

LECTURE 11

APPLIED CHEMISTRY: BOOKS

Works upon this topic are designated in the card catalogue under the heading "chemical technology", but are also referred to at times as upon industrial chemistry; special works are entered in the catalogue under the most definite, specific heading. The classes of books in this group are as many as the industries that use chemistry; progress and thus change is so rapid that by the time a process is printed in a book for public use it has often been dropped by the industry for a newer, better one. Principles, and very general methods are, however, to be had in books, in more permanent and usable form than from serial articles, even if the book is partly out of date by the time the final proof has been read. All statements with regard to books upon applications of chemistry must be considered as qualified and limited by the specifications, "best at present", "most recent work available", or some similar phrase.

They may be classed in four groups, as follows:

- A. Dictionaries and other reference works
- B. General descriptive texts, usually emphasizing manufacture
- C. Books upon analysis, adapted for technical work
- D. Books upon special topics, industries, or processes

A. *Dictionaries and other reference works*

Here the newest just now is the third edition of Thorpe's Dictionary of applied chemistry, vol. 1 published early in 1921, to be six volumes, in place of the Ed. 2, with five volumes, 1910-12. Next to this is Ullmann's *Enzyklopädie der technischen Chemie*, planned to be ten volumes; vol. 8 includes only through *Papiergarne*, so the ten may be too low an estimate; the articles are of fair length, with many references to original papers, and particularly to the newest German books, including some published in 1918.

The *Condensed Chemical Dictionary*, 1919, is for the technical workers who want much data quickly, upon chemicals; the *Chemical Directory of the United States*, published annually, gives the names of chemicals, the manufacturers, apparatus and makers, with some lists of consulting chemists and recent literature; the *Chemical Engineering Catalog*, annual, 1916-, presents information upon equipment, chiefly that for large-scale production, in the United States. There is for Great Britain, a "Directory of members of association of British chemical manufacturers", giving also the products manufactured by each firm, listed in English, French, Spanish, Portuguese, Russian, and Japanese, but no copy is here. A somewhat similar work, combining some of the features of the three American works is the "*International Handbook of the World's chemical Industry and Trade*"; Edition E, part 1, was published in 1921; the book uses three languages, English, French, and German, and while perhaps the information was not all obtained at first hand, it seems to give material that no other book does.

Reference works of a more specialized type are these: *Andes, Technologisches Lexikon*, and three volumes by Bersch, *Lexikon der Farbentechnik*, *Lexikon der Metalltechnik*, and *Allgemeine Waarenkunde*; these give technical German terms, explained in more usual German words; published in Vienna originally, they are not dated, but the *Chemisches Zentralblatt* notes the publication of the final parts of *Andes* in February, 1901. J. K. König's *Warenlexikon für den*

Verkehr mit Drogen und Chemikalien, had Ed. 12 in 1911; Ed. 1 of E. Lengning's Waren-Lexikon für Chemikalien und Drogen is of 1920, and gives information upon 3460 substances, naming for many the firm (German commonly or Scandinavian) that can furnish them at present; names of substances are in German and French or Latin, English, and Spanish, with composition, preparation, properties and uses; this is much like the Condensed Chemical Dictionary, but has a narrower range of subjects.

B. *General descriptive texts, usually emphasizing manufacture*

The newest, or most recently published general works are the 1920-21 edition of Molinari, Treatise on general and industrial chemistry, in English with considerable material added by the translator; one volume is on organic, the other upon inorganic; prices of production, given in the earlier editions are different now. Martin, Industrial and manufacturing chemistry, 2 vol. in 3, 1914-17, consists of separate chapters by men of experience; references are given to the important works for each chapter or topic, at the head of each chapter, while others are added in the text. The newest edition of Rogers, Manual of industrial chemistry (formerly Rogers and Aubert), Ed. 4, 1921, gives in chapters 1-11 authorities, methods particularly important because they are the ones used in American practice. The most recent work here in French, is Chabrie, *Traité de chimie appliquée*, 2 vol., 1908. Lewes and Brame, Ed. 4, 1914, Ed. 5, 1920, Service chemistry, for the use of English army and navy training schools is really a textbook, descriptive, but has more material upon analysis than many; all however, give some analytical suggestions.

An English work now in press is A. J. Hale, *Modern chemistry, pure and applied*; this is to be six volumes, of which the first two are published; it is described as not for research workers but to give a general insight into the everyday applications of chemical science; references are given, but the description of technical processes are sometimes very brief, and as in the case of all such treatises, the book has hard work keeping up to the current advances. Older in English are Wagner, Ed. 3 here, and Groves and Thorpe, in four volumes; these are valuable chiefly as history. Thorpe, *Outlines of industrial chemistry*, Ed. 3, 1916, is much used as a textbook; Rogers, *Elements*, 1916, is an abridgement of his *Manual*; Benson, is of the same type, but less; Hart's *Textbook of chemical engineering*, 1921, is about the same size and according to one reviewer "describes the mechanical operations of industrial chemistry".

In German, of the recent works we have Wichelhaus, *Vorlesungen über chemische Technologie*, Ed. 3, 1912; H. Ost, *Lehrbuch der chemischen Technologie*, Ed. 10, 1919; the ninth edition was published in 1918; books given at the heads of chapters are sometimes as recent as 1914. Herzog, *Chemische Technologie der organischen Verbindungen*, 1912, is chapters by various authors; it has good illustrations of machinery. Like the Sadtler, the latter Ed. 4, 1912 also but in English, it is limited to the organic field.

General works of a slightly different type are those upon plant and equipment, as the two by Nagel, *Mechanical appliances of the chemical and metallurgical industries*, 1908, and *The lay-out, design and construction of chemical and metallurgical plants*, 1911; much in both of these is now superseded. Dyson

(English) in his Manual of chemical plant, 1916-, being published in small parts attempts to include "description of every new piece of chemical plant introduced in the past quarter of a century", with "exhaustive analysis of the patent literature for the same period".

Koller, on utilization of waste products, suggests fields for research, while Baskerville in his Municipal chemistry, 1911, points out ways in which the science can be of service to the community. A French book, L'essor des industries chimiques en France, 1917, by E. Grandmougin, tries to give an idea of the scope and possible future of chemical industries in France, with some account of the situation in the United States, the Scandinavian countries and Russia; the book seems to have been printed before April, 1917.

There are four long sets, or rather "publishers' series", monographs by men of some eminence usually, that try to include works upon most phases of industrial, i. e., all applications, of chemistry. The oldest is the German Handbuch der chemischen Technologie, originally edited by Bolley, and in 1909 by Engler, published by F. Vieweg; most of this is now of historical value only. The Monographs on Industrial Chemistry, edited by Sir Edward Thorpe, published by Longmans, Green and company, comprise now some 25 to 30 volumes, partly published, partly in course of preparation; seven are on the synthetic colouring matters; zinc, silk, coal, cement show the variety of topics; the editor says these "will afford examples of the application of recent knowledge to modern manufacturing procedure"; the earliest volume appeared in 1918.

The other newer English series, is 'Industrial Chemistry, being a series of volumes giving a comprehensive survey of the chemical industries', edited by Samuel Rideal, and published by Bailliére, Tindall and Cox; the subject "will be treated from the chemical rather than the engineering standpoint", the preface states. Titles have been listed for some 25 volumes, and about ten are in print now (July, 1921). The topics so far seem to be more organic than inorganic.

Several other English publishers have series being done that are similar; Manuals of chemical technology, edited by Geoffrey Martin, Crosby, Lockwood and son; Chemical monographs, edited by A. C. Cumming, Gurney and Jackson, these being as a rule of 100 small pages each; Chas. Griffin and Co. have been publishing chemical works since 1826; Benn Bros., of the Chemical Age (English) announce a series of "Chemical Age Textbooks of Chemistry" to give "the results of the most recent research in every branch of chemical science", the first, to be The chemistry of colloids by Dr. E. K. Rideal; Benn Bros. have also in preparation a series of small Chemical Engineering handbooks the first twelve volumes to appear the latter part of 1921; these will probably be less scientific than their first-named series.

The American Chemical Society, by arrangement with the Interallied Conference of Pure and Applied Chemistry, London and Brussels, 1919, was to undertake the production and publication of Scientific and Technologic Monographs on chemical subjects; these are published from The Chemical Catalog Company of New York City, and several have appeared, the first being Falk, Chemistry of enzyme actions; others are being prepared.

In general, all these series try to consider the more important chemical industries, giving references to other, special works. The diversity of authors makes the volumes vary somewhat in style of treatment and sometimes in actual value.

C. *Books upon analysis, adapted for technical work*

There are a few huge, general works, and a multitude of special ones, the latter covering every application of chemistry, from the dairy to the steel mill.

The largest of the first class is Allen, *Commercial organic analysis*, Ed. 4, in 9 volumes, the final one having some new material and a collective index for the whole work; Lunge, *Technical chemical analysis*, 3 vol. in 6 in the English edition, has much on organic industrial; the newest here is Villavecchia, *Treatise on applied analytical chemistry*, 2 vol., 1918, for industrial and food products; Griffin, *Technical methods of analysis*, 1921, gives standard procedures of the A. D. Little laboratories. Post's *Chemisch-technische Analyse*, Ed. 3, 2 vol. is of 1908. Of the two series, one edited by Margosches, *Die chemische Analyse*, is a group of monographs on various substances, and is here; Peters, *Handbuch der chemischen Analyse*, to be 14 vol., has not come yet, though publication of its parts began before the war.

Some special works of considerable interest are Lewkowitsch, Ed. 5, on oils, fats and waxes; Leach, Ed. 4, on food analysis; Wiley, Ed. 2 and Pott (in German), on agricultural analysis; the new Official and tentative methods of analysis, 1920, of the Association of Official Agricultural Chemists, taking the place of U. S. Bureau of Chemistry Bulletin 107; Standard methods for water analysis, newest edition; Johnson, Ed. 3 on steel analysis; the above are fairly typical of their class.

D. *Books on special topics, industries, or processes*

These are extremely numerous, and tend to become out of date faster than the more general works; some fairly typical ones in various fields are noted below. Others for almost all subjects are to be found in the series noted above under C.

Coal tar industries

This includes coal, coke, gas, the distillation products, dyestuffs, drugs; Lewkowitsch discusses coal; Wagner has three recent works on the first three. Hempel, Harrop, Dennis, take up gas analysis, while Parr includes coal at more length. The making of gas is discussed by Hornby, Latta, Stone, Russell. For dyes the best are Fay, Cain and Thorpe, Beacall, Knecht, and, on analysis of dyestuffs, Green, 1915, and volume three of Mulliken on identification; a recent work in German on manufacture is by H. E. Fierz, *Grundlegende Operationen der Farbenchemie*, first published in 1920, translated as *The fundamental processes of dye chemistry*, by H. E. Fierz-David, 1921. Bucherer, *Lehrbuch der Farbenchemie*, appeared in 1918, and is said to be good.

Explosives

There are new editions of Brunswig, and Guttman; Ed. 2 of Marshall is a two large volumes, contains more than the one volume by Colver, but the latter

is more conveniently arranged; there is a new one-volume work by Marshall dealing specifically with American manufacturing processes and he has also a brief dictionary; Smith, on T N T, 1918, is an example of a highly specialized book.

Food

Besides the works on analysis of foods already mentioned, by Leach, Sherman, and others, there is the comprehensive treatise, now in Ed. 4, with supplement, by J. König giving data on the source, use, composition and methods for analysis, of practically every substance used in or for human food. H. D. Richmond, English, and Barthel, translated from Danish, take up dairy chemistry; James Grant, Chemistry of breadmaking, is now Ed. 3; R. N. Hart, Leavening agents, is 21. Emil Pott, Handbuch der tierischen Ernährung und der landwirtschaftlichen Futtermittel in three volumes, now over ten years old, is good for its field.

Oils

For mineral oils there are the new American works, Bacon and Hamor, 2 vol., descriptive, and Hamor and Padgett, one volume, 1920, on analysis; Cross, Handbook of petroleum, 1919, gives data with analytical methods, while Ellis and Meigs, Gasoline and other motor fuels, 1921, is perhaps less purely chemical. Finkler and Challenger, Chemistry of petroleum, is 1915 and English; so is Campbell, Petroleum refining, 1918; Redwood's huge treatise has in Ed. 3, 1913, three volumes, and many thousands of references. The three volumes, by Engler and Höfer in German, take up all phases of the mineral oil situation, i. e., the geology, chemistry, and its place in commerce. Kissling, Chemische Technologie des Erdöls, 1915, is vol. IX of the third series of Bolley's Handbuch der chemischen Technologie, the series noted under B; Holde's book is now published in English from the fourth German edition as "The examination of hydrocarbon oils and of saponifiable fats and waxes", 1915. Various U. S. and State publications from the respective Geological Surveys take up particular fields and phases; there are also some publications from the U. S. Bureaus of Mines and of Standards; the latter giving tests and standards; some specifications are in the publications of the International Society for Testing Materials.

For other oils, the work of Lewkowitsch, Ed. 5, in three volumes is excellent; it may be supplemented by Gildemeister and Hoffman, The volatile oils, to be three volumes; vol. 1, 1913, vol. 2, 1916. Andes has a volume each for animal fats and oils, vegetable fats and oils, and drying oils, the last emphasizing methods of manufacture; on linseed and cottonseed oils there are special works. Battle, 1916, has a Lubricating engineer's handbook, containing considerable chemistry.

Paint and varnish and materials

Some of the recent American works are Toch, Ed. 3, Sabin on manufacture. Gardner, Papers on paint and varnish, 1920; Holley, Cushman, Gardner and Cushman, on analysis and tests; the edition of 1912 in English of Bottler, German (and American) varnish making; English are, Friend, Chemistry of paints, 1910; Smith, Manufacture of paint, Ed. 2, 1915; Hurst's Laboratory guide is of 1902,

and his Dictionary of chemicals and raw products, 1901. Andes, Friend, and Newman discuss use of paint to prevent corrosion. The bulletins and circulars of the Educational Bureau of the Paint Manufacturers' Association of the United States give reports of tests of paints and raw materials.

Pharmaceutical

The U. S., British, and German Pharmacopœias give standards and official preparations, while more details and some references are in the U. S. Dispensatory. The German encyclopedic work, Hager's Handbuch der pharmaceutischen Praxis, Ed. 7, 2 vol. and supplement completed in 1913 is here in part only. The new editions of Sollmann, Cushny, and Dixon are the best here now; for synthesis May, Fränkel, Kobert (the last two in German) also the 2-vol. Heinz, 1905-C are used. For analysis, Fuller is newest; May, Nelson, and Antenrieth (poisons and drugs) are here too.

Photography, particularly microphotography

Meldola's volume, 1889, is rather old, but is of some use; Derr, Photographie, 1909, though older is less theoretical than the work by Sheppard and Mees, Investigation on the theory of the photographic process, 1907; Flint, Chemistry for photographers, 1916, is for actual work. Bagshaw, Elementary photomicrography Ed. 2, 1909, may be supplemented by Hind and Randles, Handbook of photomicrography, 1913, and Doubleday, 1916. Photochemistry proper (action of light in reactions) is discussed by Sheppard, 1914, in the series, Textbooks of physical chemistry, edited by Ramsay. Schaum, Photochemie und Photographie, 1908- is vol. 9 of the German series, Handbuch der angewandten physikalischen Chemie.

Steel and iron

Here the books consist of (a), those on metallurgy, including ores of iron (b), on the various kinds of steel and their properties, largely as indicated in metallographic study, and, (c), on the analysis of iron and steel. For metallurgy West, Metallurgy of cast iron, 1907, Moldenke, Principles of iron founding, 1907, take up the partly manufactured product; Hudson and Bengough, Iron and steel, 1913, is an introductory textbook; Stoughton, Metallurgy of iron and steel, Ed. 2, 1913, has about three times as much material; Spring, Non-technical chats on iron and steel, 1917, is a good semi-popular small book. Use of electric furnaces is dealt with by Rodenhauser and Schoenawa, the English version from the second German edition being in 1913; the Canadian government has published reports on the use of electric furnaces. Mars, Die Spezialstähle, is 1912, while Beck, High-speed steel is of 1910. Sauveur, Ed. 2, 1916, and H. M. Howe, 1916, discuss metallography and heat treatment at length; Bullens, 1916, is a briefer treatment while the similar volume, Heat treatment of steel, published by "Machinery" in 1914 is compiled from many sources. On the chemical analysis of iron and steel Heess, Practical methods is of 1908; Fay, Microscopic examination of steel, 1911, is good for that field; Ed. 8 of Blair, Chemical analysis of iron is 1918, while Ed. 3 of C. M. Johnson's work on Rapid methods, is of 1921; many of the larger s

plants have special volumes of their own methods, sometimes available to the public.

In conclusion, it must be remembered that these works on applications of chemistry, whether general or special, are nearly as impermanent as the daily paper; those mentioned are fair types of the particular ones now existing, but in any field some new discovery may be made, and a new authority arise, discrediting all previous writings. Consult the newest serial literature for recent work, and use books to obtain history, fundamental facts, general statements of principles with discussion. It seems probable that in a live industry or a growing science, any book that has been published more than ten years contains much that has been superseded in the way of methods, while the theories have no doubt suffered some revision.

LECTURE 12

APPLIED CHEMISTRY : SERIALS

These furnish the most recent information, and are therefore of great value; they may be grouped as follows, according to field and class of material.

A. General applied chemistry

1. Those containing chiefly or wholly, original papers
2. Reference serials, including some having original articles

B. Special serials for particular industries, usually having both original papers and abstracts

A, 1. *General applied chemistry, original papers*

Before 1877, this literature was in the serials of general chemistry; in that year the *Chemiker-Zeitung* was started to pay particular attention to industrial applications of chemistry; it has always given abstracts for which the title has varied occasionally, and this has sometimes formed so large a volume that it has been bound separately. Published three times a week, it has been almost a chemical daily paper; it has had no collective indexes, but has annual ones, for both parts.

The second in age, *Die chemische Industrie*, founded in 1878, "to further the interests of the German chemical industries", has paid much attention to manufacturing processes and patents, the few abstracts being chiefly upon these. Beginning with January, 1919, there accompanied it the *Patent-Berichte*, printed on one side only, apparently to be cut up and filed. There have been annual indexes but no collective one. Beginning with January 1921, this serial is published in two ways, alone, with no advertisements except a list of new books, and weekly in place of twice a month; then it is also presented as the "wirtschaftlicher Teil" of the *Zeitschrift für angewandte Chemie*, under a joint agreement between the Verein deutscher Chemiker, and the Verein zur Wahrung der Interessen der chemischen Industrie Deutschlands E. V.; the *Patent-Berichte* seems to have stopped.

Third in age (under its present name) is the *Zeitschrift für angewandte Chemie*, that succeeded the *Correspondenzblatt des Vereins analytischer Chemiker*, 1878-81, having about half and half original and abstract papers. The name was changed in 1882 to *Repertorium der analytischen Chemie* and in 1887 to the present one. Most of the time it appeared twice a month, but in 1914 it began to appear several times a week; the originally planned "three times a week" suffered at times during the war, but in 1920 they returned to publishing every three or four days. There is a collective index, for 1887-1907, annual indexes for all years. The abstracts have always been very complete, but from January 1919 on, they form the "technischer Teil", Band II and IV, of the annual volumes of the *Chemisches Zentralblatt*, thus making abstracts for pure chemistry come in Band I and III, for each year.

An index of German patents by D. R. P. number is given in the collective index, for each volume, v. 3-20, i. e., 1890 to 1907 inclusive; patents are abstracted, and indexed also by subject for the whole time, 1887-1907.

The oldest serial in English upon the applications of chemistry is the *Journal of the Society of Chemical Industry*, begun in 1882; it has always had original papers and excellent abstracts. The latter are grouped now in 25 classes, approximately the same as those used in the *Zeitschrift für angewandte Chemie*, and include both those of original papers and patents. There are annual, and two collective indexes, the latter through 1905. The present system of three pagings in each number seems to have been copied from the *Zeitschrift für angewandte Chemie*, that began it in 1914. *La revue des produits chimiques*, 1896 on, has abstracts and original papers; it appears twice a month. The *Revue générale de chimie pure et appliquée*, began in 1899, twice a month, had very brief abstracts, that since 1901 are bound as a separate serial and shelved with the reference serials. No numbers have come since v. 21, no. 9, in 1918.

The annual volumes of the *Transactions of the American Institute of Chemical Engineers*, 1908-, consist of the records of the meetings, and the papers presented by men who are recognized authorities. The American Chemical Society began to publish in 1909, the *Journal of Industrial and Engineering Chemistry*, original papers only, with annual indexes. In 1914, a section was added giving abstracts, or brief notices, of the State and U. S. publications of interest to chemists; there is also a list giving new books and some serial articles of special value for industrial chemists.

The *Chemical Trade Journal and Chemical Engineer* (English) now in its 69th volume is specifically a trade paper, i. e. for manufacturer and dealer, not for the expert chemist. It has very few scientific articles, but much news of the technical world. The nearest to it in contents for the United States are these: *Oil, Paint and Drug Reporter*, now in vol. 100, specializes on the articles named, with trade news, prices, etc.; there are special numbers each year for the various conventions, as for cotton seed oil, and a separate petroleum section each week; *Drug and Chemical Markets*, now vol. 9, has a more limited range, but is a more convenient size and shape for use. Another from England that puts emphasis on the methods and equipment for use in large works is *Chemical Engineering*

and the Works Chemist, now vol. eleven, but this is a thin monthly while the other three are rather large and appear each week.

Three that seem to have been short lived are these, two English and one from France: The **Chemical World**, a monthly journal of chemistry and chemical engineering, 1912-14; this resembled the **Chemical Age** (New York), being well illustrated; it had news items, book reviews and a record of patents taken out in England of chemical interest. The second, quarterly, was the **Journal of Chemical Technology**, 1912-, to further the chemical interests of and in Great Britain, and her dependencies; there were selected abstracts, but v. 3, no. 3, was dated July, 1917. The third, *Revue scientifique et technique de chimie appliquée*, v. 1-3, 1912-14, published vol. 3, no. 2 in June, 1914; it had original papers and a considerable number of abstracts.

French also are the two next in point of time; *L'industrie chimique, revue universelle des produits chimiques et des industries annexes*, 1914-, monthly, with original papers and abstracts, the usual lists of patents, trade notes, and book reviews. *Chimie et industrie*, founded in June 1918, as the monthly organ of the Société de chimie industrielle, promises to be very important; each number so far has had a number of excellent original papers, and at times as many as fifty pages of good signed abstracts (with the decimal classification number annexed); it is on good paper and well illustrated. The cover bears the note "Reconnue d'utilité publique par décret du 23 juin 1918".

Two in English, begun in July 1919, are **The Chemical Age** (London) and **Chemical Age** (New York); the former is "devoted to industrial and engineering chemistry", is weekly, with some abstracts, patent and market reports. The American one, that in 1920 absorbed the **Chemical Engineer** (1904-20, v. 1-27), taking over the old volume number, is monthly, has illustrations, and states that it is "for the business man in the chemical industry", for the manufacturer and dealer rather than the technical chemist. It contains personals and industrial notes, but no abstracts.

From Italy there is the **Giornale di chimica industriale ed applicata**, 1919-, published as a joint enterprise by several Italian societies; it appears monthly, and devotes about one fifth of its space to abstracts and a somewhat larger space to news and notes on industrial matters. The Spanish serial (not here), *Revista de chimica pura e applicada*, ser. 2, v. 4 being of 1919, seems from the title, and abstracts made from it, to belong in this group.

The **Canadian Chemical Journal**, 1919-, now called **Canadian Chemistry and Metallurgy**, was much like the **Journal of Industrial and Engineering Chemistry**, but it seems to become more like **Chemical and Metallurgical Engineering**, i. e., it has more on electrometallurgy in particular; the **Journal of the Chemical, Metallurgical and Mining Society of South Africa**, 1894-, is of the same type, rather than for general industrial chemistry. The oldest one of this class is the **Electrochemical Industry**, 1902-, now **Chemical and Metallurgical Engineering**; v. 3-7 were called **Electrochemical and Metallurgical Industry**, v. 8-20, **Metallurgical and Chemical Engineering**.

The *Sammlung chemischer und chemisch-technischer Vorträge*, 1896-, edited by F. B. Ahrens, is made up of monographs on chemical and technical topics.

A. 2. *Reference serials*

These include a number having original papers also, in addition to those primarily for abstract or review work. To obtain all the literature some at least of the serials on general chemistry must be used, for the earlier work. Before 1855, there was no special abstract serial for applied chemistry; in that year the *Jahresbericht über die Leistungen der chemischen Technologie* (Wagner's) was commenced; the original annual volume has grown to two, one for organic and one for inorganic; besides the annual indexes there are collective ones covering 1855-94. Biedermann: edited, 1880-1905, the *Technisch-chemisches Jahrbuch*, abstracts with an annual index, including however only what he considered the most valuable articles; it ceased publication in 1905. The only other strictly reference serial for applied chemistry is the *Report of Progress in Applied Chemistry*, the annual review volume published 1916-, by the Society of Chemical Industry; it is not all-inclusive, is semi-critical, and expressly omits certain subjects dealt with by the Chemical Society's similar Annual report, as Agricultural chemistry, Analysis, and Food.

The index serial is the Chemistry section of the *International Catalogue of Scientific Literature*, 1901-date; the *Industrial Arts Index*, 1913-, indexes a selected list of scientific serials, including some on applied chemistry; the *Engineering Index*, 1884-, includes some topics of interest to chemists.

Of the mixed abstract-original paper serials, perhaps the most useful is the *Journal of the Society of Chemical Industry*, 1882-, being in English and readily consulted; but its collective indexes at present only extend through 1905. Next is the *Zeitschrift für angewandte Chemie*, 1887 on, with collective index through 1907, annual indexes to date; but since January, 1919, the abstracts formerly here have made up Band II and IV of the annual volumes of the *Chemisches Zentralblatt*, designated as "Technischer Teil".

Use of the abstracts sections of the other serials of applied chemistry is made slow by the fact that they have only annual indexes, and if the exact year is unknown or all work for several years is to be looked up, it takes a long time. The ones including most years are the *Chemiker-Zeitung: Repertorium*, *Die chemische Industrie*, and *Revue des produits chimiques*, but the set of the last named is not complete here. Abstracts in some are very short, as in *Revue générale de chimie pure et appliquée*, and *L'industrie chimique*; others as *Chimie et industrie*, 1918-, are so recent that they include little as yet. For very recent work the annual volumes of the *Chemical Abstracts* are perhaps the most convenient place to look first: follow this with the annual volumes of the *Journal of the Society of Chemical Industry*, the volume indexes of the *Chemisches Zentralblatt*; then use the particular years of any other serials in that field, or generally, those of the special serials for that subject.

B. *Special serials*

These for the special industries are very numerous: only a few of the more important ones at hand in some special fields can be mentioned in this brief account.

Agricultural chemistry

The Experiment Station Record, 1889 to date, from the Office of Experiment Stations of the U. S. Department of Agriculture, has annual and two collective indexes; the Agricultural Index, 1916-, gives references, not abstracts. In German there are two old and important ones, Hofmann's *Jahresbericht*, 1858-, and Biedermann's *Centralblatt für Agrikulturehemie*, 1872- date; both have some collective indexes and are in the Agricultural library. The three above are reference serials. The International Review of the Science and Practice of Agriculture, 1910-, has important reviews of progress and some abstracts. The scope of the Journal of the Association of Official Agricultural Chemists, 1915-, is obvious.

Coal and coal tar industries

The serials upon coal are not purely chemical but divide their space giving much to mining problems, and a little to the manufacture of coke, gas, etc: two are Coal Age, 1910-, and Coal Industry, 1918-, the latter uniting the former Fuel with Coal and Coke Operator. For gas, the English serial Gas World is fairly paralleled by the American Gas Journal, and the Gas Record, now united with Gas Age as Gas-Age Record; the problems of water supply were formerly included by the Gas Journal (English), whose old title was Journal of Gas Lighting and Water Supply; the latter has a German counterpart in Das Gas-und Wasserfach (called to 1921, Journal für Gasbeleuchtung und Wasserversorgung); this last has some abstracts. The Gas World has a special section in the first number for each month on coking and by-products. The Proceedings of the American Gas Institute, 1908-, contain papers of importance, and others are to be found in the similar publications of various state or local organizations. The Gas Chemist's Summary is an annual English volume, 1913-15, perhaps continued, a report of progress.

Dyes

Dyes and their use are discussed in the new Color Trade Journal, (American) 1917-, original papers; the English serials are not here, but the Journal of the Society of Dyers and Colourists (v. 25 was 1909) seems to be similar to the Color Trade Journal. Dyestuffs (American) is a trade paper made up of articles from other serials. In French, there is the *Revue générale des matières colorantes, de la teinture, de l'impression et des apprêts*, 1897-, with its three supplementary serials on manufacturing; the volumes to 1913 contain mounted samples illustrating the colors on fabrics and yarns; there are annual indexes. The German *Färber-Zeitung* seems to contain similar material; *Friedländer, Fortschritte der Teerfarbenfabrikation*, 1877-, contains abstracts of patents; it has volume indexes by subject, and from vol. 4 on, each one has a collective index by number to the volumes to that date. Patents are also abstracted and may be looked up by number in Wagner's *Jahresbericht*, and *Zeitschrift für angewandte Chemie*, and by subject or patentee in Journal of the Society of Chemical Industry; Chemical Abstracts has a patent number index, and patents are also entered under subject and name of patentee.

Electrochemistry

The Faraday Society (English) publishes Transactions (formerly Proceedings); similar material is in the Proceedings of the American Electrochemical Society, while other papers are in the Chemical and Metallurgical Engineering. From Germany the *Elektrochemische Zeitschrift* is less comprehensive than the *Zeitschrift für Elektrochemie*, and the latter has one collective index; the *Jahrbuch der Elektrochemie* is not complete to date here.

Food

The leading serial has been the *Zeitschrift für Untersuchung der Nahrungs- und Genussmittel*, original papers, and abstracts, with German official regulations and laws, one collective index, 1898-1908. The *Zeitschrift für Fleisch- und Milchhygiene* specializes more closely, containing original papers and abstracts. The Analyst deals principally with problems of purity, while the British Food Journal takes up the legal phase of food adulteration. Pure Food (American) has been the organ of the brewers, bakers and yeast industries, sometimes giving translations of German articles; the American Food Journal is semi-popular, of interest chiefly to the wholesale dealers and manufacturers, but with an occasional chemical or bacteriological paper. The French *Annales des falsifications et des fraudes*, gives some abstracts.

Hygiene

This is not directly chemical, but the Journal of Infectious Diseases specializes on water-borne forms and water supply; *Hygienische Rundschau* has abstracts and original papers on both food and water supply; the Journal of Hygiene (English) is more truly medical, with special supplements on the plague in India; the American Journal of Public Health has chemical articles at times.

Leather

Here there is the Journal of the American Leather Chemists' Association, original papers and abstracts; *Collegium*, published in German as an international serial, is now wholly German, while the English serial, started under the same title 1913-14, is now Journal of the Society of Leather Trades' Chemists.

Pharmaceutical

The two distinct types are, the serials published as trade papers for those who deal in drugs at retail or wholesale, and the scientific serials. American samples of the first class are *Western Druggist*, *Bulletin of Pharmacy*, *Pacific Pharmacist*, *Pharmaceutical Era*, and for the wholesale trade in particular, *Drug and Chemical Markets*. The *Pharmaceutical Journal and Transactions*, (now, and *Pharmacist*) 1841-, was formerly in the scientific class and had many abstracts; it has now become nearly a trade paper.

The oldest American one of the second class is the *American Journal of Pharmacy*, 1830 to date, with annual and several collective indexes. The Proceedings of the American Pharmaceutical Association, 1851-, has annual indexes, and a collective one for v. 1-50; it contains many abstracts; the volumes, 1912 on, are called Yearbook. The Journal (first called *Bulletin*, 1906-11) 1912-, has original papers only. The *Journal of Pharmacology and Experi-*

mental Therapeutics, 1909-, covers a rather wider range of topics, and has no abstracts. Some State pharmaceutical societies publish useful papers.

The *Journal de pharmacie et de chimie*, original papers and abstracts, founded in 1809, is here in part, now series 7, vol. 23; rather more medical was the *Journal de chimie médicale, de pharmacie et de toxicologie*, 1825-76, when it was united with the *Répertoire de Pharmacie*, and continued under the double title. Two of the leading German publications are *Berichte der deutschen pharmazeutischen Gesellschaft* and *Archiv der Pharmazie*, both having original papers only. The *Archiv für experimentelle Pathologie und Pharmakologie* includes a variety of topics but all are original papers; for abstracts in pharmaceutical chemistry the *Chemisches Zentralblatt*, and probably the *Pharmazeutische Zentralhalle*, which seems to give some abstracts, may be used. References to literature are given in the *U. S. Dispensatory*, while a special substance or topic may be looked up in the *Index Medicus*, 1879-, and in the catalogue of the *U. S. Surgeon-General's library*; these two give no abstracts but the reference alone, and the second includes books as well as serial articles.

Photochemistry and photography

For the first, *Zeitschrift für Photochemie und wissenschaftliche Photographie*, 1903-, has original papers only; for the second, *Photominature*, 1899-, is fairly scientific, while *Photo-Era*, 1898-, and *The Camera*, now vol. 25, are more for the amateur photographer.

Steel and iron

The metallurgical serials here are many, but usually contain little chemistry; such are *Stahl und Eisen*, 1881-, *Journal of the Iron and Steel Institute*, 1869-, and the publications of the *American Iron and Steel Association*; upon metallography and chemistry are the *Iron and Steel Magazine*, 1904-06; *Journal of American Steel Treaters' Society*, 1918-20, now *Transactions of the American Society for Steel Treating*; metallographic material not all on iron and steel is found in the *Revue de métallurgie*, 1904-, abstracts and original papers, *Journal of the Institute of metals*, 1909-, and *Transactions of the American Institute of Metals*, 1907-, (v. 1-5 as of the *American Brassfounders' Association*, while v. 11, 1917-, has title *Journal of the American Institute of Metals*), now part of *Mining and Metallurgy*.

Water supply and sewage treatment

The best in German is said to be *Wasser und Abwässer*; with this may be classed the *Mittheilungen d. k. Prüfungsanstalt für Wasserversorgung und Abwasserbeseitigung*, 1902-; *Journal of Infectious Diseases*, *Journal of the American Waterworks Association*, and *Hygienische Rundschau* give some material. The abstracts in the latter and in *Chemical Abstracts* will usually be sufficient.

For some other special topics as mines and mining problems, the publications of the *U. S. Bureau of Mines*, with the various co-operating institutions, furnish much material; the publications of the *U. S. and State Geological Surveys* often contain chemical papers. The *U. S. Bureau of Standards* does valuable work, and this like that of the other two is most easily found by use of

the notes in the Journal of Industrial and Engineering Chemistry. At Illinois State and municipal publications on water supply problems are largely available in the Water Survey collection, while others are in the Municipal Reference library in Lincoln Hall.

If the engineering phase of a problem is emphasized, the Engineering library with its special indexes and serials is the more satisfactory; here too is found most of the literature upon mining, though the strictly geological works are in the Natural History library. Every special industry of any size has its own serials, as well as books, for example, ceramics, which has here its own library. However, many of these serials are abstracted in the chemical abstract serials, i. e. both those upon general and the ones dealing with applied chemistry, so that these reference serials must often be consulted in addition to the special ones, to collect all the literature upon a topic.

LECTURE 13

THEORETICAL AND PHYSICAL CHEMISTRY, INCLUDING COLLOIDS: BOOKS

The division between the first and second is not always made by authors, but the books noted will be classed where their authors place them; the chemistry of colloidal substances may be partly both, but the books will be discussed separately for convenience. We have then to consider:

- A. Works on theoretical chemistry
 1. Historical
 2. General
 3. Special
- B. Works upon physical chemistry
 1. General
 2. Laboratory manuals
 3. Special
 4. Tables of data
- C. Chemistry of colloids
 1. Comprehensive works
 2. Briefer, semi-popular books
 3. Works on special phases

With respect to the practical value of the theoretical field, Mendeleef says:

“By summoning adherents to the work of theoretical chemistry, I am convinced that I call them to a most useful labor, to the habit of dealing correctly with nature and its laws, and to the possibility of becoming truly practical men.” Nernst describes it as the theoretical treatment of practical processes. Given a logical, orderly arrangement of facts observed and laws deduced in the study of chemical changes, with a historical examination of the chemical ideas and theories, we find in theoretical chemistry a presentation of the main lines along which chemistry has advanced.