BOOK REVIEWS

Production of Heavy Water. National Nuclear Energy Series. Edited by George M. Murphy, Department of Chemistry, New York University. Part I by JAMES O. MALONEY, GEORGE F. QUINN and HAROLD S. RAY (deceased). Part II by MAXWELL L. EIDINOFF, GEORGE G. JORIS, ELLISON TAYLOR, HUGH S. TAYLOR and HAROLD C. UREY. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 1955. xvii + 394 pp. 16 × 23.5 cm. Price, $5.25.

Like its predecessors in this series Volume III-4F is designed to provide a comprehensive source of information which may be helpful in the "practical exploitation of nuclear data by American science and industry." Withheld by classification policy until only recently, much of the material is ten years old. It is of interest, however, as a complete account of the plants and processes which first produced ton lots of heavy water.

The book is divided into two parts. Part I presents data relative to the general engineering features, basic cost information and operating data for the catalytic exchange-electrolytic, water distillation and hydrogen distillation processes for the commercial production of heavy water. Plants at Trail, British Columbia, and Morgantown, West Virginia, are described, while results of the work at Columbia University, the National Bureau of Standards and elsewhere are used for estimating the cost of production of heavy water by the hydrogen distillation process. Of course, it must be borne in mind that the costs are given in terms of the 1945 dollar. The number of diagrams in this section is not excessive although adequate to show the essential details of the plant designs.

Part II describes laboratory and pilot plant studies of the various separation processes which were investigated. The theory is discussed in a clear and interesting manner with emphasis upon its applications in engineering practice. Chapter 9 deals with the development of the nickel–chromium oxide catalyst and its use in promoting the exchange reaction between hydrogen and water. Chapter 10 follows with a description of the development of platinum and palladium catalysts. Various pilot plant studies are included in Part II also.

Numerous references, principally to previously classified reports, may be found at the end of each chapter. Throughout the book names of persons, places and organizations associated with various aspects of the work are included in the text. Relatively little variation in style from chapter to chapter is found; the non-specialist reader will not encounter great difficulty.

Repetition is inevitable in any book written by several contributing authors, but this does not appear to an objectionable degree in this volume. However, in this reviewer's opinion the material comprising the second part should have been presented as Part I.

Chemists and engineers alike will find this volume interesting and profitable reading.

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Standard X-Ray Diffraction Powder Patterns. By HOWARD E. SWANSON, NANCY T. GILFRICH and GEORGE M. UGRINIC. National Bureau of Standards Circular 539. Volume V. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 1955. 75 pp. 20 × 26 cm. Price, $0.45.

This paper-bound circular is the fifth of a series of standard X-ray diffraction powder patterns prepared by the National Bureau of Standards in its program for revision and evaluation of X-ray data. The project is sponsored by a joint committee composed of members from the American Society for Testing Materials, the American Crystallographic Association, the British Institute of Physics and the National Association of Corrosion Engineers.

Standard patterns for forty-five inorganic substances are presented. All but Cs_2PtCl_6, Cs_2SnCl_6, CuF_2, GeI_4, HIO_3, Rb_2PtCl_2 and Tl_2PtCl_6 were previously included in the ASTM file and references to new and old card numbers are given. The NBS patterns were made with a Geiger Counter X-Ray Diffractometer, using specially prepared samples of "exceptionally high purity." A detailed comparison is made of all powder diffraction data available for each substance previously investigated. d-spacings in internationally defined Ångström units are calculated to four or five significant figures and are assigned Miller indices. Densities and lattice constants are calculated, and refractive indices reported where measurements were possible.

Intensity data have been evaluated from the peak height above background and are expressed as percentages of the strongest line. Reproducibility was checked with at least two independent patterns, using particle sizes within the range of 5 to 10 μ. A table comparing the three most intense lines of each pattern (as observed by various investigators) is included. These values are of particular concern since the use of the ASTM card file for identification of materials is based on sorting by first, second and third strongest lines.

A cumulative index is given listing all substances included in Volumes I, II, III, IV and V. Errata noted in volumes III and IV are listed. Volume V as well as its predecessors will certainly be of great value to all those interested in the structural properties and identification of inorganic substances.

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Fifth Symposium (International) on Combustion, Combustion in Engines and Combustion Kinetics, at the University of Pittsburgh, Pittsburgh, Pennsylvania, August 30–September 3, 1954. By BERNARD LEWIS, HOYT C. HOTTEL AND A. J. NERAD (Standing Committee on Combustion Symposia). Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1955. xxvi + 802 pp. 18.5 × 26 cm. Price, $15.00.

Combustion is an exceedingly complicated phenomenon. From the scientific standpoint it involves chemical chain reactions, heat conductivity and diffusion, turbulence, and intricate boundary conditions. Ever since the first caveman roasted a piece of meat, man has enjoyed heat, power and light from flames without ever really understanding the phenomenon. Internal combustion engines and gas burners were developed empirically on a strictly Edisonian basis. One found from experience which were the good fuels and what were the optimum burning conditions. Up to quite recently the problems of engine design and combustion in general have been regarded as purely engineering problems.

Dr. Bernard Lewis was one of the first people to recognize the role of chemistry in combustion. It is largely through his influence that at the present time there is a large amount of chemical research being carried out to determine the detailed chain mechanisms in flames—the chemical profile, the flame spectrum, etc. It is largely through the tremendous efforts which Dr. Lewis has expended that periodically the combustion experts of the world are brought together in a series of international symposia on combustion. The Fifth Symposium (International) on Combustion, like its predecessors, contains a wide variety of papers by a galaxy of experts and stresses the purely chemical problems of combustion.

This book and the previous international symposia on combustion are necessary additions to the library of any group working on combustion. All other papers on this fast-growing and fascinating subject are spread throughout the engineering, chemical, physical and technical journals of the world. There is a great need for a high grade journal on the scientific aspects of combustion research. Until such a journal is set up, it will be necessary for experts to keep up to

date periodically through the technical papers presented at these symposia. In this sense the organizers of the symposia have a great responsibility for presenting a fair and complete coverage of the high grade research throughout the world. Unfortunately the reviewer was particularly distressed that the Fifth International Symposium on Combustion would not accept any papers on the subject of the theory of flame propagation. This seemed unfortunate since it is difficult to separate the experimental from the theoretical interpretations. The illustrious members of the various subcommittees are not given an opportunity to make policy decisions. The organization of the Round Tables and the types of research presented are determined largely by the whims and prejudices of Dr. Lewis.

The categories of papers included are: Combustion in Engines, Combustion of Fuel Droplets, Propellant Burning, Diffusion Flames and Carbon Formation, Special Techniques, Flame Spectra and Dissociation Energies and Kinetics of Combustion Reactions. Approximately half of the papers pertain to the kinetics of combustion reactions. The majority of the papers are quite excellent.

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Chemistry of the Solid State. Edited by W. E. GARNER, D.Sc., F.R.S., C.B.E., Emeritus Professor, University of Bristol. Academic Press, Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1955. viii + 417 pp. 16.5 × 25.5 cm. Price, $8.80.

This book deals with the theory of the solid state and its relationship to various physical and chemical problems. The first seven chapters present fundamental methods and theory while the next eight chapters describe applications. The fifteen chapters are as follows:

1. "Chemistry of Crystal Dislocations" by F. C. Frank introduces those aspects of dislocation theory which have importance in such chemical topics as crystal growth, crystal solution and heterogeneous catalysis.
2. "Lattice Defects in Ionic Crystals" by F. S. Stone describes in greater detail defect theory as it applies to the theory of electrical conductivity and diffusion in the ionic lattice.
3. "The Action of Light on Solids" by P. W. M. Jacobs and F. C. Tompkins is concerned with the action of light, X-ray and electron beams in introducing extra electrons, excitons, f-centers, etc., and the consequent thermal deactivation, phosphorescence or photolysis of solids.
4. "The Surfaces of Solids" by P. W. M. Jacobs and F. C. Tompkins surveys the methods of surface area measurements, pore size distributions, particle size and shape determinations, and surface tension studies as applied to finely divided materials.
5. "Semi-Conductivity and Magneto-Chemistry of the Solid State" by T. J. Gray is a review of the methods and phenomena of intrinsic and impurity semi-conductivity and di-, para- and ferromagnetism as related to solid state reactions, absorption catalysis, imperfections, etc.

6 and 7. "Theory of Crystal Nucleation from Vapor, Liquid, and Solid Systems" by W. J. Dunning and "Classification and Theory of Solid Reactions" by P. W. M. Jacobs and F. C. Tompkins together represent a good summary of the theories of nucleation and growth as presently conceived. These chapters should prove particularly useful to the investigator who desires to classify kinetic data of the nucleation and growth type.

8. "The Kinetics of Endothermic Solid Reactions" by W. E. Garner deals mainly with the kinetics of dehydration of hydrates and the decomposition of carbonates.
9. "The Kinetics of Exothermic Solid Reactions" by W. E. Garner analyzes the kinetics of the decomposition of metal azides, oxalates, permanganates, chlorates and perchlorates, nitrogen iodide, nickel formide and lead styphnate. A separate section by L. L. Bircumshaw analyzes the kinetics of decomposition of ammonium salts, mainly the nitrate, permanganate and perchlorate.
10. "The Decomposition of Organic Solids" by C. E. H. Bawn introduces the reader to some basic fundamentals in the pyrolysis of organic compounds including the theory of thermal explosion.
11. "Explosion and Detonation in Solids" by A. R. Ubbelohde describes the principal characteristics of explosion and detonation, and their initiation together with experimental methods for studying detonation velocity.
12. "Solid–Solid Reaction" by A. J. E. Welch reviews the principal phenomena and possible mechanisms involved in the reaction between two or more solids from the point of view of structural inorganic chemistry and crystallography.
13. "The Photographic Process" by J. W. Mitchell deals mainly with the changes occurring in crystals of silver halides during chemical sensitation and the formation of the latent image.
14. "Oxidation of Metals" by T. B. Grimley is concerned mainly with the kinetics and reaction mechanisms of the oxidation of those metals which form protective oxide layers, *i.e.*, those metals for which the volume of oxide formed is equal to or greater than the volume of the metal oxidized.
15. "The Electronic Factor in Chemisorption in Catalysis" by F. S. Stone summarizes the available information on the nature of the adsorbate–adsorbent bond in chemisorption.

The subject of this book is so large that it would require many volumes to deal with it exhaustively. The authors of the various chapters have in general taken great pains to delineate the area of their treatment but the reader must realize that more is often left unsaid than said. Even in the delineated areas there are some surprising omissions; surely the respected methods of the ultracentrifuge deserve a place in any review of the procedures of determining particle size and shape! The book is well written by recognized authorities; it represents in easily accessible form, critically evaluated information obtainable otherwise only in the original literature. The ample bibliographies represent a good introduction to that literature. Twelve pages of author and subject index are helpful. This book which is of graduate student level should be available to all workers in the fields of catalysis, solid state physics, gas solid reactions, solid reactions, photography, corrosion and related topics.

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Beta- and Gamma-Ray Spectroscopy. Edited by KAI SIEGBAHN, Professor of Physics, University of Uppsala. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N.Y. 1955. xxiii + 959 pp. 18 × 25 cm. Price, $20.00.

We have in this thick volume an ambitious attempt to cover in complete detail an important and well-defined branch of nuclear physics: the oldest, and once the most unintelligible branch, that of beta- and gamma-radioactivity, now generalized to beta- and gamma-spectroscopy. It is a pleasure to be able to report that the attempt is successful; a veritable handbook in the old German tradition has been produced, in which one can find almost everything of consequence on the subject.

The task of preparing such a handbook is so formidable as to daunt the bravest. We are indebted to Professor Siegbahn, as editor, and to the forty-two authors (who constitute a "Who's Who in Beta-Rays,") for tackling this task. No such complete treatment has been attempted since the appearance in 1930 of Rutherford, Chadwick and Ellis's classical treatise on "Radiations from Radioactive Substances." Even a superficial comparison will reveal the enormous magnitude of the advances of a quarter century. The earlier book appeared just two years before the discovery of the neutron, and thus essentially summarized the entire early history of nuclear physics, before anyone knew even what the nucleus was composed of. The apparent lack of conservation of energy in beta-decay had been discovered, but the neutrino had not, nor had transmutation with artificially accelerated particles, nor artificial radioactivity. At present, on the other hand, we have just reached a new milestone in the development of the theory of beta-ray decay; the choice among possible interactions responsible for the process appears to have been finally resolved to a combination of scalar and tensor forms.