The Origins of Chemical Literature as a Separate Discipline of Chemistry

F. Bartow Culp[*]

Where does a scientific discipline come from? What are the forces that bring into being a particular branch of study, that define its boundaries, that establish its uniqueness from a previous undifferentiated area of study? To be sure, there is an epistemological artificiality about inserting boundaries into the flow of scientific endeavor: where does molecular biology end and biochemistry begin? However, these divisions have historically served as useful demarcations for many people, from researchers to book publishers. Certain defined fields in chemistry were derived from historical notions: "Organic" chemistry was originally thought necessarily to involve life forces, and its coalescence in the first half of the nineteenth century into a separate discipline occurred rather slowly. In contrast, it can be argued that the discipline of physical chemistry came into being over the course of a single decade, beginning with Willard Gibbs' 1876 paper "On the Equilibrium of Heterogeneous Substances", and being fully realised by the appearance of the journal, *Zeitschrift für physikalische Chemie*, founded in 1887 by Wilhelm Ostwald and Henricus van t'Hoff. Similarly, the subdiscipline of chemistry known variously as chemical literature, chemical documentation, chemical information, and more recently, cheminformatics, arose rather quickly during the first quarter of the twentieth century. This paper discusses the various forces and personalities that brought this about. It is shown herein that the discrete concept of "chemical literature" as a separate topic of study and instruction, and therefore a valid subdiscipline of chemistry, came about for three main reasons: (1) the convergence of intellectual interests, (2) perceived necessity, and (3) the availability of a suitable work force.

Converging intellectual interests and perceived necessity

From its formal beginnings as a separate science in the late 18th century, chemistry has had a remarkably unified and coherent literature. In addition to its jour-

[*] Mellon Library of Chemistry, Purdue University, 504 W. State Street, West Lafayette, IN 47904. *bculp@purdue.edu*

nals, it has had, almost from the beginning, publications that summarised and abstracted its scholarly thought. Two examples of the former effort are Leopold Gmelin's *Handbuch der Allgemeinen Chemie*, begun in 1809, and Berzelius' magisterial *Jahresberichte*, published from 1821-1849. The most important example of the second type of publication was the *Chemisches Zentralblatt* (originally *Pharmaceutisches Central-blatt*), which began in 1830 to publish abstracts of the chemical literature. However, towards the end of the 19th century, the size and scope of chemical publications had grown to the point that chemists realised that they were increasingly unable to keep abreast of the current literature, even in their own area of study. In an address to the Chemical Society of London, the chemist H. E. Armstrong said "chemical literature is fast becoming unmanageable and uncontrollable from its very vastness. Something must be done in order to assist chemists to remain in touch with their subject and to retain their hold on the literature generally" .

This increase in the number of publications came as result of the growing numbers of chemists following the establishment of chemistry as a full-time profession around the middle of the 19th century. And this increase itself was partially as a result of the swift rise of the chemical industry in the last half of the 19th century, with its attendant need for research facilities and personnel.

The international bibliographic movement

In the early 1880's two Belgian jurists, Paul Otlet (1868-1944) and Henri La Fontaine (1854-1943), began a collaboration that resulted in the formation in 1895 of the International Institute of Bibliography (IIB). The aim of this remarkable organisation, which exists today as the International Federation for Information and Documentation, was to collect, organise, and make available for use all of the world's published literature . This ambitious goal originally sprang from Otlet's desire to solve some of the problems created by the proliferation and disorderly state of the literature of the social sciences. The IIB, led by this energetic and visionary man and supported by the Belgian government, was successful, and by 1911 had created a collection of more than 11 million records, extensively cross referenced and separately entered on 3x5 in (75x125 mm) cards. The means of organising this vast amount of information, which was called the Universal Bibiographic Repertory (UBR) and which could be considered the forerunner of a modern electronic database, was the Universal Decimal Classification (UDC). Developed by Otlet, the UDC was an extension of the Dewey Decimal Classification (DDC), devised in 1876 by Melvil Dewey, an American librarian.

The subjects covered by the UBR were not only the social sciences, but increasingly included the natural sciences, especially chemistry. Otlet's efforts in this direction were strongly influenced by the ideas of another intellectual giant of that time, Wilhelm Ostwald.

Wilhelm Ostwald's long shadow

Ostwald, co-founder with van't Hoff of the discipline of physical chemistry and winner of the Nobel Prize in chemistry in 1909, was acutely aware of the need for better organisation and communication of the scientific literature. In 1908 he wrote: " Everyone who is active in science in any way appreciates the fact the task of comprehensively organising scientific reporting is a necessity which constantly grows more urgent". And later: "it has become practically impossible for the individual to follow the total production in his science" . Besides lending his authority and ideas to the IIB as a member of its advisory board, Ostwald also promoted several other ways to systematise scientific literature. One was the concept of the "monograph" article, essentially a free-standing article published on a standardised paper size, and not connected to a particular journal. It has been only recently that this idea, essentially a pdf ASAP article, has been realised. Ostwald also wrote the first book to treat specifically the organisation of scientific literature. Mostly of a theoretical nature, it was set in print in 1914 but not published until 1919.

It is not clear how directly Ostwald's and Otlet's writings and the activities of the IIB influenced the incorporation of chemical literature courses into the curriculums of universities in the United States and in Europe; however, both men were tireless promoters of their ideas both in print and at learned gatherings, and it is reasonable to assume that the main thrusts of their arguments must have had some impact on their peers:

– The understanding that it was not only desirable but necessary to better organise the burgeoning flood of scientific literature.

– The realisation that there were new tools to do this, along with a new cadre of professionals to wield these tools.

There were certainly increasing numbers of documented dissatisfactions by academic leaders in America concerning the information competencies of their students. In a speech before the New York section of the American Chemical Society in 1916, Dr. Richard C. Maclaurin, president of the Massachusetts Institute of

Technology, stated that the typical chemist treats "shamefully" the knowledge that has already been garnered, and advocated that he should "reduce his work in the laboratory by increasing his work in the library" . In a report to the American Association for the Advancement of Science, R. F. Bacon stated that "the average graduate is usually almost helpless" when attempting to "digest intelligently the important contributions which have been made upon the subject". He went on to say "the solution is to be found in the provision in the chemical curriculum…of a course of lectures on the literature of chemistry".

Opportunity: emergence of librarianship as a profession in the USA

For much of the 19th century in America, the term "librarian" was rather haphazardly defined. Librarians at academic institutes were generally faculty members who were assigned the duty of supervising the library, with no reduction in other duties and no increase in pay. Such reluctant recruits had no real understanding of the concepts of library collection development and management, nor much desire to spend time learning them. In many institutions, the book collections were dispersed around campus, generally according to their subjects, and were frequently housed in locked rooms near the department heads' offices. How the collections were organised also varied widely among different institutions, often according to a personal system devised by the current librarian . Such conditions were certainly not helpful to the faculty and students who wanted to keep abreast of the current literature!

These conditions began to change in the last decades of the century with the growing importance of academic research, which made library resources a high priority. In addition, the appearance of librarianship as a bona fide profession provided manpower to help systematise and promote those resources. Melvil Dewey, who had created the first universal (and still most widely used) classification system for libraries, was highly critical of the apprentice system then used to train librarians. At Columbia University in 1887, he established the first program for educating and graduating professional librarians. Similar schools quickly sprang up around the country to supply the growing need for librarians, both in the public sphere and in colleges and universities. Furthermore the founding of the American Library Association (1876) and the Special Libraries Association (1907) helped support the professional aspirations of librarians in the United States.

"Chem lit" courses: first stirrings in the USA

If the complaints and comments of President Maclaurin and Professor Bacon cited above are taken as true, there was little, if any, systematic instruction in the use of the chemical literature by university faculty members in the late 19th and early 20th centuries. The single exception I have found is a letter submitted in 1901 to the Library Journal by Professor H. P. Talbot of the Massachusetts Institute of Technology . In it he describes a one-credit course taught by him to chemistry majors in their junior year. The students were given practice in reading German, and were required to prepare a bibliography of the journal literature on a selected subject. While this course could not be considered as comprehensive introduction to the range of the literature of chemistry, it was at least a start in the right direction.

Such courses did not appear in any university curriculum until 1913 at the University of Illinois and 1915 at the University of Pittsburgh . The course at the University of Illinois was created by Marion E. Sparks, the Chemistry Librarian there. She was a member of the second graduating class in the University's School of Library Science in 1899, and although untrained in chemistry, wrote and published the first book to address chemical literature and library instruction. Her small book "Chemical literature and its use" was based on lecture notes for the class she taught, and covered the literature in all the areas of chemistry. It went through two editions, was very favorably reviewed and widely accepted , and formalised the field of chemical information. In 1921, M. G. Mellon, a new instructor in the Purdue University chemistry department, was given the assignment to create a course patterned along the lines of Ms. Sparks' course. Mellon was not a librarian, but unlike most of his peers, he became deeply interested in chemical literature as a subject worthy of being taught on its own. The result of his work was the publication in 1925 of the textbook "Chemical publications, their nature and use" . It was far more detailed that Sparks slim book, and established itself as the preeminent resource for this new branch of chemistry. It remained so for over 50 years, going through five editions, the last published in 1982.

It is interesting to note that the activities described above took place almost exclusively in the colleges and universities in the United States, even though the theoretical framework and initial impetus had occurred in Europe. Three main reasons are seen for this:

The rapid development of the industrial and academic chemical research infrastructure in the United States, which made the need for a proper understanding of the use of the chemical literature even more urgent;

The relatively easy adaptability of American universities to curricular changes, as opposed to the more classical and change-averse universities in Europe;

The early availability of professional librarians in the American academic system, and their subsequent acceptance by their faculties as peers, as opposed to a more stratified and hierarchical view of librarians by faculties of European universities.

For these reasons, chemical information is widely taught today in American institutions of higher learning, either as a separate course or integrated into other courses, but is still rarely encountered in European institutions. The American Chemical Society has also recognised its importance by establishing in 1943 a Division of Chemical Literature (now Chemical Information).

Notes

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