Literature Chemists—From the Past to the Present†

HERMAN SKOLNIK

Hercules Incorporated, Research Center, Wilmington, Delaware 19899

Received September 10, 1974

To understand and appreciate the discipline of chemistry that literature chemists practice, it is necessary to do away with two prevalent misconceptions: (1) that literature chemists began to exist with the formation of the Division of Chemical Literature; (2) that the importance of the chemical literature was first recognized as a consequence of the literature or information explosion of the 1940's and 1950's.

Like Moliere's *bourgeois gentilhomme*, who spoke prose without knowing it, chemists have been working as literature chemists without knowing it since chemistry has been a science. Because science is an endeavor that produces and processes information, its literature has been the basis for all scientific progress, and this has been so since writing was discovered.

Chemistry has a long past as an art, extending back to prehistorical times. As a science, however, chemistry has a short history. Until about 200 years ago, chemistry was submerged in science, and science was merely a part of philosophy. During most of the 19th century, the professional chemist was a rarity. At the time of the founding of the American Chemical Society in 1876, science in general, not only chemistry, was pursued more as an avocation than as a vocation. The Chemical Society of London was founded in 1841 with 77 members; by the 1870's the membership grew to about 600. The Priestly Centennial at Northumberland, Pennsylvania, in 1874, the first national meeting of American chemists, was attended by 77, the large majority of whom were professors of chemistry. The membership of the American Chemical Society was 133 at its founding; this grew to 290 by 1891.

When the *Proceedings of the American Chemical Society*, established in 1876, became the *Journal of the American Chemical Society* in 1879, there was only a handful of journals devoted to chemistry throughout the world. The total pages of journal articles on chemistry published during 1879 was equivalent to about 300 pages of the current *Journal of the American Chemical Society*. Yet the new Journal in 1879 published resumes of important papers published throughout the chemical world, and continued to do so until 1907 when *Chemical Abstracts* assumed this responsibility. That German chemists were concerned about the chemical literature, even when the literature was very small, was shown by the establishment of *Chemisches Zentralblatt* in 1830. When *Chemical Abstracts* was started in 1907, less than 400 journals comprised the total in the world in which one or more articles on chemistry might be published, and from which *Chemical Abstracts* selected about 8000 articles for abstracting. Certainly 300–400 journals and 8000 articles hardly constituted an information explosion.

But the inauguration of the primary journal literature and of the secondary journal literature in chemistry did establish two very important paradigms. What is a paradigm? As Thomas Kuhn describes it in his notable book, *The Structure of Scientific Revolutions*, "acquisition of a paradigm and of the ... research it permits is a sign of maturity in the development of any given field." Most simply, a paradigm is a prime example of a conceptual framework that serves to define the legitimate problems and appropriate methods in a field of study. A paradigm is a guidance system that determines the path in a field of study.

If the discipline of chemistry we practice as members of the Division of Chemical Literature is truly an art and science, then we must have paradigms that set our discipline apart from others in chemistry. We do. In fact we have more than most of us have realized. Let me now cite some of the more important ones.

We inherited a few from the Golden Age of Greece. Aristotle, both a philosopher and scientist who lived from 384 to 322 B.C., gave us the paradigm of definition which specified an object or idea by identifying the class to which it belongs and the differences that distinguish one member from all other members. He arranged the basic aspects under which something should be considered into ten categories, such as substance, quality, place, time, activity, etc., or, in short, the paradigm of classification.

In retrospect, it is quite apparent why chemistry was slow in progressing beyond alchemy until the 19th century. It could not, because there was no language of chemistry that was universally accepted. But with the Avogadro hypothesis of 1811, the introduction of symbols by Berzelius in 1813, the elucidation of atomic and equivalent weights by Cannizzaro in 1858, and Kekulé's advance of quadrivalent carbon in 1858 and of the unsaturated benzene ring in 1865, a language of chemistry emerged. This paradigm, the language of chemistry, specifically its symbols and nomenclature, has made chemistry unique among the sciences, except for mathematics, in the ease and conciseness of communication and in the high semantic content of the vocabulary of chemistry.

Classification has been an extremely important paradigm in science for both teaching and understanding knowledge. Classification is the science of similarities and differences. One of the outstanding examples of a classification system was the family–genus–species concept that Linnaeus introduced in 1738. The impact was so great that Linnaeus is credited with the systematization of botany.

The introduction of the concept of homology by Dumas in 1851 became a powerful tool in research and teaching. Homology tells a chemist that the physical properties of the members of a class of organic chemicals, such as aliphatic alcohols, have a definite relationship and that the chemical properties are very much alike. When a physical or chemical property of a member of a class is out of line, a chemist knows that he has made a mistake or that he has made a juicy discovery.

† Luncheon address before the Division of Chemical Literature, 168th National Meeting of the American Chemical Society, Atlantic City, N.J., Sept 10, 1974.

Another outstanding example of the classification paradigm in chemistry was the introduction of the periodic table by Mendeleev in 1869. Mendeleev's periodic table not only pointed out potential errors of existing information, but predicted the discovery of new elements and their properties. In addition to motivating and advancing research, the periodic table has been a powerful teaching tool.

We are also indebted to library science for one of our classification paradigms—the Decimal Classification System for library cataloging first introduced in 1876 by Melvil Dewey.

I have already alluded to our primary literature network and to our secondary indexing and abstracting services such as *Chemisches Zentralblatt* and *Chemical Abstracts.* These, plus Beilstein's *Handbuch der Organischen Chemie* and Gmelin's *Handbuch der Anorganischen Chemie,* are prime examples of the information system paradigm.

Chemistry barely existed before the 19th century, that is, as a science. This does not mean chemists did not exist. If chemists are defined as those who work with chemicals, then chemists have been plying their art since before the Egyptian civilization. But chemistry and chemists within the framework of a science slowly emerged during the early part of the 19th century and blossomed forth in the second half of the 19th century. The emerging science of chemistry and its literature during the 19th century resulted from the work and thoughts of a relatively few scientists—a number smaller than the current membership of the Division of Chemical Literature.

We are indebted for our paradigms to all ages and to many disciplines of knowledge. Let me summarize some of our important paradigms:

1. Libraries from the very earliest civilizations.
2. Definitions and classification systems from the Golden Age of Greece and succeeding civilizations.
3. Chemical symbols and the language of chemistry from 19th century chemists in Europe.
4. Chemical journals, abstracting services, and compendia from the 19th century.
5. Chemical societies from the 19th century.
6. Chemical structure correlations with chemical and physical properties from 19th century chemists.

Other paradigms that have played important roles in our work as literature chemists have been the dictionary index, the book index, the classified index, the simple 5 × 3 catalog card, the formula index, the heterocyclic index, and more recently the hand-sorted punched card, the fragmentation index, notation systems, and new concepts for utilizing computers for processing and communicating chemical information.

These paradigms have been and will continue to play a vital role in the whole of chemistry. They have been introduced by chemists for chemists and constitute the art and science practiced by literature chemists. But all chemists have to be literature chemists to the degree that they need to have knowledge of the chemical literature and they need to have skill in writing, in nomenclature, and in using the chemical literature. The literature chemist, however, must have superior skill in reading, writing, nomenclature, foreign languages, abstracting, indexing, and classifying. The literature chemist must have a superior knowledge of the chemical literature and of information sources and a uniquely superior ability in designing information systems.

These skills and specialized areas of knowledge are not possessed uniformly by all literature chemists. We tend to be generalists in chemistry and specialists in one or several areas of information science. Other than in terms of activity, it is difficult to define a literature chemist as we are not products of a college curriculum. In educational background, we are like all other chemists in having a B.S., M.S., or Ph.D. degree and being primarily an organic, polymer, physical, analytical chemist, or possibly just a chemist. We differ among ourselves in terms of involvement with chemistry, our creativity, and our ability to communicate, to relate literature with needs of an environment, and to work with and through people.

Although we are blessed with a goodly number of paradigms, we do not have a suitable name for the art and science we practice and for describing the spectrum of activities in which we are engaged. Achieving a name we can all live with may become our most dominant paradigm, for then we will have defined the doing and thinking of chemistry outside of the laboratory.