NEW BOOKS

Chapters in the History of Science. General Editor, CHARLES SINGER. III. Chemistry to the Time of Dalton. By E. J. HOLMYARD. Oxford University Press, American Branch, New York, 1925. 128 pages. Illustrated. 19 × 12.5 cm. Price $1.00.

The history of chemistry is generally divided into four periods: the Egyptian, the Islamic, the Early European and the Modern periods. The first three are generally designated as alchemistic and reflect Greek influence. It is the author of this new volume, Holmyard, who has recently done us great service by bringing light into the darkness of the Islamic period, teaching us facts which Berthelot never knew and could not know. He has persuaded us that Geber—the first and master-mind of Islamic chemistry—is to be ranked with Lavoisier in his teaching and influence. Pleasant also it is to learn something tangible of Maslama, known as al-Magriti, and of Abu'l Qasim, called al-Iraqi—those famous authors, known previously only in name, who formed the link between the Arabic and the Spanish. Perhaps, as the author suggests, we may soon be able to outline an evolution of the science of chemistry.

I confess to a little disappointment in the present book, in that the author's own field is so little represented: only about fifteen pages. An author is quite safe on his own ground and no one can teach us better the facts of Islamic chemistry than one who has mastered the difficult Arabic, one whose privilege it is to unfold for us the very words of these authors of the Mohammedan period, closed to us heretofore. Like the tomb of Tut-enkh-amen we have, in the Arabic, a treasure house in which is being revealed a craftsmanship and wealth unsuspected.

Why is it that our British cousins are so slow in recognizing the value of the work of Berthelot on Egyptian alchemy? Our author tells us, as though he were writing before 1885, that in the city of Alexandria "alchemy was studied mainly as an offshoot of magic;" also that Jabir's views "represent a distinct advance.... upon the incomprehensible mysticism of the Alexandrian school." It is difficult to follow, also, when our author tries to establish the blanket priority of the Mohammedan school. A proof seems necessary that the predecessors of this school contributed nothing. The theories of Jabir, we are told, were a modified Aristotelianism; but so were the Alexandrian theories—five centuries before. The mercury-sulfur composition of the metals came directly from Egypt. Except for the clear statement of this composition, as a working theory, nearly all the ideas and experiments of Jabir, as quoted, seem to reflect the ideas and (perhaps cruder) experimental work of the Alexandrians. Again, the word obscurity, as applied to Egyptian alchemy, was only yesterday in common use as regards Geber and his successors. This latter obscurity it has been the privilege of Holmyard to clear away. The fact

is that obscurity is a relative term and we have to guard against the possibility of its being wholly subjective. In the present case, we can not close our eyes to certain wonderful things which Alexandrian Greeks transmitted to the Court of Harun al-Rashid.

But to return to our text, the chapters which follow the Mohammedan period, "Chemistry in Europe" and "From Norton to Glauber," tell the story of European alchemy and its derivation from Arabian sources in simple and straightforward language. We are carried easily to the seventeenth century, to the development of the phlogiston theory, with the trenchant comments of Boyle, to the short, tragic, but impressive life of "Phlogiston," until "by the irony of fate, it was largely through discoveries made by eminent phlogistonists themselves that their theory was finally overthrown"—due to the interpretation of these discoveries by Lavoisier.

The author closes his little but distinguished book with the thesis that modern chemistry is founded upon the two theories of Lavoisier and Dalton: the "foundations of modern science were laid by Antoine Laurent Lavoisier and John Dalton. They are the oxygen theory of combustion and the atomic theory of the constitution of matter—the brightest achievements of the human intelligence."

Holmyard is a ready and facile writer and carries the reader delightfully along through the whole story. Since the book is a history of chemistry rather than a history of alchemy, it is proper that more than one half should be devoted to discoveries made since the beginning of the seventeenth century, for although the phlogiston theory and all the writers up to the time of Lavoisier reflected the Greek attitude of "forms," it was upon the exact materialism of Boyle and the incontrovertible demonstrations of Black, as interpreted by Lavoisier, that the quality-elements of the Greeks and the "tria principia" of Paracelsus were overthrown and the material element established.

Extracts from epoch-making writings embellish the book—just enough of these to illustrate the argument and clarify the thought.

I note that the author promises a second volume, to tell us the theory of Avogadro and "the entrancing story of the progress which chemists, on the basis of the atomic theory, were able to make in the nineteenth century." Readers will await with interest the appearance of this account of how our fathers used this "golden key to the treasures of nature—of which the full extent is even yet not more than dimly perceived."

ARTHUR JOHN HOPKINS

First Problems in Chemistry. By MARTIN MEYER, Ph.D., Instructor in Chemistry, The College of the City of New York. D. C. Heath and Company, Boston, 1925. vii + 300 pp. 17 figs. 13 × 19 cm. Price $1.60, postpaid.

Few chemists, if any, will disagree with the author of this book in emphasizing the importance of chemical calculations. The calculations,

however, which are dealt with in "First Problems in Chemistry" are the simplest of arithmetic applied to chemical relations, and certainly involve no special kind of mathematics, as the existence of such books as this might imply. In other words the demands of chemical calculations differ from those of other arithmetical problems only in the knowledge of chemistry required and in the ability to make the necessary application. The principles of chemistry involved are presented in all elementary texts, for which the book under consideration serves as an unnecessary auxiliary, not as a substitute.

The student's knowledge of the applications is apt to become merely the trick of substituting the proper numbers in a memorized formula. When this is the case, one of the chief values of chemical calculations, practice in reasoning, is lost. The segregation of calculations in a book by themselves seems to emphasize this tendency to make the subject unrelated to actual substances and conditions and to make the solutions of the problems only exercises in arithmetic. In short, why use special books on chemical calculations?

If, however, such books are to be used, "First Problems in Chemistry" is an excellent choice. It contains over six hundred problems and several hundred questions. These include problems in stoichiometry, on the behavior of gases, on the boiling and freezing temperatures of solutions and their relations to ionization, and on the use of "normal solutions." Since the statements of the problems occupy but a few pages, the most of the three hundred pages of the book are devoted to discussion of principles and laws.

One looks in vain for any mention of "significant figures" and the principle of "proportional error." The expositions and the derivations of formulas are detailed but clear, and necessarily "dry." If a student can be made to swallow and assimilate such a dose, it will be good for his constitution in these days when youth must be pampered with "interesting" information only. The large number of problems and questions will be appreciated by teachers weary of setting tests and examinations.

KENNETH L. MARK

Atomzertrümmerung: Verwandlung der Elemente durch Bestrahlung mit α-Teilchen. (Atomic Disruption; Transmutation of the Elements by α-Radiation.) By HANS PETTERSSON and GERHARD KIRSCH. Akademische Verlagsgesellschaft m. b. H., Leipzig, 1926. viii + 247 pp. 61 figs. 24.5 × 16 cm. Price, unbound, Mk. 13; bound, Mk. 15.

Modern science, not content with penetrating the atom and dissecting it electron by electron, does not halt at the threshold of the nucleus itself but is now battering its way into that "holy of holies" of the atom. The projectile used is the most powerful agent known—the high speed alpha particle, itself ejected with tremendous energy from the nucleus of radio-

active elements. The product of one atomic disintegration is thus directed to expend its energy in disrupting another nucleus.

Pettersson and Kirsch have given in monograph form an illuminating account of the researches in this field. The work has been practically confined to two laboratories, that of Sir Ernest Rutherford at Cambridge, where it was begun, and the Institute of Radium Research in Vienna, where it was taken up by Pettersson and his collaborators, who have added many valuable contributions in its continuation.

The subject is developed beginning with recognition by Rutherford of the significance of the rarity of large angle deflections or reversals of alpha particles projected through atoms. This gave us Rutherford's conception of the nuclear atom. The next step was the production of swift hydrogen particles by bombarding hydrogen or its compounds by alpha particles. The rarity of the ejection of hydrogen particles confirmed the nuclear hypothesis. The next great stride, which led into the nucleus itself, was the discovery that hydrogen particles can also be produced by bombarding atoms of other elements. This possibility was at first believed to be confined to six elements of odd atomic number—boron, nitrogen, fluorine, sodium, aluminum and phosphorus. The method of indirect or right-angle observation developed by Pettersson and his associates at Vienna has permitted the detection of very short range hydrogen particles which has extended the list of elements disrupted to include of odd-numbered atoms—chlorine, argon, copper, bromine and iodine, and of even-numbered elements—sulfur, potassium, titanium, chromium, iron, selenium, zirconium, tin and tellurium. Of the total disruptions 11 were first effected by Rutherford and Chadwick and 16 by Pettersson, Kirsch and co-workers.

The entire theme of atomic disintegration is skilfully developed in eight chapters giving detailed accounts and summaries of the work both at Cambridge and Vienna. The use of thin capillaries containing radon has proved to be a convenient source of alpha-radiation which removes the difficulty of diffusion of radon from an open source. This method, combined with indirect observation, has yielded many fruitful results. It was also employed to investigate truly "induced radioactivity" in other elements. The result was negative.

While the outer electronic structure of the atom is of primary importance to the chemist, since it touches his valence electrons and through them determines the structure of the compounds of the elements and their chemical properties, the structure of the nucleus is no less important since it touches the elements themselves. The interest attaching to the conservation of the elements and to their transmutation is one of the oldest in chemistry, which has received a tremendous revival through the researches initiated in the disruption of the atom by alpha particles. The writers do not discuss, however, the recent experiments directed toward

transmutation. A most useful appendix is one of four pages giving a condensed chronological and historical review of the subject. Atomic disruption merits the attention of all those interested in the most modern developments of physical science. Pettersson and Kirsch have, therefore, rendered a service of the first order in so admirably bringing together the results accomplished up to the present and in furnishing a basis for further progress by presenting a lucid account of their own experimental achievements.

S. C. LIND

Thermochimie. (Thermochemistry.) By F. BOURION, Professor of the Faculty of Sciences at Nancy, Libraire Octave Doin, 8 Place de l'Odéon, Paris, 1924. xii + 363 pp. 43 figs. 13.5 × 22 cm. Price, unbound, 25 fr.

This work covers the same general field as the first volume of Berthelot's "Thermochimie," and from largely the same point of view. After a clear discussion of the first law, the methods of calorimetry are taken up giving, as is good pedagogical practice, much space to the old and primitive methods of Berthelot and then skipping to modern methods especially those of White, Barry and Richards. Only enough detail is given to show the essence of the method. A particularly valuable feature of the book is the discussion of the method of determining thermal quantities by use of the second law of thermodynamics. However, to the reviewer's mind, the treatment of the so-called "third law," which is at least as important in this connection, is quite inadequate. Indeed, excepting for the treatment of the second law, one would get the impression that no great progress had been made in thermochemistry since the time of Berthelot. For example, comparatively little use is made of the ionic theory; the lattice energy concept of Born and Fajans is hardly mentioned; the quantum theory with its connection between spectroscopy and thermochemistry is omitted; even the subject of heat of dilution, the connection of which with the theory of solution was pointed out by Berthelot, is treated in a summary manner. Nevertheless, the book is to be recommended especially for student use since it gives the only elementary, yet relatively complete, introduction to the methods and concepts of thermochemistry at present available, presented with the clarity and elegance expected in a French work. It is regretted that we do not have more works of this class in English.

F. RUSSELL BICHOWSKY

The Production and Measurement of Low Pressures. By F. H. NEWMAN, D.Sc., Professor of Physics in the University College of the Southwest of England, Exeter. Ernest Benn Limited, 8 Bouverie Street, E. C. 4, London, 1925. 192 pp. 48 figs. 15 × 24 cm. Price 16s net.

This book contains a valuable compendium of information for the practical worker with high-vacuum technique. A brief discussion of the theory of pumps and of the flow of gases at low pressures is followed

by descriptions and tables of performance of some 20 different pumps, well selected to represent the various types that have been found most efficient for particular purposes. The theory of the mercury diffusion pump is treated at some length, but not, it seems, with complete lucidity. Extensive data are included on the preparation and use of charcoal for producing vacuums, and a chapter is devoted to the somewhat mysterious process by which a glowing tungsten filament destroys residual gases, and to various chemical and electrical methods of improving vacuums. Possibly the most useful chapters are the last two, which treat, respectively, of the principal modern designs of micromanometers, and of the practical operation of a high-vacuum system, which means essentially the methods of eliminating or controlling the evolution of gases from the glass surfaces, a phenomenon very puzzling and discouraging to any one using a good pump for the first time.

ALBERT SPRAGUE COOLIDGE

The Kinetics of Chemical Change in Gaseous Systems. By C. N. HINSHELWOOD, M.A., Fellow of Trinity College, Oxford. Oxford University Press, American Branch, New York, 1926. 204 pp. 9 figs. 24.5 × 16 cm. Price $4.25.

This volume contains seven chapters. The first is an Introduction, setting forth in simple fashion those developments of the kinetic theory of gases which are of special utility in the kinetics of gaseous reactions. The titles of the other chapters are as follows: Bimolecular Reactions; The Energy of Activation; Termolecular Reactions; Unimolecular Reactions; The Kinetics of Heterogeneous Reactions; Activation in Heterogeneous Reactions.

The book has been developed from a series of lectures given in Oxford by the Author. It is not a comprehensive treatise but rather a brief and interesting survey of an important field of theoretical chemistry, in which the Author has himself been productively active. The presentation is straightforward and clear, with as little emphasis as possible on the mathematical operations. On the other hand, the Author has successfully resisted the temptation toward over-simplification. The book will be read with pleasure and profit by those interested in this rapidly developing field.

ARTHUR B. LAMB

Fortschritte der Kolloidchemie. (Advances in Colloid Chemistry.) By Professor Dr. HERBERT FREUNDLICH, Member of the Kaiser Wilhelm-Institute for Physical Chemistry and Electrochemistry, Berlin-Dahlem. Theodor Steinkopff, Dresden-Blasewitz, Residenzstrasse 12 b, 1926. ii + 109 pp. 47 figs. 22.5 × 14.5 cm. Price, unbound, M. 5.50.

This small volume is based on the lectures which Professor Freundlich delivered at various universities in the United States, during the summer of nineteen hundred and twenty-five. The titles of its eight chapters

are: Adsorption; Electrokinetic Potential; Adsorption, Valence and Coagulation; Velocity of Coagulation; Stability of Hydrophilic Sols; The State and Form of Colloid Particles; The Absolute Magnitude and the Variability of Interfacial Surface in Colloidal Systems; Photodichroism and Related Phenomena.

These chapters are brief surveys of the recent progress in their various fields. They constitute, as it were, a partial supplement to the Author's invaluable "Kapillarchemie." As the Author points out, they show in a marked fashion how the progress of science consists of a series of closer and closer approximations. Our ideas of adsorption, of electrokinetic potential, of coagulation and of the shape of colloidal particles, for instance, have become progressively more sharply defined as a result of the investigations recounted in this volume.

These chapters not only fulfil admirably their function as surveys but they are also rich in suggestions for further research. They will be read with particular pleasure by those who were fortunate enough to hear the original lectures as given by Professor Freundlich.

ARTHUR B. LAMB

Chemische Bodenanalyse: Methoden und Anleitung zur Untersuchung von Böden im Laboratorium. (The Chemical Analyses of Soils: Methods for and Introduction to the Investigation of Soils in the Laboratory.) By K. K. GEDROIZ, Professor at the Forstinstitut in Leningrad. Translated into German from the Russian by Dr. L. Frey, Riga, Laboratorium des Katasteramts. Gebrüder Borntraeger, W. 35 Schöneberger Ufer 12a, Berlin, 1926. xii + 245 pp. 8 figs. 25.5 × 16.5 cm. Price G. M. 12.

This book is a laboratory manual for the chemical analysis of soils. While alternative methods are given for determining certain constituents, the book is not a comparative study of the various methods that have been more or less widely used in different countries but is a collection of selected methods. American literature on soil analysis evidently has been quite thoroughly examined and many American methods have been selected. It is rather surprising, however, that some of the methods of the Official Agricultural Chemists have not been included "as is," and that so little mention is made of Hillebrand's work on silicate analysis.

The various procedures are described in ample detail and comments are not lacking, although they are not a prominent feature of the book. Probably most chemists would have welcomed more extended remarks concerning the various methods; but in some cases the author has said about all there is to say in a few words. Regarding the acid digestion of soils the author points out: "What the ten per cent. hydrochloric acid really extracts from the soil, what compounds it dissolves and decomposes, we do not know."

The methods described cover the ultimate or "bulk" analysis of soils

after decomposition by hydrofluoric acid or by alkali fusion, analysis of soils by acid extraction, analysis of the water extract, and investigation of the soil solution. Methods for determining some of the rarer constituents of soils, such as lithium and rubidium, are included and special chapters are devoted to colorimetric determinations, to the adsorbing soil complex, and to lime requirement methods. In the chapter on the lime requirement of the soil, fourteen different methods are described. Probably some of the sixteen other existing methods which are not mentioned are just as good as those that are described, but the inclusion of fourteen is enough to show that this is not an exact determination. The omission of methods for determining the Sörensen (P_H) value of the soil, however, is a real lack, for in recent years this has been more widely used in soil investigations than any other single determination. The chapter on the determination of the adsorbing complex of the soil (we would call it "colloidal material)" is largely original material and is treated quite differently from the chapters on the older analytical methods. This chapter is especially welcome. The book should be well received as a whole although, needless to say, few chemists will accept all the procedures as being the best.

P. L. GILE

The Chemistry of Wheat Flour. By C. H. BAILEY, Ph.D., Professor of Agricultural Biochemistry in the University of Minnesota. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 19 East 24th Street New York, 1925. 324 pp. 21 figs. 23.5 × 15.5 cm. Price $4.00.

This is one of the series of the monographs of the American Chemical Society. It is a pioneer book in its field and is the fruit of years of work by the author with wheat and flour. The author gives a résumé of the most important articles bearing on the chemistry of wheat flour. The scope of the book can be seen from the chapter headings: Historical; Wheat in its Relation to Flour Composition; The Growth and Development of the Wheat Plant and Kernel; Influence of Environment on the Chemical Composition of Wheat; Defects of and Impurities in Commercial Wheat; Chemistry of Roller Milling; Changes in Flour Incidental to Aging; The Color of Flour and Flour Bleaching; Flour Strength and Enzyme Phenomena; Flour Strength as Determined by the Proteins of Flour and Colloidal Behavior of Dough.

Wheat flour is composed of the same chemical constituents that are found in wheat, but in somewhat different proportions. The quality of wheat is largely determined by the environment in which it grows and develops. Enzymes in the wheat kernel are stimulated by temperature and moisture, hence these are the most important factors affecting wheat during storage. The wheat kernel consists of three main parts: bran coat, germ and endosperm. In milling, these are separated and, as these parts differ

in chemical composition, the composition of the flour, particularly the ash or mineral content, will be affected by the condition of the milling process.

Flour undergoes changes during storage, improving for a time, and then there is a slow decrease in quality. The rate of these changes depends on moisture and temperature. The yellow or creamy color in flour is due to a natural pigment, the dark or gray color to accidental bran specks which fail to be separated in milling. The former color may be removed by bleaching, which process also has a maturing effect. The quality of wheat flour is measured by its response to the conditions of the bake shop. The most distinctive compound in wheat flour is the protein which forms gluten when water is added. Protein is a colloid and colloidal phenomena are helpful in understanding the chemistry of flour.

Probably the most valuable feature of the book is the comprehensive review of the literature on the chemistry of wheat flour, and the bibliography. These will be especially helpful to all research workers in cereal chemistry. Flour chemistry is of rather recent development, and the results obtained by various investigators have not been so well thought through and so systematically arranged as the data in several other lines of applied chemistry. This is a defect of youth in any branch of science and especially in a pioneer work. In future editions it would be well if the author would give more of his own thought and interpretation even if this will have to be done at the expense of omitting some less important data. The book will be of great value to all interested in the chemistry of wheat flour.

C. O. SWANSON

Mitteilungen aus dem Schlesischen Kohlenforschungs-Institut der Kaiser-Wilhelm-Gesellschaft in Breslau. (Contributions from the Silesian Coal Research Institute of the Kaiser-Wilhelm Society in Breslau.) By Professor Dr. FRITZ HOFMANN, Director. Second volume. Gebrüder Borntraeger, Berlin, 1925. ii + 250 pp. 5 figs. 24.5 × 16 cm. Price, bound, Gm. 19.50.

Germany has three coal research institutes, each situated in one of the three principal coal fields, namely, The Kaiser-Wilhelm Institute for Coal Research in Mülheim-Ruhr, Franz Fischer, Director; The Silesian Coal Research Institute in Breslau, Fritz Hofmann, Director; and The Institute for Brown Coal Research in Freiberg, Saxony. Even though these institutes receive their financial support from the coal mining interests, they devote the major portion of their energies to fundamental research on coal and its products, and science is indebted to them for many valuable contributions on the constitution and origin of coal, the constitution of primary tar, and the catalytic reactions of gases from coal at various temperatures and pressures.

Although the Silesian Coal Research Institute was not completed until March 1922, it has already established itself as equal in quality of research

output, if not in quantity, to that of the two older research institutes. Dr. Fritz Hofmann, the Director, is an able organic chemist who has won distinction by his successful researches on the synthesis of rubber, and more recently by the extraction of 500 kg. of an Upper Silesian coal with pyridine, and identifying a number of hydrocarbons in this extract.

The first and most important paper in this second volume of contributions from the Silesian Institute is Hofmann and Damm's second paper on the examination of the pyridine extract. It covers the neutral oils boiling above 300° including the solid paraffins, and the saturated and unsaturated hydrocarbons. Some thirty compounds were isolated and identified.

The second paper, by Hofmann and Heyn, on the solid phenols in primary tar gives a further definite contribution to our knowledge of the constitution of coal in proving that certain solid phenols found in the pyridine extract of coal may also be obtained in primary or low temperature tar if the coal is destructively distilled at the lowest possible temperature. Overheating results in liquid phenols only.

The third paper on the application of the Bergius process to the hydrogenation of coal tar gives the results of a well-conceived and carefully carried out examination of the hydrogenation products of a gas works tar and a coke oven tar. This paper is of interest both from the practical standpoint of making light oils from tar and from the theoretical point of view of the constitution of coal tar.

Papers 4, 5 and 6 also relate to the origin and constitution of coal, and are studies on polymerization processes. According to Hofmann, these have undoubtedly played an important role in the formation of coal. Two researches are reported, namely, on the action of sodium ethylate on the diethyl ester of 1,4-dibromo-adipic acid and on the polymers of the esters of muconic acid, by Kurt Vogt; and on Δ-1,3-dihydrobenzene, its derivatives and its polymerization products, by Fritz Hofmann and Paul Damm.

Lack of space prevents referring to each of the 15 papers in detail. All are well worth the attention of the coal chemist and many of them will interest the organic chemist as well. The by-product and petroleum chemist will want to read Dunkel's paper on the purification of crude benzol by polymerizing the gum-forming constituents through heating under pressure, and heating in the presence of oxygen, instead of the usual drastic acid treatment which causes a loss of useful and harmless unsaturated constituents.

The book is well bound and the paper and print are of excellent quality.

A. C. FIELDNER