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## NEW BOOKS

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**Elementary Principles in Physical Chemistry.** By T. J. WEBB, Assistant Professor of Physical Chemistry, Princeton University. D. Appleton-Century Company, Inc., 35 West 32d Street, New York, N. Y., 1936. 344 pp. 15.5 × 23 cm. Price, \$4.00.

As an introductory text in physical chemistry, this book is somewhat unconventional in choice of subject matter. This is doubtless in part due to the fact that it is written, according to the sub-title, "with special reference to the state of equilibrium in a chemical reaction and to the rate of attainment of equilibrium." As a result electrical conductance, for example, is treated with brevity and the phenomena of transference are largely omitted; similarly absent are the usual chapters on the liquid state, the solid state, the relation of physical properties to molecular constitution, and the colloidal state. Since rates of reaction are a primary object, the absence of a discussion of photochemical reactions is more difficult to understand. Subjects which are treated somewhat more fully than is usual in introductory texts are distribution laws (both Maxwell's and quantum theory), thermodynamics (making free use of entropy), the Debye-Hückel theory of electrolytes and its application to reaction rates, Eyring's theory of reaction rates, and Schrödinger's equation.

Numerous interesting tables of numerical results are included, but experimental methods receive scant attention. Consequently a student with no more than the usual experience of one beginning physical chemistry would often find himself studying theories of phenomena in advance of any appreciation of the facts; the extent to which this would create difficulty would depend upon the instructor. Since the treatment is largely analytical rather than descriptive, a student without a fair knowledge of calculus would lose much that is most useful in the book.

While it is possible to disagree with various details, on the whole the book gives evidence of having been thoughtfully written. The student who is interested primarily in the practical application of physical chemistry may perhaps not be attracted; but the student whose taste is for theoretical aspects of the subject, including those of fairly recent origin, will find much to interest him.

ROSCOE G. DICKINSON

**Quantitative Analyse. (Quantitative Analysis.)** By Dr. OTTO BRUNCK, Professor em. an der Bergakademie Freiberg. Verlag von Theodor Steinkopff, Residenzstrasse 32, Dresden-Blasewitz, Germany, 1936. 224 pp. 8 figs. Price, RM. 9.

"The Art of Gravimetric Analysis at Freiberg" would be a more exact title for this book. Professor Brunck presents the procedures of classical gravimetric analysis developed there by Clemens Winkler and enriched by his own life work. One sees on every page that the methods described have, as the author states in the preface, been tested with his own hands.

The first sixty-seven pages of the book are devoted to the general technique of quantitative analysis. Since Professor Brunck omits all chemical theory with which the student is presumably acquainted from previous study of qualitative analysis, a very thorough and helpful treatment of the practical operations such as fusions, filtrations, and ignitions is possible. A section on electroanalysis is included.

The remaining one hundred forty-seven pages are given to particular directions for the determination of water, the metals, and the non-metals. Besides the common metals of qualitative analysis, gold, platinum, palladium, molybdenum, tungsten, titanium, uranium, and beryllium are treated. At the end of each group of metals, directions for separation are added. In this part of the book repetition is avoided and cross reference is made easy by a very clear system of paragraph numbering.

It is easy to find flaws in a book written in the spirit of this one. Not all analysts will agree that calcium may be separated from magnesium by a single precipitation in alkaline solution and that the practice of weighing calcium as the oxide is to be abandoned. Many useful methods, such as the separation of iron, titanium, and other elements with cupferron, and the determination of sodium with uranyl acetate reagents, are not even mentioned. One regrets that Professor Brunck has limited the scope of his book through economic considerations. The lack of references is particularly unfortunate. Perhaps the most serious objection to the book as a text is that in many cases it would lead a student to employ gravimetric methods where volumetric methods are more suitable.

For these reasons the book is not to be recommended as a text for elementary quantitative analysis. It will be valuable, however, to more experienced workers, and teachers of quantitative analysis will find it most suggestive and stimulating.

CHARLES H. GREENE

**Die neuere Harnsäurechemie. Tatsachen und Erklärungen. (Modern Theories and Researches on the Chemistry of the Uric Acids.)** By Prof. Dr. HEINRICH BILTZ, Breslau. Verlag Johann Ambrosius Barth, Salomonstrasse 18B, Leipzig C 1, Germany. 164 pp. 14.5 × 22.5 cm. Price, RM. 5.80.

Professor Biltz's investigations on glyoxalones led him to make a searching study of the complicated chemistry of uric acid. As a result, his newer investigations have contributed much important and valuable data leading to a better understanding of the chemistry and reactivity of uric acid, especially the nature of the 4,5 double bond in this oxypurine molecule. The conclusions and theoretical discussions of the author are reported under five subdivisions or chapters which may be expressed as follows: (1) purine constructions of the uric acid type in which the 4,5 double bond of the uric acid molecule is resistant to change; (2) derivatives of uric acid resulting from a rupture of the

pyrimidine ring in the uric acid molecule; (3) derivatives of uric acid formed by rupture of the glyoxalone ring of this purine molecule; (4) chlorination products formed from uric acid and their characteristic reaction products and (5) characteristic caffolide and spirohydantoin ring compounds formed from uric acid. The author makes original applications of the electron conception of chemical action to explain many of the results obtained by experimentation, and uses this method of reasoning to explain the disagreement in chemical behavior between uric acid and xanthine. The author considers the 4,5 double bond in the uric acid molecule as a normal ethylene grouping, while in xanthine it functions in an entirely different manner as a result of its conjugation with a double bond in the 7,8 or 8,9 positions of the purine molecule.

Under these five subdivisions are discussed (1) uric acid and xanthine reactions, uric acid acidity, alkylation and acylation, hydrolytic degradation and oxidation, (2) uric acid glycols and their characteristic degradation changes, oxidation reactions with conversion to hydantoins and formation of allantoin, (3) the acetal derivatives of uric acid glycol, their behavior toward acids, reduction with hydriodic acid and interaction with diazomethane, (4) isouric acid derivatives, halogenated dihydrouric acids and pseudouric acids, and (5) the caffolides and formation of hydantoylamides, spirohydantoins and their conversion into hydantoins.

The books contain a large amount of most interesting data accumulated after years of research on uric acid. Abundant literature references are given which will be very helpful to the inexperienced worker in this field of chemistry. What is greatly needed, however, is a better organized system of classification of characteristic reactions to make the book more readable.

TREAT B. JOHNSON

**Physical Chemistry.** By FRANK H. MACDOUGALL, M.A., Ph.D., Professor of Physical Chemistry, University of Minnesota. The Macmillan Company, 60 Fifth Avenue, New York, N. Y., 1936. ix + 721 pp. 97 figs. 14.5 × 22.5 cm. Price, \$4.00.

Another text-book of physical chemistry! Perhaps it might have been said, twenty-five years ago, that there were few good American text-books of physical chemistry, but certainly, today, we have six or eight such books, any one of which will afford plenty of good grist to a professor and his class throughout a full year's milling.

Dr. MacDougall's presentation follows, "in the main, the traditional order of presentation," as stated in the Preface. The chapter headings are: I, Introduction, Atomic Theory; II, Energy and the First Law of Thermodynamics; III, The Gaseous State; IV, The Liquid State; V, The Solid State; VI, The Structure of Atoms I; VII, The Structure of Atoms II; VIII, Physical Properties and Molecular Constitution; IX, The Second Law of Thermodynamics; X, Solutions; XI, Solutions of Electrolytes; XII, Thermochemistry; XIII, Equilibrium; XIV, Heterogeneous Equilibrium and Applications of the Phase Rule; XV, Chemical Kinetics; XVI, Electrical Conductance; XVII, Equilibrium Involving Ions; XVIII, Electromotive Force; XIX, Electrolysis; XX, Photochemistry; XXI,

The Colloidal State; Index of Authors and Index of Subjects.

The book is written with an easy-flowing logic and with exceptional and gratifying clarity. Many intermediate steps in the derivations and expositions, often omitted in texts of this same class, are here included to help the student (and the professor) surmount some of the more troublesome hurdles. While several of the chapters seem very full and exhaustive for an introductory course, the topics are developed and arranged in such a way as to permit an adaptation of the subject matter to the needs of several different types of students. More than usual emphasis, but not unduly so, is given to thermodynamic approach, and the Author develops the treatment in fairly gentle stages.

This text deserves to rank with the best available. Many teachers will find it suited ideally to their requirements.

EDWARD MACK, JR.

**The Theory of the Properties of Metals and Alloys.** By N. F. MOTT, M.A., F.R.S., Professor of Theoretical Physics, and H. JONES, Ph.D., Lecturer in Theoretical Physics, The University of Bristol. Oxford University Press, 114 Fifth Avenue, New York, N. Y., 1936. x + 326 pp. 108 figs. 16 × 24.5 cm. Price, \$8.00.

**Elektronentheorie der Metalle.** (Electron Theory of Metals.) By Dr. HERBERT FRÖHLICH, Bristol. Verlag von Julius Springer, Linkstrasse 23-24, Berlin W 9, Germany, 1936. vii + 386 pp. 71 figs. 14.5 × 22 cm. Price, RM. 27; bound, RM. 28.80.

It is ten years since Fermi and Dirac suggested the principles of statistics which are now known by their names. This decade has seen those principles applied to the electrons in metals, with a success reminding one of the preceding years when Bohr's theory of hydrogen was being extended to explain the periodic table and the line spectra of the elements. The theory of metals is still far from the complete state which atomic theory has reached; the volumes under review are the first full sized books which have been devoted to it. But it is on the way and proceeding with great vigor.

The chemist should certainly be interested in this development. Most of the elements are metals, and they prefer to behave in ways quite different from the laws of valence which the chemists have worked out. Unlike the familiar chemical compounds, the laws of metals are not simple and qualitative ones, to be perceived without mathematical labors. The theory of metals is based on wave mechanics, and unfortunately on the more difficult and involved wave mechanics; and there seems to be no short cut to understanding it. But the theory is interpreting facts at such a rate that it can hardly be neglected, even by the most practical minded, for it is likely to be the foundation of the physical metallurgy of the future. There is no use pretending, however, that either of the volumes which have just appeared is easy reading, or even possible reading for one who is not already more or less familiar with the principles of wave mechanics. They are both well and clearly written, but the mathematics cannot be escaped. The day has passed when a chemist or metal-

lurgist is educated to discuss the foundations of his science, if he does not know modern theoretical physics. It is just as fundamental to the chemical physics of the next generation as thermodynamics was to the physical chemistry of the last.

The two books under discussion are very similar, as is natural when one notes that both originate in Bristol, where Mott and Jones are members of the staff, and Fröhlich has been a visitor. England has been rather in the lead in the last few years in the theory of metals, partly with the help of expatriated German scientists, though this country, Russia, Germany and France have all contributed. It has been a development not only of many countries but of many people, and no collection of the leading workers in the field would be complete without fifteen or twenty names at the very least. The authors of these books have all made significant contributions, however, and naturally each emphasizes to some extent his own work. Thus Mott and Jones treat alloys in a good deal of detail: they discuss carefully the various types of lattices, and the methods of predicting the crystal structure and phase diagrams of alloys; they take up the properties of the transition metals; in general, they stay rather close to physics and chemistry, with a minimum of mathematics. Fröhlich, on the other hand, covers the mathematical part of the theory with more care, but considers principally the alkali and noble metals, the simplest group theoretically, with comparatively little treatment of the other groups of metals, and almost none of alloys. The chemist is likely to find Mott and Jones' book more to his liking. But both are in general excellent and authoritative, and both can be read with profit.

Since books on the theory of metals are a novelty, it is worth while saying what these contain. Mott and Jones begin with a discussion of the thermal properties of a crystal lattice—the equation of state, specific heat, phase diagrams of alloys, and superstructure. Then follows a treatment of the motion of electrons in a crystal lattice, first in the absence of an external field, then in a field, leading to electrical conduction, dispersion and absorption of light. The theory of cohesion and metallic binding, as applied both to pure metals and alloys, follows next, after which there is discussion of electronic specific heat, magnetic properties, and detailed calculation of electrical conductivity. Probably of most interest to chemists will be the part dealing with alloys and the conditions governing their formation and properties. Fröhlich, as has been stated, does not treat these problems, but does take up a few questions, such as thermionic emission, which Mott and Jones omit. Both books are more inclusive in some respects than the article in the "Handbuch der Physik" by Sommerfeld and Bethe, the best known previous treatment of the subject, and contain a good deal of new material, principally on cohesion and optical properties, which have developed since the time of that article. Both contain many references, those given by Fröhlich being in the form of a fairly extensive, though sometimes inaccurate, bibliography. While there are a few points on which one may take

issue with the points of view of both books, these are minor affairs, and of small interest to the general reader. In general, it is safe to say that the electron theory of metals is now a branch of science in the most flourishing period of its growth, and that the books of Mott and Jones and of Fröhlich are excellent guides to its present development.

J. C. SLATER

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## BOOKS RECEIVED

December 15, 1936–January 15, 1937

- L. ERHARD, Editor. "Blätter für Geschichte der Technik." Dritter Heft. Verlag von Julius Springer, Linkstrasse 23–24, Berlin W 9, Germany. 101 pp. RM. 3.60.
- CHARLES S. GIBSON. "Essential Principles of Organic Chemistry." The Macmillan Company, 60 Fifth Avenue, New York, N. Y. 548 pp. \$5.00.
- JOHN READ. "Prelude to Chemistry. An Outline of Alchemy, its Literature and Relationships." The Macmillan Company, 60 Fifth Ave., New York, N. Y. 327 pp. \$5.00.
- WILLIAM RIEMAN, III, AND JACOB D. NEUSS. "Quantitative Analysis. A Theoretical Approach." McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. 425 pp. \$3.00.
- JOHN H. YOE. "Chemical Principles with Particular Application to Qualitative Analysis." John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y. 311 pp. \$2.75.
- "Gmelins Handbuch der anorganischen Chemie. System-Nummer 36: Gallium." Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany. 100 pp. RM. 13.87.
- "Gmelins Handbuch der anorganischen Chemie. System-Nummer 23, Ammonium." Lieferung 2. Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany. 360 pp. RM. 42.25.
- "Gmelins Handbuch der anorganischen Chemie. System-Nummer 37, Indium." Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany. 116 pp. RM. 15.75.
- "Gmelins Handbuch der anorganischen Chemie. System-Nummer 59: Eisen." Teil A, Lieferung 6–7. Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany. 254 + 214 pp. RM. 31.15 + 27.00.
- "Gmelins Handbuch der anorganischen Chemie. System-Nummer 59: Eisen. Teil D. Magnetische und elektrische Eigenschaften der legierten Werkstoffe." Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany. 466 pp. RM. 57.75.