REFERENCE LIBRARY FOR CHEMISTRY.*

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The following list of books is submitted as a basis for a chemical library for high schools. The titles mentioned have been selected in the main with reference to the needs of the teacher, although a number are also adapted to the use of the pupils. The books have been classified and only a comparatively few are placed under each heading. It seemed advisable to limit the number, yet include the most of the best books published. The list has been submitted to several university professors and high school teachers of chemistry and has in general met their approval.

Beginning students can make little use of reference books until they have acquired some knowledge of the general principles of chemistry, so it is recommended that students be not asked to make any special study of reference books until the second half of the first year's work.

I. HIGH SCHOOL TEXTS.

Essentials of Chemistry, Hessler and Smith. 405 pages. Benj. H. Sanborn & Co., Chicago.....	\$ 1 20
Descriptive Chemistry, Newell. 590 pages. D. C. Heath & Co....	1 20
Elementary Chemistry, Linebarger. Rand, McNally & Co.....	1 00
Elementary Chemistry, Bradbury. 486 pages. D. Appleton & Co....	1 20
Modern Chemistry, Peters. 412 pages. Maynard, Merrill & Co....	1 00
Introduction to the Study of Chemistry, Remsen. (New edition 1906.) 518 pages. (Briefer Course.) Henry Holt & Co.....	1 12
Elementary Inorganic Chemistry, Newth. 288 pages. Longmans, Green & Co.	90
Experimental Chemistry, Newell. 410 pages. D. C. Heath & Co....	1 10
Elementary Principles of Chemistry, Young. 358 pages. D. Appleton & Co.	1 20
Elementary Manual of Chemistry, Storer & Lindsay. 453 pages. American Book Co.	1 20

II. LARGE DESCRIPTIVE.

An Introduction to General Inorganic Chemistry, Alex. Smith. Pp. XVIII plus 780. Century Co.....	\$ 2 25
Outlines of Inorganic Chemistry, Gooch & Walker. 514 pages. Macmillan Co.	1 75
Text-Book of Inorganic Chemistry, Newth. 602 pages. Longmans, Green & Co.	1 75
Text-Book of Inorganic Chemistry, Holleman. 458 pages. John Wiley & Sons,	2 50
Inorganic Chemistry, Advanced Course, Remsen. 850 pages. Henry Holt & Co.	2 80
General Inorganic Chemistry, Freer. 559 pages. Allyn & Bacon, Boston	3 00
The Principles of Inorganic Chemistry, Ostwald. Translated by Alexander Findlay. 785 pages. Macmillan Co.....	6-00
Treatise on Chemistry. Roscoe and Schorlemmer, Vols. I and II. (Inorganic.) D. Appleton & Co.....	8 00

*Read before the Chemical Conference at Ann Arbor, Mich., March 29, 1906.

III. ANALYTICAL.

Qualitative Chemical Analysis, Prescott & Johnson. 420 pages. D. Van Nostrand Co., New York.....	\$ 3 50
Qualitative Chemical Analysis, A. A. Noyes. 89 pages. Macmillan Co.	1 25
The Principles of Qualitative Analysis from the Standpoint of the Theory of Electrolytic Dissociation and the Law of Mass Action, Dr. Wilhelm Boettger, translated by Wm. G. Smeaton. P. Blakiston's Son & Co.....	
Analytical Chemistry: Qualitative Analysis. Treadwell. Translated by Hall. 466 pages. John Wiley & Sons.....	3 00
Quantitative Chemical Analysis, Clowes and Coleman. 602 pages. Co., New York	4 00
Quantitative Chemical Analysis, Olsen. 513 pages. D. Van Nostrand P. Blakiston Co., Philadelphia.....	3 50
Analytical Chemistry. Quantitative Analysis. Treadwell. Translated by Wm. Hall. 654 pages.....	4 00

IV. DICTIONARIES.

Dictionary of Chemistry, Watts. 4 vols. Longmans, Green & Co....	\$65 00
A Dictionary of Chemical Solubilities, Comey. 515 pages. Macmillan Co.	5 00
The Chemists' Pocket Manual. Chemical Publishing Co., Easton, Pa.	2 00

V. THEORETICAL AND PHYSICAL.

Introduction to Physical Chemistry, Walker. 332 pages. Macmillan Co.	\$ 2 50
The Elements of Physical Chemistry, Jones. Macmillan Co.....	4 00
Chemical Theory for Beginners, Dobbin & Walker. 236 pages. Macmillan Co.	70
Physical Chemistry for Beginners, VanDeventer. Translated by Boltwood. 154 pages. John Wiley & Sons, New York.....	1 50
Theoretical Chemistry from Standpoint of Avogadro's Rule, Nernst. Macmillan Co.	5 00
Elements of Physical Chemistry, Morgan. 299 pages. John Wiley & Sons	2 00

VI. HISTORICAL.

History of Chemistry, Von Meyer. Translated by McGowan. 544 pages. Macmillan Co.	\$ 4 50
History of Chemistry, Venable. 172 pages. D. C. Heath & Co.....	1 00
Heroes of Science-Chemists, Muir. 350 pages. Thomas Nelson & Son	1 50
History of Chemistry, Ladenburg. Translated by Dobbin. 375 pages. University of Chicago Press.....	1 75
Essays in Historical Chemistry, Thorpe. 381 pages. Macmillan Co.	2 25

VII. ORGANIC.

Organic Chemistry, Perkin & Kipping. 552 pages (2 vols.). J. D. Lippincott Co., Philadelphia.....	\$ 2 00
Organic Chemistry, Remsen. 364 pages. D. C. Heath & Co.....	1 30
Organic Chemistry, Richter-Smith. 2 vols. P. Blakiston Co., Philadelphia	6 00

VIII. MISCELLANEOUS.

Outlines of Industrial Chemistry, F. H. Thorp. 528 pages. Macmillan Co.	\$ 3 30
Methods of Glass Blowing, Shenstone. 96 pages. Longmans, Green & Co.	50
Chemistry of Daily Life, Lasser-Cohn. J. B. Lippincott Co	1 75
The Teaching of Chemistry and Physics, Smith & Hall. 377 pages. Longmans, Green & Co.....	1 50

Chemical Lecture Experiments, Benedict. 476 pages. Macmillan...	2 00
Conversations on Chemistry, Part I. Ostwald. Translated by Elizabeth Ramsey. John Wiley and Sons. 250 pages.....	1 50
Conversations on Chemistry, Part II. Translated by S. K. Turnbull. 373 pages. John Wiley and Sons.....	1 50
Chemistry of Plant and Animal Life, Snyder. 406 pages. Macmillan Co.	1 40
Story of a Piece of Coal, Martin. 165 pages. D. Appleton & Co....	40

IX. PERIODICALS.

School Science, 440 Kenwood Terrace, Chicago. Monthly, October to June, inclusive.....	\$ 2 00 per year
Journal of the American Chemical Society, Eschenbach Printing Co., Easton, Pa. Monthly.....	6 00 per year
Science, 41 North Queen St., Lancaster, Pa., or 66 Fifth Avenue, New York. Weekly	5 00 per year
Science Abstracts	
Engineering Index	
Scientific American	

DISCUSSION OF LIST.

A few of the recently published high school texts are very valuable reference books for students to use along with their own text, and they can usually be obtained for such purposes gratis of the publishers.

LARGE DESCRIPTIVE.

The most useful and extensive work of reference is the inorganic portion of Roscoe and Schorlemmer's *Treatise on Chemistry*. It deals with the historical, descriptive and theoretical parts of nearly all chemical subjects. The first two volumes have recently been revised.

The other books mentioned under "Large Descriptive" are university texts. Newth is noted for its attention to industries, Holleman for the interweaving of the Electrolytic Dissociation Theory with the descriptive and theoretical part in a simple way, Remsen and Freer for lucidity and discussion of general relations. The tables of comparisons of the elements in the various families and the discussion of the periodic law are well represented in Freer. Ostwald's *Principles of Inorganic Chemistry* is a modern classic and should be in the hands of every teacher who can afford it. The new notions and theories of scientific chemistry are very cleverly presented. The author has taken particular care in the development of the conception of ions. It is a text-book of *pure* chemistry, so little attention is given to the related sciences and arts.

Every teacher of chemistry should have access to Alexander Smith's *Introduction to General Inorganic Chemistry** (just

*See the review of this work, under "Book Reviews," in this number of SCHOOL SCIENCE AND MATHEMATICS.

published). It is full of good ideas and methods of teaching different subjects. The chapters on Solution, Chemical Equilibrium, Dissociation in Solution, Electrolysis and Chemical Behavior of Ionic Substances are intensely interesting and well written. The theoretical side of chemistry is as clearly presented here as in any book on the market and it is up to date. The book contains about eighty pages of matter in smaller type which is intended especially for teachers and contains discussions of many points upon which teachers find difficulty in getting information, and also discussion of subjects upon which teachers are apt to go astray.

ANALYTICAL.

Prescott & Johnson's book is noted for the number of balanced equations and explanations of chemical reactions. Treadwell's *Qualitative Analysis* is a recent book and is generally considered an excellent one. The descriptions of the operations are full and clear, the equations are very fully treated and the treatment of acids is unusually extensive. The author utilizes the theory of electrolytic dissociation, mass action and hydrolysis, and explains their relations to analysis. Fresenius was long considered the best text-book on *Qualitative Analysis*, but it is not now generally thought of as up to date so it is not included on the list. One of the most recent books on qualitative analysis is Boettger's, now being translated by Wm. G. Smeaton of the University of Michigan. It makes practical application of the dissociation theory in the study of the metals.

If one wishes a book on quantitative analysis that describes methods of manipulation in detail and at the same time includes a compilation of the best methods of analysis, both Olsen and Clowes and Coleman are highly recommended. Olsen is more recent and seems to be the favorite in this country so far as it is known. In the back part of the book are chapters on water, gas, coal, iron and steel analysis.

DICTIONARIES.

Watt's dictionary of four volumes contains articles varying in length from a few lines to several pages, on nearly every chemical substance and every topic in scientific chemistry. It is often convenient to have a reference book on the solubility of chemical compounds to check results obtained by experiments in the laboratory or to aid one in making up solutions. Comey's dictionary

is recommended. Meade's Pocket Manual contains many valuable tables and much general information.

THEORETICAL AND PHYSICAL.

The books on Theoretical and Physical Chemistry are recommended for the use of the teachers of chemistry only. All that is necessary for students' use can be found in any good college text-book such as Alexander Smith's or Holleman's. Walker's Physical Chemistry is clear and more easily understood than most of the books on the market. The revised edition of Morgan is also very readable and a general favorite. Dobbin and Walker and VanDeventor are elementary. Jones is more complete, not so easy to comprehend but a very valuable reference book.

HISTORICAL.

No chemical library would be complete without some book on historical chemistry. A fund of information can be obtained here for making the every day lessons interesting. The teacher as well as the pupil will get a more comprehensive view of chemistry by knowing the struggles and failures and triumphs of the men who have made the science for us.

A very satisfactory book is Ladenburg's, translated by Dobbin. It is a compilation of a course of lectures and is presented in an interesting style. If one wishes a more complete treatise, Von Meyer is excellent. A very brief but reliable history of chemistry is Venable's. Heroes of Science by Muir, and Essays in Historical Chemistry by Thorpe, take up only a few subjects but they both read like romance and the pupil, as well as the teacher, will read them with delight.

ORGANIC.

A very satisfactory reference book on Organic Chemistry is Perkin & Kipping's. Remsen is very good but it is often so brief that parts are not easily understood. Remsen is desirable, however, because it is so full of easy experiments to illustrate many subjects. A very comprehensive view of the carbon compounds is to be found in Richter-Smith's book. The student and the teacher, with little preparation in organic chemistry, will probably get the most satisfaction from Perkin and Kipping's two volumes.

MISCELLANEOUS.

The industrial or practical side of chemistry always appeals to the average student. Thorpe's book seems to be a general

favorite. It requires but little encouragement to make the pupils anxious to read about the great chemical industries, such as the manufacture of soap, cooking soda, sulphuric acid and the metallurgy of iron. This book should be in every chemical library.

The Chemistry of Daily Life by Lasser-Cohn and The Chemistry of Plant and Animal Life by Snyder are intensely interesting and practical. The latter book deals with the chemistry of digestion, of foods, and the rational feeding of animals, including man.

Every wide awake teacher should have access to the teaching of Chemistry and Physics by Smith and Hall. It is full of suggestions on instruction in the class room and laboratory, tells how to present many difficult subjects and discusses the equipment of laboratories and lecture room.

Conversations on Chemistry, Volumes 1 and 2, by Ostwald are written in the form of a dialogue between the master and pupil. The teacher will get valuable ideas of presenting many difficult subjects to his students by reading these books. He is taught to realize the hard things from the pupils' standpoint.

It will add much interest to the development of any subject to illustrate it with other experiments than the ones given in the text or laboratory manual. Some such reference book as Benedict's Chemical Lecture Experiments is very desirable. It is full of interesting experiments on most topics in inorganic chemistry.

The best way to keep in touch with what is going on in the chemical world is to read at least one journal. The journal of the American Chemical Society is highly recommended because of the review given in each number of the leading articles appearing in different journals and also the mention and review of the books published on chemistry.

SCHOOL SCIENCE AND MATHEMATICS contains articles on all branches of science taught in the public schools, including mathematics. It is a magazine especially for the teachers of high schools, and no high school library should be without it. In addition to valuable and very practical articles written by university professors and high school teachers of prominence, brief reports of the science meetings in various parts of the United States are given.

The busy science teacher is too often satisfied to confine himself to the texts in use and pays little attention to what is being done in the scientific world. No progressive teacher, no matter what his salary may be, can afford to be without access to some science journal. It gives him inspiration to do better work, it keeps his mind more active, it helps more than any one thing to keep him out of a rut. It is not so important what journal the teacher reads, but read some good one and keep in touch with the scientific spirit of the time.

In conclusion let me emphasize that the teacher of chemistry cannot do his duty unless he has access constantly to at least one good reference book in each of the main branches into which the science is divided, namely: inorganic, organic, analytical, historical, physical, and industrial, and also reads some good science journal.

WHAT PHYSICS ASKS OF MATHEMATICS.

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Physics teachers are almost daily confronted with the fact that their pupils find difficulty in handling the mathematical part of the subject. (1) Mathematical interpretation and statement of the variously related data of physics problems proves a stone wall to most of our pupils; although in algebra they have stated many equations the solution of which have given A's and B's ages, or the time when the hands of the clock will again coincide, How old is Ann, etc.

(2) Principles learned and applied with facility in the solution of these problems and equations of the mathematical textbooks are beyond the power of the pupil to apply in this new field.

(3) Computation is labored and beset with errors. Many simple operations requiring repeated explanations notwithstanding the training in arithmetic.

(4) In geometry, lines, surfaces, angles, etc., are studied constantly and their relations thoroughly investigated, but not a pupil enters the physics laboratory with any idea of accurate measurements of these familiar things, nor has he first hand knowledge that these actually demonstrated facts are true in practice.