BOOK REVIEWS

Anleitungen für die Chemische Laboratoriumspraxis. Band IX. Tabellen zur Röntgen-Emissions- und Absorptions-Analyse. By Dr. KONRAD SAGEL, Wissenschaftl. Mitarbeiter im Metall-Laboratorium der Metallgesellschaft A. G. Frankfurt (Main). Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1959. vii + 135 pp. 16 × 23.5 cm. Price, DM. 27.—.

This book of tables for the X-ray analyst, compiled by an eminent metallurgical authority, is meant primarily for rapid reference purposes in the industrial laboratory. The first 36 pages are devoted to a brief presentation of the principles of X-ray emission and absorption analysis, both qualitative and quantitative, and to the German instrumentation. This section is followed by a series of 35 tables and 6 graphs of wave lengths in KX. units and critical voltages (KV.) plotted against the angle θ values and corresponding $K\alpha_1$, $K\beta$, $L\alpha_1$, and $L\beta_1$ characteristic wave lengths for CaF_2 (200 and 111 reflections), LiF, NaCl, $CaCO_3$, quartz ($10\bar{1}1$ and $10\bar{1}0$ reflections), pentaerythritol, gypsum, mica, sucrose and corundum crystal analyzers. The tables include atomic energy levels, K, L, M, N series emission, and K and L series absorption wave lengths; mass absorption coefficients, data for the various crystal analyzers mentioned, mathematical functions, etc. Much of this information is provided in up-to-date forms in the United States in the "Handbook of Chemistry and Physics" (Chemical Rubber Publishing Co.), The "Lange Handbook" (McGraw-Hill Book Co.), brochures of manufacturers of X-ray equipment, and elsewhere.

It is a complete mystery why Sagel has listed wave lengths in the old Siegbahm KX. units (based upon erroneous value of the electronic charge so that crystal and ruled grating data were discrepant) instead of absolute Ångström units. Of course KX., is converted to Å. by the correction factor 1.00202. The true consistent values are now listed in the Handbooks and in contemporary papers. Even granted that the older spectroscopic data in the literature are all in the Siegbahn units, there seems to be no valid reason for this retention for present research and testing. This book, well printed and attractively bound in pliable plastic, may well be a useful compendium of data for the X-ray analyst, especially in Europe.

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Induced Oxidation. By W. P. JORISSEN, Formerly, Reader in Inorganic and Physical Chemistry, University of Leiden (The Netherlands). D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, New Jersey. 1959. x + 208 pp. 15.5 × 23.5 cm. Price, $8.75.

The monograph "Induced Oxidation" by Professor Jorissen describes primarily the extensive and valuable contributions of its author and associates and the schools represented by Engler, Böeseken, Haber, and other European contemporaries to the field of *induced oxidation* or *oxygen activation*. One may be surprised in reading this volume with the many important applications found for induced oxidation not only in the elucidation of mechanisms of oxidation, but in such important applications as control of inflammation and explosion limits in gases, retardation and control of cancer, promotion of biological processes involving oxidation, *e.g.*, combustion of lactic acid promoted by ascorbic acid. Moreover, one may be especially interested in the links provided by this work and its author with the great Dutch scientists Van't Hoff and van der Waals and with other renowned European scientists of the late 19th and 20th centuries, including among others Arrhenius, Nernst, Christiansen, Kramers, Haber, LeChatelier and Bone.

In this volume the author uses a style characteristic of the old school of chemists in which experiments are sometimes presented in seemingly irrelevant and unimportant detail. While this may seem objectionable to a casual reader, careful study will permit one to experience the historical and educational value of this style especially in connection with the development of many of the important modern concepts of chemistry. Certainly one cannot study this volume without being excited with new ideas suggested to him from time to time by the occasionally incomplete, yet enlightening, results described in the detail characteristic of this style. A unique feature of this work is the occassional appearance of paragraphs entitled "Suggestion" or "Suggestion for further Research" which illustrate, perhaps, that the author himself experienced the same generation of ideas as will reward one who makes a careful study of this volume.

The work is divided into three main parts. Chapter I discusses experimental results and ideas in the development of the concept of oxygen activation which the author prefers to call *induced oxidation*, including the older concepts of "nascent oxygen," the development of the concept of equipartition of oxygen between acceptor and promoter in the process of induced oxidation, and the development of the chain mechanism which led eventually to the most satisfactory understanding of induced oxidation, especially in some of the more complicated organic oxidation reactions. Chapter II describes the oxidation of organic fuels and gaseous mixtures, and adds a great deal of insight into the mechanism whereby explosion and inflammability limits, particularly the lower limit, may sometimes be controlled. Finally Chapter III treats various biochemical aspects of induced oxidation, and presents information highly suggestive of possible fruitful methods of approach, especially in the control, if not the actual cure, of cancer.

This monograph should be of great value to chemists, especially in view of the long and varied experience of its author. It is to be hoped that others with like experience and stature who have not already done so will be influenced by this work to present similarly their own contributions to the field of chemistry.

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Thermodynamics and Statistical Thermodynamics. By JOHN GELDART ASTON, Professor of Organic Chemistry and Director of the Low Temperature Laboratory, and JAMES JOHN FRITZ, Associate Professor of Chemistry, The Pennsylvania State University. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1959. xiv + 556 pp. 16 × 23.5 cm. Price, $8.25.

This book is the text which has been used at Pennsylvania State University in recent years for a one-year graduate course in Thermodynamics and Statistical Thermodynamics. The emphasis on spectroscopic and other molecular data as the source of ideal gas thermodynamic quantities is heavy, as may be seen from the space allocated to the various chapters: Scope, 3 pages; Units, 13; History of First Two Laws, 8; Equations of State, 13; First Law, 21; Second Law, 34; Phase Equilibria for Pure Substances, 9; Partial Molal Quantities, 19; Gibbsian Thermodynamics I, 12; Imperfect Gases, 22; Solutions of Nonelectrolytes, 21; Equilibrium Constants, 24; Solutions of Electrolytes, 15; EMF of Cells, 12; Variables Other Than P, T, Composition, 21; Energy Levels and Spectra, 61; Statistical Mechanics, 20; Statistical Mechanical Calculations for Ideal Systems, 27; S.M.C. for Diatomic Gases, 22; S.M.C. for Polyatomic Gases, 19; Crystals, 18; Magnetic Effects, 14; Gibbsian Thermodynamics II, 34. There are in addition ten appendices, occupying 79 pages, of which 40 cover material one might normally find in a Physics course on molecular structure.

The authors make little attempt to hide their disinterest in the classical methods of empirical thermodynamics. For example, in the chapter on partial molal quantities, after a very brief introduction, they state: "The following section gives detailed directions for specific techniques which are useful in determination of partial molal properties. It will be found essential for the reader who is either measuring or using partial molal properties, but it may be omitted by the more general reader without loss." The section in question is printed in smaller type, thus reinforcing the student's impression that partial molal properties have only a few special applications.

Contrast this with the calculation of thermodynamic functions from spectroscopic data, a subject close to the heart of the senior author (and to mine). It is possible to take the position that atoms and molecules have energy levels which are determined by physicists and published in journals such as "Physical Review." Treatment can then be limited to derivation of the desired functions. No such course has been taken. Discussion of energy levels begins with wave equations and ends with selection rules.

The wide scope of the text, combined with the use of mathematical methods with which the student is not expected to be familiar, creates problems in exposition. For example, in deriving Mulholland-type expressions for rotational partition functions, it is never mentioned that these are asymptotic expansions, with a specialized type of convergence. The skeptical student who attempts numerical verification with a minimum of arithmetic by using a very low temperature will have to seek elsewhere for explanation of his failure. To take another example, it is difficult to believe that any student who first sees a wave equation at the top of page 253 can have even a faint understanding, by the middle of the page, of the way in which this equation gives discrete energy levels.

There is no reason to doubt that the content and organization of this course has been satisfactory at Penn State. I feel that it is generally better for the student (and surely more comfortable for the professor) to have quantum mechanics taught by the Physics Department. Granted, it is good to abolish barriers between the sciences. Good for the organic chemist to learn thermodynamics. Good for the physical chemist to learn quantum mechanics. Good for the physicist to learn higher mathematics, and good for the organic chemist too, no doubt. Yet must all who set foot on a good road follow it to the end? May not the organic chemist (even the biologist) study thermodynamics without quantum mechanics, while physical chemists in the same class learn quantum mechanics with physicists? Since I would teach the course with such a philosophy, this volume could not be my basic text, but it would be heavily used for supplemental assignments.

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The Enzymes. Volume 1. Kinetics. Thermodynamics. Mechanism. Basic Properties. Second Edition, Completely Revised. Edited by PAUL D. BOYER, Department of Physiological Chemistry, University of Minnesota, Minneapolis, Minnesota; HENRY LARDY, Institute for Enzyme Research, University of Wisconsin, Madison, Wisconsin; and KARL MYRBÄCK, Institute for Organic Chemistry and Biochemistry, University of Stockholm, Stockholm, Sweden. Academic Press Inc., 111 Fifth Avenue, New York 3, N. Y. 1959. xiii + 785 pp. 16 × 23 cm. Price, $24.00.

The statement that the second edition is completely revised is certainly correct. The first edition barely touched on the primary problem of enzyme chemistry—why are enzymes such good catalysts? A good portion of the volume is devoted to this problem, either directly or through topics which are likely to throw light on this problem.

The first chapter on the development of enzyme kinetics, by H. L. Segal, gives an excellent account of the many erroneous ideas and rate equations proposed for enzyme reactions. It is instructive to see the length of time taken for the idea of the enzyme–substrate complex to be proposed, an idea now considered so simple and obvious. The development of equations for inhibition and integrated rate equations are also discussed.

The second chapters by Hearon, Bernhard, Friess, Botts and Morales examines enzyme kinetics in exhaustive detail. Steady state equations for several substrates, different types of inhibition, several reactions in succession are discussed for all possible cases. Transient kinetics also are examined, and published data are compared with the theory for several enzymes. The treatment is very involved, and it is doubtful whether the equations will be of much help to those doing detailed kinetic studies. However, the discussion should be helpful in avoiding numerous pitfalls when working out one's own equations.

A short third chapter by R. A. Alberty discusses the rate equation for an enzyme reaction. There is considerable duplication of the material in the second chapter, but the discussion is clear, to the point, and should be useful to workers who plan to investigate the kinetics of an enzyme in detail.

The fourth chapter on some aspects of thermodynamics and mechanisms of enzymic catalysis by R. Lumry is superb. A discussion of the thermodynamics of binding and reaction of substrate molecules is followed by a discussion of how the protein may interact with the substrate, and finally there is a discussion of the various hypotheses for mechanisms of enzyme action. The reviewer knows of no better treatment of these problems, and all enzymologists will obtain helpful ideas from this chapter.

The fifth chapter by H. Gutfreund discusses structure and stereospecificity of enzymes. The discussion centers on the specificity of enzymes for metals, coenzymes, "identical groups" (as in citric acid), and group transfer reactions. Unfortunately, few data are presented on the different degrees of specificity in different enzymes, nor is there any discussion of the specificities of antibodies for haptens, for which there are many data and which is probably a similar problem.

The sixth chapter by F. H. Westheimer gives an excellent treatment of enzyme models. The models for coenzymes and derivatives, ester hydrolysis, concerted reactions, metal ion catalysis and decarboxylation are examined. Both the usefulness and limitations of model reactions in understanding enzyme mechanisms are clearly and critically discussed. The presentation and discussion of the data in Westheimer's excellent style makes this chapter one of the best in the volume.

The seventh chapter by D. E. Koshland, Jr., takes up the mechanisms of transfer enzymes. The specificity, the stereochemistry of the substrate and product, the mechanisms and nature of the active site of transfer enzymes are discussed. There is also some treatment of general mechanisms of enzyme action.

The eighth chapter by P. George and J. S. Griffith is on electron transfer and enzyme catalysis. Detailed discussion is given of electron exchange between inorganic cations, especially the Fe(II)–Fe(III) exchange, the oxidation of Fe(II) by O_2, and the thermodynamics of all possible intermediates in the reaction of O_2 to H_2O. A shorter discussion of these topics would have permitted the authors to take up other systems such as $SO_4^{=}$ to H_2S, NO_3^- to NH_3, etc., which are important in certain bacteria. Much of the discussion probably is not applicable to biological systems; for example, the Fe(II)–Fe(III) electron transfer would not apply to oxidative phosphorylation since there appear to be coenzyme intermediates between the different cytochromes.

The ninth chapter by R. J. P. Williams deals with coordination, chelation and catalysis. The stability, spectra, oxidation–reduction potentials and catalytic activity of transition metal complexes are discussed. There is an excellent treatment of the porphyrin complexes. The facts and ideas presented in this chapter should be helpful to those who work with enzymes containing transition metals.

The tenth chapter by Linderstrøm-Lang and J. A. Schellman on protein structure and enzyme activity takes up the primary, secondary and tertiary structure of proteins and the types of bonding that may be involved in maintaining these structures. Optical rotation, entropy and enthalpy changes in folding are discussed, as well as the sequences of amino acids in several enzymes. The treatment is excellent, but limited by the small amount of data in the field.

The eleventh chapter by P. D. Boyer on sulfhydryl and disulfide groups of enzymes gives a good discussion of this chemistry both in enzymes and in model compounds. Useful tables of SS and SH content of various enzymes are given. Enzymes in which SH groups probably form part of the active site are examined in some detail.

The twelfth chapter by H. Fraenkel-Conrat discusses other reactive groups of enzymes besides SH groups. The reactions of the amino, carboxyl and aliphatic hydroxyl groups in proteins are reviewed, as well as iodination, oxidation and the reactions of active sites of enzymes.