

into and out of the catalyst granule is rate determining, and the decrease in the rate constants with increasing pressure and with decreasing  $H_2$  to  $N_2$  ratio, are of particular significance. The magnitude of the change in the rate constants with pressure is not the same for all catalysts, being lowest for the doubly promoted  $Al_2O_3-K_2O-Fe_3O_4$  catalyst.

In Chapter 6 are presented the properties of various catalysts which are of industrial importance such as temperature stability, effect of promoters, the characteristics of reversible poisoning by  $O_2$ ,  $H_2O$ ,  $CO$ ,  $CO_2$  and more permanent poisoning by  $S$ ,  $As$ ; the optimum reduction procedures, and the effect of particle size on activity and on pressure-drop in industrial reactors. The extent of reduction is of critical importance to the activity of the catalyst. Virtually complete reduction is desirable because of the poisoning action of  $H_2O$ , and it is obtained by the use of very high space velocities of the reducing gas and the highest temperatures consistent with minimum deterioration of the catalyst by sintering. Promoters such as  $Al_2O_3$ ,  $CaO$  and  $K_2O$  markedly lower the rate of reduction of  $Fe_3O_4$ .

X-Ray diffraction patterns of various catalysts before and after reduction are presented and discussed in Chapter 7. The distribution of  $Al_2O_3$  in the spinel lattice of  $Fe_3O_4$  is uniform and this accounts for the structural promotion of  $Al_2O_3$ . Whether  $CaO$ , or  $MgO$  are "dissolved" in the  $Fe_3O_4$  is not yet determined.  $K_2O$  remains largely on the surface of the reduced catalysts, and its promotional activity probably is related to its effect on the thermionic work function of the surface and consequently on the rate and extent of activated adsorption of nitrogen (the rate determining step in the synthesis).

Chapters 8 and 9 are concerned with the details of the reaction mechanism as determined by critical experiments on surface properties, the energetics of chemisorption of  $H_2$  and  $N_2$  and measurements of the rates of nitrogen isotope exchange reactions. The data and discussion are of critical importance to an understanding of heterogeneous catalytic reactions. Although structural heterogeneity of catalyst surfaces exists and is effective in the selectivity of certain catalysts, and although surface interaction of chemisorbed molecules and atoms also contributes to energetics of the surface reactions, nevertheless neither of these factors is adequate to explain the changes in heat of adsorption with extent of surface coverage. Boudart's calculations of the influence of the electrical double layer which is formed on a catalyst surface by a fully or partially ionized adsorptive bond show large changes in thermionic work-function and adequately large decreases in heat of adsorption with increase in the fraction of the surface covered.

Nielsen's book is a valuable one for both scientists and engineers who are interested in heterogeneous catalysis.

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In addition to the preparations, properties and reactions of compounds, the structural side is quite adequately dealt with considering the scope of the book. There are but few errors and, although the views expressed in some sections now need modification, the book is fairly well up to date—almost an impossibility in this field at the present time. The final section on cyclopentadienyl compounds is one of the weakest, and the discussion of bonding in ferrocene and similar compounds is far from illuminating. Metal-benzene derivatives are mentioned only in a footnote.

On its information content alone this book is a worthwhile addition to one's library and it has the additional merit of being handy for the pocket.

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**Chimie Physique Nucléaire Appliquée.** BY JACQUES ERRERA, Professeur a l'Université de Bruxelles. Masson et Cie., Éditeurs, Librairies de l'Académie de Médecine. 120 Boulevard Saint-Germain, Paris VI, France. 1956. 226 pp. 16.4 × 24.8 cm. Price, 2,100 fr.

This little book covers applications of radioisotopes to areas where physico-chemical methods are common. The contents of the several chapters (and their lengths in pages) are approximately as follows: the atom and the nucleus (14); nuclear reactions (19); fission, reactors, nuclear power (36); fusion reactions (3); military applications of nuclear energy (4); fields of application for nuclear reactions (4); detection of nuclear radiations (20); units of radioactivity (4); preparation of radioisotopes (5); comparison of usefulness of stable and radioactive tracers (2); health protection (9); applications to pure and applied science (81); list of elements and table of useful radioisotopes (4). The text is written on a semi-technical level.

Of the 150-odd references and illustration credits in the book, 2 are to British journals, 2 to a Belgian article, 1 to a recent British compendium, and the remainder to current American textbooks, monographs and journals. The book seems to be largely a collection of review and summary material published elsewhere. The book can be recommended to students who are preparing for their pre-doctoral French examinations.

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## BOOKS RECEIVED

May 10, 1957–June 10, 1957

**Organo-metallic Compounds.** BY G. E. COATES, M.A., D.Sc., F.R.I.C., Professor of Chemistry in the University of Durham. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1956. viii + 197 pp. 13 × 19 cm. Price, \$2.50.

This little book deals with organometallic compounds, defined as substances containing a metal to carbon bond. Alkoxides and other compounds in which metal atoms are bonded to organic systems *via* oxygen, nitrogen or sulfur, and which are often referred to as organometallic compounds, are excluded. A further restriction on the scope of the book is the entire omission of the organic chemistry of silicon, phosphorus and arsenic, on the reasonable grounds that their inclusion in a book of this size would impair the treatment of the other elements.

The author deals with the compounds of the alkali metals, and of the elements of Groups II, III and IV, of antimony and bismuth, and of the transition elements. Whilst the book is written in a rather terse style and is not particularly readable, it is, however, well worth close study, since it contains a wealth of information and the large numbers of references to the original literature given at the end of the chapters, although not exhaustive, are most useful.

C. H. BAMFORD, Chairman. "Symposium on Techniques in Polymer Science." Lectures, Monographs and Reports, 1956. No. 5. The Royal Institute of Chemistry, 30, Russell Square, London, W. C. 1, England. 1956. 79 pp. \$1.15.

CALVIN CALMON and T. R. E. KRESSMAN (Edited by). "Ion Exchangers in Organic and Biochemistry." Interscience Publishers, Inc. 250 Fifth Avenue, New York 1, N. Y., 1957. 761 pp. \$15.00.

HAROLD GOMES CASSIDY. "Fundamentals of Chromatography." Volume X. Technique of Organic Chemistry. Editor: Arnold Weissberger. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1957. 447 pp. \$9.75.

E. J. CRANE, Director and Editor, AUSTIN M. PATTERSON and ELEANOR B. MARR. "A Guide to the Literature of Chemistry." Second Edition. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1957. 397 pp. \$9.50.

- E. M. CROOK. (Organized and Edited by) "The Structure of Nucleic Acids and Their Role in Protein Synthesis." Biochemical Society Symposium No. 14 held at the London School of Hygiene and Tropical Medicine on 18 February 1956. Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 1957. 74 pp. \$3.75.
- JOHN G. ERICKSON, PAUL F. WILEY AND V. P. WYSTRACH. "The 1,2,3 and 1,2,4-Triazines, Tetrazines and Pentazines." The Chemistry of Heterocyclic Compounds. Volume 10. A Series of Monographs. Arnold Weissberger, Consulting Editor. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1956. 261 pp. \$10.50. Subscription price \$9.50.
- M. HAÏSSINSKY. "La Chimie Nucléaire et ses Applications." Masson et Cie., Editeurs, 120 Boulevard Saint-Germain, Paris 6<sup>e</sup>, France. 1957. 651 pp. Broché: 5.000 fr. Cartonné toile: 5.600 fr.
- IRVING M. KLOTZ. "Some Principles of Energetics in Biochemical Reactions." Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 1957. 64 pp. \$3.00.
- EUGEN MULLER. "Neuere Anschauungen der Organischen Chemie. Organische Chemie für Fortgeschrittenen." Zweite Gänzlich Umgearbeitete Auflage. Springer-Verlag, Reichpietschufer 20 (West-Berlin), Berlin W 35, Germany. 1957. 550 pp. Ganzleinen DM. 59,60.
- EUGENE G. ROCHOW, DALLAS T. HURD AND RICHARD N. LEWIS. "The Chemistry of Organometallic Compounds." John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1957. 344 pp. \$8.50.
- The late Sir JOHN SIMONSEN AND W. C. J. ROSS. "The Terpenes. Volume IV." The Triterpenes and their Derivatives, Hydrocarbons, Alcohols, Hydroxyaldehydes, Ketones and Hydroxyketones. Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 1957. 524 pp. \$13.50.
- H. STEPHEN, Executive Editor. "Tetrahedron. The International Journal of Organic Chemistry." Volume 1, Nos. 1/2. Pergamon Press Inc., 122 East 55th Street, New York 22, N. Y. 1957. 176 pp. Subscription per volume (including postage) (A) \$17.00, (B) for subscribers certifying that the journal is for their own personal use, \$9.80.
- J. TERIEN, G. TRUFFAUT AND J. CARLES. "Light, Vegetation and Chlorophyll." Translated by Madge E. Thompson. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. 1957. 228 pp. \$6.00.
- H. C. VAN DE HULST. "Light Scattering by Small Particles." Structure of Matter Series, Maria Goeppert Mayer, Advisory Editor. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1957. 470 pp. \$12.00.
- JEAN VÈNE. "Chimie Organique Générale." Masson et Cie, Editeurs, 120 Boulevard Saint-Germain, Paris 6<sup>e</sup>, France. 1957. 349 pp. Broché; 3.500 fr.; Cartonné toile, 4.100 fr.