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## NEW BOOKS

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**Molekülspektren und Molekülstruktur. I. Zweiatomige Moleküle.** (Molecular Spectra and Molecular Structure. I. Diatomic Molecules.) By DR. GERHARD HERZBERG, Professor of Physics in the University of Saskatchewan. Verlag von Theodor Steinkopff, Residenzstrasse 32, Dresden-Blasewitz, Germany, 1939. xvi + 404 pp. 169 figs. 15.5 × 22.5 cm. Price, RM. 21; bound, RM. 22.50.

In the first chapter, the author gives a short survey of the principles of the theory of atoms and of atomic spectra, essentially a collection of the formulas and concepts necessary for the subsequent molecular theory. An empirical treatment of the molecular spectra is presented in the second chapter. In about twenty-five excellent figures, the different spectral types are reproduced; their interpretation in band head schemes for vibrational analysis or Fortrat diagrams for rotational analysis are represented in figures and tables. The theory for the rigid rotator and for the harmonic oscillator are developed by classical and wave-mechanical methods; the selection rules and the formation of the infrared and Raman spectra are derived from the theory in the next chapter. The expansion of the simple theory to the anharmonic oscillator and the connection between potential curves and dissociation are treated; besides that the non-rigid rotator and the symmetric top model are considered. The wave-mechanical derivations show the symmetry properties of the rotational functions; after the introduction of the nuclear spin, the author gives the explanation for the ortho and para modifications of hydrogen, heavy hydrogen and nitrogen. In an appendix, the isotope effect on rotation and vibration is derived.

Chapter IV includes a general empirical treatment of the visible and ultraviolet bands, based on an electronic transition and the superposition of the vibrational and rotational motions of molecules. The selection rules and the intensity relations of the Franck-Condon principle are derived. There is presented a very thorough and critical treatment of those methods, by which the molecular constants may be obtained from the measured spectrum lines. Chapter V contains the finer details of electronic bands: the multiplicity of the electronic states and the coupling of the molecular rotation with the motion of the electrons. In twenty-five pages, all the known types of electronic bands are explained with excellent figures and with typical examples. Quadrupole radiation, Zeeman effect in bands and perturbations are dealt with briefly. In Chapter VI, the Aufbauprinzip and the problems of the derivation of the term scheme of a molecule from those of the separated atoms on one hand and from the united atom on the other are given, as well as the symmetry properties of the single electrons and of the terms containing equivalent or different electrons. We find there the Heitler-London theory of valence and its extension to other molecules, and the concept of the ionic bond and of the van der Waals bond. In Chapter VII, continuous and diffuse molecular spectra

are explained by potential energy curves. Here is presented the determination of the dissociation and predissociation limits, one of the methods of the band spectra research which finds valuable application to chemistry and astrophysics. It is no surprise to find this chapter is just perfect, for Herzberg is the leading physicist in this field, and we owe to him its major development. All the different methods for getting the heats of dissociation for molecules are excellently described. In the concluding chapter, we find some term schemes and potential energy curves and, in addition, a table of the constants for the normal electronic states of all the diatomic molecules and their isotopes, as far as they are known. Besides that, a brief summary is given of some applications of the results of band spectra analysis to other fields of physics, chemistry and astrophysics. The very extensive indices of books, papers, authors and subjects facilitate the use of the book.

The book appears at a time when the subject is well established and is written by one of the leaders in the field. Herzberg has carried through many analyses of bands, has explained diffuse spectra and determined final values for the heats of dissociation of nitrogen and oxygen. He has described all the methods he used so comprehensively and lucidly that no one faced with a problem in molecular analysis can find a better presentation. There are other books which treat the wave mechanical theory more thoroughly, but none which is more useful to the experimenter. In 1932, Max Born told in a lecture that band spectra theory is not difficult at all, only very complicated. I had my doubts. But Herzberg's book seems to prove that Born was right. Herzberg shows that there are no difficulties; but he could not possibly eliminate the complexities.

Every experimenter in band spectroscopy looks forward to the appearance of the second volume treating polyatomic molecules.

HANS G. BEUTLER

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**Qualitative Analysis by Spot Tests.** Inorganic and Organic Applications. By Dr. Ing. FRITZ FEIGL, Director of the Research Laboratory, Soc. Belge de Recherches et d'Etudes, Gand.-Emerit. Professor of Analytical and Inorganic Chemistry of the University of Vienna. Second English Edition, translated from the Third German Edition by JANET W. MATTHEWS, Ph.D., F.I.C. Nordemann Publishing Company, Inc., 215 Fourth Avenue, New York, N. Y., 1939. xv + 462 pp. 27 figs. 36 tables. 16 × 24.5 cm. Price, \$7.00.

The appearance of the second English edition of Feigl within less than two years of the first attests both the importance and recognition of an indispensable chemical tool. This second English edition is an authorized translation of the Third German edition, a review of which was published by THIS JOURNAL, 60, 2831 (1938). It does not,

however, include the theoretical part, separate publication of which is announced in an insert.

This second English edition contains 62 more pages, 3 more figures and 5 more tables than the first. The general arrangement and sequence is precisely the same as that of the first, *cf. ibid.*, 60, 734 (1938), the substantial increase of material being rather evenly distributed over the whole book. A very substantial increase in the number of references to the literature is particularly noticeable. The subject index has been greatly improved and occupies 37 pages as compared with 15 in its predecessor.

ERNEST H. HUNTRESS

#### Applied Mathematics in Chemical Engineering.

By THOMAS K. SHERWOOD, Associate Professor of Chemical Engineering, and CHARLES E. REED, Assistant Professor of Chemical Engineering, Massachusetts Institute of Technology. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N. Y., 1939. xi + 403 pp. 113 figs. 16 × 23.5 cm. Price, \$4.00.

Teachers of physical chemistry and of chemical engineering commonly find that the great majority of their students cannot use the calculus as an effective tool in dealing with chemical problems. Even those who have taken Freshman and Sophomore courses in college mathematics commonly have difficulty in thinking of a derivative as anything else than the slope of a curve or of an integral as anything except the area under a curve. Most of them have trouble when the independent variable is time or temperature, or pressure, or volume, or mole fraction. They may be able to differentiate or integrate complicated functions covering the whole range of Peirce's Tables of Integrals but many of them are unable to set up the proper differential equations applicable to chemical or chemical engineering problems, or evaluate integration constants from the boundary conditions. Many teachers of chemistry handle this situation either by avoiding the use of calculus or by devoting the time in the chemistry classes to teaching calculus; and in their spare time they cuss the Mathematics Department. Sherwood and Reed have attempted to meet this pedagogical difficulty by writing a book covering the calculus and some other branches of mathematics with the illustrative examples taken mainly from the field of chemical engineering and chemical thermodynamics. The authors are justified in the claim made in the preface, "It should be possible for anyone with a good grounding in the calculus to follow the text without great difficulty." But a student who really had a good grounding in the calculus would find a large fraction of this text already familiar to him from his previous study, since much of the text is devoted to definitions of terms and explanation of mathematical procedures with the customary illustrations taken from geometrical problems to be found in any standard text on the calculus, supplemented by illustrations taken from chemical engineering which are not found in the texts written by mathematicians. It therefore appears that the text is really aimed at the student or professional chemical engineer whose previous grounding in the calculus is not good or at least partly forgotten so that he needs to renew his study of old material before

tackling the problems drawn from chemical engineering and thermodynamics.

On the other hand, the book would not be suitable for a student with no previous knowledge of the calculus because too much that is fundamental is taken for granted, including the rules for the differentiation and integration of sums, products, ratios, surds, trigonometrical and exponential functions. Considerable systematic drill on the simpler parts of Peirce's Tables is essential for the mastery of the calculus and is not provided in this text. However, this is not a criticism because the book is not intended to be used in this way.

Although most of the book is devoted to the calculus, the other branches of mathematics discussed include infinite series (including Taylor's Theorem, Fourier's series and Bessel's Functions); numerical analysis (formulation of empirical equations to fit a set of data, numerical differentiation and integration and interpolation); graphical analysis including a discussion of logarithmic, polar and triangular graph papers and alignment charts; theory of errors, probability distribution curves and method of least squares.

The applications of the mathematical principles to chemical engineering are numerous and varied and are worked out in considerable detail in the text. In some cases the solution is given in generalized form and in others by highly specific numerical examples.

There are no practice examples for solution by the student scattered through the text but an appendix gives 38 problems of varied character, including some that are purely mathematical.

The authors in their preface say "Chemical engineering gives many indications of rapid advancement along quantitative and mathematical lines." This book will undoubtedly aid and stimulate this advancement as well as help many a laggard to keep up with the procession.

GRINNELL JONES

#### Vapor Charts and Special Tables for Turbine Calculations.

By FRANK O. ELLENWOOD and CHARLES O. MACKEY, Professors of Heat-Power Engineering, Cornell University. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1939. iv + 43 pp. 21.5 × 28.5 cm.

The original "steam charts" first published by Professor Frank O. Ellenwood in 1914 showed the convenience in making calculations of having a chart of thermodynamic properties divided into many parts for easy reading. The present book of charts shows the thermodynamic properties of water, ammonia, dichlorodifluoromethane (freon), and air-water-vapor mixtures.

The steam charts employ specific enthalpy and log volume, the latter coordinates extending from 0.05 to 3500 cu. ft. per pound. A new chart for liquid water is also included accompanied by tables of jet velocities, squares of numbers, and barometric corrections. The design and test of performance of modern high pressure turbines requires a series of tedious and time-consuming calculations which will be much facilitated by the new charts.

Paper quality, type character, sharpness of intersections are everything that could be desired. The exact data

available have enabled the authors to prepare a set of tables which should possess a high degree of permanency.

FREDERICK G. KEYES

**The Nature of the Chemical Bond and the Structure of Molecules and Crystals.** By LINUS PAULING. Cornell University Press, 124 Roberts Place, Ithaca, New York, 1939. 429 pp. Price, \$4.50.

The need for a modern and comprehensive discussion of the electronic structure of molecules, in particular as it affects their stability and their spatial configuration, has been keenly felt for some time and no other book could be more welcome than this treatise of Pauling. An idea of its scope may be given by a brief summary of contents. In order the chapter headings are as follows: I. Resonance and the chemical bond; II. The partial ionic character of covalent bonds and the relative electronegativity of atoms; III. The directed covalent bond. Bond strengths and bond angles. The magnetic criterion for bond type; IV. The resonance of molecules among several valence-bond structures; V. Interatomic distances and their relation to the structure of molecules and crystals; VI. Types of resonance in molecules; VII. The structure of molecules and complex ions involving bonds with partial double-bond character; VIII. The one-electron bond and the three-electron bond; IX. The hydrogen bond; X. The sizes of ions and the structure of ionic crystals; XI. The metallic bond; XII. A summarizing discussion of resonance and its significance for chemistry.

The author makes full use of the results of quantum-mechanical treatment of molecules but the presentation is substantially non-mathematical; as he says "The ideas involved...require for their understanding no more, or little more, mathematical preparation than the familiar concepts of chemistry." In the application of these general ideas to specific molecules examples are drawn from all fields of chemistry, so that an organic chemist will find in the book as much of immediate interest as, for instance, a specialist in the chemistry of complex inorganic ions.

The presentation, by and large, is lucid and a student with little more preparation than the four basic courses in chemistry should be able to digest most of the contents; yet even for one familiar with the field the reading will prove interesting and stimulating. Only few unimportant misprints and dubious statements have been noted in the text. To mention some: it would be desirable either to omit the numbers on the coordinate axes of figures like those on pp. 18 and 19 or to explain their meaning by giving the units; the statement on page 118 that a molecule resonates "with a high frequency" between two valence structures is unfortunate, if only from the pedagogical point of view. The reviewer objects to the casual manner in which the resonance energy is set equal to the free energy change (p. 189) without any discussion of the entropy changes accompanying the formation of a resonating structure.

Dr. Pauling has been so successful in his attack upon many of the problems in the field that his advocacy of the doctrine of the infallibility of Pasadena research and the somewhat pontifical style in which this book is written

are understandable and should not be taken amiss. The book is highly recommended to all who are not satisfied with the bond-dashes of a chemical text and wish to get a deeper understanding of their meaning.

G. B. KISTIAKOWSKY

**Gmelins Handbuch der anorganische Chemie.** (Gmelin's Handbook of Inorganic Chemistry.) Edited by E. PIETSCH. **Aluminum, Part A. Aluminum Alloys,** Supplementary Volume, Collection of Patents, Part I. By G. Apel. Verlag Chemie G. m. b. H., Corneliusstrasse 3, Berlin W 35, Germany, 1939. 880 pp. Price, RM. 72.

It is stated in the Preface that this Supplementary Volume covers all the patents on aluminum alloys which have appeared in Germany, England, France, Switzerland and the United States in the interval since the completion of the original volume on the subject (beginning of 1935) and up to February, 1938. Some 10,000 different specific combinations of elements are listed, the arrangement being alphabetical, based on the first letter of the symbols of the constituent elements. In a second column are given the percentage amounts of the alloying constituents; in a third the characteristics and uses of these combinations; and in a fourth column the patentee and the patent literature references. There is an additional list of the trade names or brands of aluminum alloys, with their manufacturer or inventor and their composition.

The concluding Part II of this volume is announced to appear by the end of 1939.

ARTHUR B. LAMB

**Colloid Chemistry. (A Textbook.)** By HARRY BOYER WEISER, Professor of Chemistry at The Rice Institute. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1939. viii + 428 pp. 103 figs. 15.5 × 23.5 cm. Price, \$4.00.

Professor Weiser has rendered a further service to colloid science by writing this authoritative textbook. Apart from his own experimental contributions, he has been in a key position to observe the development of the subject as Chairman of the annual National Colloid Symposia for many years, and through the detailed consideration of the existing information with regard to inorganic colloids compiled in his previous three-volume monograph. Added to this is his power of clear and precise presentation.

This textbook is addressed to advanced undergraduate and graduate students and the purpose of the author is three-fold, "to acquaint the student with the foundations of colloid chemistry and with the role that the classical experiments have played in the development of the modern theories and applications of the subject; to formulate systematically and to correlate critically the theories underlying colloid chemical behavior; and to illustrate the widely diversified applications of the principles of colloid chemistry in such fields as the industrial arts, agriculture, and biology." However, it is the more purely scientific aspects of the subject that are chiefly dealt with, rather than applications and practical information.

The book is organized into six parts. The first occupies

one quarter of the text and deals with surface phenomena and the various manifestations of adsorption. Part II is the main section of the book. It deals with sols, their formation, purification, properties, constitution, stability and interaction with electrolytes and each other. Part III discusses gelatinous precipitates, jellies and gels. Part IV describes emulsions and foams; Part V, aerosols and solid sols. Part VI gives more extended consideration to contact catalysis, to dyeing and to colloidal clay.

This textbook is indispensable to serious students of the subject. It is attractively published and interestingly written.

JAMES W. McBAIN

**Biological Oxidation.** By CARL OPPENHEIMER and KURT G. STERN. Nordemann Publishing Company, Inc., 215 Fourth Avenue, New York, N. Y., 1939. 317 pp. Illustrated. Price, \$8.25.

The authors have divided their treatment of biological oxidations into two sections. In the first of these, the "General Part," which occupies the smaller half of the book, the theoretical aspects of oxidative enzymes are considered. Wieland's hydrogen activation theory and Warburg's interpretations of his experimental work are developed historically. Then the authors attempt to fuse these conflicting ideas into a "unitary theory" to represent the present status of an admittedly complex field. But unfortunately this scheme is not enough to make the present treatment a reasonably intelligible one. The writer feels that a more condensed and straightforward account with less emphasis on scattered literature references (there are 1383 in the book) would have been more acceptable.

The "Special Part" or second half of the book is most successful in its presentation of the chemistry of the enzymes. The following topics are treated: the hemin systems, the vitamin enzymes, the nucleotide derivatives, the quinoid mesocatalysts and the fumaric and citric acid systems. The material is complete, but not confusing, and is arranged in a logical way. Its careful study is full of reward for the reader.

The publisher, Dr. Junk of The Hague, Holland, is to be congratulated for the large number of valuable books he is now making available in the English language. It is hoped that he may soon be able to overcome the fairly abundant typographical errors, which in this particular volume are ever present and often confusing.

WILLIAM F. ROSS

**Vitamin E.** A Symposium held under the auspices of the Food Group (Nutrition Panel) of the Society of Chemical Industry on Saturday, 22nd April, 1939, at the School of Hygiene and Tropical Medicine, Keppel Street, London, W. C. 1, England. Published by the Society of Chemical Industry, Clifton House, Euston Road, London, N. W. 1, England, 1939. 88 pp. 13.5 X 21 cm. Price, 5/- post free.

This small book contains the papers presented at the Symposium, and the remarks made from the floor during the ensuing discussions. The Symposium was organized

into three sections. Section I dealt with the "Chemical Structure and Properties of Tocopherol," and papers were presented by A. R. Todd, P. Karrer, A. Emmerle and Chr. Engel, and E. L. Smith and R. Bailey. As the Symposium occupied only one day, and there were many papers, the individual contributions were of necessity brief. As a consequence the papers cannot be regarded as complete reviews, for instance, those of Todd and Karrer (Dr. Karrer's paper was read by Dr. Bergel) in no way compare in extent or in critical value with reviews of the chemistry of vitamin E published elsewhere.<sup>1</sup> Nevertheless the brief papers serve admirably to define the position of various phases of vitamin E research at the time of the meeting. The paper by Emmerle and Engel contains a good discussion of their ferric chloride- $\alpha,\alpha'$ -dipyridyl analytical method, and the paper by Smith and Bailey contains a critical discussion of all of the analytical methods in common use for the determination of tocopherols.

Section II of the Symposium dealt with "Physiological Action of Vitamin E and the Consequences of Vitamin E Deficiency." Papers in this group were contributed by J. C. Drummond, K. E. Mason, S. W. F. Underhill, T. Moore, A. J. P. Martin and K. R. Rajagopal, A. M. Copping and V. Korenchevsky, and A. L. Bacharach. The topics included a general discussion of the physiological aspects of vitamin E (Drummond, Moore, *et al.*); the relationship between the vitamin and the reproductive functions (Mason); the connection between vitamin E deficiency and the endocrine glands (Underhill); the effect of vitamin E deficiency on the weights of organs of male and female rats (Copping and Korenchevsky); and a critical discussion of the methods of bioassay (Bacharach). The papers in this group are uniformly good, although, again, the manuscripts are too brief to be classed individually as comprehensive reviews.

Section III of the Symposium dealt with "Clinical and Veterinary Uses of Wheat Germ Oil and Vitamin E Preparations." Papers in this group were presented by P. Vogt-Moller, E. Shute, D. W. Currie, C. R. MacDonald, and F. J. Browne. The papers in this group show a lack of agreement as far as the uses of vitamin E in human and veterinary medicine are concerned: it is claimed (V-M.) that 75% of the cases of habitual abortion are treated successfully; the usefulness of vitamin E in the treatment of this condition is denied, but it is claimed that success is achieved in 68% of the cases of threatened abortion (S.), while again habitual abortion is amenable to treatment with vitamin E, while threatened abortion is not (MacD.). Such disagreements as to the results and value of the clinical experiments are to be expected at the present stage in the development of vitamin E therapy, and much good cannot fail to result from an open discussion among the active workers in the field. These papers are presented with candor and restraint, and with an admirable regard for the variables and uncertainties involved.

The reports of the discussions of the various papers, while very brief [some of the discussions are reported in greater detail in *Angew. Chem.*, **52**, 427-430 (1939)] constitute one of the most interesting features of the book,

(1) (a) Karrer, *Helv. Chim. Acta*, **22**, 334 (1939); (b) John, *Angew. Chem.*, **52**, 413 (1939); (c) John, *Ergeb. Physiol. biol. Chem. exper. Pharmacol.*, **42**, 1 (1939).

for these discussions serve to emphasize, even more than the papers themselves, unsettled questions and so point the way to future researches.

This Symposium, including among its members a large number of the foremost authorities in the various phases of vitamin E research, is a tribute to its promoters and to the Society which they represent and the little volume issued as a report is a most welcome addition to the rapidly growing literature on vitamin E. While the papers are presented by and for specialists in the field, nevertheless the general reader may gain from the book an accurate picture of the general knowledge concerning vitamin E as it existed last April, when such a congress of authorities from many nations was still possible.

LEE IRVIN SMITH

**Nomogramme zum Mineral Bestimmen mit Röntgenstrahlen.** (Charts for the Analysis of Minerals by X-Rays.) By M. MEHMEL. University of Rostock. Verlag der Deutschen Mineralogischer Gesellschaft e.V. through the Verlagsbuchhandlung Gustav Fischer in Jena, 1939. 13 charts. 21 × 29 cm.

The identification of crystalline compounds by means of their X-ray powder diffraction patterns has potential possibilities which have not yet been fully utilized. The recent tables of Hanawalt, Rinn and Frevel (*Ind. and Eng. Chem., Anal. Edition*, 10, 475 (1938)) giving the spacings and relative intensities for 1000 compounds, represent the first big step toward making X-ray identification a practical working method. The Mehmel charts are essentially supplementary to data such as given in the Hanawalt tables. The charts give the diffraction diagrams for 17 minerals of interest in sedimentary petrography (quartz, calcite, clays, feldspar, etc.). Each pattern is represented by a series of vertical lines, the height of a line giving the intensity, and the lines being plotted against  $\log \sin \theta$  as abscissa. For each mineral there are three charts corresponding to Cu, Fe and Cr radiation. Since the charts give a direct picture of the diffraction pattern, they are a useful supplement to tabulated spacing data.

The wisdom of plotting intensity against  $\log \sin \theta$  seems to be very questionable. Plotting against  $\theta$  gives directly the appearance of the diffraction pattern, plotting against  $\sin \theta$  crowds together the lines at large angle, and plotting against  $\log \sin \theta$  crowds the large angle lines still more. The only advantage to be had from plotting against  $\log \sin \theta$  comes from the fact that one chart will suffice to give the line positions for any wave length. In this series, however, since charts are given for three different wave lengths, there is no advantage to plotting against  $\log \sin \theta$ . The three charts for each structure would have been better spaced, and better suited to direct comparison, if plotted against  $\theta$  or  $2\theta$ .

In order to make the identification of unknowns by powder patterns a working method, it would be ideal to have the tabulated spacing and intensity data, charts giving the appearance of the diffraction patterns, and the type of index suggested by Hanawalt which gives the strongest lines of various substances catalogued in order of decreasing spacing. An enormous amount of work is involved in the preparation of such tables and charts.

It appears to the reviewer that before going farther with the preparation of a series of charts, the question of plotting against  $\theta$  rather than  $\log \sin \theta$  should be seriously considered. The charts are clearly labelled, well drawn, and of generous size. They appear to be quite accurate and reliable and will certainly find use.

B. E. WARREN

**The Raman Effect and its Chemical Applications.** By JAMES H. HIBBEN, Research Physical Chemist, Geophysical Laboratory, Carnegie Institute of Washington, with a Theoretical Discussion by JAMES H. HIBBEN and EDWARD TELLER, Professor of Physics, The George Washington University. American Chemical Society Monograph Series. Reinhold Publishing Corporation, 330 West 42nd Street, New York, N. Y., 1939. 544 pp. 72 figs. 15.5 × 23.5 cm. Price, \$11.00.

For some time there has existed the need for a comprehensive survey in English on the Raman effect, and, in some respects, the present one may supply this need. The book is divided into three main sections of which the first, 122 pages, is devoted mainly to theory, the second discusses experimental results, their interpretation, and their applications to chemical problems and the third is an extraordinarily complete and useful bibliography.

The theoretical part treats in a clear and simple manner the rotations and normal vibrations of molecules, the infrared and Raman effect, and the far reaching conclusions that may be drawn from a consideration of the electric polarizabilities of molecules. The discussion of normal vibrations, polarizability, and the selection rules, is from a purely physical or intuitive point of view; no use is made of complicated dynamics or the intricacies of the group theory, and only a knowledge of elementary physics is necessary to understand the treatment given. A description of the fundamental modes of vibration is given for some of the important symmetrical molecules. The beginner and experienced worker alike will find the theoretical part of interest, but he may regret that additional chapters dealing with the subject in a more fundamental and complete manner are not included. It is regrettable that a more complete table of degeneracies and polarizations of permitted Raman lines for a larger variety of molecular types is not included, that the use of molecular spectra in thermodynamics is so briefly treated, and that the more familiar  $q$  and  $Q$  rather than Greek letters are not used to represent generalized and normal coordinates.

The second section of the book is divided into two parts, and it presents a survey and discussion of the experimental results for a large number of organic and inorganic compounds, respectively, both in their normal state of aggregation and in solution. In the case of gases and comparatively simple molecules in the liquid state for which fairly complete analyses of the spectra have been made, the results are given in moderate but not always sufficient detail; but since the great majority of molecules and solutions studied are too complicated to permit of exact treatment, a more or less qualitative point of view is adopted. This method of treatment has some value, but it is not as satisfying or illuminating as the exact one, and its extensive use often makes the content of the book descriptive rather

than analytical. An attempt is made to present the large mass of available material critically and to clarify, augment, or correct statements found in the literature, but the imposed brevity decreases the value of the effort somewhat; not infrequently the content consists of a mere abstract of results. In some cases, for example that of the intensity relations in the pure rotation spectrum of nitrogen, the fundamental importance of the results is not even stated. In spite of these defects, those working in the field may find the survey of results very useful and timesaving. Many applications of Raman spectra to chemical problems are clearly described, and data are to be found that have been published only in inaccessible journals.

In the last section of the book the reader will find an excellent bibliography arranged alphabetically according to authors, and an index of compounds whose Raman spectra have been studied. References to nearly two thousand papers are given.

The book contains a good many errors of one sort or another: thus, none of the calculated interatomic distances in Table 60 are in accord with either the accepted values or the values calculated from frequencies by more precise methods; the force constants in Table I are not precisely defined; the use of the term "symmetrical vibration" is confusing (pages 79 and 80); Fig. 11 represents  $C_2N_2$  as bent, when in fact this molecule is linear; equation 27 is wrong by a factor of  $2\pi$ ; and on page 221 the structural formulas of cedrene are confusing and apparently incorrect. The typography in this book is of indifferent quality; for example, the type used for the symbols  $M$ ,  $D$ ,  $K$  and Roman subscripts and superscripts is too large, the signs of integration are much too long and a capital  $T$  in place of the more acceptable  $t$  is used to represent time. There are typographical errors in equation 39, and in the one leading to 20.

We consider that this book will prove useful to those interested in the field. We also believe that the price is too high. This country has now taken the lead in scientific research, and the publication of books of a research character becomes our responsibility; it would be a pity if excessively high prices prevented the free circulation of such books among the very people for whom they are intended.

DON M. YOST

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## BOOKS RECEIVED

December 10, 1939, to January 10, 1940

PAUL ARTHUR. "Lecture Demonstrations in General Chemistry." McGraw-Hill Book Co., Inc., New York, N. Y. 455 pp. \$4.00.

EUGENE C. BINGHAM, Editor. "Rheological Memoirs." Volume 1, No. 1. Rheological Memoirs, Easton, Pa. 101 pp. \$2.00 per volume.

G. W. SCOTT BLAIR. "Einführung in die technische Fleisskunde." Translated from the English by H. Kauff-

mann. Verlag von Theodor Steinkopff, Dresden-Blasewitz, Germany. 132 pp. RM. 6, bound, RM. 6.75.

W. BÖTTGER, Editor. "Physikalische Methoden der analytischen Chemie." Dritter Teil. Akademische Verlagsgesellschaft m. b. H., Leipzig, Germany. 863 pp. RM. 63, bound RM. 65.

WILLIAM C. BRAY AND WENDELL M. LATIMER. "A Course in General Chemistry." Third edition. The Macmillan Co., 60 Fifth Avenue, New York, N. Y. 206 pp. \$1.60.

NEIL E. GORDON AND WILLIAM E. TROUT, JR. "Introductory College Chemistry." Second edition. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 753 pp. \$3.50.

W. H. HATCHER. "An Introduction to Chemical Science." John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 423 pp. \$3.00.

JOEL H. HILDEBRAND. "Principles of Chemistry." Fourth edition. The Macmillan Co., 60 Fifth Avenue, New York, N. Y. 359 pp. \$2.50.

N. A. MCKENNA. "Theoretical Electrochemistry." D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, N. Y. 469 pp. \$5.50.

C. I. REED, H. C. STRUCK AND I. E. STECK. "Vitamin D." The University of Chicago Press, Chicago, Illinois. 389 pp. \$4.50.

BRUCE H. SAGE AND WILLIAM N. LACEY. "Volumetric and Phase Behavior of Hydrocarbons." Stanford University Press, Stanford University, California. 299 pp. \$5.00.

ALFRED T. SHOHL. "Mineral Metabolism." No. 82, American Chemical Society Monograph Series. Reinhold Publishing Corporation, 330 West 42d St., New York, N. Y. 384 pp. \$5.00.

THE SVEDBERG AND K. O. PEDERSEN. "Die Ultrazentrifuge." Band VII of the "Handbuch der Kolloidwissenschaft." Verlag von Theodor Steinkopff, Dresden-Blasewitz, Germany. 433 pp. RM. 26.25; bound RM. 27.25.

"Gmelins Handbuch der anorganischen Chemie." System Nummer 68. "Platin. Vorkommen." Teil A, Lieferung 2. Verlag Chemie, G. m. b. H., Berlin W 35, Germany. 165 pp. RM. 19.50.

"Gmelins Handbuch der anorganischen Chemie." System Nummer 68. "Platin. Physikalische Eigenschaften des Metalls." Teil B, Lieferung 2. Verlag Chemie, G. m. b. H., Berlin W 35, Germany. 107 pp. RM. 12.75.

"Gmelins Handbuch der anorganischen Chemie." System Nummer 68. "Platin. Electrochemisches Verhalten des Metalls." Teil B, Lieferung 3. Verlag Chemie, G. m. b. H., Berlin W 35, Germany. 81 pp. RM. 10.50.