For the literature of the separate elements and their compounds, a good
starting point is in most cases, the bibliography or list of references in Albrecht's
in Gaebler-Kraut's Handbuch, supplemented by the data from Hoffman's
Lexikon, and the newer material from the general abstract serials.

LECTURE 7

CONCUSSION OF LOOKING UP ALL THE LITERATURE FOR A TOPIC IN GENERAL,
ANALYTICAL, OR INORGANIC CHEMISTRY

The material upon any given topic may consist of books or chapters, even
paragraphs, or, there may be articles in old serials, or in the current ones; again,
there may be patents, old or new, foreign or American.

For information in books, try first the subject heading in the card catalogue
that is most exactly what is needed; if this gives no result, try the heading that
seems more general; for example, if you find no entries under Coal, try Fuel.
Subject cards in the catalogues have the subject on the top line, usually in red; in
the Chemistry library catalogues, the name of the seminar library containing the
book is in the left margin below the call number; cards not so marked are for
books in the main library. If no books can be found for your topic, go to the
general or censusiveive works in that field, as Lange, or Allen for technical
analysis, and casuscic index, ordinarily placed at the back of the book, looking
under the most specific heading. Here we sometimes find single references, or
brief bibliographies, i.e., lists of articles or books upon the topic. The diction-
aries may be used, as Landenburg for the older historical work, or Theroux, Vol. 3,
for recent information; both will give some reference to books or serial articles.

When the books have been exhausted, contain nothing, or only what is too
old, the reference, i.e., index, review and abstract serials form the next source,
and the last of the three are usually best, since the review serial gives very little
from any one article, though it may list a number of papers upon the topic. The
following lists give the principal reference serials here for the particular fields.

I. General chemistry

A. Before 1840
1785-, Annales de chimie
1822-, Jahresbericht (Berichtig)
1822-, Annalen der Chemie
1832- Chemisches Zentralblatt (then Pharmaceutisches Central-
Matt)
1834- Journal fur praktische Chemie

Of these all but the fourth have collective indexes.

B. 1840 to 1870
Add to the ones above the following:
1840-88, The Chemical
1841-, Journal of the Chemical Society

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1842-49, Chemical Gazette; continued by Chemical News, 58 on
1847-, Jahresbericht (Liebig and Kopp)
1858-, Bulletin de la Société Chimique de Paris (now of France)
1867-, Berichte der deutschen chemischen Gesellschaft

Note that Berenheet's Jahresbericht ceases with 1849; Chemical and Chemical Gazette have only annual indexes. The abstracts in Annales Annales, and Journal für praktische Chemie cease at this time or in a year or two. For this period the Chemisches Zentralblatt has published only annual indexes.

C. 1850 to 1906

For this the most rapid method is to take advantage of the collective indexes whenever possible; if one reads German, which is nearly essential for advanced work in chemistry, the order might well be the following:

a. Jahresbericht (Liebig and Kopp)

b. Journal of the Chemical Society

c. Bulletin de la Société Chimique de France

d. Chemisches Zentralblatt, indexes, 1870-81, 1896-1906

e. Journal of the Society of Chemical Industry, 1882-1905

f. Jahresbericht (Wagner); indexes, 1855-94

g. Zeitschrift für angewandte Chemie, index, 1887-1907

h. Jahrbuch (Meyer) index, 1891-1900; annual indexes after 1900

i. Chemiker-Zeitung: Repertorium, annual indexes

Of these, e, f, g, and l, will probably be of use only if the topic is definitely applied (industrial) chemistry; for those who can not read German, those must be made of b, c, and e, assuming a knowledge of French. The abstracts of Meyer's Jahrbuch, though not including all possible articles are very good, particularly for organic chemistry.

D. 1907 to 1921

Here, for the quinetest work, the order might be as follows:

a. Chemisch Abstracts, annual and annual indexes

b. Journal of the Chemical Society, index, 1903-12, and annual ones

c. Chemisches Zentralblatt, 1907-11, and semi-annual indexes

d. Bulletin de la Société Chimique de France, annual indexes

e. Jahrbuch (Meyer), annual indexes

f. Journal of the Society of Chemical Industry, annual indexes

g. Chimie et Industrie, 1918 on, volume indexes

In this period, the Jahresbericht (Liebig and Kopp) here only includes 1897 to 1910 inclusive; Wagner's Jahresbericht is here through 1914, and with f, and g, will be found of use only for industrial topics, as a rule. The Chemistry section of the International Catalogue of Science.
II. Inorganic chemistry

For this, before 1860, the same group of serials is to be used as for general chemistry; the same thing is true for the period 1840 to 1870, and for the more recent years.

However, if the topic is an inorganic compound, the first place to look is in the Hofmann, Lexikon der anorganischen Verbindungen, using the numerical table of elements to find the right volume; this will give references, usually one being to the seventh edition of Gmelin-Kraus's Handbuch, where there will be found a fairly complete bibliography, i.e., the literature down to the date of that volume; then consult later abstract serials for more recent work.

If the compound or topic is not in the Lexikon, try the indexes of the volumes of Gmelin-Kraus or of Aebli; later when they are completed consult the Textbook of inorganic chemistry, edited by Friend, or the newer six-volume Inorganica chemica by Moller. These will give the most important references and newer papers can be found from the reference serials. The collective index of the Zeitschrift für anorganische Chemie covers only the original papers published there but may sometimes index a particular point that has been overlooked by the abstractors. The inorganic section of Wagner's Jahresbericht is good if the topic is of an industrial nature.

III. Analytical chemistry

Use the same method and the same serials as for general chemistry; as references works, the larger, newer texts on analysis either general, or for the special substance or method will be used.

It will be advisable to use for the periodicals that they cover the three principal serials of analytical chemistry, since all have abstracts and collective indexes; these are:

1862 to date, Zeitschrift für analytische Chemie
1877 to date, The Analyst
1836 to date, Annales de chimie analytique

In addition, the special serials upon the topic should be used.
INTERLIBRARY LOANS

If your library does not own the serial or the book needed, the system of interlibrary loans may be used; thus, any library is able to borrow from some other that does possess it, almost any serial or book; the borrowing library usually pays all expenses and takes the responsibility for the article’s return; a department may ask the graduate students to pay half or all, or none, but the library does the borrowing. This privilege may be varied by making copies by means of photography or by typing, in case a book or serials are too precious or in use, e.g., unbound serials are not often lent.

This loan system is aided by the union lists of serials, that have been made for many cities and other centers of libraries. These are available for the following localities: Washington, D.C., New York City, Chicago, Boston, Philadelphia, Pittsburgh, Toronto, Rochester, University of Illinois, the state of Indiana, and some others. The Chemical Club in New York does some reference work, locating and furnishing copies of articles. The Information service of the National Research Council, 1701 Massachusetts avenue, N.W., Washington, D.C., will too, but for any considerable article the cost is estimated and notice of this sent first. The Engineering Societies’ Library, New York, has a similar service.

The more popular articles may of course be found from the general serials by the use of the Poole’s Index, continued by the Cumulative Index, 1896-1903, and the Readers’ Guide, 1903 to date. A select list of scientific serials is indexed by the Industrial Arts Index, 1915, another by the Index to Agricultural Literature, 1916, and a third group is dealt with by the Engineering Index, which is the oldest of the three, dating from 1884; the new arrangement with entries in one alphabet instead of a separate one for each branch of engineering, makes this easier to use.

REFERENCE SERIALS

Some of The Principal Index, Abstract and Review Serials, in the Order of Title Covered

General Chemistry

1789-1878 Annales de chimie et de physique; a few abstracts to 1873
1822-1849 Jahresbericht über die Fortschritte der Chemie und Mineralogie (Benzidin)
1820-date Chemisches Zentralblatt; some varies; 1829-31 not here
1832-1899 Annalen der Chemie; abstracts were never numerous and gradually decreased
1834-1873 Journal für praktische Chemie; abstracts practically ceased then
1894-1935 The Chemist; ceased publication
1841-date Journal of the Chemical Society, London; the volumes for 1841 to 1846 had title Manus, but index for them is in first collective one

1842-1859 The Chemical Gazette; continued by the Chemical News
1838-date Bulletin de la Société chimique de France
1859-date Chemical News; abstracts few but often long, even to reprints
1867-1896 Berichte der deutschen chemischen Gesellschaft; after this date the abstracts are in the Chemisches Zentralblatt

1847-1910
1877-date Chemiker-Zeitung; Repertoire; sometimes bound separately
1877-1905 Journal of the American Chemical Society
1891-date Jahresbericht der Chemie (Meyer); selected abstracts only
1891-1918 Revue générale de chimie pure et appliquée; abstracts section called
Repetitorium, and bound separately part of the time; the serial
has not both received here since 1918
1901-date International Catalogue of Scientific Literature: Chemistry; this is
an index serial to abstracts of contents of papers
1904-date Chemical Society, London: Annual Reports; this reviews the progress
made, noting important articles only
1907-date Chemical Abstracts; has one collective index

Agricultural chemistry
1854-date Jahresbericht über die Fortschritte auf dem Gesamtgebiete der
Agriculaturenchemie (Hoffmann)
1872-date Zentralblatt für Agriculaturenchemie (Biedermann)
1895-date Experiment Station Record (U. S. Department of Agriculture)

Analytical
1862-date Zeitschrift für analytische Chemie
1857-date The Analyst
1896-date Annales de chimie analytique et de chimie appliquée
1908-date Annales des faubplacements (now, and of the fruandes)

Biochemical
1851-1918 Jahresbericht über die Fortschritte der Tier-Chemie... continued
by Berichte über die gesamte Physiologie, 1919 on
1899-date Journal de physiologie et de pathologie générale
1900-? Centralblatt der experimentelle Medizin; titles were Centralblatt für
Stoffwechsel- und Verdauungskrankheiten 1905-09; Zentral-
blatt für Physiologie und Pathologie des Stoffwechsels, 1906-11; none received since July, 1914.
1902-date Zentralblatt für Biochemie und Biophysiik; this was Biochemisches
Centralblatt, 1902-09; is now Berichte (1919 on), below
1916-date Physiological Abstracts
1919-date Berichte über die gesamte Physiologie und experiemntelle Pharma-
kologie (Neue Folge des Zentralblatts für Biochemie)
1921-date Physiological Reviews; this is a serial review, American

Food
1882-date Zeitschrift für Untersuchung der Nahrungs- und Genußmittel; 1882-
89 had title: Vierteljahrsschrift der Chemie der...
1889-date Experiment Station Record (U. S. Dept. of Agric.)
1897-date Zeitschrift für Fleisch- und Milchhygiene
1901-date Higienische Rundschau
1901-date Repertoire... sur la composition... des denrees alimentaires (Frat
three volumes published in Dutch)
1908-date Annales des falsifications et des fraudes
Organic:

Here becomes known of the existence of Richter’s Lexikon, and its supplement, the Literatur-Register, with Beidargen’s Handbuch, there is less need for the reference serials; this should be noted however, that annual indexes by formula, for organic compounds discussed in their own original articles, are published by certain serials, those providing lists newer even than the Literatur-Register. These serials are:

- Annalen der Chemie
- Annales de chimie
- Berichte der deutschen chemischen Gesellschaft
- Journal of the Chemical Society (in the Transactions section)
- Mnatshefte
- Recueil des travaux chimiques des Pays-Bas

These of course need only be used for very recent years; they have not always had the formula indexes; such an index is in the Jahresbericht (Liebig and Kopp, 1905-19); a formula index, giving both inorganic and organic compounds is a new feature of the annual index of Chemical Abstracts, beginning with 1920.

Pharmaceutical:

1869-date Journal de pharmacie et de chimie (ser. 1, 1809-14 called Bulletin); set at Hibon is not complete
1870-date American Journal of Pharmacy
1871-date Pharmaceutical Journal and Transactions (now Pharmaceutical); this has very few abstracts now
1872-1879 Chemical Gazette
1881-date Chemical Abstracts: Proceedings; called Yearbook, 1912 on
1879-date Berichte über die gesammte Physiologie und experimentelle Pharmakologie

Some pharmaceutical literature is abstracted in the serials on biochemistry, particularly the Jahresbericht (Maly) 1820 to 1918.

Physical:

1899-1904 Zeitschrift für physikalische Chemie
1894-1907 Jahrbuch der Elektrochemie and angewandte physikalische Chemie
1896-1910 Journal of Physical Chemistry
1903-1912 Journal de chimie physique
1904-date Fortsetzung der Chemie, Physik und physikalische Chemie; this was an abstract serial, 1904-99 with title Physikalisch-chemisches Centralblatt and was called "Internationale with the new name it became a review serial

Technological:

1853-date Jahresbericht über die Leistungen der chemischen Technologie (Wagner)
1873-date Chemiker-Zeitung; Repertorium
LECTURE 8

SUMMARY ON THE HISTORY OF CHEMISTRY, WITH REFERENCES

ANCIENT PERIOD TO ABOUT 350 B.C.

Our knowledge of the chemistry of the ancient period is drawn largely from material objects rather than from written sources; the Egyptian manuscripts, records from the north central part of Asia, the discoveries of archaeologists in Chaldia, Crete, Egypt, with the records from India and China, form the principal part of the actual historical information; various legends or traditions add something, but may be true, or present evidence that leads us to believe the statements by early writers. During this period, there was, certainly, an accumulation of facts about substances, their properties and uses, while important discoveries were made often by accident. Means of record were few, the desire to share knowledge was not general, and the loss of valuable information was possible. Theory was almost neglected, except for speculation on the kind and nature of the primary substance or on the elements. The amount of practical knowledge seems to have been much alike in all the countries of the earth that had arrived at a certain stage; drugs, dyes, the more obvious metals or those most readily obtained and worked, making of glass and pottery, tanning, textile industry, preparation of some of the compounds we call chemical as inks, paints, acids, oils, extracts, and some metallic salts.

MASTERMIND, PERIOD, TO ABOUT 1500 A.D.

In the period of alchemy, chemical knowledge was deliberately restricted to those persons whom the teacher thought suitable, generally the apprentice or assistant who worked years before being told his master's secret methods.
Faulty translation of the Egyptian and some of the later Arabic manuscripts led men to think that their predecessors had made gold and silver, whereas the directions given were for the making of alloys resembling the precious metals.

The Greek philosopher Democritus 470 (?) to 362 (?) B.C. wrote upon chemistry; his statements were taken over by Arabians writers later translated into Hebrew, and then to Latin; comparison of the original Greek text, the papyri from Egypt and the Latin of the period of alchemy shows the confusion that arose in the attempts to repeat the Egyptian work. In this futile work, improvements were made in apparatus and technique; but scarcely any truly scientific advance. Some individuals made scattered discoveries, as Roger Bacon (1214-84), "demonstrated that things are deemed to be supernatural merely through ignorance of natural philosophy" (Brown), but even Bacon had to profess to believe in magic to save his life. His work with gunpowder is the best known but his real service was to give an impulse to original research, instead of accepting older authorities blindly.

PERIOD OF MEDICAL CHEMISTRY (PYRENEUMONIA) 1580 to 1650 or 1680

This was a fairly logical result of the idea of alchemy; a substance capable of transforming base metals into gold and silver must be powerful, and as a medicine would probably be a universal remedy, a panacea for all ills. All that was needed then, granted that the philosopher's stone existed or could be made, was to find a solvent; and it seemed probable that this solution, elixir, should be capable of prolonging life or causing eternal youth. Theory was lost sight of and science was not, in the struggle for this elixir. Physicians or alchemists claimed to be weaving the chemists; however in some cases they hit upon compounds of actual value as medicines. Paracelsus severely condemned chemistry a place as a science, but claimed that every physician should be taught it; some attempts were made to communicate information discovered, but van Helmont's work on gases was practically lost for a century.

PERIOD OF PHLOGISTON 1680 to 1786

The idea that some connection existed between fire, life, combustion and evaporation, had been suggested; Roger Bacon called air the food of fire. But it remained for two German chemists to present the explanation of combustion in a plausible form, i.e., that every substance that was affected by fire in the manner of burning possessed some quantity of an imperceptible, perhaps imponderable constituent, one man suggested that it had a negative weight, elementary in character. This phlogiston, mere name as it was, persisted for more than a century, and eminent men made out careful tables showing the quantities of phlogiston in various compounds and substances. Not till the study of gases had progressed till van Helmont's gas atmosphere was rediscovered, and oxygen was isolated, identified, named and fairly thrust upon the scientific world, was the phlogiston theory actually given up.

MODERN PERIOD 1786 to ?

This is usually assumed to begin with the acceptance of the new element oxygen, after the publication of Lavoisier's paper. Now it became possible to
do real analysis, and the improved methods made accurate work; the next step was synthesis, then the study of the complex substances of living matter, and the discovery that organic compounds could be made without the aid of the vital principle, with Wöhler's synthesis of urea. This began the study of the carbon compounds; it took first place for many years and it is a question now answered according to the speaker's personal bias, whether the present science is chiefly physical chemistry as the elder Ostwald said in 1884, the chemistry of colloids (the younger Ostwald proclaimed this in 1896), the chemistry of the twentieth century?", the chemistry of the radioactive elements, pure organic chemistry, or, what is perhaps its most important application, biochemistry, i.e., that of living matter.

Some people divide this time, 1780 on, into the quantitative, and later the carbon period, when Liebig's explanation of the structure of carbon compounds is another landmark.

Since then, the commercial side of the science has grown and extended into almost every industry. The discovery of sodium and sodium-free glass opened a new chapter in industry, and lends a semblance of truth to the early conception of a universal "primitive" substance. Electrochemistry, physical and colloid chemistry, the metallurgical study of alloys, applications of chemical science in agriculture, biology, and medicine have put chemistry in close contact with nearly every man's life. The development of chemistry as an important weapon in war emphasized the variety and importance of the resources for that purpose in a manner beyond the wildest imaginings of the writers of fiction; this moreover served to bring chemistry into universal notice, and emphasized its value as a curative agent for the harm it was doing. The history of the science since 1850 or 1900 has yet to be written, for any contemporary account lacks the perspective, given by time, that enables the historian to decide on what was of real importance.

REFERENCES ON THE HISTORY OF CHEMISTRY

The references given later, no. 1.4, present in a little over a hundred pages, a concise history of general chemistry in English.

1. Ancient, alchemical, astrochemical, to 1550
Romsey, Essays, pp. 1-17; or Moule, History, pp. 1-24; or Thorpe, W., I, pp. 1-23

2. Philochemic, Boyle to Lavoisier, 1650-1790
Tilden, Short history, Ed. 2, pp. 1-17; or Moule, pp. 23-46; or Ladenburg, History, pp. 1-12; or Thorpe, I, pp. 54-63

3. Modern, 1798-1920, Dalton to Benzene, inclusive, in part
Brown, History, pp. 313-352; or Thorpe, I, pp. 84-120

4. Modern, 1920-1900, Lideb and later workers
Thorpe, Essays, Ed. 2, chap. 16, pp. 511-555

Supplementary chapters in English are also found in these:
1, a. Ancient
Bauer, History, pp. 1-60; Meyer, History, pp. 1-39, Ed. of 1891

Later chapters in each turn up analytical and astrochemical, at more length.
2a. Philopatin
Browe, History, pp. 223-274
Ramsay, Essays, pp. 18-39

4a. 1880-1900, in Great Britain particularly
Thomson, Ed. 2, chap. 11, pp. 554-562

Tilden in his Chemical discovery and invention in the seventeenth century, 1910, considers most of the important developments up to the entrance of chemistry into the war.

4b. Jones, New era in chemistry, pp. 1-73; this is descriptive of the new research.

For American chemical history and biography in particular there are besides a number of papers by various authors, usually found in the Journal of the American Chemical Society, the following books, all by Edgar F. Smith:

Chemistry in America: chapters from the history of the science in the United States, 1914.
The Life of Robert Hart, an American chemist, 1784-1858, 1917.
James Woodhouse, a pioneer in chemistry, 1770-1809, 1918.
Princeton in America, 1724-1864, 1921.

A number of works have appeared recently, but it is too soon for the complete history of chemistry in the war during 1914-19 to be written, and the section of new developments in medicine will be nearly equal to that describing chemical as weapons.

ORGANIC CHEMISTRY: BOOKS AND WORKS OF RESEARCH

The distinction between the chemistry of living and non-living matter was first made by Nicholas Louis de la Cava de Bovin, in 1675. The term "organic chemistry" was not in use till nearly or quite 1800; the authors discuss the chemistry of animal and vegetable matter. This division of chemistry is still more recent in some ways than the inorganic, but the literature is voluminous and well arranged for use.

The books and reference works may be grouped as follows:

A. Books in general
1. Comprehensive descriptive
2. Briefier works
3. Laboratory manuals

B. Special works
1. Methods
2. Preparations
3. Analysis

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