the handful of graduate students at that time the history of science seemed to be dominated by the astronomy and physics of motion of the sixteenth and seventeenth centuries. This was an approach in tune with Sarton, who believed that the maturity of a science was dependent on the extent to which it had been mathematicized. Accordingly, little time was spent in our courses and seminars on chemistry or the biological sciences while medicine was completely ignored. As a chemist myself, I was disappointed with this approach; and I soon found that chemical and iatrochemical texts formed a very large part of the literature of the Scientific Revolution. Although important research had been carried out in the study of alchemy and early chemistry, relatively little of this had affected the history of science as a whole.

Over the past half century there has been an ever increasing number of scholars investigating the development of chemistry. An international conference on alchemy and early chemistry was held at Groningen in 1989 and a second one in Philadelphia at the Chemical Heritage Foundaion in 2006. The present volume includes many of the papers from the latter meeting and presents the reader with a much needed overview of the present state of this field of research. One name that appears frequently throughout the volume is Paracelsus, the firebrand sixteenth-century Swiss-German reformer who sought to make chemisty a part of medicine. Much current Paracelsian research is centered on his followers and their debates. Here Didier Kahn discusses the French Paracelsians at the Court of Henry IV, while Bruce T. Moran presents a paper on the German enemy of mysticism, Andreas Libavius. A proponent of Aristotelian logic and philosophy, Libavius accepted traditional alchemical texts while rejecting Paracelsian mysticism. Stephen Clucas touches on some of the same points in his paper. Referring again to Libavius, Clucas points to his attack on the obscurity of language in alchemical texts as well as their confusion of chemistry and religion. Peter Forshaw turns to Heinrich Khunrath in his paper, whom he shows to have been concerned with laboratory practices even though he has frequently been dismissed as a mystic.

Dane T. Daniel is concerned with the reception of Paracelsian theology among his early followers. A related paper is that of Margaret D. Garber, who contrasts the differing views of matter theory upheld at the University of Prague by J. Marcus Marci and the Jesuit, Roderigo Arriaga. In this case the concept of *semina* presented a problem for the understanding of the Eucharist.

Hiro Hirai presents a paper on Athanasius Kircher's views on the Creation and spontaneous generation, which he shows to have been derived from Paracelsian chemical concepts, Marcus Marci's optical theory of plastic power,

and the corpuscular views of a largely neglected Padual physician, Fortunio Liceti. William Newman shows the influence of another seldom mentioned author, in this case Johann Grasseus, whose views on the generation of metals influenced Isaac Newton.

Other papers reflect more traditional research in alchemical subjects. Wouter J. Hanegraaf follows his own and Ruud M. Bouthoon's earlier work on Ludovico Lazzareli in the examination of the mercurial phoenix and its miraculous powers as the philosophers' stone. Barbara Obrist describes the alchemical significance of an early sixteenth-century miniature painting by Jean Perréal. The sexual metaphors found in alchemical texts are the subject of Allison B. Kavey's offering, while Gabriele Ferrario compares the Arabic and Hebrew versions of the Liber de aluminibus et salibus, which was translated into Latin by Gerard of Cremona in the twelfth century. An interesting paper by Tara Nummedal discusses alchemical fraud and in particular, the case of Heinrich Nüschler, who was eventually hanged (1601) because of his failure to carry out a successful transmutation. Nummedal emphasizes the importance of contracts made between alchemists and their patrons.

The laboratory practice of early modern chemistry is discussed in two papers. In the first, Marcos Martinón-Torres shows that the finest crucibles in the sixteenth and seventeenth centuries came from two areas, Hesse and Bavaria. The equipment of a Paracelsian laboratory is described by R. Werner Soukup from discoveries made during the excavations at Castle Oberstockstall in Austria.

The book ends with seven papers related to late seventeenth- and eighteenth-century chemistry. The first three deal with chemistry in the French Academy of Sciences. Victor D. Bonantza discusses the reaction of Samuel Cottereau Duclos to the work of Robert Boyle. His work shows the influence of corpuscular and mechanical thought as well as a continuing interest in traditional vitalism. Luc Peterschmitt presents a paper on the Cartesian impact on chemistry through the texts of Gérard de Cordemoy, Jacques Rohault, and Pierre-Sylvain Régis. In the end he concludes that "Chemistry turned mechanism into a problem, because chemistry is a limit for mechanism" (p 201). In his paper Bernard Joly turns to a long-running debate in the Academy between Etienne François Geoffroy and Louis Lemery regarding the possibility of preparing an artificial iron.

John C. Powers offers a paper on the alchemical interests of Hermann Boerhaave, while Kevin Chang turns to Georg Ernst Stahl. Historians of chemistry have presented Stahl primarily as the originator of the phlogiston theory and have paid little attention to his voluminous other work. Here Chang writes of Stahl's change from a belief in transmutation to disbelief. Other works by him show that he rejected the vital influence of the celestial to the terrestrial worlds indicating a major shift away from the vitalistic cosmology. Another shift in thought is to be found in Hjalmar Fors' contribution on the Swedish Board of Mines. In his discussion of the work of Georg Brandt and Fredrik Cronstadt he illustrates the gradual move from a Paracelsian emphasis to a reliance on Boerhaave, Descartes, and Newton.

Anyone who has spent time with the alchemical bibliographies of Ferguson or Duveen is well aware that the eighteenth century was a time of continued strong interest in alchemical and Paracelsian texts. Claus Priesner touches on some of this material in his paper on two eighteenth-century German secret societies: the Gold- and Rose-Cross and the Illuminati. There is little doubt that there is still much to be done in this area—not only to understand its continued appeal in the period of the Enlightenment, but also to indicate its connection with the Romantic movement, a subject in which David Knight has contributed so much for the English scene over the past half century.

The present volume reflects the breadth of current interest in pre-Lavoisier chemistry and alchemy. Because of this I have already recommended it to several prospective graduate students in the field. If there is any weakness in the collection, it may be to give adequate recognition to the work and influence of J. B. van Helmont or to reflect the intricate connection between chemistry, pharmacy, and medicine in this period. The latter was a legacy of the late medieval distillation books and the vast Paracelsian and iatrochemical literature. Regardless, this is a very important book; and we may congratulate the editorial work of Professor Principe, the production skills of Science History Publications, and the support of the Chemical History Foundation. *Allen G. Debus, The University of Chicago*.

Robert Wilhelm Bunsens Korrespondenz vor dem Antritt der Heidelberger Professur (1852): Kritische Edition. Christine Stock, Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart, 2007. (Quellen und Studien zur Geschichte der Pharmazie, F. Krafft and C. Friedrich, Ed., Vol. 83). cxlviii + 610 pp., ISBN 978-3-8047-2320-7, € 49.

Christine Stock rightly notes in her introduction that Robert Bunsen (1811-1899) "was one of the most significant scientists of the nineteenth century" (p xxiii). Of the great figures of that century, he was also one of the most prolific, influential … and, until now, least studied by historians. The invaluable critical correspondence edition under review here reproduces all known letters or documents to or from Bunsen bearing dates from September 27, 1830 (the earliest such document known) until August 15, 1852, his last surviving letter before he moved to Heidelberg to take up his new professorship there. The letters thus span the periods he spent in Göttingen (as student and then Privatdozent, 1830-36), in Kassel (as Friedrich Wöhler's successor at the School of Trades, 1836-39), in Marburg (as ausserordentlicher, then ordentlicher Professor, 1839-51), and finally in Breslau for three semesters as professor at the Prussian University (1851-52). These letters are currently held in thirty-three different archives in Germany, England, France, Sweden, Italy, and Poland.

Some years before his death in 1899 Bunsen consigned his entire correspondence files to the flames, and in his will he directed his executor to destroy all letters and other papers that had inadvertently escaped this fate. Fortunately, that executer—Philipp Bunsen—could not bring himself to follow these instructions for the few letters he found in his uncle's effects. Moreover, although he felt bound by the will not to take any steps to publish these remaining letters himself, Philipp raised no legal barriers to others' taking such actions. In this way, 56 letters to Bunsen from the stated period survived to be included in this edition, along with 246 letters from Bunsen to various correspondents—for, of course, Bunsen had no power to destroy letters that were in the possession of his friends and colleagues. These 302 transcribed letters are supplemented by 164 interpolated headings for additional specific Bunsen letters known to have once existed (e.g., because they were mentioned in surviving letters as having been received). Stock's final entry, a letter from Bunsen to Eilhard Mitscherlich in August 1852, is therefore numbered the 466th of this edition. The edition includes many important letters, the majority hitherto unpublished, to or from Jacob Berzelius, Heinrich Debus, Edward Frankland, Hermann Kolbe, Justus von Liebig, Mitscherlich, Jules Pelouze, Lyon Playfair, Victor Regnault, John Tyndall, Friedrich Wöhler, and many others.

If only all correspondence editions were conducted with such scrupulous care and editorial professionalism as is found here! The letters appear *verbatim et literatim*, and readers can rely on the accuracy of the transcriptions, down to the minutest detail. For each letter the editor provides a complete physical description, current location, citations to any previous publication of (or even published reference to) the item, commentary or necessary identifications in footnotes, and a list of changes in draft by the original author or emendations by the editor. Stock was indefatigable in tracking down even the most minor references. Her energy and accuracy can be exemplified by the 37 (!) different personal names with the patronymic "Bunsen" that are fully referenced in her name index; or (for instance) Bunsen's casual allusion to the "Römischer Kaiser" in one letter (p 306), which Stock succeeds in identifying as the name of a former inn on the Gouvernementplatz in Kassel. Consequently, if one reads the annotation "bislang nicht identifiziert" in a footnote, one may assume that much expert effort has been frustrated there!

Despite the editor's admirable diligence, we can infer that what we have here is only a small fraction of what once existed. For example, in one missive (p 441) Bunsen apologized for his poor handwriting, for, he said, this was the tenth of twelve letters that he needed to write that day; however, of the twelve, only the letter that contains this reference has survived—and these were outgoing letters, immune from his epistolary pyromania. Nonetheless, the present volume still provides us an extraordinarily clear picture—and the best we are likely to get—of Bunsen's doings, especially regarding his research and his dealings with university administrations. Moreover, Stock obviously mastered Bunsen's entire unpublished correspondence, including the ca. 500 surviving letters to or from our hero with dates later than August 1852, for she often interpolates material or direct quotations from these later letters, wherever appropriate. Consequently, from a close reading of this volume we gain much historical benefit from not just ca. 300, but from all ca. 800 surviving letters from Bunsen's correspondence. (Bunsen's post-1852 correspondence was the subject of Stephanie Hoss-Hitzel's 2003 Heidelberg Ph.D. dissertation, but that work is disappointing and cannot compare to this one; for one thing, Hoss-Hitzel included only brief summaries, not transcriptions of the letters.)

We learn plenty from perusal of this volume. The descriptions of Bunsen's several travels, described in long letters to family members, are priceless. We avidly follow as the peripatetic 21-year-old newly-minted D. phil. tells his parents all about his Wanderjahr (actually 16 months) in Berlin, Paris, and Vienna, as well as an interesting three days spent with Liebig in Giessen at the very time of his collaboration with Wöhler on the benzoyl radical found in the oil of bitter almonds. Over 100 pages of this edition are devoted to this trip alone. Not less interesting are ground-level insights into Bunsen's work on the cacodyl radical, on physical-chemical investigations of gases, and on the geology of Iceland. Those interested in learning how German academic politics actually operated in the nineteenth century will gain new appreciation of the different ways that German governments decided upon candidates for academic posts, and how candidates conducted themselves in these searches. Until one has read these letters it has not been understood just how influential Bunsen obviously became, not only in international science but in local academic politics in his later Marburg years and in Breslau.

Finally, we can now write a much fuller account of how it was that he was lured—with great difficulty!—from Marburg to Breslau, and with what trepidation he finally went; only the repressive post-1848 political environment in Kurhessen provided the necessary push. The pull, of course, was the promise by the Prussian authorities to build him a new laboratory institute in Breslau. However, we learn here that Bunsen made this request only after officially accepting the call. His reduced bargaining leverage meant that the lab almost did not get built. The existing facilities, Bunsen wrote his friends, were worthless; his predecessor, N.W. Fischer, whom Bunsen referred to in one letter (p 522) as an "alter Esel," had run Breslauer chemistry into the ground. This, combined with the poverty of the student body—a majority of whom were granted remission of fees, dramatically lowering Bunsen's income—was a depressing combination of circumstances.

On the eve of his departure for Breslau, the arrival of a letter from authorities in Baden offering him a professorship in Heidelberg saved Bunsen. Although he was not in a position to accept the offer—he felt morally bound to keep his promise to the Prussians—he now had the leverage he needed to get that new laboratory building. In fact, we learn that it required three separate "calls" by the state of Baden over fourteen months, before Bunsen finally overcame his scruples to accept the Heidelberg post. By the time of his departure in 1852, the new lab in Breslau was nearly finished. But Heidelberg, having lost out to Munich in the competition to entice Liebig away from Giessen, had promised Bunsen an even bigger and better laboratory. In fact, these various calls formed the beginning point of the gradual rise of German academic chemistry to its leading European rank towards the end of the century.

Bunsen was a man of remarkable probity, modesty, and kindness, probably the most uniformly and justly admired scholar of his generation. He scrupulously avoided conflict, in both conversation and in correspondence; he used to say that one would be able to read his letters aloud in the marketplace without embarrassment. But this, we now know, was at least a slight exaggeration. In fact, he absorbed, or at least shared, many of the same aversions of the chemist whom he most revered, Berzelius. Both men thought that J. B. Dumas was foolish, insincere, and vain (pp 202, 293), and when Liebig broke with Berzelius and began to bandy insults, Bunsen offered the Swede his fullest sympathy, with private vitriol directed against the sage of Giessen (pp 271, 293, 379). In 1832 Bunsen compared many lectures in Parisian institutions to the performances of conjurers (p 67), and in 1840 expressed his low regard for academic chemistry in England, where the resplendence of the laboratories bordered on charlatanry (p 195—a complaint borne of envy, which two decades later would be echoed by the French against German laboratories!). It is however noteworthy that Bunsen's rare unbuttoned derogations are found almost exclusively in letters to Berzelius—a man whom he knew to be sympathetic, whom he venerated, and who resided in a foreign country.

The volume is fully equipped with indexes, an admirably complete bibliography, and a foreword by Fritz Krafft (who directed Stock's 2005 Marburg dissertation, which formed the basis for the present work). Most important, though, is a superb 148-page introduction that summarizes the new historical knowledge provided by this correspondence, and also (though to a lesser extent) the current state of Bunsen scholarship *tout court,* over the course of the protagonist's entire life. Extensive footnotes provide both specific detail and broader context, ranging widely across the history of science as well as the general history of the period as it pertains to the action on stage. In short, this volume provides a major new contribution to the understanding of one of the most important scientists of the nineteenth century, as well as of his partners in correspondence. *Alan J. Rocke, Case Western Reserve University, Cleveland, OH 44106/USA.*

Scientific Institutions and Practice in France and Britain, c. 1700-c.1870. Maurice Crosland, Ashgate, Aldershot, Hampshire, 2007. Cloth, xvi + 270 pp, $109.95.

The name of Maurice Crosland is well known to the history of chemistry community. Winner of the 1984 Dexter Award in the History Chemistry and the author of such classics as *Historical Studies in the Language of Chemistry* (1962), *The Society of Arcueil* (1967), and *Gay-Lussac: Scientist and Bourgeois* (1974), he is widely regarded as the world expert on 18th- and early 19th-century French chemistry. The volume under review is part of Ashgate's Valorium Collected Studies Series and consists of reprints of 12 of Crosland's most recent publications, all of which originally appeared either as papers in various journals or as book chapters in various edited volumes. As such, it is a successor to an earlier collection (*Studies in the Culture of Science in France and Britain Since the Enlightenment*) of Crosland's papers published as part of the same series in 1995. The first seven selections in the current collection deal with various institutional aspects of chemistry and science in both France and Great Britain, and the remaining five selections with various aspects of laboratory practice. Also included is a brief introduction by Crosland, a complete bibliography of his publications since the appearance of the first collection in 1995, a general index, and an attractive portrait of the author, which appears opposite the title page.

The various papers and book chapters have been reproduced as photofacsimiles of the originals rather than being reset in a uniform manner. Though the reproduction of the original printing is of high quality, the same cannot be said of many of the original illustrations, several of which resemble low grade photocopies. In addition, the publisher has retained the original pagination of each paper and, rather than adding a secondary pagination for the collection as a whole, has instead assigned each paper a Roman numeral, which is then combined with the original page numbers to create the various index entries.

So much excellent work on the history of chemistry gradually becomes lost in the back volumes of various journals, that it is a pleasure to see some of it given a fresh lease on life. Reprint volumes of this sort not only give an author's work a more permanent and focused format; they also aid its dissemination, as many smaller libraries, which are unable to afford or maintain complete runs of the journals in question, are able to afford individual volumes of this sort. In this regard, it should also be noted that Ashgate's Valorium reprint series contains several other volumes of specific interest to historians of chemistry, including collections of papers by William Brock, Trevor Levere, and the late Wilfred Farrar. Ashgate is to be congratulated in making this opportunity available to British historians of science, though it is a great pity that no similar opportunity appears to be available to American historians. *William B. Jensen, University of Cincinnati*.

New Dictionary of Scientific Biography. Noretta Koertge, Editor-in-Chief. Charles Scribner's Sons, an Imprint of Thomson Gale (now a part of Cengage Learning), Farmington Hills, MI 48331-3535, 2008; http://www.gale.com; hardbound, 8 vol., cxvi + 3,271 pp, ISBN 978-0-684-31320-7, $995.

In 1965 Charles Scribner's Sons, supported by the American Council of Learned Societies, began the immense task of publishing authoritative biographies of the most important natural scientists and mathematicians who had lived up to that time. The project resulted in the publication (1970-1980) of the 16-volume Dictionary of Scientific Biography, with Charles Coulston Gillispie as Editor-in-Chief. In 1990 two supplementary volumes (Volumes 17 and 18), under the editorship of Frederic L. ("Larry") Holmes, were added to include recently deceased scientists such as Rachel Carson, Kurt Gödel, Werner Heisenberg, Carl Shipp Marvel, Jacques Monod, and Gerold Schwarzenbach. The 18-volume set, hailed by Choice as "monumental" and by Booklist as "the definitive biographical source for scientists," became an indispensable educational and research tool for historians of science as well as a popular reference for high school, college, and university students and the general public.

An abridged one-volume version, Concise Dictionary of Scientific Biography, appeared in 1981, while a second edition (2000) included material from the 1990 supplementary volumes.

In late 2004 Noretta Koertge approached scholars for proposals of biographies to appear in a forthcoming *New Dictionary of Scientific Biography* (NDSB), again with the support of the American Council of Learned Societies. Koertge received her B.S. (1955) and M.S. (1956) degrees in chemistry from the University of Illinois, where she completed all the work for her Ph.D. in 1959. After a decade as a lecturer and professor in the United States, Turkey, England, and Canada, she received her doctorate in the philosophy of science under Heinz R. Post at Chelsea College, University of London in 1969. In 1970 she joined the Department of the History and Philosophy of Science at Indiana University and retired in 2000, as Professor Emerita. Her research interests include the history of methodology and of chemistry and the philosophy of science. She was also Editor-in-Chief of the journal *Philosophy of Science* (1999-2004).

The NDSB, with Koertge as Editor-in-Chief, aided by a nine-member advisory committee, 23 subject editors, and nine consulting editors, appeared in eight volumes. The 629 authors hail from 37 countries. In contrast to the DSB, all volumes appeared simultaneously, and they contain numerous portraits, photographs of scientists at work, and images from their publications to increase its accessibility to a general readership. The coverage now includes anthropology and psychology and, to a limited extent, some areas of economics and sociology. As was the case with the original DSB, the goal has been "to identify the most noteworthy scientists and present the story of their accomplishments within the broader context of their lives in essays that reflect the best available historiographic research," an objective that, in my opinion, has been eminently attained.

The NDSB extends, complements, and comments on the original set with 775 completely new entries. About 500 articles are devoted to scientists who died since 1950 and were not included in the DSB such as Hans Bethe, Francis H. C. Crick, Richard Feynman, Stephen Jay Gould, Fred Hoyle, Christian Klixbüll Jørgensen, Mary Leakey, Willard Frank Libby, Konrad Lorenz, Barbara McClintock, Linus Pauling, Andrei Sakarov, Burrhus Frederic (B. F.) Skinner, and Edward Teller. Seventy-five "gap" entries on scientists previously overlooked in the DSB, such as Chrysippus, Ernest Everett Just, and Alfred Kinsey, as well as 225 "postscript" commentaries on important figures who have inspired new research or interpretation, such as Archimedes, Aristotle, Robert Boyle, Charles Darwin, Albert Einstein, Sigmund Freud, Hypatia, August Kekulé, Antoine-Laurent Lavoisier, and J. Robert Oppenheimer, are intended to supplement, but not to replace, the original articles in the DSB. For example, the entry on Isaac Newton's alchemy (Volume 5, pp 273-277) adds a new dimension to our understanding of his theory of matter, while the entry on (Johann) Gregor Mendel (Volume 5, pp 97-101) elucidates the surprising link between his famed pea experiments and earlier discussions of heredity that occurred at meetings of the Moravian Sheep Breeders Society.

While key figures in biology, chemistry, mathematics, and physics have not been neglected, scientists who have pioneered new disciplines that play pivotal roles in today's society are also included. To achieve this purpose special editors for cognition, computer science, decision theory, ecology, ethology, neuroscience, and space science were appointed. Traditional fields that have matured and increased in importance like climatology, physical anthropology, and psychology have been emphasized.

The increase in historical research on women in science since the publication of the DSB and the changes in the social structure of the scientific community are reflected in the greater number of entries devoted to women, e.g., Maria Gaetana Agnesi (Volume 1, pp 19-21), who wrote a famous book on calculus; Caroline Lucretia Herschel, sister of astronomer William Herschel (Volume 3, pp 286-287), who discovered several comets; Ada Augusta King, Countess of Lovelace (Volume 4, pp 118-120), who wrote the first computer program; and Maria Sibylla Merian, who contributed to botany, entomology, ethnography, and natural history (Volume 5, pp 118-120).

The DSB was criticized for its neglect of non-Western scientists; the NDSB has filled this gap by a greater emphasis on Arabic, medieval, African-American, and Asian researchers. Because our understanding of past and current science is influenced by philosophical and sociological theories about its structure and development, the NDSB contains entries on Thomas Samuel Kuhn and his notion of the paradigm (Volume 4, pp 170-177), Robert King Merton and his theory of scientific norms (Volume 4, pp 121-126), and Karl Raimund Popper and his falsifiability criterion (Volume 6, pp 133-137). Many of the new essays reflect the growing interest of historians in the social conditions and disciplinary organizations in which scientists work.

The NDSB retains the superior print, alkaline paper, design, and binding of the DSB. Although the separate volumes do not appear to be available individually, they bear different ISBNs. Biographies take up Volumes 1-7. Volume 8 contains lists of contributors, their affiliations, and article titles (25 triple-column pages); scientists by field (14 triple-column pages); Nobel Prize winners (1 triple-column page); and articles (5 triple-column pages) as well as a note on the index (2 double-column pages). The index itself comprises 208 double-column pages.

Simultaneously with the publication of the print version of the NDSB, an electronic version of the 8 volumes of the NDSB, along with the 18 volumes of the original DSB titled the *Complete Dictionary of Scientific Biography*, was published. (ISBN 978-0-684-31559-1) Since the online "e-book" version is fully searchable, users can pose questions that would elude even the best print index. Not only will this facilitate research but can lead to new avenues of inquiry about how science works. Also, the Complete DSB, when integrated into a library's collection becomes cross-searchable with a potentially limitless array of other reference works. The price for e-books depends on the account type and population served. To register call (800) 877-4253 or e-mail gale.galeord@cengage.com.

In the Complete DSB new material is interleaved with old, but the actual material is not merged. Future emendations, additions, revisions, and updating will occur on a regular basis so that this standard reference source will remain definitive for many years to come.
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It's Part of What We Are: Some Irish Contributors to the Development of the Chemical and Physical Sciences, Science and Irish Culture Series No. 3. Charles Mollan, Royal Dublin Society, Ballsbridge, Dublin, Ireland, 2007; http://rds.ie/science/publications; to purchase or for additional information e-mail Dr. Claire Mulhall: science@rds.ie; hardbound, 2 vol., xlviii + 1770 pp, ISBN 978-0-86027-055-3, €60; €50 for RDS members (not including postage and packaging).

In 2004 the Royal Dublin Society initiated a series of volumes titled "Science and Irish Culture," in which chemist Charles Mollan, a longtime member of the Royal Dublin Society (RDS) Committee of Science and Technology and an authority on the development of science in Ireland, played a prominent role. The first two volumes—D. Attis and C. Mollan, Ed., *Why the History of Science Matters in Ireland,* and C. Mollan, Ed., *Science and Ireland—Value for Society: A Volume to Acknowledge the Return to Dublin of the British Association for the Advancement of Science in September 2005*, appeared in 2004 and 2005, respectively. The third volume, the subject of this review, appeared in 2007.

Historians of Ireland have paid little attention to the role that men and women born in the Emerald Isle or with strong Irish connections, either at home or abroad, played in the advancement of science. For example, there is no university department devoted to the history of science in Ireland, whereas academic study of the history of science flourishes much more in countries outside of Ireland, especially in Great Britain and the United States, where scholars have taken a special interest in Ireland and Irish scientists. However, their studies have been scattered across the many books and journals dealing with the history of science in general or the history of specific sciences. Also, the Irish connections of scientists have often been ignored, particularly for those who emigrated to enjoy a more favorable environment than was available at home. Many of these scientists are claimed by their adopted countries, and their Irish background, which was of critical significance to their character and approach to their work, is overlooked. The series of RDS volumes specifically devoted to historical studies of Irish science and technology is intended to encourage a greater interest in this area by both scientists and historians. It may also have important lessons for other countries interested in

understanding how science relates to their culture, their society, and their opportunities for development.

It's Part of What We Are contains carefully researched and meticulously documented biographies, chronologically arranged according to birthdates and ranging in length from three pages to several dozen pages, profiling 118 astronomers, chemists, physicists, mathematicians, and other persons who played significant roles in advancing knowledge of the physical sciences during the last three centuries.

Mollan has left no stone unturned in his goal of focusing attention on the lives and achievements of these persons, whom he considers as people, not merely as scientists. He describes them "warts and all" and places them in the context of Irish—and to a lesser degree, international—scientific, social, educational, and political history. He deals not only with their scientific achievements but also with their views on other matters, often in their own words. As he puts it, "I do try to make human the people whom I am profiling, and I try to avoid jargon and too much scientific detail" (p xxxv). Wherever relevant, he includes their membership of and commitment to the Protestant ascendancy (the political, economic, and social domination of Ireland by great landowners, establishment clergy, and professionals, all members of the Established Church during the seventeenth through nineteenth centuries) and/or part in the struggle for Irish national independence.

Mollan also includes several exiled scientists, some of whom remained abroad for the remainder of their lives to the advantage of their adopted countries, while others returned home when conditions permitted. He explores their religious convictions, their scientific philosophy, and their views on the best forms for the education of Irish people of different persuasions over the relevant centuries. Although some of the persons profiled benefited from inherited wealth, e.g., the Boyles, most of the scientists came from ordinary middle class families. Largely overlooked in Irish historical studies, these persons exhibited remarkable abilities and accomplishments at a time when little encouragement for scientific endeavor existed in Ireland.

In this set, intended for a nonscientific readership, Mollan eschews technical terms and avoids chemical and mathematical equations so that readers with little knowledge of science can understand and enjoy the biographies. He includes numerous stories and anecdotes, both humorous and otherwise, as well as poetry, songs, and other literary excerpts. His viewpoint is usually Irish (He repeatedly uses the phrase "this island"). His definition of "Irish" is extremely broad, and he includes persons who were born in Ireland but carried out their work elsewhere. He also includes two persons who, while not born in Ireland and whose major work was not performed there, had an Irish parent or parents—Joseph Black and Guglielmo Marconi.

"Labor of love" is often an overused expression, but in this case the appellation is fully justified. Mollan is obviously enjoying himself in spinning the tales that he relates. His style and tone are decidedly personal and conversational, and much of his writing is in the first person. Often he sprinkles his biographies with general observations or with revelations about himself so that we learn much about his life and career as well as that of his biographies.

For example, Mollan begins his essay on Aeneas Coffey (1780-1852), inventor of the Coffey still with the confession, "I am not a big drinker. I do, though, make my own wine, which we drink most evenings with dinner" (p 329). In his essay on George Boole (1815-1864) he acknowledges, concerning a biography of Boole, "I got my copy free (£19.95 was a serious amount of money to me in those days), since I had the pleasure of reviewing it for the *Irish Times* of 20 April 1985)" (p 734). (As a frequent book reviewer I can certainly empathize with him). His introduction to the essay on Hugh Ryan (1873-1931) shows his sly sense of humor: "It is interesting to speculate about the differences in personalities between those enlightened people, like me, who choose chemistry as their scientific specialisation, and those misguided souls who choose physics" (p 1,390). In another essay he states, "John Lighton Synge was one of the few people in this book whom I actually met" (p 1,511).

The set contains an "eclectic selection" of 149 illustrations of formal and informal single and group portraits, apparatus, telescopes, medals, title pages, advertisements, laboratories, buildings, caricatures, inventions, tombstones, newspaper articles, banknotes, and space groups from Mollan's personal collection, reproduced on heavy, glossy paper in the middle of the two volumes (Fig. 1-76 between pp 406 and 407 in Vol. 1 and Fig. 77-149 between pp 1290 and 1291 in Vol. 2). References appear in abbreviated form at the bottom of each page and refer to the 78-page bibliography of books and articles in Vol. 2. A detailed index comprising 62 triple-column pages facilitates location of material. British spelling is used consistently throughout the set.

Mollan proclaims his goal and the set's title: "I hope that this book will confirm that we as a race have a tradition of innovation and that ability in the physical sciences is, indeed, Part of What We Are (p xli). In my opinion, he has succeeded in attaining his objective, and I am pleased to recommend this unique, scholarly but eminently readable, copiously illustrated, and modestly priced two-volume set to historians of science in general and of Irish scientists in particular. It should also find a welcome home in academic and public libraries. As the most comprehensive treatment of the subject, hitherto never adequately addressed by a single author, it adds a previously undervalued dimension of what constitutes Irish culture. *George B. Kauffman, Department of Chemistry, California State University, Fresno, Fresno, CA 93740-8034, USA, georgek@csufresno.edu*.

Molecules that Changed the World. K. C. Nicolaou and T. Montagnon, John Wiley & Sons, Inc., New York, 2008, xvi + 385 pp, ISBN 978-3-527-30983-2, $55.

The book by Nicolaou and Montagnon contains a fascinating description of science evolution through the discovery, identification, and development of individual molecules. Emphasis is placed on natural products with medicinal applications, and not unexpectedly, with a strong tie to the molecules of interest to the authors. It would be a faulty and naive assumption to believe that this book, or any book, could describe all of the molecules that 'changed the world;' and the authors go to great lengths to disavow themselves from that claim. Heavy emphasis is placed on the role organic chemists played in the development of each molecule; yet the book does not dwell on a detailed description of organic synthesis. Interplay between natural product science, biology, biochemistry, clinical data, and organic chemistry is highlighted. Scientific development, stimulated by these molecules, is revealed as a multidimensional equation that relies upon serendipity, dedication, and intellectual flash points.

A unifying feature of all chapters, with the exception of the chapter on Small Molecule Drugs, is the identification of a natural product as the impetus for the discovery and development. In this way the book makes a strong case for continued natural product discovery efforts and the role organic synthesis can play in understanding the natural product-medicine relationship.

The early chapters of the book are devoted to relatively simple molecules like urea, camphor, and aspirin; and the complexity of molecules of interest increases as one progresses through the book. Each chapter is organized in a similar fashion. The natural medicinal value of an unrefined natural product or the serendipitous discovery of a uniquely exciting substance is presented in the context of scientific advancement. The challenges encountered in taking advantage of these great opportunities are presented, with advances often tied to the efforts of synthetic organic chemists. Unlike *Classics in Total Synthesis*, detailed analyses of the synthetic pathways are modest and deemphasized, although references are provided for those readers interested in more of the synthetic details. The book is remarkably free of errors; and the appearance of low-technical mini reviews of topics like aldol reactions, asymmetric synthesis, metathesis reactions, and cross-coupling reactions will be useful for the non-expert. The final two chapters of the book are focused more directly on medical applications and provide a broad overview of pharmaceutical and biotechnology development.

The book is blessed with an abundance of beautiful illustrations and photographs. The style and quality of the graphical presentation are reminiscent of a National Geographic book. Many of the photographs are of individual scientists responsible for the scientific advances. While the organization of the book is based upon molecules, the individual scientist is the protagonist of each story. Personalities of the scientists who drove the discoveries are frequently revealed, often through the inclusion of quotations. The single-minded dedication of these scientists is celebrated, and their passion for discovery is placed front and center.

This book is targeted for a broad audience, and it will find use in a variety of constituencies. For the synthetic organic chemist, the book provides an opportunity to observe the beauty and innovation of synthetic approaches, as well as to appreciate the maturation of organic synthesis as a discipline. For the educator, the book will serve as a powerful resource for stories that can awaken sleepy undergraduates to the history of science and to the possibilities that await the scientists of tomorrow. A reader with a modest familiarity with organic chemistry will appreciate, in addition to the history of individual molecules, the stories about individual scientists, whose dedication, passion, and insight moved chemistry and, in many cases, all of science forward. *Charles K. Zercher, University of New Hampshire, Durham, NH 03824.*

Nylon and Bombs: DuPont and the March of Modern America. Pap A. Ndiaye, translated by Elborg Forster, Johns Hopkins University Press, Baltimore, MD, 2007, ISBN 978-0-8018-8444-3, hardcover, $45.

This is a very important book that ought to be read by all chemical engineers who seek a broad understanding of the history of their profession. The author brings to bear on this history an impressive collection of analytical and descriptive tools and a carefully designed and clearly articulated understanding of the context of the development of chemical engineering that produces a masterpiece. The original appeared in 2001, written in French from Ndaiye's professorial post at the École des Hautes Études en Sciences Sociales (the school of advanced social science) in Paris. It has been ably rendered in English by Elborg Forster.

The author has chosen to focus on MIT and the DuPont Company, both of which are exemplary, leading academic and educational institutions in the field. While the AIChE plays a role in catalyzing the development of the profession in this account, it is not the central agency, as it is in most accounts of the profession. Instead, the crucial interactions between MIT and DuPont produced many of the curricular and research innovations that shaped the status and success of chemical engineers in the 20th century.

While this focus excludes developments in petrochemicals, in which DuPont had little interest, it takes advantage of the abundant evidence available at the Hagley Library and Archives, one of the few significant industrial chemistry archives open to outsiders. Ndiaye also uses interviews with DuPont engineers as well as a wide range of secondary sources, which are conveniently evaluated in an appended historiographical essay.

The author's solid grounding in American history allows him to describe this interaction between DuPont and MIT in the political environment of the 20th century. The political relations of DuPont and the federal government in the Progressive Era and the New Deal were difficult. As the largest manufacturer of explosives before and during World War I, the firm came under the scrutiny of both Theodore and Franklin Roosevelts' administrations, as well as the United States Congress, most notably the Nye Committee, to whom the firm appeared to be a "Merchant of Death" in World War I. World War II reconciled the firm with the federal government, which needed its expertise in both traditional and nuclear explosives.

One response of the company to a hostile political environment was to diversify its product line after World War I. The opportunity was presented by the seizure of German chemical patents by the Alien Property Custodian during that war, which allowed chemical firms in the United States to contemplate competition with Germany in synthetic chemistry. One product of this contemplation was nylon, DuPont's signature contribution to both military and consumer markets after 1939.

The diversification under Pierre S. du Pont brought the company into collaboration with MIT, where A. D. Little, William Walker, and Walter Lewis, the canonical founders of the discipline of chemical engineering, had created the most prominent department in the field just after the war. Since Pierre and other du Ponts were alumni of the Institute, it was a "natural" choice for an

academic partner; but the negotiations between the Institute and DuPont were complicated by their academic and industrial cultures. The nuances of these negotiations are deftly described by Ndiaye, who points out that chemical engineers had to struggle for recognition and respect from the chemists, who dominated both the MIT Chemistry Department and the DuPont Wilmington Experimental Station. His parallels between academic and corporate politics illuminate barriers that stood in the way of the social and professional aspirations of chemical engineers in the 1920s and 1930s.

The protagonists of the story are the chemical engineers who joined DuPont after World War II and established their value to the firm in the development of nylon in the 1930s. Crawford Greenewalt stood out among them, both because of his elite background (he was related by marriage to the du Pont family) and because of his extraordinary ability to embrace the culture of the Wilmington firm. Within a quarter of a century, he rose to the presidency, solving the production problems posed by scaling up Wallace Carother's novel polymer, nylon, and the complexities of mass-producing Glenn Seaborg's novel element, plutonium. Using Greenewalt as the most prominent representative of DuPont's chemical engineers, Ndaiye is able to depict the personal, professional, and political dimensions of their rise to leadership in the firm, their success in both the commercial and military markets, and their role in reshaping the corporate culture of DuPont.

The technical aspects of nylon and plutonium production are less developed in this account. Although nylon has been the subject of considerable interest by other historians of DuPont, particularly in David Hounshel and John Smith's history of DuPont research and development, it is beyond the institutional and historical focus of the account presented here. Such technical accounts of the development of plutonium are fewer in number and, in the current climate of concern over nonproliferation, unlikely to be widely available soon. Nevertheless, published accounts by Seaborg and newly available notes by Greenewalt might have afforded some explanation of the challenges DuPont faced. The author's reliance on the official histories of the Atomic Energy Commission, dating back almost fifty years, rather than on more recent accounts, makes this part of his narrative less satisfying.

Nevertheless, the "big picture" of nylon and bomb production presented here is limned with analyses that seldom appear in more restricted accounts of these two new signature materials. These analyses are explicit and buttressed with convincing research and state-of-the-art historical methodology. Since historians of technology have largely escaped the prolixity in their terminology, the book is easily accessible to the laiety and well worth reading. *Robert W. Seidel, Department of Chemical Engineering and Materials Science, University of Minnesota, Minneapolis, MN 55455.*

Distilling Knowledge: Alchemy, Chemistry, and the Scientific Revolution. Bruce T. Moran, Harvard University Press, Cambridge, MA, 2005, hardcover, 210 pp, ISBN 0-674-01495-2, $16.95.

Andreas Libavius and the Transformation of Alchemy. Bruce T. Moran, Watson Publishing International LLC, Sagamore Beach, CA, 2007, hardcover, vii + 344 pp, ISBN 978-0-88135-395-2, $49.95.

Within the 16th and 17th centuries, the history of alchemy and chemistry can seem a murky place. Alchemy seemed to be moving away from the traditional pursuit of the transmutation of metals and began focusing more and more on preparation of medicines. At the same time, chemistry itself was not yet a distinct practice or discipline, and individuals commonly pursued both "alchemical" and "chemical" activities without significant distinction. To further complicate the study of this time period, even the terms "alchemy" and "chemistry" were used largely interchangeably making it nearly impossible to separate these two fully intertwined practices. In recognition of this difficulty, the pivotal work of Newman and Principe has advocated the use of the archaically-spelled term chymistry to refer to the activities of this time period, as they can not be purely differentiated into either chemistry or alchemy. It is into this murky, yet rich, time

period that historian Bruce T. Moran delves with two texts covering the transition of alchemy to chemistry.

In the first of these publications, *Distilling Knowledge: Alchemy, Chemistry, and the Scientific Revolution* (2005), Moran argues the important contribution of alchemy to the Scientific Revolution and proposes that, rather than the common perception of alchemy as irrational and pseudoscientific, it should be considered an early form of scientific pursuit when viewed within the context of the time period and cultural perspective. Most historians of chemistry recognize the contributions of alchemy to the development of chemistry, particularly in terms of techniques (distillation, sublimation, etc.), laboratory apparatus (stills, heating baths, flasks, etc.), and the isolation of important chemical species (alcohol, inorganic salts, mineral acids, etc.). Moran highlights many of these contributions. The arguments put forth for the scientific nature of alchemy, however, suffer from the fact that Moran seems to ignore the complications of distinguishing chemistry from alchemy as discussed above, and he offers what could be viewed as the more "chemical" activities of practitioners as the strongest evidence of the "scientific" contributions of alchemy. At points, he does acknowledge that some authors used the term chemistry to refer to alchemy but seems to suggest that these are purely alchemical activities. Another confusing aspect of Moran's presentation is that he often seems to equate discovery or technology with science. Processes and practices are stressed to be as important to the pursuit of knowledge as theory, but he does not seem to acknowledge that process and practice alone can not advance understanding. However, it should be pointed out that while the contributions of alchemy may have been primarily practical, it was practitioners' interest in these techniques and the materials produced from them that ultimately led to the development of chemistry. Thus, the important contributions of alchemy in the history of science should not be overlooked; and in advocating these contributions, Moran is definitely passionate.

Overall, it is unclear as to who was the intended audience of this book. The writing style and discussion, particularly early in the text, seem to suggest the book was written for a general audience, but the overall discussion requires at least some knowledge of the subject. For example, while a large number of examples of the activities of various alchemists are provided, it is never explained what it is that defined alchemy as an activity prior to its intermingling with the beginnings of chemistry, nor does it give background into the underlying theories on which alchemy was based. Likewise, familiarity with the general ideas and work of Hippocrates, Galen, and Aristotle is assumed. As such, this book is not a good starting point for those interested in the later alchemical era, but neither does it really offer enough new material or insight to provide significant interest to more knowledgeable readers.

Moran's second offering came two years later with *Andreas Libavius and the Transformation of Alchemy* (2007), a study of the life, writings, and philosophy of German alchemist Andreas Libau (ca.1560-1616), more commonly known through the Latinized name Libavius. While it covers some of the same ground as his previous text, this work is drastically different in nature and is clearly an academic text aimed at the historian of chemistry. The discussion is logically presented and well written, with each chapter heavily footnoted with sources and further comment. In addition, the general confusion of alchemy vs. chemistry seen in the previous work has been replaced with the use of chymistry as advocated by Newman and Principe, although it should be noted that Moran's use of the word is more of a pre-chemistry and, at times, he still tries to differentiate it from 16th-century alchemy.

Libavius is most well known for his work *Alchemia* (1597), which is considered by some to be the first systematic textbook on chymistry. Moran, however, does not limit himself to this single work and presents material from a fair number of lesser known writings as well. Moran focuses on the general philosophy of Libavius, presenting his views on the place and nature of chymistry, while also describing many of Libavius' various conflicts with supporters of Paracelsian doctrine. With the exception of a brief description of Libavius' design for a model laboratory, the technical aspects of Libavius' writings are not discussed. But even with this limitation, Moran presents plenty of interesting material and provides a deeper look at this important historical figure. Overall, this book is a worthy addition to the collection for those studying this complicated period of the history of chemistry. *Seth C. Rasmussen, North Dakota State University.*

Nobel Laureate Contributions to 20th Century Chemistry. David Rogers, Royal Society of Chemistry, Cambridge, 2006, xii + 651 pp, ISBN 0-85404-356-X, £99.95.

Rogers has assembled biographical information and descriptions of Nobel laureates' scientific innovations from 1901 to 2000 in this invaluable reference source. As the title indicates, these laureates made contributions to chemistry, although they were not always recipients of the Nobel Prize in Chemistry. Hence, Rogers has included, in a separate section, recipients of the Nobel in Physiology or Medicine, but whose research was substantially chemical in nature.

A brief preface allows the author to explain his reason for undertaking this ambitious project and to comment on a few outstanding examples of laureates: Marie Curie, the only woman to have received two awards; Linus Pauling, who uniquely was awarded two undivided Nobel Prizes; Fred Sanger, the only recipient of two Nobel Prizes in Chemistry.

There follows a short section on Alfred Bernhard Nobel, the benefactor and creator of the idea of these prizes, which includes a quotation from his will spelling out the guidelines for the award program.

Section 1, "Chemists Awarded the Nobel Prize for Physiology or Medicine," 22 pages in length, begins with Henrik Carl Peter Dam, 1943, and concludes with Martin Rodbell, 1994. The major portion of the book, Section 2, with 615 pages, covers all the chemistry Nobel Prize winners from 1901 to 2000.

Four to five pages are allotted to each awardee, whose picture is followed by biographical information on "The Early Years," "The Career," "Honors and Awards," and with a fairly detailed account of the research accomplishments. A bibliography is included for each biography. Those laureates who shared a prize are so designated as "0.5," "0.33," or "0.25."

As the author laments, many are called but few are chosen. He offers recognition of those who were nominated (up through 1950) but never elected in a table in Section 3, "Collaborations and Influences." A sampling of those with fervent but unheeded support are G. N. Lewis (nominated 17 years); Lisa Meitner (nominated 14 years); and Georges Urbain (nominated 22 years)! Also in Section 3 are tabular and graphical analyses and professional "family trees," to illustrate the interconnection between Nobel Prize winners. Finally, the index is a cumulative alphabetical listing of Nobel laureates from Sections 2 and 3.

All chemists with even the least enthusiasm for the history of their discipline will find this compendium of enormous value and will treasure owning it. *Paul R. Jones, University of Michigan*.