LOOKING AHEAD: KEEPING HISTORY OF CHEMISTRY RELEVANT TO THE FUTURE OF CHEMISTRY (1)

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Introduction

Where is HIST headed? What lies in its future? These were some of the questions I was invited to contemplate as a participant in the symposium, "HIST at 85: Looking Back and Looking Ahead." Rather than embrace such a notoriously difficult task as prediction, I turned to a more tractable and in many ways more interesting question: the relationship of a past-oriented organization like HIST to the future. For clearly HIST *is* interested in the future. Part of the concern of HIST members with the history of chemistry is a sense of stewardship of the legacy of chemistry to pass on to the present and future of the discipline. Furthermore, part of the mission of HIST is to help the larger American Chemical Society (ACS) achieve its vision and missions (2), and those are certainly future oriented (3).

How, then, do HIST, its members, and similar organizations focused on the past engage the future? This paper will touch on three answers: using new media to disseminate historical content, providing historical perspective on current issues and events of the recent past, and interpreting the past in educational materials for future chemists.

New Media

The internet has put powerful publishing and broadcasting tools into the hands of the many. Websites are no longer new media, but they will continue to be important means of distributing information of all sorts. In recent years, the HIST website (2) has dramatically increased its content. In addition to serving as a portal for divisional information, such as the newsletter, programs for national meetings, and Executive Committee records, it is a repository of records relating to the division's journal (this journal), awards, and other business. The website includes indices of this journal and biographical sketches of Dexter and Edelstein award winners. Electronic access to back issues of this journal is a likely development before too much longer. Electronic communication for and among the HIST membership continues to be a topic of discussion among the executive committee, and the division website will continue to serve as an important vehicle for that communication.

Looking at the internet beyond HIST, one can see that some large electronic databases now available include raw materials of history of chemistry. The emergence of digital libraries of archival materials is a welcome development. Sites such as Panopticon Lavoisier (4) at the Institute and Museum of the History of Science in Florence and the Ava Helen and Linus Pauling Papers at Oregon State University (5) have made images of notebooks, letters, and the like available on line. Among the images one can find at Panopticon Lavoisier is a 1774 letter (Fig. 1) in which Carl Scheele thanks Antoine Lavoisier for a book and gives a recipe for an air modern readers would know as oxygen. A 1952 telegram from the American State Department to Linus Pauling (Fig. 2) regarding a passport application

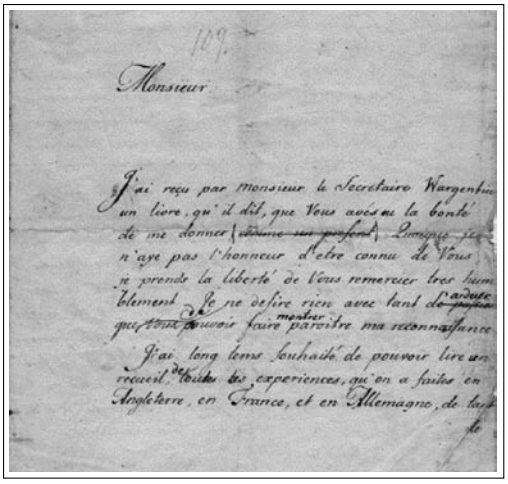

Figure 1. *1774 letter from Carl Wilhelm Scheele to Antoine Lavoisier, from Panopticon Lavoisier. Carl Wilhelm Scheele's archives, F1:1, Center for History of Science, Royal Swedish Academy of Sciences. Copyright © Royal Swedish Academy of Sciences*

is among the documents displayed at the Pauling papers site in an exhibition about the competition to find the structure of DNA; it illustrates the role of loyalty oaths in US anti-communist efforts. These and other digital library projects allow scholars and students to examine unique materials like these without having to travel.

More broadly based digital libraries such as Gallica (6) at the French National Library, Google Books (7), and several patent libraries already contain much of interest to historians of chemistry and history-minded chemists, and that content will continue to expand. In addition to what one might expect to find in Gallica, such as a long run of *Comptes rendus* and books by French chemists, there is also relevant material in English, including a long run of the *Philosophical Transactions of the Royal Society* (London). Thanks to its partnership with several of the world's premier research libraries, Google Books contains many older works of chemistry and history of chemistry. Both of these libraries contain page images of complete books and journals, mainly from the early 20th century and earlier. Coverage at present is hit and miss. For example, at the time of writing, John Dalton's *A New System of Chemical Philosophy* (1808) was not available at Google Books but Humphry Davy's *Elements of Chemical Philosophy* (1812) was. Google Books aims eventually to produce a comprehensive resource.

Patent images have been available on the Internet for some time from US and European patent office sites (8, 9). These databases have extensive search utilities for patents issued after 1976. Users of these databases can access images of patents issued before then—but only if they know the patent number from some other source. Chemists have long had another source, *Chemical Abstracts*, at least for chemical patents issued after 1907. Google's database of US patents (10) can be searched in full text, at least to the extent that the scanned patents have been properly translated into text by optical character recognition.

New digital media include blogs, wikis, podcasts, and video. A blog (from the phrase "web log") is a website containing serial entries, often on a particular theme or subject. A wiki is a website that allows many users to edit its content and sometimes its form. A podcast is a digital file or series of such files, usually audio or video, distributed over the Internet for playback on a personal computer or portable media player (such as an iPod). Video is not a new term, but the ease with which digital video can now be created and distributed on the Internet makes it in many ways a new medium.

There is not much history of chemistry content currently available in these forms, but there is some. The Chemical Heritage Foundation (CHF) supports a weekly podcast called Science and Society (11). The series is not devoted exclusively to chemical issues—let alone history of chemistry—but there is certainly a lot of chemistry in the topics the series uses to define itself, namely "medical breakthroughs, energy and the environment, space exploration, nanotechnology, and K-12 science educa-

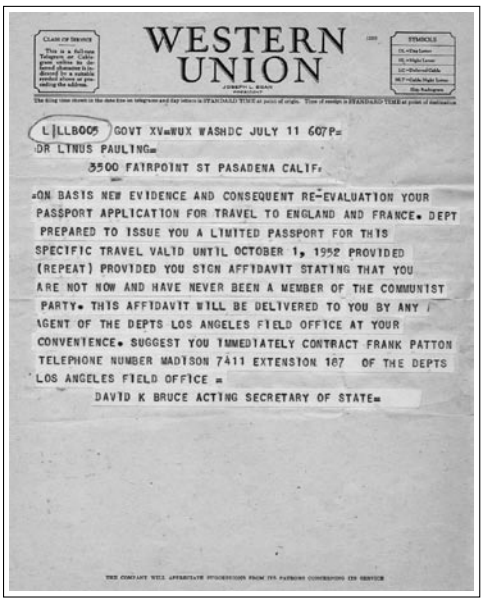
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Figure 2. *1952 telegram from the US State Department to Linus Pauling, from the Ava Helen and Linus Pauling Papers, Special Collections, Oregon State University.*

tion." The podcast has featured two presidents of ACS (Catherine Hunt in February 2007 and William Carroll in October 2006) and several guests from CHF.

The best known example of a wiki is Wikipedia (12), the web-based encyclopedia written and edited by volunteer contributors from around the world. There are many Wikipedia articles on scientific topics, and some of these include historical material. Evaluating the reliability of resources is a persistent problem for users of all sorts of Internet media, and Wikipedia has been a prominent lightning rod for this sort of criticism. The very democratization of the means of production and distribution of media that excites many scholars and educators about the Internet means that these media are highly uneven in quality. (Wikipedia's slogan "the free encyclopedia that anyone can edit" epitomizes both the promise and the problem.) One wiki that is both a reliable Internet site and a guide to reliable sources in chemistry is the chemical information wiki at Indiana University, prepared largely by chemistry librarian and chemical information specialist Gary Wiggins (13). Knowledgeable guides like Wiggins and his colleagues provide valuable direction in the forest of chemistry resources (Internet and otherwise), and their wiki includes some sources on chemical history.

Although there is currently precious little history of chemistry in blogs, wikis, podcasts, and video, it would be foolish to extrapolate that paucity into the future. After all, the few **websites** that had history of chemistry content ten years ago were not a reliable indicator of the sites available today.

Engaging the Present: Perspectives on Current and Recent Events

One straightforward prediction about the future of history of chemistry is that historians will have new stories to tell as the present turns into the past. The 2007 and 2006 recipients of the Edelstein award for outstanding achievement in the history of chemistry, Anthony Travis and Peter Morris respectively, have both concentrated on chemistry and chemical industry of the 20th century, which has itself only recently receded into the past.

Stories of the recent past can capture the attention of chemists of the present. The current generation of chemists can identify with stories of their teachers, mentors, and older colleagues, even if they are not more generally interested in the history of their field. A recent example of chemical history that made a big splash in the contemporary chemical community is Jeffrey I. Seeman's article on the first formal synthesis of quinine (14). Seeman's first public venue for this story was rather modest, a presentation in the HIST program at the 232nd National Meeting of ACS in San Francisco in 2006 (15). Meanwhile, his paper was working its way through the peer review process at a leading journal devoted to current chemical research, *Angewandte Chemie*; that paper was published early in 2007. Shortly thereafter, *Chemical and Engineering News* picked up the story, thereby reaching a still larger audience through a news article (16) and an editorial (17). In fact, *Chemical and Engineering News* had previously devoted a fair amount of ink to quinine synthesis, as well as to other topics of recent chemical history. Both Seeman and Rudy Baum, editor-in-chief of *Chemical and Engineering News,* addressed the relationship of history of chemistry to the present at the symposium, "HIST at 85: Looking Back and Looking Ahead" (18, 19).

HIST programming at ACS national meetings has often included symposia that focused on the recent past or that treated a subject over time up to the present. Recent examples include a symposium Seeman organized with the eminent analytical chemist Daniel Armstrong for the 226th National Meeting in New York (Fall 2003) on 100 years of chromatography. The primary sponsor of that event was not HIST but the Division of Analytical Chemistry. The anniversary was the jumping off point for a series of talks that included very recent developments. At the Spring 2005 meeting (229th National Meeting in San Diego), Carmen Giunta organized a symposium on the rise and fall of chlorofluorocarbons, which told the story of those compounds from their invention as safe refrigerants to their ban as threats to the global ozone layer and their subsequent replacement. That symposium included accounts by prominent participants as well as recent studies on replacement compounds.

Mary Virginia Orna is responsible for the most recent examples. "Going with the Flow: Water Sustainability Past, Present, Future" fit into one of the multidisciplinary themes of the 233rd National Meeting (Spring 2007, Chicago), namely sustainability. It was the third of four symposia Orna organized around areas of current or recent applied chemical research. All were intended to further aims articulated by ACS presidents Ann Nalley and Catherine Hunt when they first took the office of President-Elect, and all were designated Presidential Events at their respective meetings. The previous two were on "Health Materials and Techniques" (232nd National Meeting, San Francisco, Fall 2006) and "Phar-

maceutical Research and Development" (231st National Meeting, Atlanta, Spring 2006). The subtitles for both 2006 symposia, "Investment in Basic Research Leading to Benefits for Society," were designed to complement Nalley's emphasis on stories about chemistry's benefits to society. The remaining symposium in the series, which will celebrate 100 years of Chemical Abstracts, is set for Boston in fall 2007 (234th National Meeting).

CHF's Center for Contemporary History and Policy is another example of an organization devoted to the history of chemistry engaging in recent and current issues. Its areas of major initiative are biotechnology, electronic materials, environment and risk, innovation, and pharmaceutical policy and politics.

In addition to being current, these areas are all highly interdisciplinary. Interdisciplinarity is an important current aspect of the practice of chemistry, one that has attracted highly visible notice within ACS. Attention to interdisciplinarity appears to reflect a growing awareness that nature does not recognize disciplinary boundaries. Different disciplines bring different approaches, tools, and assumptions to problems. Conventional wisdom holds that multiple perspectives can be combined to generate more robust understanding.

Chemistry has long had porous boundaries with several other scientific disciplines, so historians of chemistry are used to dealing with scientific interdisciplinarity. At the moment, the boundary with biology attracts the most attention, raising questions such as whether one has to be a chemist to win the Nobel Prize in chemistry and what is a chemist anyway? For example, the 2006 laureate in chemistry, Roger D. Kornberg, is Professor of Medicine at Stanford University Medical School's department of Structural Biology. He was awarded the prize "for his studies of the molecular basis of eukaryotic transcription" (20). Historical perspective can shed light on what makes the current chemistry-biology boundary unique and what about it resembles other interesting boundaries in chemistry's past. (Recall, for instance, that nearly 100 years ago, the winner of the Nobel Prize in Chemistry was someone who certainly did not consider himself a chemist, namely Ernest Rutherford.) Historical case studies can shed light on interdisciplinary interactions, including successful syntheses and instances of interdisciplinary ignorance and disciplinary blinders. Such studies can cast light on interdisciplinarity, a topic of current interest, without necessarily drawing upon current or recent cases. Historical approaches to science can be valuable in understanding interactions between established disciplines as well as the emergence of new disciplines. Both phenomena are of current interest, but neither is an entirely new phenomenon.

Educational Materials

History of chemistry has a role in educating future chemists and citizens. The National Science Education Standards promulgated in 1996 include standards on the history and nature of science. In 1997 ACS published a reader and resource manual for high school teachers called *Chemistry in the National Science Education Standards*. Mary Virginia Orna wrote the chapter on the history and nature of science standards (21). A new edition is in preparation, and the corresponding chapter is being written by Seth Rasmussen, Carmen Giunta, and Misty Tomchuk (22).

The standards on the history and nature of science include understanding science as a human endeavor. This is an area in which classroom materials produced by CHF excel. From *Chemical Achievers* (23) to "Her Lab in Your Life" about women in chemistry (24) to "The life and science of Percy Lavon Julian" (25), CHF has put well researched history of chemistry and inspirational characters and stories into resources and activities that teachers can use. In addition to materials specifically designed for the classroom, websites that include photos and biographical sketches of chemists further this educational aim by providing easy access to supplementary information for teachers and students.

Making historical materials available for chemistry education will continue to be a way that chemists and educators interested in their history attempt to affect the future of chemistry. Translating history into educational materials seems to be a perennial activity, done in different ways and with different media in each generation. It is also an area in which individual teachers or small groups produce materials for their own classrooms and possibly for wider distribution as well.

Here are just two examples of such individual projects. James and Virginia Marshall have been working for several years on a project called "Rediscovery of the Elements." The ultimate product of the project, expected around 2010, is a DVD tour of sites associated with the isolation and characterization of the elements (26). Classic Calculations, available on Carmen Giunta's Classic Chemistry website, is a collection of quantitative problems that use data from historically important chemists, an attempt to bring history into the chemistry classroom

in a way that supports the main learning objectives of introductory chemistry courses (27).

Conclusion

HIST members and the broader community of chemists interested in their history may well have one eye fixed firmly on the past, but they are interested in the present and future as much more than eventual fodder for history. At least in part, that interest in the present and the future is a consequence of this community's commitment to chemistry. *Chemists* interested in their history are still chemists, committed to their discipline. This paper has touched on a few ways in which this community is and can be engaged with the present and talking to the future. HIST and other history-oriented chemists can use new technologies for communicating as they come along, not for the sake of novelty but to the extent that they serve the purposes of scholarship and education (28). They can influence the future by engaging and informing the present generation of chemists about the past, particularly about their own past—about fields in which they are active and about the achievements of their teachers, their mentors, and their institutions. They can influence the future by instructing the next generation of chemists about their heritage.

ACKNOWLEDGMENTS

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28. One of the referees expressed a concern that the availability of materials on the internet could have an adverse effect on the quality of historical scholarship. In effect, this referee cautioned that the availability of such low-hanging fruit might divert scholarly attention from more thorough scholarship by way of traditional sources. It remains the duty of scholars, including conscientious reviewers, to uphold the values of solid scholarship. I am grateful to this referee for providing a concrete example of a way in which new digital media may not necessarily serve our purposes.

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WEBSITES

HIST: http://www.scs.uiuc.edu/~mainzv/HIST

CHEMICAL HERITAGE: http://www.chemheritage.org

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