universities of Kazan and St. Petersburg. Zinin was an important early figure in the Kazan school of chemistry. Trained initially in physics and mathematics he was instructed, for such was the autocratic nature of Russian universities at that period, to become a teacher of chemistry. He was given three years to study in Western Europe, and attended courses in Germany, France, and England. He spent a year doing research with Liebig, and then returned to take up his duties in Kazan. Major contributions made by Zinin to organic chemistry included the discovery of the benzoin condensation and the preparation of aniline from nitrobenzene.

Lewis writes in similar depth about the lives and careers of many other Russian organic chemists including Butlerov, Menshutkin, Borodin, Beilstein, Markovnikov, Zaitsev, Zelinskii, and Favorskii, bringing his story up to the early twentieth century.

Spinger Verlag has made an admirable choice in starting its series "Springer Briefs in Molecular Science: History of Chemistry" with David Lewis's book. It is nicely illustrated and has a full index and bibliography. This important work sheds light on a relatively little studied area of the history of organic chemistry in an easily read and authoritative manner.

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Inventing Chemistry. Herman Boerhaave and the Reform of the Chemical Arts, John C. Powers, The University of Chicago Press, Chicago and London, 2012, viii + 260 pp, ISBN 978-0-226-67760-6, $40.

Herman Boerhaave (1668-1738) received his degree in Philosophy at the University of Leiden (1689) and a degree in Medicine at Haderwijk (1693). He was appointed lecturer at Leiden in 1701 and Professor of Botany and Medicine in 1709. In 1714 he became Rector and introduced a system of clinical medicine to advance the experiential education of medical students. In 1718 Boerhaave was appointed Chair in Chemistry. In 1729, in ill health, he resigned the Chairs of Botany and Chemistry and suffered declining health until his death.

The impact of Herman Boerhaave (1668-1738) on the history of chemistry is all too commonly considered to derive solely from his masterwork, *Elementa Chemiae*, the first authorized edition appearing in 1732. In a very limited sense that book can be considered the bridge between the important series of seventeenth-century chemistry textbooks, especially those published by the French chemists beginning with Jean Beguin, then Nicaise le Fèvre, Chistolphe Glaser and Nicolas Lemery and textbooks in the middle-to-late eighteenth century that provided more discussion of theory. Indeed while the first edition of Lemery's *Cours de Chimie* appeared in 1675, the final printing of the final edition was published in 1757. Still, Lemery's text book was in a classical tradition that discussed chemical operations (e.g. distillations, crystallizations) before providing specific preparations of reagents, useful substances and medications.

The author of the present monograph, John Powers, is a faculty member in the Department of History and Assistant Director of the Science, Technology and Society Program at Virginia Commonwealth University. He assesses Boerhaave's pioneering work in formulating a powerful didactic approach in his teaching, providing standing for chemistry in the university curriculum and contributing to the application of experimentation to test chemical theory.

Chapter one ("Medicine as a Calling") provides background relevant to appreciating medical education in late seventeenth century Europe and young Boerhaave's early intellectual development. The section "Path to Professorship" in this chapter has a familiar ring to it for twenty-first century university faculty: a university's appointments swayed by powerful public officials; a university suffering financial distress and failing in attempts to hire academic "stars," filling diminishing ranks with part-time lecturers and facing diminishing matriculations. Boerhaave barely held onto his lecturer's appointment at this time but was kept on because he had a three-year contract. Jacob Le Mort, Boerhaave's predecessor to the Chair of Chemistry at Leiden, had earlier campaigned hard for the chemistry chair and would have been appointed in 1697, except that William of Orange, King of England and Dutch stadholder, objected because of Le Mort's acceptance of Cartesian Philosophy. However, when William died in 1702, Le Mort's appointment was accomplished in short order.

Chapter Two describes Boerhaave's contributions to "didactic chemistry" in the historical context. The first chemistry textbook, one that really developed the foundation for performing chemical operations (building ("chemical house"), furniture, apparatus, chemicals) was the *Alchemia*, published by Andreas Libavius in 1597 (expanded illustrated folio edition, 1606). Nonetheless, the chemistry taught in the medical schools of the seventeenth and early eighteenth centuries did not recognize chemistry (or perhaps "chymistry" as Lawrence Principe and William Newman describe it) as sufficiently "philosophical" to be a rigorous academic subject. Typically, the expectations of the chemistry course were limited to useful descriptions of techniques and specific recipes for medications. During the first half of the seventeenth century a very small number of medical schools provided professorships and specific courses in chemistry. Two of these early professors were Johannes Hartmann (Marburg) and Werner Rolfinck (Jena). Le Mort's appointment to the Chair of Chemistry at Leiden was an early recognition of the growing importance of chemistry in the medical school curriculum.

Chapters Two ("Didactic Chemistry in Leiden") and Three ("The Institutes of Chemistry") focus on the development of the didactic chemistry and Boerhaave's advancement in chemistry at the University. Boerhaave taught his first chemistry course in 1702 as lecture only but began to include demonstrations in fall 1703. Le Mort's course, part of the Leiden curriculum, could be attended without extra fees, since the price was included in the matriculation fees that covered Le Mort's salary. In contrast, Boerhaave was given permission by the University to offer his course for a separate fee, from which he could derive some salary. Despite this extra expense, students favored the more dynamic Boerhaave's course. Upon Le Mort's passing in 1718, Boerhaave ascended to the Chair in Chemistry and Chapter Four ("Chemistry in the Medical Faculty") describes modifications in the curriculum and in the perception of the role of chemistry in medicine that followed. Powers notes that "Boerhaave's appointment to the chair of chemistry represented the success of a new type of chemical medicine, derived from the empirical and experimental practices of his medical mentors, Anton Nuck and Charles Drélincourt" (the latter used the pseudonym "Le Vasseur").

Boerhaave's contribution to didactic chemistry was to adopt what is termed the "instrument theory," which had its origins with Daniel Sennert (at Wittenberg) in 1629 (second edition of his *De Chymicorum…*) and was transmitted to Boerhaave by Johannes Bohn. A very "heterogeneous group" of instruments ("fire, air, water, earth, menstrua and chemical vessels") would be applied to "shift the focus of chemical theory to the latent properties of chemical species, which were seen as inherent to individual species, and were revealed only through action with instruments."One of these instruments, fire, was the subject of some of Boerhaave's most important work (Chapter Five "Instruments and the Experimental Method"). In attempting to quantitate fire, Boerhaave remarked how subjective human perceptions of heat are. A damp cave feels colder than a dry cave even as the temperatures of the two, via the newly-designed Fahrenheit thermometer might be equal. As noted by Powers: "The instruments course instilled in students a methodology and philosophical perspective that supported Boerhaave's vision for a chemistry based on experimentally determined principles." Curiously, the word "phlogiston" does not appear in this chapter or in the book's index. However, it is widely agreed that Boerhaave had reservations about phlogiston theory since this "substance of fire" could not be quantitated using thermometry. Boerhaave's advocacy of thermometry as an objective measure of the ability of fire to "rarify" matter was a very important contribution both to the teaching and the practice of chemistry.

Chapter Six (Philosophical Chemistry) is largely devoted to Boerhaave's magnum opus, the *Elementa Chemiae* (1732). The "pre-history" of this book is well known to chemical historians (and book collectors). Leiden students had assembled Boerhaave's lectures into a textbook, not authorized by the professor, published in 1724 and, indeed, this unauthorized work was translated into English in 1727. (In 1684, students published the *Collectanea Chymica Leydensia*, liberally mixing the lectures of Carel De Maets, the Leiden predecessor of Le Mort, Le Mort himself- at the time "merely" a lecturer, and Christiaan Marggraf, another competing chemistry lecturer in this academic "free market." All three despised the book, particularly De Maets, the one with highest standing and having the most to lose). Boerhaave was quite upset with the unauthorized publication of his lectures. He signed an attestation page for every copy of his sumptuous, illustrated first Leiden edition of 1732. In this chapter, Powers does briefly discuss the fact that Boerhaave does not mention Stahl's phlogiston theory anywhere in his *Elementa Chemiae*. He notes that Boerhaave's *pabulum ignis*, compared by some modern day scholars to phlogiston, was presented as "the material cause of inflammability… needed to interact with instrumental fire… for combustion to occur." Stahl's phlogiston, by contrast, was considered to be the very substance of fire "fixed" in an inflammable body. The final chapter ("From Alchemy to Chemistry") describes Boerhaave's investigations and teachings over three decades of the mercurialist theory of chemistry. Essentially the concept that all metals shared a rarified form of mercury gave some theoretical support to the possibility of transmuting metals. However, Boerhaave's devotion to experimental testing of theory led him to discredit this notion. In considering the credulity to the notion of transmutation by outstanding minds of the period (Boerhaave and, earlier, Boyle and Newton), it is well to remember that it was only near the end of the eighteenth century that Lavoisier provided a useful definition of the term "chemical element."

Professor Powers' book is a concise work, dense with information, yet highly accessible for historians and non-historians alike. In each of seven chapters, followed by a section titled CONCLUSION ("Boerhaave's Legacy"), the author provides an outline at the start and a brief, helpful wrap up at the conclusion. There are 30 pages of Notes, nicely indexed both to chapter and also in the running header to pages. This is followed by a 21-page bibliography and an adequate index that occasionally misses important specifics- for example, le Fèvre and Glaser are important chemists, discussed in the body of the book, but missing in the index.

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Sir James Dewar, 1842-1923: A Ruthless Chemist, J. S. Rowlinson, Ashgate, Farnham, 2012, xviii + 236 pp, ISBN 978-1-4094-0613-6, $124.95.

The dictionary defines a clerihew as a "whimsical, four-line biographical poem" invented by the British humorist, Edmund Clerihew Bentley (1875-1956), while still a 16-year old schoolboy. One of his earliest attempts is an example well-known to historians of chemistry:

> Sir Humphry Davy
> Abominated gravy.
> He lived in the odium
> Of having discovered sodium.

Recently I had occasion to examine Bentley's first published collection of clerihews, *Biography for Beginners* (London, 1905), and was delighted to discover that, in addition to Davy, yet another chemist was embedded among the many satirized literary figures, politicians, philosophers and theologians:

> Professor Dewar
> Is a better man than you are,
> None of you asses
> Can condense gases.

Aside from the rather exaggerated pronunciation of Dewar required to make the rhyme work, this little ditty is of interest for two reasons. First, it focuses on Dewar's later work on the liquefaction of gases at low temperatures, which led in turn to his development of the vacuum flask or thermos bottle—probably the only aspect of his career known to most present-day chemists. In recognition of this accomplishment, the vacuum flask—at least among American chemists—is often referred to simply as a "Dewar."

Second, there is a suggestion of intellectual arrogance on the part of Dewar—an aspect of his personality also reflected in the subtitle of the book under review: *A Ruthless Chemist*. Though short biographical summaries of Dewar's life and career have long been available, this is the first book-length study of this talented, albeit irascible, Scottish chemist. Its author, Sir John Rowlinson, is well-known among physical chemists for his work on the theory of liquids and liquid mixtures, and is increasingly known among historians of science as well for such works as his reprinting with commentary of the English translation of J. D. van der Waals' classic 1873 thesis, *On the Continuity of the Gaseous and Liquid States*