

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 Abegg's in Gmelin-Kraut's *Handbuch*, supplemented by the data from Hoffman's *Lexikon*, and the newer material from the general abstract serials.

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## LECTURE 7

### SUGGESTIONS UPON 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 catalogue have the subject on the top line, usually in red; in the Chemistry library catalogue, 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 comprehensive works in that field, as *Lange*, or *Allen* for technical analysis, and consult the 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 dictionaries may be used, as *Ladenburg* for the older historical work, or *Thorpe*, Ed. 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

1789-, *Annales de chimie*

1822-, *Jahresbericht* (Berzelius)

1832-, *Annalen der Chemie*

1832-, *Chemisches Zentralblatt* (then *Pharmazentisches Centralblatt*)

1834-, *Journal für praktische Chemie*

Of these all but the fourth have collective indexes.

##### B. 1840 to 1870

Add to the ones above the following:

1840-58, *The Chemist*

1841-, *Journal of the Chemical Society*

- 1842-59, *Chemical Gazette*; continued by *Chemical News*, 18  
on  
1847-, *Jahresbericht* (Liebig and Kopp)  
1858-, *Bulletin de la Société chimique de Paris* (now de  
France)  
1867-, *Berichte der deutschen chemischen Gesellschaft*

Note that Berzelius' *Jahresbericht* ceases with 1849; *Chemist and Chemical Gazette* have only annual indexes. The abstracts in *Annales*, *Annalen*, 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. 1870 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 i, will probably be of use only if the topic is definitely applied (industrial) chemistry; for those who can not read German, choice 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 quickest work, the order might be as follows:

- a, *Chemical Abstracts*, decennial 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 1907 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 Scien-*

tive Literature, 1901 on, is useful to make sure that no papers have been overlooked.

Patents are to be looked up first by means of the abstract serials under subject; having both topic and patent number or even the latter alone, abstracts may be found in the Chemical Abstracts, Journal of the Society of Chemical Industry, and the volumes of the *Zeitschrift für angewandte Chemie*, up through 1918; after that date all abstracts from the *Zeitschrift* are published as the *Technischer Teil* of the *Chemisches Zentralblatt*. If the patents are for particularly technical processes, some account may be found in Wagner's *Jahresbericht*, that also has an index by patent numbers.

## II. *Inorganic chemistry*

For this, before 1840, 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 Hoffman, *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-Kraut'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-Kraut or of Abegg; later when they are completed consult the *Textbook* of inorganic chemistry, edited by Friend, or the newer six-volume *Inorganic chemistry* by Mellor. 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 reference 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 periods 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*

1896 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 Chemists' 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, 1913-, 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 TIME COVERED

#### *General chemistry*

- 1789-1870 Annales de chimie et de physique; a few abstracts to 1873  
1822-1849 Jahresbericht über die Fortschritte der Chemie und Mineralogie (Berzelius)  
1830-date Chemisches Zentralblatt; name varies; 1830-31 not here  
1832-1860 Annalen der Chemie; abstracts were never numerous and gradually decreased  
1834-1873 Journal für praktische Chemie; abstracts practically ceased then  
1840-1858 The Chemist; ceased publication  
1841-date Journal of the Chemical Society, London; the volumes for 1841 to 1846 had title Memoirs, but index for them is in first collective one  
1842-1859 The Chemical Gazette; continued by the Chemical News  
1858-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 Jahresbericht  
(Liebig & Kopp)

- 1877-date Chemiker-Zeitung: Repertorium; sometimes bound separately  
 1879-1905 Journal of the American Chemical society  
 1891-date Jahrbuch der Chemie (Meyer); selected abstracts only  
 1899-1918 Revue générale de chimie pure et-appliquée; abstracts section called Répertoire, and bound separately part of the time; the serial has not been received here since 1918  
 1901-date International Catalogue of Scientific Literature: Chemistry; this is an index serial, no abstract 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*

- 1858-date Jahresbericht über die Fortschritte auf dem Gesamtgebiete der Agrikulturchemie (Hoffman)  
 1872-date Zentralblatt für Agrikulturchemie (Biedermann)  
 1889-date Experiment Station Record (U. S. Department of Agriculture)

### *Analytical*

- 1862-date Zeitschrift für analytische Chemie  
 1877-date The Analyst  
 1896-date Annales de chimie analytique et de chimie appliquée  
 1908-date Annales des falsifications (now, et des fraudes)

### *Biochemical*

- 1871-1918 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 1900-05; Zentralblatt für Physiologie und Pathologie des Stoffwechsels, 1906-11; none received since July, 1914.  
 1902-date Zentralblatt für Biochemie und Biophysik; this was Biochemisches Centralblatt, 1902-09; is now Berichte (1919 on), below  
 1916-date Physiological Abstracts  
 1919-date Berichte über die gesamte Physiologie und experimentelle Pharmakologie (Neue Folge des Zentralblatts für Biochemie)  
 1921-date Physiological Reviews; this is a review serial, American

### *Food*

- 1882-date Zeitschrift für Untersuchung der Nahrungs- und Genussmittel: 1882-90 had title Vierteljahresschrift der Chemie der . . .  
 1889-date Experiment Station Record (U. S. Dept. of Agric.)  
 1891-date Zeitschrift für Fleisch- und Milchhygiene  
 1891-date Hygienische Rundschau  
 1901-date Répertoire . . . sur la composition . . . des denrées alimentaires (first three volumes published in Dutch)  
 1908-date Annales des falsifications et des fraudes

### *Organic*

Here because of the existence of Richter's Lexikon, and its supplement, the Literatur-Register, with Beilstein'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, thus providing lists newer even than the Literatur-Register. These serials are:

- Annalen der Chemie
- Annales de chimie
- Berichte der deutschen chemischen Gesellschaft
- Journal für praktische Chemie
- Journal of the Chemical Society (in the Transactions section)
- Monatshefte
- 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) 1905-10; a formula index, giving both inorganic and organic compounds is a new feature of the annual index of Chemical Abstracts, beginning with 1920.

### *Pharmaceutical*

- 1809-date Journal de pharmacie et de chimie (ser. 1, 1809- 14 called Bulletin); set at Illinois is not complete
- 1830-date American Journal of Pharmacy
- 1841-date Pharmaceutical Journal and Transactions (now Pharmacist); this has very few abstracts now
- 1842-1859 Chemical Gazette
- 1851-date American Pharmaceutical Association: Proceedings; called Yearbook, 1912 on
- 1919-date Berichte über die gesamte Physiologie und experimentelle Pharmakologie

Some pharmaceutical literature is abstracted in the serials on biochemistry, particularly the Jahresbericht (Maly) 1870 to 1918.

### *Physical*

- 1889-1904 Zeitschrift für physikalische Chemie
- 1894-1907 Jahrbuch der Elektrochemie und angewandten physikalischen Chemie
- 1896-1906 Journal of Physical Chemistry
- 1903-1912 Journal de chimie physique
- 1904-date Fortschritte der Chemie, Physik und physikalische Chemie; this was an abstract serial, 1904-09 with title Physikalisch-chemisches Centralblatt and was called "international"; with the new name it became a review serial

### *Technological*

- 1855-date Jahresbericht über die Leistungen der chemischen Technologie (Wagner)
- 1877-date Chemiker-Zeitung: Repertorium

- 1880-1905 *Technisch-chemisches Jahrbuch*  
 1882-date *Journal of the Society of Chemical Industry*  
 1887-1918 *Zeitschrift für angewandte Chemie*; abstracts 1919 on, are technological section of *Chemisches Zentralblatt*; the *Zeitschrift* was preceded by *Repertorium der analytischen Chemie*, 1881-87  
 1898-date *La revue des produits chimiques*; organ of *Le Cercle de la Chimie*; set at Illinois is incomplete  
 1909-date *Journal of Industrial and Engineering Chemistry*; the abstracts in this began in 1914, and are for U. S. and State publications  
 1914-1917 *Journal of Chemical Technology*; for chemists of the British empire; seems to have been stopped by war  
 1914-date *L'industrie chimique*  
 1916-date *Reports of the Progress of Applied Chemistry*, by the Society of Chemical Industry; review serial, similar to the *Annual Reports of the Chemical Society*  
 1918-date *Chimie et industrie*  
 1919-date *Giornale di chimica industriale ed applicata*

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## LECTURE 8

### SUMMARY ON THE HISTORY OF CHEMISTRY, WITH REFERENCES

#### ANCIENT PERIOD TO ABOUT 350 A. D.

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 Chaldea, Crete, Egypt, with the records from India and China, form the principal part of the actual historical information; various legends or traditions add something, that 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 divisions 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.

#### ALCHEMICAL 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 Arabian writers, later translated into Hebrew, and then to Latin; comparison of the original Greek text, the papyrus 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 (IATROCHEMISTRY) 1500 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 those who claimed to be were the chemists; however in some cases they hit upon compounds of actual value as medicines. Paracelsus scarcely conceded 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 1780

The idea that some connection existed between air, fire, combustion and respiration, 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 being burned 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 sylvestre* was rediscovered, and oxygen was isolated, identified, named and fairly thrust upon the scientific world, was the phlogiston theory actually given up.

#### MODERN PERIOD 1780 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 1906 "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 prefer to divide this time, 1780 on, into the quantitative, and later the carbon periods, while Kekulé'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 radium and radio-activity opened a new chapter in theory, and lends a semblance of truth to the early conception of a universal "primitive" substance. Electrochemistry, physical and colloid chemistry, the metallographic 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 emphasize its value as a curative agent for the harm it was doing. The history of the science since 1890 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 below, no. 1-4, present in a little over a hundred pages, a concise history of general chemistry in English.

1. Ancient, alchemical, iatrochemical, to 1650  
Ramsays, *Essays*, pp. 1-17; or Moore, *History*, pp. 1-24; or Thorpe, v. I, pp. 1-53
2. Phlogiston, Boyle to Lavoisier, 1650-1790  
Tilden, *Short history*, Ed. 2, pp. 1-17; or Moore, pp. 25-46; or Ladenburg, *History*, pp. 1-12; or Thorpe, I, pp. 54-83
3. Modern, 1780-1820, Dalton to Berzelius, inclusive, in part  
Brown, *History*, pp. 313-352, or Thorpe, I, pp. 84-120
4. Modern, 1820-1900, Liebig and later workers  
Thorpe, *Essays*, Ed. 2, chap. 16, pp. 514-553

Supplementary chapters in English are also found in these:

#### 1. a. Ancient

Bauer, *History*, pp. 1-60; Meyer, *History*, pp. 1-20, Ed. of 1891

Later chapters in each take up alchemy and iatrochemistry, at more length.

2.a. Phlogiston

Brown, History, pp. 224-274

Ramsay, Essays, pp. 18-30

4.a. 1820-1900, in Great Britain particularly

Thorpe, Essays, Ed. 2, chap. 17, pp. 554-582

Tilden in his Chemical discovery and invention in the twentieth century 1916, considers most of the important developments up to the entrance of chemistry into the war.

4.b. Jones, New era in chemistry, pp. 1-75; this is descriptive of the newer 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 Hare, an American chemist, 1781-1858. 1917.

James Woodhouse, a pioneer in chemistry, 1770-1809. 1918.

Chemistry in old Philadelphia. 1919.

Priestley in America, 1794-1804. 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.

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## LECTURE 9.

### ORGANIC CHEMISTRY: BOOKS AND WORKS OF REFERENCE

The distinction between the chemistry of living and non-living matter was first made by Nicholas Lemery in his Cours de Chymie, in 1675. The term 'organic chemistry' was not in use till nearly or quite 1800; the authors discussed the chemistry of animal and vegetable matter. This division of chemistry is thus 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. Briefer works
3. Laboratory manuals

B. Special works

1. Methods
2. Preparations
3. Analysis