

REFLECTIONS ON THE LAST AND THE NEXT HUNDRED YEARS

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Abstract

The ACS History Division has fostered a hundred years of fascinating work in the history of chemistry, presented orally and in writing. The following essay offers a series of suggestions of what the future might hold. There is still much to be discovered, celebrated, reinterpreted, and pondered.

The Division of History of Chemistry has come a long way since Charles Albert Browne and Edgar Fahs Smith took a break from attending ACS sessions, and spent a relaxing hour chatting about their mutual historical interests under a stand of trees on Evanston's Lake Michigan shore in September 1920 (1). The two men took steps to begin to organize a new ACS division during the following two semiannual ACS meetings. At the spring 1921 meeting, Browne and Smith sought to convene "all cranks who were interested" in helping to launch such a section; in the fall, they summoned fellow "kindred spirits" together "to discuss their hobbies" (2). The waggish tone implying that the history of chemistry was merely a harmless hobbyhorse of cranks seems a little surprising, considering that Browne and Smith were both educated partly in Germany, which had a long and continuing tradition of sophisticated historical scholarship in history of science, and also considering that both men proved to be thoroughly able historians. However, the tone fit with the early twentieth-century American pattern of purely avocational interest by professionals in the history of their discipline (3). By a generation later the

discipline of history of science in the United States had dramatically matured, with the rise of graduate programs and university departments dedicated to the subject. By the 1970s, the authors of a history of the ACS discussed the resulting competition in the History Division between "historians of chemistry" who had been formally trained in the historical discipline, and "chemist-historians" who had come to the subject from chemistry itself. Each of these communities, Skolnik and Reese tactfully and correctly opined, "have crucial roles to play" (4).

The nearly half-century since Skolnik and Reese's assessment has seen further changes, and although I will shortly suggest many compelling reasons for celebration and optimism, it must be said that some recent developments have been disappointing. When I began graduate study more than fifty years ago, there were two highly respected historians of chemistry in the Department of History of Science at the University of Wisconsin, Aaron Ihde and Robert Siegfried. Today there are no historians of chemistry in Madison, and even the department itself no longer exists, the historians of science having been absorbed into Wisconsin's Department of History. This is an example of loss to our field that is paralleled in some other American universities, including my own. Advanced study in the history of the physical sciences has been partly coopted in recent years by the history of bio-medically related fields, and partly displaced by a growing emphasis on the history of the social and human sciences (which is not to suggest that those fields

are unworthy of study). Making matters worse is the state of the Ph.D. job market. When I began graduate study, openings were still reasonably plentiful, but by the time I was looking for a tenure-track position the market was already in deep recession, and it has not improved since that time. Even more personally troubling, our field in recent years has lost some of its most eminent members, distinguished scholars and beloved colleagues such as Jim Bohning, George Kauffman, Stan Tarbell, Owen Hannaway, Colin Russell, Larry Holmes, Mel Usselman, David Knight, and Maurice Crosland.

But there is also an abundance of good news. Many younger scholars have successfully braved the headwinds; they are finding positions and are steadily contributing fine new scholarship. The annual production of monographs and scholarly articles in our field continues to increase, as does the number of specialist journals, book series, societies, and conferences. The *Bulletin for the History of Chemistry* and *Ambix* continue to publish papers of the highest quality; indeed, in 2013 *Ambix* successfully transitioned from a triannual to a quarterly journal, with a ca. 33% increase of content and no diminution of quality. *Angewandte Chemie International Edition* continues regularly to publish fine historical papers. Two independent journals for philosophy of chemistry were founded during the 1990s, *Hyle* and *Foundations of Chemistry*, and more recently the history of chemistry celebrated the creation of a new peer-reviewed open access journal, *Substantia*. The “Synthesis” book series of the University of Chicago Press has to date published 19 books on the history of chemistry since its inception in 2010; moreover, there are now two different book series from a single publisher, SpringerBriefs in the History of Chemistry, and Springer’s new series entitled “Perspectives in the History of Chemistry.” Due to appear next year is Bloomsbury’s six-volume multi-author *Cultural History of Chemistry*, charting the development of the science from antiquity to the present—the first multivolume history of chemistry since J. R. Partington’s masterwork concluded more than 50 years ago. For the past 30 years the historical group within the European Chemical Society has been organizing stimulating biennial international conferences in the history of chemistry. The Chemical Heritage Foundation in Philadelphia, recently renamed Science History Institute but still devoted principally to the history of chemistry, has grown apace over its nearly 40-year history, and constitutes a scholarly mecca for our field. Another outstanding international focal point for the pursuit of history of chemistry, as well as for other specialties in the history of science, is the Max Planck Institute for the History of Science, founded in Berlin in

1994. These are just some of the markers that indicate the continuing health of our field.

The range and importance of historical studies of the chemical sciences derive directly from the range and importance of chemistry itself. In recent years chemists have sometimes expressed dismay that the very word “chemistry” is used less frequently today to label chemical specialties, departments, and programs, in preference to such words as “molecular biology,” “nanoscience and nanotechnology,” “macromolecular science,” “molecular sciences and engineering,” “materials science”—even “molecular biophysics,” which leapfrogs verbally right over chemistry, which is at the heart of the molecular, biological, and physical aspects of that field. But there is a sense in which this trend must be more expected and celebrated than lamented, for of all the scientific disciplines it is chemistry, the “central science,” that has the most uniquely fuzzy and permeable borders. As a consequence, interdisciplinary efforts that cross those borders, as reflected in the phrases just cited, have a correspondingly wide range of labels from which to choose.

And it is here that we find even more good news. Since chemistry sometimes functions in this way partly as a disciplinary tool-box for neighboring fields, we historians of chemistry have available to us a correspondingly large range of historical topics and approaches from which to choose, a degree of flexibility that is enjoyed by few other branches of history of science. In addition, chemistry is today, and has been throughout history, more closely tied than any other branch of science to material productivity and to industrial, artisanal, and medical fields. This circumstance also opens the historian’s door to innumerable kinds of studies that explore the relevance of chemistry to social, cultural, and technological history.

What this means, in turn, is that there is scope for a wide range of new historical studies with a chemical theme. We have barely begun to explore many areas. Probably the most wide-open field of all is the hugely significant and hitherto little explored history of recent chemistry. Such investigations can be done with many different approaches and foci, but relatively few scholars have the technical prerequisites and have braved the intrinsic difficulties in carrying out these kinds of studies. One obvious approach here is to explore in a detailed and technically proficient manner the rise of landmark scientific contributions, as Jeffrey Seeman does with such mastery (5); another type is the skillful interweaving of sociological and institutional history with the actual chemistry, as is admirably exhibited in recent papers by Stephen Weininger (6). We need many

more studies of these types, as well as investigations of the cultural, social, technological, and political dimensions of our science in the twentieth (and even the early twenty-first) century. It would be gratifying, and an opportunity seized, if we could see more work from the community of chemist-historians appear in journals that are usually patronized by historians of chemistry, as well as more work by historians of chemistry in chemical journals. Perhaps another means of bridging and unifying these two communities would be to see more published research by co-authored collaborations across that divide, a pattern that to date has been only occasionally seen.

At the other end of the chronological spectrum, we can surely say that the revolution in our understanding of the history of alchemy that has taken place over the last generation only demonstrates how much there is still to learn about early chemistry, chymistry, alchemy, and related artisanal pursuits (7). We have only begun to understand the full scope of chemically-related activity in antiquity and the middle ages, partly because of the linguistic skills that are needed to carry out such studies—not only Latin and Greek, but also in many cases Arabic, Syriac, or even, for the most distant antiquity, cuneiform Akkadian. Regarding the Latinate and vernacular medieval and early modern worlds, Pamela Smith's multidisciplinary "Making and Knowing" project at Columbia University crosses boundaries between artisanal crafts, chymistry, and early modern epistemologies; similar in some ways is Ursula Klein's program to explore the "ontology of materials" and early technoscience in seventeenth- and eighteenth-century Europe (8). Smith and Klein exemplify another wide-open approach to the history of chemistry, namely pursuing studies that integrate the history of chemistry with philosophy of science. The leading exemplar of this kind of project, mostly applied to a later chronological period, is Hasok Chang's innovative program of "complementary science," which can be carried further in innumerable directions (9).

One can easily construct an arbitrarily extendable list of further relatively open fields for new studies in the history of chemistry. Purely for illustration, here are a few examples: the history of women and underrepresented minorities in chemically-related endeavors; chemistry in "the periphery"—that is, anywhere other than the major European countries from the early modern period on, such as the United States before 1900, south Asia, east Asia, Africa, South America, the Middle East, and European nations whose people speak "minor" languages; chemically related subjects in domestic life and other mostly hidden contexts, such as food production

and preparation; the development of laboratories and laboratory apparatus and instruments; the development of chemistry as a discipline; chemistry and war through the ages; mutual interactions with politics and political economy in history; and chemistry and culture, e.g. in relation to the history of literature, music, and fine arts (10). I do not mean to suggest any of that these areas are still devoid, or even close to devoid, of good contributions; fine scholars have produced much excellent work in all eight of these categories. I only mean to indicate that in each case there is still plenty of room for countless additional interesting and important historical investigations. History of chemistry, like the history of science more broadly, is still a relatively young field. For this reason it is much more open, compared to fields of history that have been intensively cultivated (or, using another metaphor, mined) for generations, thus requiring doctoral candidates to be satisfied by ever narrower research projects. That is not our problem.

The areas I know best are naturally those in which I have been active over many years: the development of chemistry in Great Britain, France, and especially Germany during the course of the nineteenth century, with particular attention to the rise and development of the atomic theory and of the field of organic chemistry. By contrast to my illustrative list of eight notably open fields in our discipline mentioned in the previous paragraph, the rise of English, French, and German chemical atomic theory and organic chemistry are subjects that have always been considered to sit at the very heart of the history of chemistry, and so there was already a rich historiography in these subjects before I ever began work as a historian. However, despite this more intensive cultivation by historians—admirable work that extends back well over a century and a half—even here there are innumerable historical questions still to be more fully answered, and countless complex historical puzzles that have not satisfactorily been resolved.

An example is the extraordinary career of Jacob Berzelius, which has often been studied, but rarely examined in the sort of definitive detail that we really would like to see (11). Turning from Sweden to France, I am struck by the extraordinary richness of manuscript sources that have only begun to be fruitfully mined; some collections have scarcely been touched. Despite Maurice Crosland's masterly biography of Gay-Lussac (12), there is much that we still want to know about this extraordinary scientist. Regarding Jean-Baptiste Dumas, who was so powerful a player in French (and pan-European) chemistry that younger contemporaries sometimes jocularly

referred to him as “l’être suprême,” we have a variety of important studies, but nothing like what we really need in order to understand his career in all its multifarious detail (13). A partial list of important and interesting figures in the history of nineteenth-century Francophone chemistry whom I consider to be still radically insufficiently studied, especially by Anglophone historians, I would name (alphabetically ordered): Antoine Balard, Marcellin Berthelot, Auguste Cahours, Michel-Eugène Chevreul, Henri Sainte-Claire Deville, Edmond Frémy, Charles Friedel, Charles Gerhardt, Auguste Laurent, Charles Marignac, Alfred Naquet, Jules Pelouze, Jean-François Persoz, Victor Regnault, Jean Servais Stas, and Louis-Jacques Thenard.

This enumeration suggests the richness of what is yet to be explored in a subset of my own already relatively well-worked specialty field, the history of nineteenth-century chemistry; and it should be noted that the list was predicated on just two search terms: “French or Francophone” and “biographical approaches.” A similar abundance of future meaty research topics in the history of nineteenth-century European chemistry can be seen when we turn to other countries, and to other approaches besides biography: internal scientific, cultural, social or sociological, political, institutional, topical, industrial, and so on. Opportunities abound for us and all of our younger and future colleagues of the field.

But why, exactly, do we bother? What is it that draws us to investigate the history of chemistry? I want to suggest five (nonexclusive and often overlapping) reasons.

Certainly one important goal is professional acculturation, education, and elevated status. Chemistry is obviously an occupation for which one trains, but it is also more than that: it is a true profession that demands, and benefits from, proper professional formation. What distinguishes a profession from “a job” is not just deep expertise, but also the associations, the culture, the ethics, the esthetics, the social functions ... *and the history* ... of the relevant field. Just as attorneys, physicians, clerics, musicians, and visual artists feel themselves to be members of socially significant callings extending back through the centuries, so do (or so should) scientists. In short, the history of chemistry is (or should be) an essential element of what it means to become, and to be, a chemist.

Second, our endeavors offer the means toward a new perspective not just on science of the past, but on our contemporary science, as well. One category of such historical projects are those that provide novel instruction

and practical ways to look at the science of today. Hasok Chang has argued that history can play a heuristic role, in regaining lost work, lost methods, and lost perspectives that have present utility. Another category of the multivalent relationship between the old and the new is laboratory replications of landmark historical chemical contributions, which can provide new insights into historical events (14). There is much to learn by following the difficult paths that our forebears have successfully struck through the scientific thickets.

Third, there is inspiration and collective memory to consider. The history of chemistry is a multifarious tale of extraordinary achievements that richly deserve memorialization; it represents our professional heritage, and merits celebration in many ways and forms. This is the formative thought behind two ACS programs, the National Historic Chemical Landmarks and the Citations for Chemical Breakthroughs.

Fourth, a closely related point: history of chemistry illuminates the essential humanity of science—the creativity, imagination, and artistry, along with serendipity, that so often is exhibited by the best science (along with the 99% perspiration about which Thomas Edison rightly spoke). This can be a helpful corrective to the unfortunate image often unintentionally portrayed in textbooks, of colorless automatons mindlessly following a tedious algorithmic scientific method, isolated from their social milieu. The science of chemistry has been created by centuries of efforts by fascinating and (mostly) admirable individuals working in formative historical contexts. Exploration and appropriate portrayal of those individuals and those contexts is vital both for effective science pedagogy, and for the promotion of public appreciation of contemporary chemistry.

Finally, let us never forget the simple pleasures of pursuing and reading history, of whatever kind; done right, it is wonderful fun. As L. P. Hartley famously put it, “The past is a foreign country; they do things differently there;” and in the same way that it is fascinating to visit actual foreign countries, so also it is a special treat vicariously to breathe the air, to view the scenes of daily life, and to witness the labors, disappointments, and triumphs of our predecessors in this endlessly intriguing endeavor we call chemistry.

For all of these reasons, and for the indefinite future, I look forward to the fascinating history that will be revealed in each new issue of the *Bulletin for the History of Chemistry*—as well as in all the other journals that publish papers in our field.

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References and Notes

1. C. A. Browne, "The Past and Future of the History of Chemistry Division," *J. Chem. Educ.*, **1937**, *14*, 503-516 on 504. See also J. J. Bohning, "Looking Back: Eighty-five Years of Chemists and their History," *Bull. Hist. Chem.*, **2007**, *32*(2), 66-81.
2. C. A. Browne and M. E. Weeks, *A History of the American Chemical Society: Seventy-Five Eventful Years*, ACS, Washington, DC, 1952, p 288.
3. R. Laudan, "Histories of the Sciences, and Their Uses: A Review to 1913," *Hist. Sci.* **1993**, *31*, 1-34.
4. H. Skolnik and K. M. Reese, *A Century of Chemistry*, ACS, Washington, DC, 1976, pp 308-309. I write the following thoughts as an academically trained historian; chemist-historians would surely have different and equally legitimate perspectives on these matters.
5. E.g., J. I. Seeman, "The Woodward-Doering/Rabe Kindler Total Synthesis of Quinine: Setting the Record Straight," *Angew. Chem. Int. Ed.*, **2007**, *46*, 1378-1413; J. I. Seeman, "Woodward-Hoffmann's *Stereochemistry of Electrocyclic Reactions*: From Day 1 to the JACS Receipt Date," *J. Org. Chem.*, **2015**, *23*, 11632-11671. Peter Morris and Seeman discuss history of recent chemistry in their essay in this issue: "The Importance of Plurality and Mutual Respect in the Practice of the History of Chemistry," *Bull. Hist. Chem.*, **2022**, *47*(1), 124-137.
6. E.g., L. Gortler and S. J. Weininger, "Private Philanthropy and Basic Research in Mid-Twentieth Century America: The Hickrill Chemical Research Foundation," *Ambix*, **2017**, *64*, 66-94; S. J. Weininger, "Delayed Reaction: The Tardy Embrace of Physical Organic Chemistry by the German Chemical Community," *Ambix*, **2018**, *65*, 52-75. Weininger's essay in this issue is about the history of recent chemistry: "'The Poor Sister': Coming to Grips with Recent and Contemporary Chemistry," *Bull. Hist. Chem.*, **2022**, *47*(1), 119-123.
7. I refer to the works of such scholars as Allen Debus, William Eamon, Bruce Moran, William Newman, Tara Nummedal, Lawrence Principe, and Pamela Smith.
8. E.g., P. H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution*, University of Chicago Press, 2004; U. Klein, *Technoscience in History*, MIT Press, 2020.
9. H. Chang, *Is Water H₂O? Evidence, Realism, and Pluralism*, Springer, Dordrecht, 2012.
10. Regarding the interrelations between chemistry and wider culture, or the culture of chemistry itself: in my close involvement with the preparation of the *Cultural History of Chemistry* series mentioned above I was continually struck by how problematical it proved to be to ask chapter authors to remain closely tied to the first word of the series title.
11. There are exceptions to this generalization. For Berzelius's early research on stoichiometry see Evan Melhado, *Jacob Berzelius: The Emergence of His Chemical System*, University of Wisconsin Press, 1981; for his atomic theory, Anders Lundgren, *Berzelius och den kemiska atomteorin*, Almqvist and Wiksell, Stockholm, 1979. Even H. G. Söderbaum's foundational 3-volume biography, *Jac. Berzelius levnadsteckning*, Almqvist and Wiksell, Stockholm, 1929-31, has limitations, only partly for being almost a century old and available only in Swedish. See also Melhado and Tore Frängsmyr, Eds., *Enlightenment Science in the Romantic Era: The Chemistry of Berzelius and its Cultural Setting*, Cambridge University Press, 1992, and Carl Gustaf Bernhard's inimitable *Through France with Berzelius: Live Scholars and Dead Volcanoes*, Pergamon, Oxford, 1985.
12. M. Crosland, *Gay-Lussac: Scientist and Bourgeois*, Cambridge University Press, 1978.
13. The most recent monograph on Dumas—Jimmy Druhlon, *Jean-Baptiste Dumas (1800-1884): La vie d'un chimiste dans les allées de la science et du pouvoir*, Hermann, Paris, 2011—is invaluable for biographical aspects, but not particularly for the history of chemistry.
14. See for example the historical replication pertaining to the first Seeman paper cited in note 5 that was provided by A. C. Smith and R. M. Williamson, "Rabe in Peace: Confirmation of the Rabe-Kindler Conversion of *d*-Quinotoxine into Quinine," *Angew. Chem. Int. Ed.*, **2008**, *47*, 1736-1740. Lawrence Principe and William Newman have published many fine historical investigations using laboratory replications. For another example, and a guide to the literature using this technique, see also M. Usselman, T. Reinhart, K. Foulser and A. Rocke, "Restaging Liebig: A Study in the Replication of Experiments," *Ann. Sci.*, **2005**, *62*, 1-55.

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