

the value of the coefficient  $B'_{\text{glucose}} = +24,100$  has been found. It is shown that the calculated and observed rotations of five acyl derivatives of gentiobiose and maltose agree closely; the rotations of seven related derivatives have now been calculated (Table II). Arguments are presented in support of the recommendation that measurement of the rotations of new optically-active compounds, particularly those of the sugar group, be made in water or in chloroform solution wherever possible.

WASHINGTON, D. C.

---

### NEW BOOKS

**The Structure of Crystals.** By RALPH W. G. WYCKOFF. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 19 East 24th Street, New York, U. S. A., 1924. 462 pp. 213 figs.  $24 \times 15$  cm. Price \$6.00 net.

In all the history of science there is no more brilliant page covering a period of only ten years than the development of X-ray analysis of crystal structure. Up to January 1, 1924, the positions of atoms in some 200 crystalline substances were determined with a considerable degree of exactness. One of the chief contributors to the field, and one of whose work America should be justly proud, is R. W. G. Wyckoff. His painstaking experimental work, authoritative interpretations, and now the exceptionally high caliber of his new book, justify completely his selection as the author of an American Chemical Society Monograph.

Dr. Wyckoff has been, during the past four years, the chief expositor and proponent of the theory of space groups as applied to crystal structures. His belief in this theory is so profound that it is only natural that the monograph should reflect a strongly individualistic point of view. Consequently, it is admittedly in no sense an impartial handbook of methods and results of X-ray analysis compiled by an unprejudiced editor.

"It is rather intended to give (in Part I) the reaction of a single point of view towards the material of crystal analysis as it now exists. All of the tools that are available are here considered, but all of the different ways of using them are not touched upon. It is the purpose of the second part to treat all existing diffraction data from the point of view outlined in Part I."

This strongly individualistic quality of the monograph may, in some important particulars, militate against its general usefulness as a source of information or as a textbook. One finds, for example, in Ewald's excellent monograph "Kristalle und Röntgenstrahlen," which appeared recently and constitutes the only real competitor, a much more liberal point of view. On the other hand, it must be admitted that the successes of the space group theory justify a very favorable attitude towards it. It has within a few months been adopted by the Braggs and others who did not formerly utilize it. Further advances into the field of more complex structures seem now to be hopeless without its application. This

does not mean that all contributions which are not based upon the theory should be discarded as utterly wrong and worthless. This great study of crystal structure is a difficult one and it must progress by the combined contribution of every point of view. If the theory of space groups, in which atoms are mathematical points disposed with precision in space, actually accounts for the facts, as it so far seems to have done, it will stand upon its merits without the assistance of propaganda. This does not mean to say that the monograph is propaganda. It is simply an admirably and keenly enthusiastic expression of honest and well-founded conviction, tempered by a most pleasing tolerance of other contributions and points of view which has not always been displayed earlier in the author's papers. Thus, in losing a degree of general usefulness by its bias, it gains absolute sincerity, color and authoritativeness.

First of all, then, the greatest appeal and value of the book are to those who are actually doing experimentation, and particularly to those who are beginning or contemplating such researches it should be an indispensable guide, for it presents clearly a knowledge of the best working tools and how to use them. It is surprisingly complete and specific; for example, if one desired a powder spectrograph he would find on p. 179 a description of an apparatus involving the best experiences of several investigators, so specific that the construction is simply a matter of course. Or, if information is desired upon the crystal structure of a compound, it will be found carefully classified and the original work evaluated from the definite point of view which unifies the entire presentation. The enormous and painstaking labor involved in the writing of Part II on "The Results of Crystal Analysis"—investigation of original sources, recalculations, classification, evaluation—is clearly evident and should be deeply appreciated.

As is to be expected, the more purely crystallographic side of the presentation is treated with much greater ease and authority than the X-ray phases. Chapter II on "Some Properties of X-rays," granting the limitations of space, attempts to cover too much ground apparently, with the result that it adds little to the development, and lacks the coherence and the atmosphere of authority which one finds elsewhere; the well-founded impression is gained that X-rays are a very incidental tool and that the chapter is somewhat of a concession. Expansion of the same material into twice as many pages, at the expense of some of the discussion of individual crystals in Part II, would have added materially to the scientific value of the book as a whole.

To the layman or general reader, the monograph will perhaps not have such an appeal, for it is not a popular treatise. He will probably become discouraged, if he is not a crystallographer, in the very first chapter on the symmetry characteristics of crystals. But this is a subject which cannot be sugar-coated and Dr. Wyckoff is to be highly commended for meeting

the issue squarely and for putting it up unequivocally to the reader. The book is to be *studied*, just as its subject matter must be, even for ordinary comprehension. And yet there are portions which all chemists may easily read with understanding and profit. The reviewer strongly recommends that Chapter XV (the last) on "Some Applications of Diffraction Information" be read *first*. This is so well written that it should serve as a real impetus for beginning at Chapter I and following through conscientiously the development of this great new science.

The mechanics of the monograph are all that can be desired. Inestimable value is gained by the 213 excellent drawings and photographs which are more eloquent than many times as many pages of text, by a complete bibliography arranged under authors' names, by tabular appendices and by a subject index.

The possibility that anyone might write a better book than this covering the same ground is negligibly small. The brilliant author deserves sincerest thanks for this masterly presentation, involving as it has an enormous amount of labor, though glorified by an abiding and strictly scientific enthusiasm which does not fail to communicate itself. Only in this way, after all, does science move onward to greater achievements.

GEORGE L. CLARK

*Couleur et Constitution Chimique. (Color and Chemical Constitution.)* By Dr. J. MARTINET and M<sup>lle</sup>. P. ALEXANDRE. O. Doin, 8, Place de l'Odéon, Paris, 1924. 328 pp. 22 × 13.5 cm. Price 25 francs.

This useful treatise is based upon a course of lectures offered by the senior author at the University of Besançon and, after an introductory discussion of color and unsaturation, presents the subject under the following headings: Colored Hydrocarbons; Chromophores; Auxochromes; Linkage of Chromophores and of Auxochromes; Halochromism and Salification of the Chromophore; Molecular Combinations; Organo-metallic Complexes; Coloration and Tautomerism; Chromoisomerism; Thermotropism and Phototropism; Free Radicals; Chromophores, Auxochromes and Physical Properties; Chromophores, Auxochromes and Chemical Properties.

The dominant note throughout is the dependence of color upon unsaturation and upon variation in the distribution of valence. A distinction is drawn between the specific atomic unsaturation found in the auxochromes and the constitutive unsaturation of the chromophores. That of the former is regarded as due to residual valence of "basoid," or positive sign, that of the latter to a similar valence of "acidoid," or negative sign. Union of the two is then polar in character and bathochromic in effect. The presence of color in the so-called "molecular compounds," such as picrates, combinations of trinitrobenzene with indoles, and the like, is ascribed to analogous polar unions. The type of molecular structure most frequently found associated with color is that containing one or more crossed con-

jugated systems of double bonds. The actual cause of color is believed to be an intra-atomic oscillation of the valence electrons of the acidoid chromophore, which varies according to the influence of the basoid unsaturation of the auxochrome.

Beginning with the colored hydrocarbons themselves, where constitutive unsaturation alone is present, the effects produced by the introduction of various chromophores and auxochromes in the same molecule are marshaled in critical review. Such difficult fields as halochromism, chromo-isomerism, thermotropism (thermochromism) and phototropism, are presented concisely and in unprejudiced fashion. The discussion of valence and of the variation in the value of the four affinities of carbon is sane and convincing. Each chapter closes with a helpful summary.

The book is concerned with the color of compounds and not with their tinctorial effects, although the dye chemist will find therein much of interest and value, as for example in the consideration of the non-ionizable organo-metallic complexes used as mordant dyes. Its purpose is not to attempt to explain the mechanism of selective absorption, since that falls within the domain of the physicist, but rather to discover what chemical configurations are usually associated with color, to correlate and classify the facts, so that such general conclusions may be drawn therefrom as will enable the chemist to predict color from constitution and constitution from color. To this end a great accumulation of experimental data is presented, accompanied by references to the original articles and with liberal use of graphic formulas. From a study of this material it is evident that every change in the chemical structure of a compound is accompanied by a change in its selective absorption of light.

The authors point out that the most important feature of such a study is the closer examination of the forces which hold the atoms together in the molecule, the nature of saturation and unsaturation, and similar questions leading to a more accurate conception of valence, the foundation of modern chemistry.

A detailed Table of Contents is given, but an index also would be helpful. The book is interesting and valuable and can be recommended heartily to all chemists.

MARSTON TAYLOR BOGERT

**Physikalisches Handwörterbuch** (Physical Dictionary). Edited by ARNOLD BERLINER and KARL SCHEEL. Julius Springer, Berlin, 1924. vi + 903 pp. 573 figs. 20 × 27.5 cm. Price, bound, \$9.30.

This encyclopedic volume is intended by the compilers (of whom 59 are named) to be an aid to physicists who wish to familiarize themselves with work outside of their special fields. It is, however, so well planned and the subject matter so clearly and simply presented that it should serve admirably to give an accurate summary of modern developments in the

theory and practice of physics to those engaged in any branch of work involving the use of that fundamental science as an instrument of research. As might be expected, many topics are treated that in recent years have become important to physical chemists.

In all, about 5000 topics are included; these are arranged alphabetically, both by key words with cross references, and by subjects. The average length of article is about 200 words but many articles are considerably longer. Thus, radium is given about 4500 words, photometry and its various branches require 15,000 words and the periodic classification of the elements is allotted 2000 words. Clearly arranged charts aid in the presentation of typical data, and sectional diagrams illustrate many of the new, complicated types of physical apparatus. The pages are double columned and the type is about the size of the smaller type used in *THIS JOURNAL* (8 point). Paper, press work and binding are adequate.

It is a book that should prove to be of great value to all those who must content themselves with only brief incursions into the literature of physical science, but who, nevertheless, wish to feel that they have been accurately informed about the matters that have interested them.

WILLIS A. BOUGHTON

**An Introduction to the Study of the Compounds of Carbon, or Organic Chemistry.**

By IRA REMSEN. Revised and enlarged with the collaboration of the Author, by W. R. ORNDORFF, Ph.D., Professor of Organic Chemistry, Cornell University. D. C. Heath and Company, Boston, New York, Chicago. xi + 567 pp. 20.5 × 14 cm. Price \$2.40, postpaid.

The appearance of this pioneer textbook of organic chemistry in a revised and enlarged edition will be a source of gratification to its old friends.

The statement in the preface that for one who studied organic chemistry when the book was first written, one hundred study it now, is probably conservative. It is evident, then, that such factors as choice of material, amount of theory, methods of presentation, extent of reference to industrial processes and relation to other sciences, can scarcely be combined in a textbook for beginners to the satisfaction of all the teachers engaged in guiding this large and varied body of students.

Many will be disappointed that the authors did not break precedents by giving a certain measure of consideration to some of the newer theories inspired by the development of physical chemistry. It is as futile, perhaps, to prescribe the nomenclature of our science as the spelling of our language, yet the writer ventures the opinion that the term "ethereal salt" so prominent in this text should be given every opportunity to become obsolete. The esters are sufficiently different from the metallic salts to deserve a class name entirely their own. It is a debatable question just how much discussion of fundamental operations such as crystallization, methods of analysis, distillation, etc., should be included in such

a book. It does, however, seem somewhat unfortunate that, regardless of its technical importance, a system, ethyl alcohol and water, whose vapor pressure curve shows a maximum, should be chosen to illustrate fractional distillation when the whole subject of distillation does not receive more exhaustive treatment.

Much space has been saved and a great improvement made by leaving out directions for laboratory experiments. Such directions are seldom adequate when crowded into the space allotted to them in a text, and belong distinctly in special treatises.

The text is a straightforward, fascinating story, unencumbered by all too much detail, setting forth facts clearly, and basing structural relations upon them convincingly. Its interest is heightened by frequent reference to industrial processes, and the importance of many reactions emphasized by figures showing the amount of production of chemicals by their use. The authors have woven cleverly into their text the relations of organic chemistry to physiological processes and pharmacology without yielding to the temptation to go too far into the medical field.

The book has the special merit that from the standpoint of the beginner it contains a wealth of well selected descriptive material by the careful study of which the student can acquire that background of facts and the thorough understanding of elementary principles, so necessary to the successful pursuit of more advanced work.

C. E. BOLSER

**Treatise on General and Industrial Organic Chemistry.** By DR. ETTORE MOLINARI, Professor of Industrial Chemistry at the Royal Milan Polytechnic and at the Luigi Bocconi Commercial University. Second English edition, translated from the third enlarged and revised Italian edition, by THOMAS H. POPE. Part II. P. Blakiston's Sons and Company, 1012 Walnut Street, Philadelphia, 1923. viii + 441 pp. 303 figs. 25 × 16 cm. Price \$8.00.

The characteristics of this work are those described in the review of the first edition<sup>1</sup> but it has undergone extensive revision, for not only has the volume on Organic Chemistry been divided into two parts, published independently, but a comparison shows that Part II has been increased by 36 pages and by 45 figures in the text. Closer examination shows that not only have new figures been introduced but some old ones omitted and that the number of tables has been reduced by ten. The revision has, therefore, been profound and this extends to the statistics of exports, imports, production, consumption and prices which constitute a unique feature of the book.

One is puzzled to find the criterion of importance applied to subjects. Thus in the table on the "More Important Nitro Derivatives" the constants for three mono- and one dinitrotoluenes are given but no trinitro-

<sup>1</sup> THIS JOURNAL, 36, 205 (1914).

toluene appears, while the description of the mode of manufacture of trinitrotoluene in the text is given in a line and a half though a half page is devoted to that of picric acid. Under lampblack no mention of carbon black or natural gas black is found; nor of macaroni in connection with wheat flour or gluten. Also, under furfural and mucic acid there appears no mention of the new sources of supply and methods for producing these substances commercially developed in this country.

Molinari quotes names and dates freely but, except for patents, he gives no clue to the source. On p. 664 he says picric acid "was discovered in 1771 by Amato di Welter." Explosives authorities, including Italian, credit this discovery in 1771 to Woulfe. In the absence of a reference, it may take some time to determine which is correct. Attention is called to this detail because this publication, with its wealth of information on commercial and economic matters, is of especial value to chemical experts who not only are frequently called upon to report upon the state of an art but also to assist in determining priority. It is also of special value to students of chemical economics, while every chemist will find it a very valuable addition to his library.

CHARLES E. MUNROE

**Die physikalischen und chemischen Grundlagen des Eisenhüttenwesens.** (*The Physical and Chemical Foundations of Ferro-Metallurgy.*) By WALTHER MATHESIUS, Professor in the Technical High School, Berlin. Otto Spamer, Leipzig, 1924. Second revised edition. xviii + 483 pp. 157 figs. 25 × 17 cm.

This book is one of a series of technological monographs and the viewpoint throughout is strictly that of the engineer. The first section, comprising 120 pages, is, however, mainly devoted to chemical and physical laws and data. It is the reviewer's impression that those primarily interested in this phase of the work will find little that is stimulating. No attempt appears in the book, if the title be excepted, or in the author's statement of his purpose, to interest the investigator. This should normally inspire increased care in the choice and emphasis of the material discussed, as well as in the method of the treatment, but apparently has not in this case. To illustrate, the mass law is nowhere adequately presented, and no mention of equilibrium is made in the discussion of the reduction of iron oxides by carbon monoxide and carbon on pp. 88 and 89. Later, however, on p. 224, in connection with reactions in the blast furnace, the equilibrium diagram published by Baur and Glaesner in 1903, and now known to be seriously incorrect, is employed. It is noted as a good feature that the author recognizes and uses in some of his presentations the distinction between rate and equilibrium; in one case, however, on pp. 4 and 5 the two appear to be confused. On p. 29 the statement is made, virtually as a recommendation, that the change in heat of reaction with temperature may usually be disregarded. The wisdom of this as a general

policy, without study of the particular case, seems doubtful to the reviewer, even in practical work. On p. 3 the reaction,  $C + O = CO$ , is cited as a "pure" oxidation reaction, but "there are no pure reduction reactions." Reversible reactions in this section are treated only from the standpoint of reversal through change in temperature, which leads to some queer definitions and rules on pp. 6 and 7.

In the second part, 40 pages are devoted to fuels, the remainder of the book, comprising three sections, being given over to the discussion of the processes, and methods of control employed in the production of iron and steel. The greatest space is naturally given to the blast furnace, and the author considers his most valuable contribution to be his "theory" of its operation, which it is claimed points the way to considerable economies in production. It may be mentioned that there is little said concerning two of the questions of much recent interest, namely, oxygen enrichment of the blast, and electrical reduction.

E. D. EASTMAN

**Kohlenchemie. Entstehung und Chemisches Verhalten der Kohlen und ihrer Bestandteile; Untersuchung der Kohlen.** (The Chemistry of Coal. The Origin and Chemical Characteristics of Coal and its Constituents; the Testing of Coal.) By Dr. HUGO STRACHE, Professor, and Dr. RICHARD LANT, Assistant, in the Technical High School, Vienna, Austria. Akademische Verlagsgesellschaft m. b. H., Leipzig, Germany, 1924. 599 pp. 52 figs. 24 × 16 cm. Price, unbound, 24 Gm.; bound 26 Gm.

The object of the present work is to bring the chemistry of coal up to date. A relatively short time has elapsed since the appearance of the third edition of Muck's well-known "Chemie der Kohle" by Hinrichsen and Taczak in 1916, but during that period the knowledge of the chemistry and general nature of coal has made tremendous progress, so that that work is now entirely out of date. Although a considerable amount of the literature has been drawn from the Muck-Hinrichsen-Taczak edition, Strache and Lant's book differs from it greatly in style, arrangement and treatment of subjects. A large amount of the literature has been drawn from *Brennstoff-Chemie* and *Gesammelte Abhandlungen zur Kenntnis der Kohle*.

While in other works bearing a similar title, coal is discussed as a whole, in this one the chemical nature of the plant constituents that contribute to coal and their chemical transformation during coalification, as well as certain constituents of coal, are discussed separately.

The old theories of Potonié in respect to the origin of coal have been adhered to, supplemented by the newer conceptions of Franz Fischer and his associates. Coal, lignite, brown coal and peat are considered genetically related and all are treated in every chapter. The separate chapters deal with the origin of coal; the kinds and ranks of coal and their chemical and physical characters; occurrence; mining; preparation and storage; constitu-



ents of coal and their chemical behavior; the chemical behavior of coal as a whole; behavior of coal on heating; methods of testing and analysis of coal.

The chapter on mining, preparation and storage of coal is too brief. It might well have discussed the newer experiments and methods of washing, such as the float-and-sink, froth flotation, and the Chance sand-flotation methods, of which no mention is made. The chapter on the constituents and their chemical behavior is the most practical one to the student interested in the origin of coal, occupies considerable space, and is well done. The mother substances of coal, such as cellulose, lignin, sugars, starch, resins, waxes, fats, oils and humins are treated separately, and are well treated at some length. Nitrogen and sulfur are duly considered.

The chapter on the chemical behavior of coal as a whole deals with its behavior towards solvents, reagents and during storage. Although this chapter presents a vast amount of information, the part on spontaneous combustion could have been more complete in view of the attention this subject has had lately. In the chapter on behavior of coal on heating, the part on primary distillation, in view of the important consideration which that phase of the chemistry of coal is commanding at the present, is fully and comprehensively handled. The authors, however, are too confident as to the commercial success of some of the low-temperature distillation methods.

The work may be criticized on the scope of the literature digested. While the German literature is completely reviewed and referred to, English literature is not so well treated. Some works of importance within the scope of this book both as to time and subject, are not even alluded to. Particularly is this shortcoming true as regards American literature; further, many references are incomplete. To give just one case of many, Parr and Olin's pioneer work on low-temperature distillation of coal is treated at some length apparently from abstracts, the original source not being even cited. Referring to these abstracts, it is seen that the original publications are but briefly and inadequately treated.

The work might have been improved if some of the old ideas and theories on coal had been entirely ignored, and if only the more recent findings had been spun into the modern concept of the origin, composition and nature of coal.

REINHARDT THIESSEN