1910, Holbaum, Zeitgemässe, Herstellung, Bearbeitung und Verzierung d feineren Hohlglases;

1911, Diakonov und Lermantov, Die Bearbeitung des Glases auf dem Blas tisch. Ed. 2;

1914, Frary, Laboratory manual of glass blowing;

1920, Vigreux, Le soufflage du verre dans les laboratories scientfiques industriels. Ed. 2.

1921, Bolas, Handbook of laboratory glass blowing.

Bulletin 107 of the U. S. Bureau of Standards reports tests of chemical glas ware, and considerable material may be found in the chemical serials, 1914 to dat

Two periodicals on apparatus in German are the Zeitschrift für Instrumen kunde, and Chemische Apparatur; the latter is here and seems to pay mc attention to equipment of large size.

Prices of chemicals and supplies may be had from the various dealer catalogs, and these may be checked by the weekly price quotations for chemica in the Drug and Chemical Markets, or the similar lists in the Oil, Paint and Dru Reporter. The manner and amount of material needed to fit up a small labor tory will differ with the purpose for which it is planned; the dealers have list copious enough, for ordinary student equipment, and are ready to furnish then the specialist will know what extra pieces his work requires. Nagel, Mechanic appliances of the chemical and metallurgical industries, Ed. 2, 1909, and h Lay-out, design and construction of chemical and metallurgical plants, 191 are for the engineer rather than the chemist, besides being now old. Dyso Manual of chemical plant, is descriptive of progress in the devising of apparatu on the large scale.

LECTURE 5

INORGANIC AND MINERAL CHEMISTRY: BOOKS

This, the oldest section of chemistry, has in recent times seemed almo overshadowed in importance by the developments in the organic section; rece work upon theoretical inorganic, structure and other phases, with alloys ar metallography, has brought the inorganic side into prominence. The bool here include those on the elements, inorganic proper, and those on the miner and metals, the manufactured products.

A. *General works*
   1. Comprehensive
   2. Brief
   3. Dictionaries

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

C. *Related topics*
   1. Metallurgy
   2. Metallography
   3. Assaying

D. *Special substances*
   1. Precious metals
   2. Iron and steel
   3. Other metals and minerals
   4. Alloys

A, 1. *Comprehensive*

These are at present five, two in German, two in English and one in French. In German, the oldest, counting from when it was started, is the Edition 7 of Gmelin-Kraut's Handbuch; this is now nearly complete, with supplements in each part, the individual parts and volumes ranging in date from 1907 down. It has many references, mixed in among the text. Abegg's Handbuch der anorganischen Chemie, likewise not yet complete, has here at present six bound parts; the chapters are dated if they differ from the volume in point of time, and the references are massed at the close of the chapters, with reference to them by number in the text.

The Treatise on chemistry, originally prepared by Roscoe and Schorlemmer, and called theirs yet, has Ed. 4 and in part Ed. 5, for the two volumes on inorganic chemistry; the organic section which formed part of the original has not been revised in the English version for over thirty years. The longer English work is the Textbook of inorganic chemistry, 1914-, to be in 9 volumes, edited by J. Newton Friend; this is a set of monographs by authorities upon the different divisions, and gives references to newer literature than either of the German ones. Mellor's Higher inorganic and theoretical chemistry, to be six volumes, is in press. Moissan's five-volume work resembles the Roscoe and Schorlemmer, though more extensive, but was published, 1904-06.

A. 2. *Brief works*

These are generally in one volume, and include works of widely differing purposes. The newest English one is Partington, A textbook of inorganic chemistry for university students, 1921, having over 1000 pages, and copious references to original papers. A similar American work is Norris, Textbook of inorganic chemistry for colleges, 1921, having nearly 700 pages; it is in the International Chemical Series of the McGraw-Hill Book company. Mellor's Modern inorganic chemistry, New edition, 1918, is almost as large as the Partington. Others only slightly less are the new editions of Newth, Alex. Smith, Holleman, all in English. There are also the German edition of Erdmann, Ed. 2, 1900, Blount in English, Ed. 10, and the older Ostwald, and Ramsay; recent French and German ones we do not have as yet. Werner's volume on structure and the fourth edition of Stewart's Recent advances in inorganic and physical chemistry, 1921, are on special phases of inorganic chemistry. The recent works by Levy, Spencer, Johnston, on rare earths, with Browning on analysis for rare elements, cover only portions of the inorganic field.

A, 3. *Dictionaries*

For historical purposes, Ladenburg's Handwörterbuch, 13 volumes with collective index, is good; for modern work on application, Thorpe's Dictionary of applied chemistry, Ed. 3, to be in six volumes, (v. 1, Jan., 1921) or the older Ed. 2 in five volumes is best. For inorganic chemistry purely, Hoffmann's Lexikon is the most useful, but is not completed; planned to combine the encyclopedic with the condensed material of a dictionary, it gives all known compounds presumably, with reference to the literature, very often to Ed. 7 of Gmelin-Kraut; this is done as follows: N: 5, 2, 879, that is, see Gmelin-Kraut, Ed. 7, vol. 5, part 2, page 879. Comey and Hahn, Dictionary of solubilities, 1921 seems very satisfactory; Segerblom's similar work is elementary in character.

B, 1. *Methods*

The only large recent one is Stähler's Handbuch, to be complete in a short time probably, in several volumes.

B, 2. *Preparations*

The largest and newest is the inorganic volume of Vanino, Handbuch der präparativen Chemie, 1913, which presents the best information available at that date; its predecessor, the inorganic volume of Bender and Erdmann's Chemische Präparatenkunde appeared in 1893. Smaller works, but all old, are Blanchard, Lengfeld, an English edition of Erdmann's brief text, and the book by F. H. Thorp, 1896, which is often used yet as a laboratory manual.

B, 3. *Analysis*

The only work here specifically upon quantitative inorganic analysis is Mellor's Treatise of 1913, designed for ceramists. Much is found of course in the general works, as Prescott and Johnson, Treadwell, while Scott in his Standard methods, 1917, gives 500 pages to analysis for the elements before taking up compounds. Lunge, Technical methods, presents much upon inorganic analysis. The descriptive industrial works, as the new editions of Martin and Molinari, contain some material upon analysis of substances.

C, 1. *Metallurgy*

Here the number of books is large, but not all are available. Hoffman, General metallurgy, 1913, has not been superseded yet; Fulton's Principles is dated 1910. Types of the older ones are Austin, Metallurgy of the common metals, Ed. 4, 1913; the two-volume work of Schnabel, translated from the German, Ed. 2, 1907; Ed. 3 of this, 1921, 2 vol., is practically new, Louis the translator having revised and enlarged it considerably.

C, 2. *Metallography*

This subject takes up the relation between chemical and physical properties and internal structure, and there are several recent works. Guertler's, begun in 1909, is not finished; Hoyt has a new (1921) three-volume work partly done; Rosenhain, Physical metallurgy, 1915, has much of value; Robin, in French, 1916, is much like it; Ruer, 1910, and Goerens, 1908, both small, were in German but have been translated. Desch's book, written in English, 1910, has been somewhat revised and translated into German. Osmond's older book on microscopical analysis of metals belongs here.

C, 3. *Assaying*

Rhead and Sexton is a type of the older books; Ed. 2, rev., is 1914; Furman, 1905; Lodge, Ed. 3, 1911; Fulton, Fire assaying, 1911; Lord, 1913, and White, 1915, are on metallurgical analysis; Low, Technical methods of ore analysis, Ed. 8 rev., 1919, is good and new. Moses and Parsons, Elements of mineralogy, crystallography and blowpipe analysis, Ed. 5 rev., 1916, may be included here.

D, 1, 2, 3. *Special substances*

For works on the different metals see the names in the catalogue; some recent ones descriptive of the various minerals in general are the following:

Dammer, B. and Tietze, O. Die nutzbare Mineralien mit Ausnahme der Erze, Kalisalze, Kohlen und des Petroleums, 2 vol. 1913;

Bayley, W. S. Descriptive mineralogy. 1917;

Phillips, A. H. Mineralogy. 1912;

Merrill, G. P. The non-metallic minerals. Ed. 2. 1910.

Samples of special works are Hofman, and Peters, on copper; Sauveur; Bradley Stoughton, Howe, and Johnson, on iron and steel; Ingalls, Betts, on lead; Richards, on aluminum; Smith, on zinc.

D, 4. *Alloys*

The Waterbury book of alloys is for the manufacturer; Giua and Giua, Chemical combination among metals, 1918, is the most recent, till Hoyt's of 1921; others are Buchanan, Practical alloying, 1910, and the older works by Brannt, Desch, Laws, Hiorns. Analysis of non-ferrous alloys is taken up by Price and Meade (American), Ibbotson and Aitchison (English), and a new work by J. R. Downie, published by Spon in 1920.

LECTURE 6

INORGANIC AND MINERAL CHEMISTRY: SERIALS

There is only one specific serial for inorganic chemistry, but most of the general serials and a number of those upon applied chemistry have some articles upon the topic; there are several special serials for individual metals or separate subjects.

A. Serials containing general original papers.

B. Serials containing abstracts or reviews.

C. Special serials.

A. *General*

Here the first is the Zeitschrift für anorganische Chemie (und allgemeine Chemie was added to the title in 1914); this was founded in 1892, to rescue the papers on inorganic chemistry from being submerged by the flood of organic ones, and has always had original papers only; there is a collective index for the first fifty volumes, with annual indexes for the several volumes of each year.

The four others perhaps next in value for this field are Journal of the Society of Chemical Industry, 1882-, Zeitschrift für angewandte Chemie, 1887-, Journal of Industrial and Engineering Chemistry, 1909-, and the Chemical and Metallurgical Engineering, 1902-, (fourth variation of the title). The first has always had both original papers and many good abstracts; the second had too, until January 1919, when its abstracts became a section of the Chemisches Zentralblatt;

the Journal of Industrial and Engineering Chemistry had no abstracts till 1914, when it began to give abstracts of U. S. and State publications of interest to chemists. The fourth, largely electrochemical, has had in recent years a few abstracts; all four contain patents, some book reviews and general notes on society meetings. The Engineering and Mining Journal contains less chemistry, but occasionally has valuable articles.

B. *Reference serials*

Here, use the general abstract serials, usually, with those from the first and second of the list above. Note that inorganic compounds are entered in the formula index of the index for Chemical Abstracts, v. 14, 1920. The inorganic section, later a whole volume, of Wagner's Jahresbericht, 1855-, has some abstracts; others are found in the Repertorium section of the Chemiker-Zeitung, 1877-, which is chiefly on general chemistry with emphasis on applications of commercial value. Current prices for metals are found in the third and fourth of the list in A, and, for chemicals, in the Drug and Chemical Markets, weekly, N. Y.

C. *Special serials*

Metallurgy: Here are the French, La Metallurgie, the Italian La metallurgia italiana, and the German, Metallurgie, that is now divided into two, Metall und Erz, and Ferrum. The French Revue de metallurgie leans strongly to metallography, and has each year one volume of abstracts.

Metallography: The old Metallographist became the Iron and Steel Magazine, and was then absorbed by what is now Chemical and Metallurgical Engineering. Similar material is in the Journal of the Institute of Metals (English) and the Transactions of the American Institute of Metals (American, and now part of the publication Mining and Metallurgy from the American Institute of Mining and Metallurgical Engineers), and in the Journal of the American Steel Treaters' Society (now Transactions of the American Society for Steel Treating). The Internationale Zeitschrift für Metallographie, 1910-16, is now Zeitschrift für Metallkunde.

Minerals and mining: The Bulletins of the U. S. Bureau of Mines, and the publications of the U. S. and State geological surveys contain much material: the Mineral Resources of the U. S., annual, is good but slow to appear as a bound volume. The Engineering and Mining Journal has current information, with annual summaries, and publishes the Mineral Industry, an annual descriptive and statistical volume, usually promptly published, and unrivalled in its field.

Alloys: All the metallographic serials have articles on alloys; the Brass World indicates its topic by the title, while the Metal Industry includes a wider range of non-ferrous metals; these are practical papers but have some scentific articles.

Iron and steel: For this field there are many serials, but only a few are at chemistry; the works of the two Institutes of Metals noted above, and Ferrum, with the serials upon metallography are here. Stahl und Eisen is more of an engineering serial, and so too are Eisen-Zeitung, Journal of the Iron and Steel Institute, with the bulletins and other publications of the American Iron and Steel Association.

For the literature of the separate elements and their compounds, a good rting 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.

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 Lunge, 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 Pharmazeutisches 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