THE LONG AND SHORT OF IT: THE FUTURE WRITING OF HISTORIES OF CHEMISTRY

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Abstract

Following reflections on the experience of writing a long, thick history of chemistry in 1992 and, some 24 years later, a short thin one in 2016, the author notes how quickly the historiography of chemistry changed in just two decades. He asks whether book-length histories of chemistry, whether long or short, have a future. While the writing of biographical articles may seem straightforward, journal articles present problems as contemporary chemistry becomes more and more bound up with its sister sciences, computing and engineering, and the history of science with social and cultural history. Probably the only way to tackle late twentieth- and twenty-first-century chemistry satisfactorily is through a collaboration between technically-trained chemists and historians of science who may (or may not) have studied chemistry in their early education. The author reflects on two of his recent experiences of such collaboration.

Introduction

One of the sources I once used to understand how the Oxo Company manufactured Liebig's Extract of Meat was an article in one of the beautifully illustrated, four volumes of *Chemistry in Commerce* (1). Evidently published in weekly parts, the volumes covered a wide range of industries that were active in the 1930s, ranging from electroplating to gas manufacture, brewing and the manufacture of pharmaceuticals. It was particularly good on the food industry. What struck me in perusing the pages was that all of the dozens of analytical quality control procedures mentioned and illustrated in the volumes were all time-consuming wet analyses. The only instrumental techniques mentioned were pyrometry, the design and use of autoclaves, and one brief essay on an automatic recording device. From the present perspective, there was also a complete absence of information on the monitoring of waste products of industry and on pollution and its control.

As historians and chemists well know, the sea change in analytical instrumentation occurred in the 1950s (2). The second edition (1951) of Arthur Vogel's *Quantitative Inorganic Analysis*, which I used as an undergraduate in 1956, still emphasized the need for the classical training in group analysis laid down as student exercises by Liebig in the 1830s at the University of Giessen (3). Instrumentation was arriving while I was a student, but it was slow in affecting British undergraduate training, mainly because electronic instruments were still beyond the financial resources of the average College laboratory. Vogel's textbook did, in fact, have chapters and illustrations of instruments for calorimetry, potentiometry and polarography, but my undergraduate generation was never introduced to them. I do not recall handling any instrument, other than an ordinary spectroscope, until my third and final year when, while investigating the spectra of tetrahedral molecules, I was allowed to use the department's one and only spectrophotometer (4).

The point of these personal reflections is that any historian, like myself, who abandoned chemistry sixty

years ago, is severely disadvantaged by lack of experience with instrumental investigations involving IR or UV spectroscopy, mass spectroscopy, gas chromatography and NMR, let alone production control instruments in industrial settings. Inevitably, then, those of us who retrained as historians of science in the 1950s and 1960s have tended to investigate chemistry's deeper past, particularly the development of alchemy (if we have Latin), the early modern chemistry that is now appropriately dubbed chymistry, the eighteenth-century chemical revolution, the establishment of atomic theory, and the emergence of organic chemistry, valence and structural formulas at the end of the nineteenth century. But we remain ill-equipped to deal with twentieth-century chemistry, let alone the chemistry of the recent past.

Today, most of the younger generation of historians of science have taken degrees in the humanities which may, or may not, have included some history of science, but they have not studied the physical sciences beyond school level. Few have had practical experience in the laboratory. Consequently, they face a problem when dealing with twentieth-century and more recent chemistry beyond writing about it from a sociological perspective.

A Long, Thick History

I wrote most of my *Norton History of Chemistry* in 1990-91 at the Chemical Heritage Foundation (now Science History Institute) in Philadelphia. It was published in the UK in 1992 and in the States a year later, as part of a series of volumes planned by the late Roy Porter to embrace the whole of the history of science and culture. Sadly, for various reasons, volumes on the history of physics and biology never appeared. When I returned to the States in the summer of 1993, I learned that my book was a "bestseller" and was being recommended by the *New York Times* (5). The work is now nearly thirty years old and, in several respects, out of date. Like chemistry itself, historical interests and perspectives change and evolve. The historiography of the subject has, not surprisingly, greatly altered since 1992, notably with changed perspectives on the role of alchemy, the significance of Robert Boyle, the role of synthetic methods in the development of structural chemistry in the nineteenth century. The book also lacked a place for a full treatment of physical chemistry. Despite decent sales and its use in undergraduate teaching, a revised edition was never called for. Although the book carried no overt "message," by being arranged around what might be considered as defining "landmark" monographs and papers from Lucretius's *On the Nature of the Universe* to Ronald Nyholm's "Renaissance of Inorganic Chemistry," I was able to tell chemical stories around each of these "landmark" items that avoided the drudgery of chronology; it was intended to appeal to a readership of both professional chemists, general readers and, of course, historians of science. Oddly, around the same time, several other historians of chemistry published their own "take" on the subject (6), leading the late George B. Kauffman to express amazement at such a plethora of books by professional historians of science "when courses were no longer a part of the usual undergraduate curriculum." He compared his own introduction to the discipline in Claude Deicher's class at the University of Pennsylvania in 1950 when the only suitable text was by the chemist Frank J. Moore (7).

Chemists have always needed to be aware of the historical background to their research. This was the purpose of finding aids, such as those provided by Berzelius, Gmelin and Beilstein, or patent lists. These reference works provided information on who had first made compounds x and y, how they were prepared, and in what journals background papers and information might be sought (8). Abstracting services and annual reviews of the literature by diverse chemical societies followed at the beginning of the twentieth century. Complementing such aids to research were the long or short histories that chemists such as Thomas Thomson, Hermann Kopp, and many others have published since the beginning of the nineteenth century (9).

With no new edition of my "history" being called for, when, in 2013, Oxford University Press invited me to write a history of chemistry for its attractively-illustrated and inexpensive series of "Very Short Introductions," I leaped at the opportunity (10, Figure 1). The OUP pocket-size series was first launched in 1995 as accessible ways to find about a whole range of subjects new to a reader. The series now extends to over 600 books and includes, apart from my own contribution, 35.000-word monographs on the history of astronomy (M. A. Hoskin, 2003), mathematics (J. Stedall, 2012), medicine (W. B. Bynum, 2008), the periodic table (E. Scerri, 2011; 2nd ed. 2019), physics (J. Heilbron, 2018), the Scientific Revolution (L. M. Principe, 2011), as well as fine introductions to chemistry (P. Atkins, 2015), organic chemistry (G. Patrick, 2017), and physical chemistry (P. Atkins, 2014). In addition, there have been biographies of Bohr (J. Heilbron, 2020), Copernicus (O. Gingerich, 2016), Darwin (J. Howard, 2001), Faraday (F. A. J. L. James, 2010), Galileo (S. Drake, 2001), and Newton (R. Iliffe, 2007). Together, and with others still to follow, the books make an excellent introduction to many aspects of the history of the sciences (11).

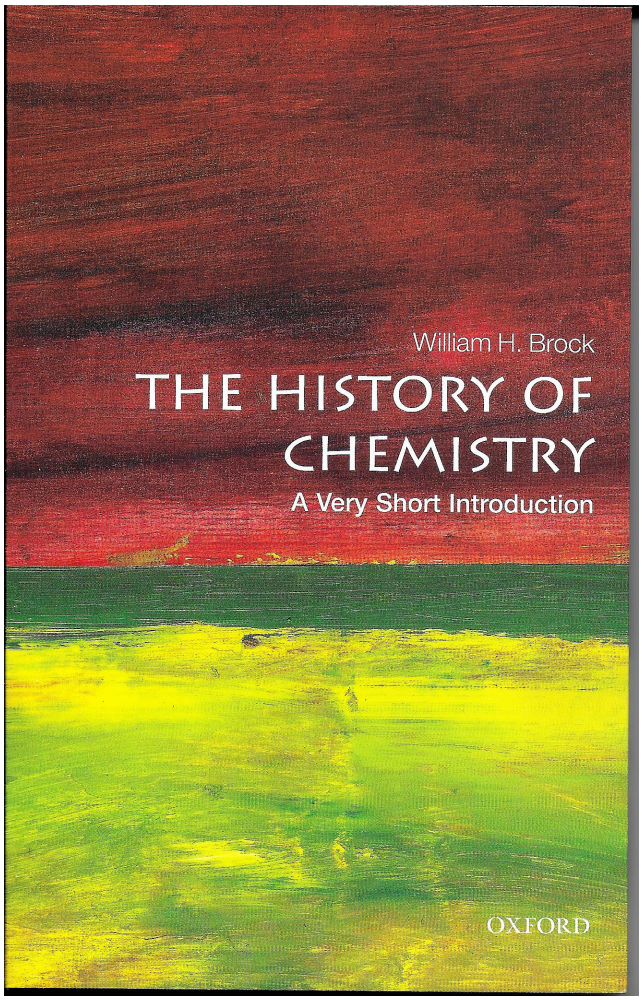

***Figure 1**. William Brock's history of chemistry entry in Oxford University Press's "A Very Short Introduction" series, bearing a cover typical of the series. Reproduced courtesy of OUP.*

Short Histories

Most authors in the series, myself included, have divided their word limit into six chapters of 5000 words apiece, allowing another 5000 words for overrun, preliminaries, bibliography and index. But some have opted for short chapters of 2,000 words. In opting for six chapters, I wondered whether any historian of chemistry had limited themselves in such a way before, apart from writing an encyclopedia entry—which OUP warned against. A literature search soon showed that there had been several volumes entitled *Short History of Chemistry*, beginning with Francis Preston Venable, a German-trained chemist at the University of North Carolina who published his book in 1894. Although only 183 pages in length, it seems most likely that he called it "short" in comparison with Hermann Kopp's 4-volume German history (1843-47) each volume of which was roughly 400 pages in length (12). Venable's book was based upon lectures he gave to chemistry undergraduates in the belief that history added to their understanding of modern chemistry. It was divided into six chapters, Genesis, Alchemy, Qualitative era (Paracelsus to phlogiston), Quantitative (Dalton and Berzelius), Structural Chemistry and Periodicity (one of Venable's specialties), and a final chapter on Specialization.

Ignoring William Tilden's "short history" of 1899 which only covered recent progress in the chemistry (13), the next chemist to compile a short English text was Thomas Percy Hilditch (1886-1965). This was frankly a pot-boiler written when he was a post-doctoral student working with William Ramsay at University College London in 1911 (14). It was designed for undergraduates to pass a University of London compulsory paper on the history of chemistry—an examination paper that formed part of the B.Sc. degree until the end of World War II. This explains the call for several reprints as late as 1922. Hilditch called his book "A Concise History" rather than a short history, presumably because he tabulated much of the information. It was certainly concise, but it was not short, running to 263 pages. It is not without merit since it still offers today's historian a wide view of the state of chemistry in the early 1900s, especially organic chemistry. Hilditch never returned to history. In 1911, he entered the soap industry of Joseph Crosfield in Warrington just when the firm was being absorbed into the alkali company of Brunner Mond. In 1925 he was appointed to a chair of industrial chemistry at the University of Liverpool from where he wrote many hefty books on the chemistry of natural fats.

Secondary school science teachers also needed information on the history of chemistry because chemistry was often taught from an historical perspective, especially when demonstrating and teaching about gases and combustion. Rose Stern (1869-1953), who had studied chemistry with Percy Frankland at the University of Birmingham (B.Sc. 1894), taught chemistry at a leading London girls' school, the North London Collegiate. She encouraged many of her pupils to take up chemical careers, as the Rayner-Canhams have noted (15). In retirement, in 1924, she published a short history for schoolgirls as well as other science teachers (Figure 2). Interestingly, she ended the story in 1900 because she thought more recent work on radioactivity and atomic structure was too difficult for young minds (16).

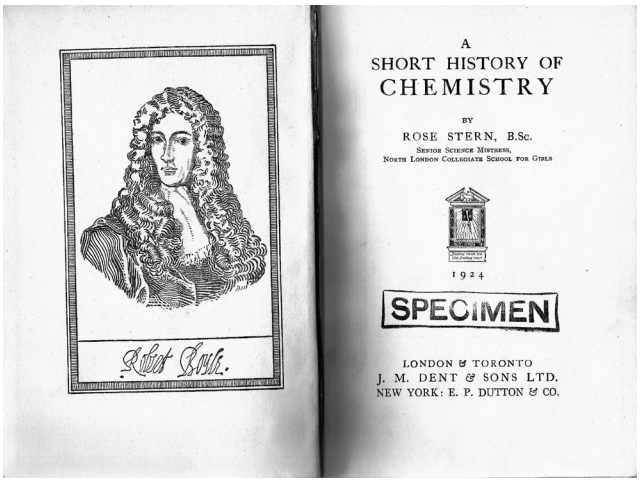

***Figure 2**. Rose Stern's title page and frontispiece, 1924. Reproduced under Fair Dealing exemption.*

Eric J. Holmyard (1891-1959) was another, more famous, schoolteacher at the important private school, Clifton College, Bristol, that has often been noted for producing alumni who took up scientific careers and who often became Fellows of the Royal Society (17). Holmyard, who taught both physics and chemistry from an historical viewpoint, was also a significant self-taught Arabist and one of the founders of the Society for the History of Alchemy and Early Chemistry in 1935 (18). His books *Chemistry to the Time of Dalton* (1925), *Great Chemists* (1929) and *The Makers of Chemistry* (1931), although not entitled "short," should also be included in the discussion (19). Meanwhile, Holmyard's physical chemistry contemporary, James Riddick Partington, whose work needs no introduction to the *Bulletin's* readers, produced his short history in 1937. In retrospect, it can be seen as the ground plan for the multi-volume history of chemistry that he planned to occupy his retirement and to be the English "Kopp" (20).

Short histories continued to be produced after World War II. Isaac Asimov was commissioned to write one (Figure 3) for the post-*Sputnik* American Science Study education series, that also included I. B. Cohen's magnificent *Birth of the New Physics* explaining Newtonian dynamics (21). Asimov was a professional biochemist in New York who wrote many popular science books. His short history was not a bad book, but its purpose was help High School youngsters learn chemistry through the medium of its history and not to offer fine analysis and detail. And finally, and most recently, we have the French work by Sacha Tomic, a pupil of Bernadette Bensaude-Vincent (herself the co-author of a previously mentioned history of chemistry and a work on the philosophy of chemistry) that very much reflects on the Janus-faced

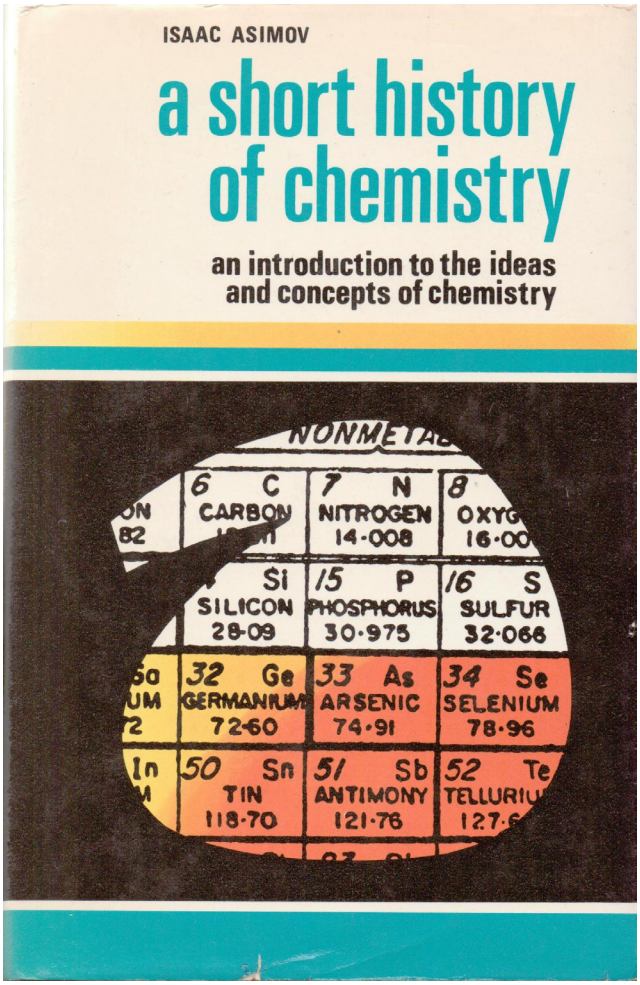

***Figure 3**. The first edition of Asimov's short history, 1965. Reproduced courtesy of Penguin Random House.*

nature of chemistry and the need for a greener industrial chemistry in the twenty-first century (22).

This literary and bibliographical investigation revealed to me that there were many historical models for writing short histories. Most had been written for school/college/university educational purposes and not for historians *per se* or the general reader. The aim of OUP's series was to attract readers who were not just academic historians of science, but an educated public that included chemists and anyone curious to know what chemists have done in the past and what its developmental landmarks were. Constrained to 35,000 words, what should be included? What could be left out? Industrial chemistry, that deserved its own short history, was an obvious candidate for just a fleeting mention. Otherwise, I decided to build a narrative around the theme that chemistry is the science of change, metamorphosis and transformation of matter, and how its historiography had altered since the 1990s.

How the Historiography has Changed since 1992

The result was, probably in many readers' eye, a fairly conventional narrative beginning with the changes wrought in historians' minds by archaeological chemistry and the modern instruments of analysis that have enriched our views of ancient technology. I was particularly intrigued that the still was probably evolved from the hearths originally used in cooking and early metallurgy. Alongside this, there was Marco Beretta's work on glass as an artisanal craft that began in Egypt and had a close connection with alchemy through the coloring of glass to make artificial jewelry. The glass theme coupled nicely with the recent work of Catherine Jackson and her argument that useful synthesis only began in Germany in the 1870s when chemists found the ability to blow their own specialized apparatus and to adopt new safety measures in laboratory design (23).

There had also been a completely new interpretation of alchemy produced by the researches of William R. Newman and Lawrence M. Principe that undermined the old debate as to whether alchemy evolved into chemistry or whether it had offered nothing to modern chemistry except raw data about acids, alkalis and salts, as well as useful bits of apparatus. We can now see chymistry (with a y) as a respectable artisanal occupation whose members were applied chemists and chemical engineers who applied their skills for powerful European patrons. Some, but not all, believed in the possibility of metallic transmutation, but this never lessened their employability. Alongside this we have to face Andrew Cunningham's argument that the world picture of early modern European scholars was totally different from that which followed in the eighteenth-century Enlightenment and the naming of "the scientist" in the 1830s (24). Their observations and experiments were conducted in a world in which macrocosm and microcosm, and the entailed linkages between man, nature and God, were literally a world apart from the world of Lavoisier and Dalton. There is a discontinuity in the history of the sciences that has to be confronted when writing about early-modern chemistry. Older histories often christened Robert Boyle as "the father of chemistry," but our understanding of Boyle has matured following his placement in the context of his contemporaries like George Starkey and Daniel Sennert, while Michael Hunter has explored his voluminous archive (25). The work of various scholars has clarified the reasons for Boyle's (and for that matter, Newton's) deep interest in alchemy, and thereby illuminated the details of his corpuscular, but non-mechanical philosophy, and its links with the ancient ideas of atomic *minima.*

For the eighteenth century, Jonathan Simon's work on the pharmaceutics tradition has highlighted the hitherto much neglected, but real, importance of the development of French chemistry via the extraction of salts from plants that led to the fundamental chemical theorem that acids + bases = salts (26). The theorem led to affinity tables and the evident tension between theories of matter that were physical in orientation (like Boyle's) and chemical by way of property-bearing principles (like Stahl's). Lavoisier, too, has to be seen anew, in terms that stress his reformation of chemical language and nomenclature and another crisis of tension between physics and chemistry evidenced in the work of Priestley. Hasok Chang in his *Is Water H_2O?* has also challenged historians by asking what was lost when phlogiston was abandoned (27). He notes that important chemical problems disappeared from view—problems that were only resolved many decades after phlogiston vanished. He highlights the character of metallicity that was explained by phlogiston, but only "explained" in the twentieth century by electrons. His intriguing idea of scientists and historians engaging in "complementary science"—that is, looking at past experiments that got nowhere, deserves the attention of chemists and historians of chemistry.

Structural chemistry has also received a new lease of life for historians. Debates over the significance of Liebig's potash bulbs have been crowned by work on glass and its significance for organic chemists in creating apparatus that helped in determining structure by degradation and synthesis at the end of the nineteenth century. Finally, there has been an astonishing growth in the philosophy of chemistry since 1990, and a new appreciation of how twentieth-century chemistry transformed the world through a combination of academic chemistry and chemical engineering, and new black-boxed instruments and computers that replaced painstaking wet and dry methods of chemical analysis—the starting point of this essay.

The Future

What then of the future of history of chemistry? Do book-length histories of chemistry, whether long or short, have a future? The recent appearance of a multi-volume history of chemistry in German, and the forthcoming multi-volume cultural history of chemistry, suggests the answer is undoubtedly affirmative (28). But I believe "short" accounts are the most promising way forward,

either as articles or as monographs. In fact, the genre of "short" monographs on specific topics in the history of chemistry had been established by the Scottish chemist Andrew N. Meldrum as far back as 1904, but was not followed up by later chemists (29). While the writing of biographical articles may seem more straightforward, journal articles present problems as contemporary chemistry becomes more and more bound up with its sister sciences, computing and engineering, and the history of science with social and cultural history. Probably the only way to tackle late twentieth- and twenty-first-century chemistry satisfactorily is through a collaboration between technically-trained chemists and historians of science who may (or may not) have studied chemistry in their early education.

Bearing in mind, and with tongue in cheek, that "collaboration" can also mean "cooperation with the enemy," we should recall and overcome William Jensen's exploration of "the problematic relation" between contemporary historians of science and the interests of professional chemists (30). In practice, my own recent experiences of collaborating with professional scientists, who are interested in the history of their science, has worked remarkably well (31). It has, however, revealed a minor issue involving the very different presentation styles expected by editors of scientific and humanities journals. Academic humanities periodicals always expect authors to cite the full titles of cited literature, where science journals only ever require the citation of the relevant journal's title (in a standardized abbreviated form such as suggested by CASSI), the volume number and the article's first page number; titles are ignored. Consequently, because the actual titles of twentieth-century and contemporary chemistry articles can be interminable (particularly if they form part of a series of investigations), the cumulative effect is the production of a very long paper. The length is further increased because the expectation—indeed, the requirement—of history of science editors and their referees is that there should be the fullest possible reference to the existing secondary literature relevant to the topic. A paper for an historical journal can thereby easily exceed the length tolerance of the periodical concerned. A compromise will need to be found—a formula already suggested by *Angewandte Chemie, Chemistry—A European Journal,* and *Substantia*—for articles on historical topics. Another solution is the one followed by Meldrum in the early twentieth century, namely short monographs that explore thematic topics, a facility now happily provided by the SpringerBriefs mentioned in Alan J. Rocke's essay in this issue (32)—though, curiously, such a collaboration between chemist historian and historian of chemistry has yet to appear in the series.

There is much to do. Such future collaborative ventures might exploit the many rich European and American archives that have been deposited by chemical practitioners, explore chemists' relations with the professional societies and publishers; create more histories of important teaching and research departments; highlight less well-known chemists such as Frederick Abel or Frank Dainton, who played significant roles in government. My files bulge with potential topics that, as an octogenarian, I am unlikely ever to have the chance to explore: accounts of chemists who spent parts of their careers in the colonies of various nations, particularly in India and Australia; explorations of chemical feuds, and of blind alleys (or alternative chemistries) such as the claims of the spectroscopist Cyril Baly that he had carried out photosynthesis *in vitro*, or of the not unimportant pre-electronic Barlow-Pope model of crystallization.

Conclusion

While there will continue to be ample scope for further interpretations of the progress of chemistry before 1900, there is an even greater need for interpretations of the history of chemistry since then. (See the essays in this volume by Stephen Weininger and by Peter Morris and Jeffrey Seeman for further thoughts about the history of recent chemistry (33).) The way forward, I suggest, is through journal or monographic collaboration between chemical historians (or professional chemists) and historians of chemistry. This is not a new idea and there are already some exemplary models. But it is the only way forward given the complexity of contemporary chemistry and that the majority of historians of science have received no training or research experience in chemistry. The history of chemistry will always be an important and valuable adjunct to the study of chemistry. As Liebig wrote to his former pupil and sometime agricultural antagonist, Joseph Henry Gilbert, in 1870 when he declined an invitation to deliver that year's Chemical Society Faraday Lecture, he had been studying the history of chemistry and recalling how he regretted giving up his friendship with Berzelius over thirty years before (34):

> I have learnt that all our theories are not Truth itself, but resting places or stages on the way to the conquest of Truth, and that we must be contented to have obtained for the strivers after Truth such a resting place which, if it is on a mountain, permits us to view the provinces already won and those still to be conquered.

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31. W. H. Brock and D. E. Lewis, "A Different Kind of Nierenstein Reaction. The Chemical Society's Mistreatment of Maximilian Nierenstein," *Ann. Sci.* **2021,** *78*, 221-245. W. H. Brock and M. Jewess, "Unwise Relationships and an Unsound Valence Theory: The Chemical Career of Robert Fergus Hunter (1904-1963)," *Ambix*, **2021**, *68*(4), 407-430, doi: 10.1080/00026980.2021.1984623. Another good example of such collaboration is shown in J. Seeman and G. Restrepo, "The Mutation of the 'Nobel Prize in Chemistry' into the 'Nobel Prize in Chemistry or Life Sciences': Several Decades of Transparent and Opaque Evidence of Change," *Angew. Chem. Int. Ed.*, **2020**, *59*, 2942-2961.
32. A. J. Rocke, "Reflections on the Last and the Next Hundred Years," *Bull. Hist. Chem.*, **2022**, *47*(1), 171-175.
33. S. J. Weininger, "'The Poor Sister:' Coming to Grips with Recent and Contemporary Chemistry," *Bull. Hist. Chem.*, **2022**, *47*(1), 119-123. P. J. T. Morris and J. I. Seeman, "The Importance of Plurality and Mutual Respect in the Practice of the History of Chemistry," *ibid*., 124-137.
34. Liebig to Gilbert, Munich, Dec. 25, 1870, Rothamsted archives, GIL13, Rothamsted Research Library, Hertfordshire, UK. The invitation had come, in fact, from A. W. Williamson, but although Liebig longed to see England again, "no old man is suitable for the Faraday Lecture."

About the Author

William H. Brock retired from teaching the History of Science and Victorian Studies at UK's University of Leicester in 1998 and is currently an Honorary Research Associate at his chemistry undergraduate alma mater, University College London. In retirement he has published biographical studies of Justus von Liebig (1997), Sir William Crookes (2008), and a book of chemical stories, *The Case of the Poisonous Socks* (2011). He received the Dexter Award in 1995.