

DO HISTORIANS OR CHEMISTS WRITE BETTER HISTORY OF CHEMISTRY? (1)

Seymour H. Mauskopf, Duke University, shmaus@duke.edu

This paper was the response to a challenge set me as the senior historian of chemistry (in age) serving on the ACS National Historic Chemical Landmarks Committee. The challenge was to reflect on the history of chemistry in terms of the question posed in the paper's title. Although there is a "tongue in cheek" quality to the question, it also has its serious side and it challenged me. I have to say that, until two weeks before my talk, I had no idea how I would respond. Then I had my epiphany and the result is the following historiographical reflection.

Let me state at the outset that I am primarily an historian rather than a chemist. Although I was only one credit shy of completing an undergraduate major in chemistry at Cornell, in fact, I was graduated with an official major in history and received "highest honors" for a senior thesis on twelfth- and thirteenth-century canon law! But I did encounter Henry Guerlac in two courses and subsequently did my graduate study in the history of science at Princeton (1960-1964) under Charles Coulston Gillispie, with a field in the history of chemistry and a dissertation that combined history of late eighteenth-century-early nineteenth-century chemistry with related areas in the history of physics. In my graduate studies in the history of chemistry, I did my first reflective survey of the field as it had developed down to about 1960. I had not done a sequel until this challenge was posed.

In retrospect, I see that the principal obstacle I faced was definitional. I think I know how to define a "**chemist-historian**" (i.e., a chemist who researches and writes the history of chemistry) but I was less sure regarding an "**historian of chemistry**." Because of the technical nature of the field, virtually all of us who do history of chemistry have some background in chemistry, as my own example illustrates. Some have considerably more

than I have. Alan Rocke, for example, did graduate work in chemistry. Arnold Thackray worked as a chemical engineer. Lawrence Principe has a joint appointment in the history of science and in chemistry and teaches chemistry. Does this make them chemists doing history of science or historians of science doing history of chemistry?

My epiphany was the realization of the following definition: an "**historian of chemistry**" is an "historian of science" doing the history of chemistry. By "historian of science," I mean someone who has (a) received training in the history of science and (b) holds some full-time position related to the history of science—be it an academic position or one in some institution promoting history of science (e.g., a museum).

This immediately provides a structure to my historiographical reflection. Until the mid-twentieth century, virtually all the people writing history of chemistry were chemists (one gigantic exception—Hélène Metzger), for the simple reason that there were virtually no trained historians of science (more on this and on Metzger below). By, say, 1960, history of science programs were emerging and training historians of chemistry, among other fields. These scholars (the Thackrays, Rockes, Principes—and Mauskopfs) became the norm although some chemists continued to display an active and abiding interest in the history of chemistry as witnessed by the Dexter-Edelstein Award tradition, activities of the ACS Division of the History of Chemistry (HIST), and the National Historic Chemical Landmarks Committee.

I shall discuss the work of a somewhat idiosyncratic group of **chemist-historians**—idiosyncratic in being of personal interest. Then I shall turn to the development of the history of science as a disciplinary field in mid-twentieth century and offer some conclusions.

Chemists and the History of Chemistry

The nineteenth century was already replete with historical activities of chemists. When I was in graduate school in the early 1960s, the most comprehensive standard historical reference work for chemistry was still Hermann Kopp's *Geschichte der Chemie* (2). I can still remember waiting with bated breath for the first published volume of J. R. Partington's *A History of Chemistry* (3) to see whether it would really supplant Kopp. (It did, but primarily as an immense reference work in my view.) Kopp's history of chemistry is merely the most prominent of historical productions by chemists including such notable productions as Thomas Thomson's *The History of Chemistry* (4), Albert Ladenburg's *Vorträge über die Entwicklungsgeschichte der Chemie in den letzten hundert Jahren* (5), Jean Baptiste Dumas' edition of the works of Lavoisier (first four volumes, followed by the remaining two edited by Eduard Grimaux) (6), and the works of Marcellin Berthelot on medieval chemistry and alchemy (7) to name a few. Since I mention Berthelot, I ought for the sake of equity mention his opponent, Pierre Duhem's *Le mixte et la combinaison chimique: Essai sur l'évolution d'une idée* (8), a work which I consulted with great profit a few years ago while writing on the historical background to Proust's law of definite proportions.

In connection with my work on Proust, I would also like to mention an historical study by a chemist that I came upon as a graduate student and found both quite amazing and inspirational. I refer to Ida Freund's *The Study of Chemical Composition: An Account of Its Method and Historical Development* (9). Freund (1863-1914) had an extremely interesting life and career—in some respects comparable as pioneer woman scientist to her more famous contemporary, Marie Curie. Born in Austria, Freund was both orphaned and seriously injured at a young age (losing a leg in a bicycle accident). Initially educated in Vienna, she was taken to England by an uncle (a member of the Joachim string quartet) where she was able to enter Girton College, Cambridge, in 1882 and take the natural sciences tripos, obtaining a first class degree with a specialty in chemistry. She spent the rest of her life teaching chemistry and doing research at Newnham College. The basis for *The Study of Chemical Composition* was a third year lecture course that Freund devised for her women students reading chemistry (10).

There were active historically-minded chemists in the United States at about the time Duhem and Freund were publishing their pioneering historical studies on chemical composition. One famous one was Edgar Fahs Smith, chemist, historian, and, best known today

for the magnificent historical collection in chemistry at the University of Pennsylvania. Probably less known is his Tarheel contemporary, Francis Preston Venable (1856-1934). Son of a professor of mathematics at the University of Virginia (and aide-de-camp to Robert E. Lee in the Civil War), Venable was trained in chemistry at the University of Virginia and he was offered the chair in chemistry at the University of North Carolina at Chapel Hill in 1880. Going overseas for advanced training, he earned a doctorate at the University of Göttingen and then returned to UNC to carry out important chemical research. Most notable was his identification of calcium carbide. In 1893 he received the Mary Ann Smith Professorship, the first endowed chair at UNC. In 1899 he served as Vice President of the Chemistry section of the AAAS and in 1905 President of the ACS. From 1900 to 1914, he was President of UNC (11).

Despite a busy schedule—to put it mildly—Venable had time both to collect historically important works in chemistry (which now constitute the core of the Venable Collection at UNC) and to carry out writings in the history of chemistry. He published two major historical studies (or three, depending on how you count): *A Short History of Chemistry* (1894 and subsequent editions), *The Development of the Periodic Law* (1896), and an expanded version of the *Short History* under the title *History of Chemistry* (1922). (12)

The prefaces to these books are interesting in giving some clue as to why a Tarheel chemist would be so astonishingly pioneering in historical studies. That of his *Short History of Chemistry* gives a context or origin similar to that of Freund's book and even prefigures the motivation behind the *Harvard Case Histories in Experimental Science* of more than fifty years in the future. I quote from Venable's preface:

This History has been written because of a conviction, from my own experience and experience with students, that one of the best aids to an intelligent comprehension of the science of chemistry is the study of the long struggle, the failures, and the triumphs of the men who have made this science for us. The work is based upon a course of lectures delivered for several years past to my classes in the University of North Carolina. The effort has been made to systematize and digest the material on hand so as to render it available for those desiring a general knowledge of the subject. (13)

Venable was very familiar with the literature in the history of chemistry that had built up in the course of the nineteenth century.

I would like to know a lot more than I do about the details of the success of this book—who bought it and how it was used—for *Short History* went through a number of editions. Venable wrote in the preface of the sequel of 1922 that, although the *Short History* “had passed through a number of editions, there has been no attempt to bring it up to date nor to revise it in any way:”

It has now been entirely rewritten on a changed plan of arrangement and made to cover the great progress in the science which has taken place since it first appeared. (14)

The Prefatory Sketch to *The Development of the Periodic Law* is also interesting in that Venable provided a *philosophical* rather than pedagogical motive for writing the book:

The reproach that chemistry is not, in the fullest sense, a science will continue just so long as chemists content themselves with taking together the straws of facts, gleaners many of them in a harvested field, and neglect the ‘weightier matters of the law.’ The gathering of facts is good, gleaning is good, but contentment with such gains means stagnation. The task has been undertaken in the hope of arousing interest in this matter and of aiding in the further development of the still incomplete system. (15)

The result was Venable’s most ambitious historical monograph, running to almost three hundred pages of text.

It is clear to me that Francis Venable was a **chemist-historian** who merits more study.

Activity of chemist-historians did not slacken in the first half of the twentieth century. One of the most useful results of such activity, in my opinion, is Tenny L. Davis’ *The Chemistry of Powder and Explosives* (1943), with its wealth of historical material (16). This, too, I believe, was the fruit of a course on the subject that Davis taught at MIT. These decades also witnessed the first historical publications of J. R. Partington and the complete oeuvre of Hélène Metzger (1889-1944), who died tragically in a Nazi concentration camp (17). Metzger, trained as a crystallographer but unable to obtain an academic position and able to support herself privately, treated history of chemistry as a species of intellectual history very much as part of the milieu of French historical and philosophical studies being carried out by her contemporaries such as Gaston Bachelard, Émile Meyerson, and Alexandre Koyré.

What they did—particularly Metzger and Koyré—was to historicize their subject matter. Rather than the orientation of Venable on “the long struggle, the failures,

and the triumphs of the men who have made this science for us,” Metzger attempted to get in the mindsets of her seventeenth- and eighteenth-century protagonists with as little reference as possible as to whether they were ultimately “right.” It is significant that, early on in *The Structure of Scientific Revolutions*, Thomas Kuhn cites Metzger (along with Meyerson and Koyré), as having shown him “what it was like to think scientifically in a period when the canons of scientific thought were very different from those current today (18).”

Emergence of History of Science as an Academic Discipline

All of the above belongs to the “archaic” period of the history of science as an academic discipline. During the first half of the twentieth century, the history of science began to emerge as an academic discipline but only slowly. There were few journals in the field before the 1940s (*Isis*, 1913; *Annals of Science*, 1936; *Archives internationales d’histoire des sciences*, 1947) and few academic positions. George Sarton, for example, who was the progenitor of the field in the U.S., never had a regular position at Harvard although he spent his entire American career there. Rather, he was a Research Associate in the Harvard Department of History, his financial support coming from the Carnegie Institution (19). The first American to receive a Ph.D. in the history of science was I. B. Cohen, who received his degree at Harvard in 1947 in the Program in the History of Science and Learning instituted by James Bryant Conant in 1936 (20).

Mention of Conant suggests that chemists—and the history of chemistry—were important in the genesis of the history of science as an academic discipline. The next history of science program to be officially instituted was at the University of Wisconsin in 1941 and the young scholar, Henry Guerlac, was invited to form it up (21). Guerlac had majored in chemistry at Cornell and done graduate work there and at Harvard in chemistry before switching to earn a Ph.D. in European history. Although not technically an alumnus of the Harvard history of science program, he had done coursework with George Sarton and a dissertation on science and the military school at Mézieres in the *ancien régime*.

Guerlac started up the department and then left in 1943. He did not return after the war but, instead, was hired by his alma mater, Cornell, to begin history of science there. By the late 1950s, Cornell had a flourishing program and by the 1960s, his graduate students were pursuing research on the subject on which he had come

to focus in his own research: Lavoisier and the Chemical Revolution.

At Wisconsin, the history of science program was resumed after the war. At the same time, a young chemist, Aaron Ihde, returned to his alma mater, Wisconsin, to accept a tenure-track position in the chemistry department. In 1946, Ihde was able to manifest his interest in the history of chemistry by instituting (or better resurrecting) an undergraduate course. By the end of the 1940s, Ihde was playing a central role in developing an undergraduate liberal arts education at Wisconsin and emphasizing the history of science.

Ihde strengthened his connection with the history of science (and history of chemistry) by spending the year 1951-52 at Harvard teaching in a course Conant had instituted on "case histories in experimental science" co-taught with the chemist, Leonard K. Nash, and Thomas Kuhn. Although he apparently was not formally added to the faculty of the history of science program until 1957, he in fact was the mentor for the first Ph.D. completed in that program; Robert Siegfried received his degree with a dissertation, appropriately enough in the history of chemistry, in 1953. Of course, it has also to be mentioned that Wisconsin was concurrently developing the leading program in the nation in the history of pharmacy.

So the 1950s can with a good deal of justice be considered the first decade when history of science emerged as an academic discipline. It was also, of course, the decade when the Dexter Awards began. I doubt that anyone then was conscious of a connection but we can certainly make one now: the development of the academic discipline of the history of science was heavily influenced by, indebted to, and focused on the history of chemistry. The tradition of chemist-historians continued and would be joined by the first group of historians of science with a focus in the history of chemistry. By the early 1960s, Cornell, under the tutelage of Henry Guerlac, and the University of Wisconsin, under the leadership of Aaron Ihde, emerged as centers for training "historians of chemistry." By the early 1970s, these universities had been joined by the University of Pennsylvania's Department of the History and Sociology of Science founded by Arnold Thackray. I should mention that a parallel development was taking place in England, particularly at University College London, where Douglas McKie joined the nascent Department in the History and Method of Science in 1925, remaining one of only two permanent department members until 1946. McKie's biography of Lavoisier appeared in 1935 and monographs of some of

his students on topics in eighteenth-century chemistry also were published already in the 1930s (22).

1950s and 1960s: "Heroic Age" of the History of Chemistry.

In the 1950s and 1960s, the influence of professional history of science began to become evident in the history of chemistry. I shall discuss a number of seminal publications of these decades.

The Historical Background of Chemistry by the biochemist, Henry M. Leicester (1956) (23). In my terminology, Leicester was a **chemist-historian**.

Looking over this book now, in relationship to Venable's venerable *History of Chemistry*, there are interesting parallels and differences. The major parallel is the topic and period covered, which are roughly the same despite the over fifty years that separated the two histories. Both works, moreover, give much more attention to the development of inorganic chemistry than organic, even in the nineteenth century.

But there are significant differences, which come out in Leicester's preface. Firstly, although a **chemist-historian**, Leicester recognized the professional changes then taking place, Leicester naturally employed the term, "historians of science." Moreover, his story was no longer primarily one of "failures" and "triumphs" of individual men, as it was for Venable but rather:

It is clear that the full story of such developments involves not only the personalities and intellects of the scientists themselves, but also the social and economic conditions which surrounded them and the philosophical ideas to which they are exposed.

He noted that such a comprehensive history would involve a massive project but also, "As yet, such a volume is lacking in the history of chemistry." Leicester did not propose to carry out the project in this work but rather "the development and interrelation of chemical concepts." (24)

A good marker of their differences in historical perspectives is found in their treatment of the phlogiston theory. Venable rather irritably dismisses it (25): "Since the theory was false, it obscured or twisted facts and necessarily retarded progress." Leicester, by contrast, gives a much more nuanced and positive account (26): "In this field [combustion], the phlogiston theory supplied an excellent explanation for the known facts." (27)

Harvard Case Histories in Experimental Science, James Bryant Conant, General Editor, Leonard K. Nash, Associate Editor (1957) (28). Conant and Nash were **chemist-historians**.

This two volume set the fruit of the course that Conant had instituted and with which Ihde had been associated in the early 1950s. In aim, the publication is not unlike Venable's: to enlighten the science student and the general public about the nature of science.

But this work deeply reflected the new perspectives of the history of science in much the ways that Leicester's book had. A general conceptual structure was established at the outset, which, while holding to an empiricist and progressivist view of scientific change, nevertheless took full cognizance of the complexities involved in the origins and ascendancy of new scientific concepts. Moreover, each case study was heavily interlarded with quotations and sometimes long excerpts from original sources to give the reader a real historical flavor of the narrative.

Not surprisingly given the two editors, four of the eight case studies can be said to fall in the domain of the history of chemistry (29). At least two ("Overthrow of the Phlogiston Theory" and "The Atomic-Molecular Theory") still regularly show up in history of science course syllabi, and the "Overthrow of the Phlogiston Theory" became the basis for the treatment of the Chemical Revolution in Thomas Kuhn's *The Structure of Scientific Revolutions*.

Lavoisier—the Crucial Year: The Background and Origin of his First Experiments on Combustion (1961) by Henry Guerlac (30), **historian of chemistry**

Although there were other important Lavoisier scholars before Guerlac and contemporaneous with him (McKie, Maurice Daumas), this book was a defining one in the development of the history of science generally because it represented the archival-based, detailed studies of science that came to dominate the history of science in the 1960s. Moreover, it was an interrogation of "origins;" scientific "advance" could no longer be assumed to be natural or inevitable but, like all historical events, had to be thoroughly explained. Guerlac, through his students, dominated the history of chemistry in the 1960s and 1970s, with the focus being on Lavoisier and his work.

The Development of Modern Chemistry (1964) by Aaron Ihde (31), **chemist-historian (?) historian of chemistry (?)**

It is difficult to know how to categorize Aaron Ihde—as a chemist-historian or as primarily an historian of chemistry. In *his* preface, he articulates something like Leicester's vision of what the history of chemistry should be, emphasizing especially its relationship to industry:

I have sought to give proper attention to the part played by individuals without making the account a series of biographical sketches. At the same time I have attempted to place chemistry in the framework of the times. It has influenced human life in major ways, particularly in the nature of industrial and agricultural activity. At the same time, the growth of chemistry has been influenced by human affairs—political, economic, and social. These interactions I have sought to reveal. (32)

Moreover, in contrast to Leicester, Ihde carried his historical narrative down well into the twentieth century. In the twentieth-century sections, Ihde covered not only the substance of chemistry but industrial and agricultural chemistry as well. Moreover, indicative of what soon would be rising environmental concerns, Ihde concluded his massive history with a section titled "Nonprofessional Problems Created by Chemistry." Here, he discussed various kinds of environmental problems and hazards created by chemical activities: nuclear waste, industrial waste and hazards, environmental chemical hazards. He began this section with eloquent and prophetic words:

These problems demand the best wisdom of the world's leaders, and they will be resolved only very gradually, even where there is good will and a sincere desire for their solution. Chemists can help in their solution but will need the collaboration of the best minds in many other fields. Perhaps chemists can be of greatest service if they will become more conscious of the results of their activities and use their influence to delay the introduction of new products and new processes until they can be sure the advantages outweigh the disadvantages. (33)

The Development of Modern Chemistry was, in an important way, Janus-faced. Along with Partington's multi-volume set, it was the last and most ambitious of the synoptic narratives of history of chemistry. Yet it did represent the beginnings of a different kind of history of chemistry. Although its core was the history of chemical theories, there were now considerations of chemical education, industrial chemistry, and environmental and ecological problems.

Conclusion

Although only one of these five authors was clearly an **historian of chemistry**, all the others played important roles in the development of the history of science. Given the comprehensive influence of the history of science on all of them, and the obvious blurring of my categories for most of them, I might now want to declare the question, “Do historians or chemists write better history of chemistry?” to be irrelevant and non-informative.

What I can say as an historian—and an historian of science—is that Guerlac’s *Lavoisier—the Crucial Year* became paradigmatic of the nature and style that monographs in the history of science were to assume, and this included those in the history of chemistry.

By contrast, Leicester’s and Ihde’s histories represent the last and possibly the greatest exemplars of a genre of historical writing practiced by **chemist-historians**: the general narrative of the history of this scientific discipline (34).

The decades when these works were published (and perhaps the 1970s as well) marked the high point in the productions of works in the history of chemistry—by both **chemist-historians** and **historians of chemistry** as I have defined them. Particularly in the history of science community in America, which I know best, history of chemistry moved from centrality in the 1960s to a much more marginal position by the 1980s, and many of the actors of the earlier decades moved on to research in other fields. It is difficult to say why. Possibilities include the negative image that chemistry bore by the 1970s, the fact that increasing numbers of young scholars entering the history of science lacked the technical knowledge of their forebears (necessary in pursuing history of chemistry), and perhaps the fact that chemistry did not deal with the increasingly fashionable “existential” issues of our origins, destiny, and purpose as did biology (and geology), physics, and psychology. But these are speculations.

Among the small but intrepid cadre of **chemist-historians** in HIST, interest in the history of chemistry was maintained and, with the appearance of the Beckman Center for the History of chemistry and its successor, the Chemical Heritage Foundation, the history of chemistry has at last found an institutional home.

In recent years, there has been a resurgence of interest in the history of chemistry but the foci of research are somewhat different from earlier decades. Firstly, there is now an interest in very recent developments, such as molecular biology and genomics. Secondly, at the other

temporal end, there has been a real increase [was “take up”] in the study of alchemy or “chymistry” of the sixteenth and seventeenth centuries. Thirdly, there is a good deal of interest in the history of the development of industrial research in chemistry and chemical industry. Finally, and more generally, scholars are interested in chemistry as “material culture:” the pursuit of chemically-related crafts such as pharmacy, metallurgy, and the making of products such as perfumes.

All of these foci in one way or another emphasize a feature of chemistry that often was underplayed in earlier writing both of chemist-historians and historians of chemistry: chemistry has always been as much about the making of products as it has been about discovering and scientifically explaining natural knowledge. It has always contained both craft and scientific components. In contemporary research in the history of chemistry, the science of chemistry is being recognized in its full extent.

References and Notes

1. Presented at the 233rd National Meeting of the American Chemical Society, Chicago, IL, March 27, 2007, HIST 29.
2. H. Kopp, *Geschichte der Chemie*, 4 Vols., F. Vieweg und Sohn, Braunschweig, 1843-1847.
3. J. R. Partington, *A History of Chemistry*, 4 Vols., Macmillan, London, 1961-1970.
4. T. Thomson, *The History of Chemistry*, 2 Vols., Henry Colburn and Richard Bentley, London, 1830-1831.
5. A. Ladenburg, *Vorträge über die Entwicklungsgeschichte der Chemie in den letzten hundert Jahren*, F. Vieweg und Sohn, Braunschweig, 1869.
6. J.-B. Dumas and E. Grimaux, *Oeuvres de Lavoisier*, 6 Vols., Imprimerie imperial, Paris, 1862-1893.
7. M. Berthelot, *Les origines de l'alchimie*, G. Steinheil, Paris, 1885, is one example.
8. P.-M.-M. Duhem, *Le mixte et la combinaison chimique: Essai sur l'évolution d'une idée*, C. Naud, Paris, 1902.
9. I. Freund, *The Study of Chemical Composition: An Account of Its Method and Historical Development*, Cambridge University Press, Cambridge, England, 1904.
10. M. B. Ogilvie, “Freund, Ida (1863-1914), chemist,” Oxford Dictionary of National Biography, <http://www.oxforddnb.com/index/101048490/Ida-Freund>. There has recently been an uptake of interest in Freund. See B. Palmer, “Ida Freund: Teacher, Educator, Feminist, and Chemistry Textbook Writer,” *IPSI BGD Transactions on Internet Research*, 2007, 3, 49-54, <http://www.internet-journals.net/journals/tir/2007/July/Paper%2012.pdf>; M. Hill and A. Dronsfield, “Ida Freund, the First Woman Chemistry Lecturer,” *Roy. Soc. Chem. Historical Group Newsletter*, January 2011, <http://www.chem.qmul.ac.uk/rschg/Newsletter/NL1101.pdf>.

11. M. Bursey, *Francis Preston Venable of the University of North Carolina*, Chapel Hill Historical Society, Chapel Hill, North Carolina, 1989.
12. F. P. Venable, *A Short History of Chemistry*, D. C. Heath, Boston, 1894 [1901]; *The Development of the Periodic Law*, Chemical Publishing Company, Easton, Pennsylvania, 1896; *History of Chemistry*, D. C. Heath, Boston, 1922.
13. Venable, "Preface," *A Short History of Chemistry* (1901), no pagination. The preface is dated in the text as June, 1894.
14. Venable, "Preface," *History of Chemistry*, no pagination. The preface is dated in the text as June, 1922. I used the London edition (same date and publisher).
15. Venable, "Prefatory Sketch," *The Development of the Periodic Law*, 1.
16. T. L. Davis, *The Chemistry of Powder and Explosives*, Wiley, New York, 1943.
17. Her major works in the history of chemistry were: *La genèse de la science des cristaux*, Alcan, Paris, 1918; *Les doctrines chimiques en France du début du XVII^e à la fin du XVIII^e siècle*, Presses Universitaires de France, Paris, 1923; *Newton, Stahl, Boerhaave et la doctrine chimique*, Alcan, Paris, 1930. For recent scholarship, see G. Freudenthal, Ed., *Études sur Hélène Metzger*, Brill, Leiden, 1990.
18. T. S. Kuhn, "Preface," *The Structure of Scientific Revolutions*, 3rd edition, University of Chicago Press, Chicago, 1996, viii.
19. For a thoughtful article on Sarton and his role in developing the history of science as a professional field, see A. Thackray and R. K. Merton, "On Discipline Building: The Paradoxes of George Sarton," *Isis*, **1972**, 63, 472-495. For an entire issue of *Isis* devoted to Sarton and the development of the history of science in the United States, see: "Sarton, Science, and History," *Isis*, **1984**, 75, 1-240.
20. J. Dauben, M. L. Gleason, G. E. Smith, "Seven Decades of History of Science: I. Bernard Cohen (1914-2003), Second Editor of *Isis*," *Isis*, **2009**, 100, 4-35.
21. The history of the inception and development of the Wisconsin program is based on V. L. Hiltz, "History of Science at the University of Wisconsin," *Isis*, **1984**, 75, 63-94. Before 1940, Edward Kremers (1864-1941) had promoted the teaching of the history of pharmacy and professional activities in the history of science generally. For Henry Guerlac, see M. Boas Hall, "Eloge: Henry Guerlac, 10 June 1910-29 May 1985," *Isis*, **1986**, 77, 504-506.
22. W. A. Smeaton, "History of Science at University College London, 1919-1947," *Brit. J. Hist. Sci.*, **1997**, 30, 25-28.
23. H. M. Leicester, *The Historical Background of Chemistry*, Science Editions, Wiley, New York, 1965 [first edition, 1956].
24. Leicester, "Preface," *Historical Background*, v.
25. Venable, *History of Chemistry*, 34.
26. Leicester, *Historical Background*, 123.
27. I have not treated J. R. Partington in this article but I will make a comparative reference to his *A Short History of Chemistry* here. This work has the virtue of attention to primary sources, quoted extensively. I would judge its evaluation of the phlogiston theory to be mid-way between that of Venable and Leicester: "Stahl inverted the true theory of combustion and calcination.... He neglected the quantitative aspects of chemical change, disregarded what was known of gases, and paid little attention to atomic theory. On the other hand,... his theory linked together a large number of facts into a coherent body of false doctrine, suggested new experiments, and led to discoveries." J. R. Partington, *A Short History of Chemistry*, 3rd ed., Macmillan, 1957 [1965 reprint], London, 88.
28. J. B. Conant and L. K. Nash. Eds., *Harvard Case Histories in Experimental Science*, 2 vols., Harvard University Press, Cambridge, MA, 1957.
29. Case 2: "The Overthrow of the Phlogiston Theory" (Conant); Case 4: "The Atomic-Molecular Theory" (Nash); Case 5: "Plants and the Atmosphere" (Nash); Case 6: "Pasteur's Study of Fermentation" (Conant).
30. H. Guerlac, *Lavoisier—the Crucial Year: The Background and Origin of his First Experiments on Combustion*, Cornell University Press, Ithaca 1961.
31. A. J. Ihde, *The Development of Modern Chemistry*, Harper & Row, New York, 1964.
32. Ihde, *Development*, xi.
33. Ihde, *Development*, 733.
34. Not quite the last; a major general narrative of the history of chemistry, written by a distinguished historian of chemistry, appeared in 1992: W. H. Brock, *The Fontana History of Chemistry*, Fontana Press, London, 1992, published in the US as *The Norton History of Chemistry*, W. W. Norton & Co., New York, 1993.

About the Author

Seymour Mauskopf received his B.A. from Cornell University and his Ph.D. from Princeton University in the history of science. His fields of research interest are the history of chemistry [*Crystals and Compounds*, 1976, *Chemical Sciences in the Modern World*, 1993] and the history of marginal science (parapsychology) [*The Elusive Science*, with Michael R. McVaugh, 1980]. In 1998, he received the Dexter Award for Outstanding Contributions to the History of Chemistry from the American Chemical Society. He taught history of science at Duke University since 1964 (receiving the Alumni Distinguished Undergraduate Teaching Award in 2006) and retired at the end of 2010. Currently, he is working on a book on Alfred Nobel's interactions with British munitions scientists in the late nineteenth century.