CHEMICAL LITERATURE AND ITS USE

Notes of twelve lectures, for juniors in chemistry and chemical engineering, University of Illinois.

LECTURE I.

Purpose of the course

1. To show what the literature of chemistry is, how it is arranged, and made available, with practice in its use.
2. To give some idea of the growth of the science.

Materials

Serials and books in the University libraries, chiefly those at Chemistry.

Methods of work

Problems, involving use of the literature, one for each lecture, to be looked up in the Chemistry library. Keep some notes of these for reference. Reports are given orally in class, on (first semester) history of chemistry and noted chemists; and, (second semester) on papers in current serials.

Notebooks

These must contain, for reports by members of the class, the date, name of speaker, topic, reference, (these items are put upon the board by each speaker) with some notes upon the subject matter of the report. Notebooks are inspected twice each semester.

Apparatus is necessary, but not all the glassware made in Jena tells you the structure of an organic compound, nor even how to look it up in Richter's Lexikon. Chemistry has been called, "the intelligence department of industry," and the chemist, beginning on the basis of all previous knowledge, builds upon that foundation, further research to develop this science, which touches every phase of human welfare and endeavor.

Many of the larger industrial plants recognize the value of using what others have learned, and have libraries that vary in size from a few hundred to more than fifty thousand volumes (or, better, pieces), for in many cases a ten page pamphlet may be more important than a ten-pound book. Users of such a library are experts and work done for them teaches one much. Librarians there must know the science, first, and the simpler part of library methods at least, as well as be able to translate, make abstracts, bibliographies, check up lists of references, record formulas.

Articles describing such work as done for some of the larger companies interested wholly or in part in chemistry are in:

I. Journal of industrial and engineering chemistry,
v. 2, p. 83-87, 1910;
v. 11, p. 578-88, 1919.

Reference to the work attempted here and in other places may be found in:

Science v. 70, p. 377-381, 1918;

II. Chemical and metallurgical engineering, v. 20, p. 578-581, 1919.

One of these in I, should be read.

Topics of the Lectures

First semester

1. Classification and arrangement of books and serials
   The catalogue. Some general reference works
2. Literature on the history of chemistry. Societies
3. General chemistry and analysis
   Reference serials for use in problems
4. Inorganic and mineral chemistry: books
5. Inorganic and mineral chemistry: serials
6. Summary of the history of chemistry, with references

Second semester

7. Organic chemistry
8. Applied (industrial), chemistry: serials
9. Applied (industrial), chemistry: books
10. Theoretical, physical, colloid chemistry: serials
11. Theoretical, physical, colloid chemistry: books
12. Biochemistry (physiological chemistry).

Selected lists of the literature available here will be given, with direct reference to the library problems assigned, and special use will be made of the important materials found in particular works. Students will be shown some of the most necessary books and serials, and are expected to know author, title, and approximately, the date, number of volumes, and class number, for at least three important works discussed in each lecture.

Arrangement

Material without orderly arrangement might as well not exist. In the libraries on this campus, and in perhaps three-fourths of the other libraries in the United States, the system of arrangement is that of "relative location", based on the Dewey system of classification. This is planned to place together on the shelves all books upon the same topic, so far as possible. Book A may not be in the same inch of one shelf, but it is in its alphabetical place (by author's name) among other books upon the subject. New books are marked, and inserted in the class to which they belong.

The method for this is fairly simple. The field of knowledge is divided into nine main classes, to which are assigned the digits, 1 to 9. Each one of these is divided into nine divisions, and each of these again into nine subdivisions, leaving the zero to indicate very general works for each class, division, etc. These first three figures are considered as forming a whole number, and any figures annexed are treated as decimals, making more minute subdivision possible.

Books are classified according to the major portion of the contents. Certain form divisions, always a digit preceded by a 0, are used in every class, division or subdivision, as needed. They include: 03, dictionaries, 04, essays, 05, serials not society organs, 06, serials that are society organs, 07, study and teaching, 08, collected works of an author, 09, history.

For example, history of chemistry is 540.9, history of metallurgy is 669.09.

EXTRACTS FROM DECIMAL CLASSIFICATION SHOWING LOCATION OF MOST OF THE MATERIAL UPON CHEMISTRY AND ALLIED SUBJECTS

General classes

0 General
1 Philosophy
2 Religion
3 Sociology
4 Philology
5 Natural sciences
6 Useful arts
7 Fine arts
8 Literature
9 History

510 Mathematics
530 Physics
540 Chemistry
550 Geology
570 Biology
590 Zoology
610 Medicine
612.01 Biochemistry
615 Pharmacy
620 Engineering

Divisions

630 Agriculture
640 Household science
660 Chemical technology
670 Manufactures
680 Mechanic trades
690 Building and materials
750 Painting (artists')
770 Photography
920 Biography (individuals)

Subdivisions of theoretical and applied chemistry

540 General
541 Theory, physical
542 Laboratory methods
543 Analysis
544 Analysis, qualitative
545 Analysis, quantitative
546 Inorganic chemistry
547 Organic chemistry
548 Crystallography
549 Mineralogy

660 General
661 Manufacture of chemicals
662 Explosives
663 Beverages
664 Manufacture of foods
665 Lighting materials
666 Ceramics
667 Bleaching, dyeing, paints
668 Organic chemical industries, glue, soap
669 Metallurgy, assaying

Books classified by this plan are placed together upon the shelves, and those having the same class number are then arranged alphabetically according to the surname of the author. Each book is marked, usually upon a label pasted on the back, with the class number, and the author mark, (commonly a letter and one or more figures, indicating the name of the author), and the whole is termed the "call number", since this abbreviated designation is used when the book is called for by the reader, and when it is recorded in the library.

Example: 546

M72t3Ef

546, inorganic chemistry, subject M 72, Molinari
t, initial of first word of title in original Italian
3, third edition
E, indicates a translation into English
f, initial of translator's name.

Books are shelved from left to right, and the spaces between the vertical uprights that support the shelves are treated as pages on which the shelves correspond to the lines.

Serials, as distinguished from books, are those publications, whether published as the organ of a society or not, that begin and then continue for an indefinite period. Because the sets increase yearly, these are usually shelved separately from books. Class numbers of serials end in 05 or 06; the decimal point may be before, after or between the 0 and the digit, according to the class number.

Arrangement of books and serials in the Chemistry library of the University of Illinois is as follows, in 5 groups, those in each group being in numerical order.

Groups

I. Palmer, (a) books; (b) serials; a special collection, shelved separately, in southeast stack.

II. General works, not serials nor works of reference, but including "reserve" books, which are each so marked by a special label.

III. Works of reference, do not circulate; dictionaries, tables of constants, cyclopedias and similar works. These are marked by a letter R.
See shelf label, where it begins, immediately after Group II.

IV. Abstract, index, and review serials.
Follows Group III. See shelf label.

V. General and special serials, containing chiefly original papers.
Arranged by call number from point of beginning, after Group IV, to north wall.
Some of these as Analyst, Journal of the Chemical society, contain both original papers and abstracts.

A few books much too large to be shelved in numerical order, are placed on a special "Oversize" shelf, in the case along the north wall. In the proper numerical places for these books are wooden or pasteboard "dummies" showing the location of the work.

Unbound numbers of serials are on the shelf at the close of each serial, followed by the collective indexes for that serial if the library has them.

The Catalogue

The catalogue of the Chemistry library consists of three parts:

1. An author list of books, and a title list of serials, arranged in one alphabet, in the top row of trays.
2. Dictionary catalogue of all chemical books and serials on the University campus. For any such works that are at Chemistry ONLY, the author entries are omitted from the dictionary catalogue, since these are already entered in the author list (no. 1).
3. Shelf list, of the five groups, as the items stand on the shelves. These trays are marked with class numbers, not with letter-labels.

Articles published in serials, are, except a few exceptional government and

state publications, not entered in the catalogue, and are to be looked up in the abstract and review serials, where the original references may be found.

Books, not serials, not reference nor "reserve", may be taken out on signing a slip at the desk, for two weeks. "Reserve" books may be taken at nine any evening, to be returned by nine the next day, the library is open.

Reference Works

Here is Thorpe's Dictionary, Ed. 2, in 5 volumes; Van Nostrand's Annual, 1918, giving chemical and physical constants; Richter's Lexikon, organic compounds arranged by formula, and giving references to the cyclopedic Beilstein, Handbuch; Abegg, and Gmelin-Kraut, for inorganic, with Hoffman's Lexikon; Abderhalden's Handlexikon, in many volumes, biochemistry; older dictionaries, as Ladenburg; Chemiker-Kalender; Landolt-Börnstein; and many others less often used, for more special service in pharmacy, and other phases of applied chemistry.

General Serials

These are the chemist's most used reference books, and a few should be noted here.

For original papers:

American: Journal of the American chemical society
Journal of industrial and engineering chemistry
English: Journal of the Chemical society
Journal of the Society of chemical industry
French: Annales de chimie
Chimie et industrie
German: Annalen der chemie
Zeitschrift für angewandte chemie

For abstracts:

American: Chemical Abstracts (Amer. chem. soc.)
English: Both English journals above
French: Bulletin de la Société chimique de France
German: Chemisches Centralblatt; this includes the abstract section of Zeit. für angew. chemie, Jan., 1919 on.
Jahresbericht (Liebig & Kopp).

All the abstract serials have more or less complete collective indexes, covering series of years, enabling one to cover much ground rapidly.

Reviews

Two annual reports of progress both from the English societies, covering theoretical, and applied, chemistry; theoretical chiefly, is 1904—date; applied, 1916 on.

A very brief survey of the array of literature will convince most people that chemistry, starting as it did before written history, for a chemist had to prepare writing materials first, was not invented by any one nation or group; and no one now has a monopoly; it is simply the problem of using the knowledge earlier workers have gained, to the best advantage, for improvement of living conditions, or products designed for use or beauty. The ideas now current as to the theoretical basis for the science have changed many times from the first form, and the study of some of these changes, the men and influences that caused the change in ideas and theories, may give some indication of what remains to be done, before we know all about even the simplest particle of substance and its actual formation, not to mention its composition and possible uses.

For centuries learned men laughed at the idea of a "primitive substance", basal, and from which all matter was derived; then radium was discovered, and chemical theory suffered a considerable shock; atoms we admit are indivisible, but how are we to weigh and measure ions,—and electrons—and they may not be the final form, or manifestation.

Plenty of room for all the research workers, though each set decides, "We have solved all the problems".

LECTURE II.

LITERATURE OF THE HISTORY OF CHEMISTRY

There are five fairly well-marked periods in the history of chemistry. The dates for these are however only approximate.

Ancient, to 350 *A. D.*

The chemistry here was largely a craft, applications not theory, till the Greeks made it a philosophy.

Alchemical, 350-1500

Based on wrong translations of Egyptian manuscripts; men wasted years in search for a substance that should transmute other metals to gold or silver, the philosopher's stone.

Iatrochemical, 1500-1650

Medicine grew up, demanded a universal remedy, elixir of youth.

Phlogiston, 1650-1780

Combustion called for explanation, and this theory was accepted, till a rational one came. Gases studied, and this lead up to discovery of oxygen.

Modern, 1780-?

Oxygen discovered by Scheele, Priestley; Lavoisier names it.

Chemistry of carbon compounds develops.

Literature upon the history of chemistry

This consists of general histories, more or less elaborate, the accounts of special periods and divisions, studies on theory, biographies, and essays, these often biographical.

General

These, since Lavoisier, are in order of time, Trommsdorf, German, 1806, not here; Thomson, English, 1831, second edition, here; Hoefer, 1843, in 2 vol. includes history to 1815; a third volume was planned but not published; Kopp, 4 volumes, covers all chemistry to 1840, in German, 1843-47, and is supplemented by a later paper, bringing it down to 1860. E. von Meyer, in German, 1888, has been re-edited and translated several times. Stange, 1908, in German, gives chronologically, "a general view of the development of chemistry" with emphasis upon individuals. The most comprehensive in English is Brown, from lecture notes, covering the time to 1900. Brauer is a small book translated from German, Armitage is in English, while the one of 1918 is by an American, Moore. E. von Meyer in his Chemie, 1913, gives much on the time since Liebig.

Alchemy

Chapters in the larger works, are supplemented by Berthelot, in a 3-volume work giving facsimiles and translations of Arabic manuscripts; he has also edited a 3-volume set of similar Greek and Latin texts, and done a volume on Origines de l'alchemie, 1885, and a 4-volume work on chemistry in the middle ages. Muir, in English has two small works here; Kopp has a volume also on it.

Modern

This is dealt with in English, by Tilden in two books, giving accounts of progress since 1830 particularly. Ladenburg, in German, and also translated, takes up the time from Lavoisier to 1886, and he wrote a brief summary first published in the Sammlung, on work done 1880-1900.

Theories

The first edition of Lothar Meyer's book, Modernen theorien, 1864, was written "for the information of scientists who are not chemists"; there are more recent versions (and editions) in French, Russian, and English as well as German.

Freund, in English, 1904, discusses historical development of theories as affecting composition specially. M. M. Pattison Muir, 1907, describes "investigations which in my judgment have given powerful impulses to the advance of chemical science."

Divisions, special phases

Pope, for the organic, and Stewart in his two volumes which include the one physical and inorganic, the other organic, present accounts of the work done since 1880. Lowry tries to trace the development of methods and apparatus. Bolton, besides his Bibliography of Chemistry, 1492-1892, with the several supplements, has written a number of short papers on topics in chemical history. Smith, Chemistry in America, is a vivid picture of early American work. This suggests, as light reading, the semipopular works of Duncan, Letts, Martin, Philip, Friend, Findlay, and, most recent, Hendrick's Everyman's Chemistry.

Biographies

Chemistry has no adequate biographical dictionary. Brief notes, with reference to longer ones, are in Tilden, Progress of scientific chemistry in our own times, Ed. 2, 1913; somewhat similar material is in Meyer, Stange, and for the older men in Kopp. The collected Memorial addresses from the Chemical society (London) and Roberts' book are in English, while the small German dictionary has been out of print for ten years. (Schaedler, 1891.)

Memorial addresses appear in the serials usually during the year following the man's death.

A few individuals are taken up in the first volume of Wurtz's Dictionnaire. Some collections of letters are classed as biographies. Biographies of individuals, if books, are classed in 920, but for this 3-figure number a B is used, followed by an "author mark" derived not from the author's name, but from that of the person written about, thus grouping all biographies of one man.

Essays

These include biography, criticism, history. Brown, Ramsay, Thorpe, and others are here.

Chemical Societies

These may be considered as part of history, since without them, there would be much less to record. Organization and concerted effort by the societies, toward sharing all knowledge, have to some extent, replaced older ideas of profound secrecy, with mysteries only imparted to selected assistants.

Bolton's list in 1901, gives 66, about 30000 members, Germany in the lead. The present number of societies is about the same, but the American society alone has about 13000 members. The first society for modern chemistry alone, was founded by James Woodhouse, the Chemical society of Philadelphia, 1792, and for 17 years it met every week; the second, the Columbian chemical society, 1811, also in Philadelphia, was under the patronage of Thomas Jefferson.

Publications of the Principal Existing Societies

American

Journal, 1879 on (absorbed in 1914 the American chemical journal 1879-1913.)

Chemical abstracts, 1907 on.

Journal of industrial and engineering chemistry, 1909 on.

English

Annual reports, 1904.

Memorial addresses, 2 volumes to date.

Jubilee volume.

Proceedings, brief notes of papers read; no longer published as a separate serial.

Journal (called at first Memoirs, then Quarterly Journal) 1841-; this is in two parts, Transactions, original papers, and the section of Abstracts, very comprehensive.

English society of chemical industry

Journal, 1882, with many excellent abstracts.

Annual reports, 1916.

German

Berichte 1867.

Chemisches Zentralblatt (formerly Pharmaceutisches centralblatt, then Chemisch-pharmaceutisches centralblatt) 1832.

Litteratur-register, two-year supplement to Richter's Lexikon, 1910-11.

German industrial organizations

Die chemische industrie 1877.

Zeitschrift für angewandte chemie 1887.

(Abstract section of this last is, from January, 1919, published as part of the Chemisches Zentralblatt).

French

Bulletin, original papers and abstracts, 1858.

French industrial society

Chimie et industrie, original papers and abstracts, with illustrations, 1918.

Chemical Laboratories

Individuals permitted special students to work in their laboratories, from the time of the alchemists; the first chair of chemistry is said to have been established in the University of Marburg about 1600; state laboratories for government work were opened in 1683, at Altdorf in Bavaria, and at Stockholm, the latter being under the patronage of Charles XI, with Urban Hiärne as director; one of the pupil-assistants at Stockholm was Leopold Gmelin, first of seven generations of chemists. Both these State laboratories began publishing "contributions", giving results of their work.

Laboratory work as a means of instruction for students was carried on by Thomas Thomson in his laboratory in Edinburgh before 1811, and he continued the practice on his removal to Glasgow in 1818. Lomonossoff, as professor of chemistry at the University of St. Petersburg, had a laboratory built there, opened in 1748, for instruction and research, where it is said students did laboratory work. Thomas C. Hope, professor at Glasgow, 1787-1795, and at Edinburgh, 1795-1843, did experiments himself in lectures, but the first record of his students doing practical work dates from 1823, when his assistant Anderson, was given charge of this work. The commonly accepted date, of 1824, under Liebig at Giessen, as the beginning of instruction by classes doing laboratory work, may perhaps be subject to revision.