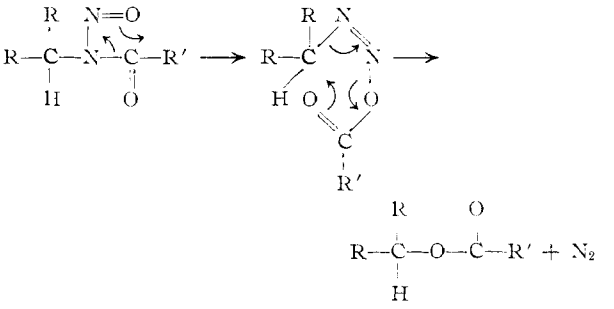
0° (10–20 min. required). A 0.2 *M* solution of N-(*n*-butyl)-N-nitroso-3,5-dinitrobenzamide (m.p. 63–63.5° dec., *Anal.* Calcd. for $C_{11}H_{12}O_6N_4$: C, 44.60; H, 4.08; N, 18.91. Found: C, 44.88; H, 3.95; N, 18.88. I.R.: C=O, 5.81 $\mu$; N=O, 6.52 $\mu$) in hexane[4] was refluxed for 15 hr. to yield nitrogen, 1-butene,[5] 3,5-dinitrobenzoic acid (17–19%), and *n*-butyl DNB (80–82%) (DNB = 3,5-dinitrobenzoate); m.p. (crude product) 62–63°, lit.[6] 64°. The infrared spectrum of the crude ester was superimposable[7] in detail on that of an authentic sample of *n*-butyl DNB. Similarly, the *iso*-butyl analog yielded nitrogen, 2-methylpropene, 3,5-dinitrobenzoic acid (33%), *iso*-butyl DNB (62%), *sec*-butyl DNB (3%), and *tert*-butyl DNB (1%). The analogous nitrosobenzamides and nitrosoacetamides gave identical yields of the respective esters, whereas the nitrososulfonamides and nitrosourethanes gave lower yields (15% less) of the sulfonates and carbonates, respectively. The N-nitroamides were also found to be thermally labile, forming nitrous oxide and esters; the yields of the latter were the same as those from the related nitrosoamides.

Work in progress on optically active *sec*-butyl nitrosoamides has shown that *retention* of configuration occurs in the reaction. The intramolecular nature of the reaction is shown by the elimination of nitrogen from N-(*sec*-butyl)-N-nitrosobenzamide in excess acetic acid to yield some *sec*-butyl acetate, but predominantly *sec*-butyl benzoate. On the basis of the latter facts, the nature and yields of the reaction products, and other evidence to be reported later, the following mechanism is proposed for the reaction.[8] The nitrogen elimination step, therefore, represents a new type of $S_Ni$ reaction.[9]



(4) The yields of reaction products are relatively independent of the solvent used; however, the purest esters and the highest yields were obtained in non-polar solvents.

(5) Infrared spectra indicate pure 1-butene. In one experiment, perbenzoic acid titration gave 16% olefin.

(6) R. L. Shriner and R. C. Fuson, "Identification of Organic Compounds," John Wiley and Sons, New York, N. Y., 1948, pp. 226.

(7) A comparison with spectra of standard mixtures of the *n* and *sec* butyl esters, indicates that less than 1% of the *sec* isomer could have been formed in the reaction.

(8) The cyclic six-membered transition state as pictured represents a simplified way to indicate the $S_Ni$ reaction. Our data indicate that the mechanism is actually more complex and not as synchronous as pictured.

(9) W. A. Cowdrey, E. D. Hughes, C. K. Ingold, S. Masterman and A. D. Scott, *J. Chem. Soc.*, 1267 (1937).

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# BOOK REVIEWS

**Structure and Properties of Solid Surfaces.** Edited by ROBERT GOMER and CYRIL STANLEY SMITH. The University of Chicago Press, 5750 Ellis Avenue, Chicago 37, Illinois. 1953. xvi + 491 pp. 14.5 × 22 cm. $8.50.

This book is a carefully edited collection of fourteen papers and of the discussion attending their presentation at a conference sponsored by the National Research Council at Lake Geneva, Wisconsin, in September 1952. In the preface, one of the authors adequately summarizes the purpose of the book and conference as follows: "The great practical importance of surfaces is equaled by their purely scientific interest. Although we have skillfully harnessed surface properties, much of our success is the result of luck and intuition, and many fascinating problems remain unsolved. It was the purpose of the conference which gave rise to this book to throw some light on these problems. In particular, it was hoped to find common denominators for different aspects of surface study by combining contributions from many fields."

The nature of the subject matter of the book and the high quality of presentation can be judged from the following table of contents and authors: I, "The Use of Classical Macroscopic Concepts in Surface-Energy Problems" by Conyers Herring; II, "Atomic Theory of Surface Energy" by P. P. Ewald and H. Juretschke; III, "The Mechanical Properties of Crystalline Metal Surfaces" by A. J. Shaler; IV, "Wetting of Solids as Influenced by the Polarizability of Surface Ions" by W. A. Weyl; V, "The Study of Solid Surfaces" by George P. Thomson; VI, "The Adhesion of Solids" by F. P. Bowden and D. Tabor; VII, "Crystal Growth and Chemical Structure" by A. F. Wells; VIII, "Some Remarks on Facts and Theories of Crystal Growth" by H. E. Buckley; IX, "Epitaxy" by H. Seifert; X, "Physical Adsorption of Gases on Solids" by Terrell L. Hill; XI, "Surface Structure from the Standpoint of Chemisorption and Catalysis" by M. Boudart; XII, "Physical and Chemical Adsorption of Gases on Iron Synthetic Ammonia Catalysts" by P. H. Emmett; XIII, "Chemisorption on Solid Surfaces" by Ahlborn Wheeler; XIV, "The Catalytic Action of Spinels" by G.-M. Schwab, E. Roth, Ch. Grintzos and N. Mavrakis.

In addition to the above mentioned authors, the following individuals, most of whom are recognized authorities in their various fields, participated in the rather extended discussions: J. A. Becker, R. F. Brill, Stephen Brunauer, N. Cabrera, Robert Gomer, A. Guinier, George Jura, J. E. Mayer, Erwin W. Müller, LeRoy G. Schulz, Cyril S. Smith, I. N. Stranski, David Turnbull, Carl Wagner and Adrienne R. Weill.

The coverage of the subject matter is both thorough and critical. The book, like the conference itself, represents a real contribution by virtue of its being a coöperative effort by a number of specialists in a field that is too large to be covered authoritatively by any one individual. Furthermore, the format, the freedom from typographical errors, and the general excellence of editing seem to this reviewer to set a standard that may well be emulated by those organizing and publishing the papers and discussions of other scientific conferences and symposia.

Just as it is true that the material covered by this book is too diverse to be mastered by one individual, it is equally true that it is too diverse to be appraised critically by a single reviewer. With this limitation in mind, and with the handicap of having written one of the chapters, this reviewer will comment only briefly on groups of chapters. Chapters I, II and III seem to constitute a careful, detailed and authentic discussion of surface energy of solids. Chapter IV is a thought-provoking review of the "effect of the properties of ions, in particular polarization properties, on the surface forces of solids." Chapters V to IX, inclusive, contain a wealth of new material on tools, techniques and results obtained in studying the adhesive and crystal growth properties of solids. Chapters X to XIV, inclusive, have been written with a view to summarizing the information and points of view of those concerned with the physical and chemical adsorption of gases on solids, and especially on metals. They include a comparison of the adsorptive and catalytic properties of bulk metals and commercial catalysts with those of thin metal films. Except for the beautiful new adsorption experiments of Becker for nitrogen on pure tungsten ribbons, and the catalytic results of Schwab and his co-workers on spinels, these last five chapters contain little that is new to the specialist in catalysis but a great deal, it is hoped, that may be helpful to those working on the parts of the subject covered by the first nine chapters.

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**Annual Review of Nuclear Science.** Volume 3. By JAMES G. BECKERLEY, Editor, United States Atomic Energy Commission, and Associate Editors MARTIN D. KAMEN, Washington University Medical School, DONALD F. MASTICK, United States Atomic Energy Commission, and LEONARD I. SCHIFF, Stanford University. Annual Reviews, Inc., Stanford, California. 1953. ix + 412 pp. 16 × 23 cm. $7.00.

"Nuclear science," as interpreted by the Editorial Committee of this Annual Review, is a broad subject indeed, ranging from meson physics through various fields of physics and chemistry to radiobiology and medicine, and includes essentially all of the basic scientific interests of the United States Atomic Energy Commission. Articles for such a broadly based volume should ideally be presented in a fashion sufficiently clear and elementary to be understood by all physicists, chemists and biologists who are interested in high energy radiations and their modes of origin, while on the other hand they should be sufficiently detailed to provide a complete summary of current work for the use of specialists in the particular fields being surveyed. Complete coverage of each topic, moreover, must be attained in the space of about 30 pages. Thus the authors of the various review articles are offered a very difficult challenge.

In the field of chemistry, a most excellent article is offered by J. E. Willard on "Chemical Effects of Nuclear Transformations." What might seem in a less skillful summary a confusion of contradictory results becomes in Willard's hands a fascinating and rapidly consolidating field of chemical experimentation. This article may be recommended without reservation, both to those already conversant with the field and to outsiders who would like to become acquainted with it. An article by P. E. Yankwich on "Isotope Effects in Chemical Reactions" gives little background on the subject and is essentially a mere catalog of the papers on this topic which appeared during 1952. It will be of value to the specialist but of little value to general scientific readers. An article by P. C. Stevenson and H. G. Hicks on "Separation Techniques Used in Radiochemistry" takes the opposite approach. It gives an elementary description of the kinds of separation techniques used but with few specific examples. It would be appropriate as an introductory chapter in a textbook but will be of no interest to specialists. Still another approach is taken by J. L. Magee in an article on "Radiation Chemistry." Magee makes no attempt to review the facts of radiation chemistry, which indeed have frequently been covered in the "Annual Reviews of Physical Chemistry" and elsewhere, but attempts a complete discussion of the physical processes (radiation absorption and the subsequent behavior of ions and electrons) which underlie the observed chemical changes. The present reviewer, being a specialist in this field, found this discussion of great interest, but the approach results in a general impression of forbidding complexity, and seems hardly suitable as an introduction to radiation chemistry for the uninitiated.

Turning to the field of physics we find an extremely fine article by D. J. Hughes on "Neutron Optics." Starting with basic principles of neutron behavior, the current achievements and problems in the field are clearly and attractively presented. Those not familiar with this field will be amazed at the variety and richness of information about the structure of matter which can be obtained by the use of slow neutron beams. Another article that is in every respect a pleasure to read is by L. Leprince-Ringuet, on "Mesons and Heavy Unstable Particles in Cosmic Rays." The available evidence on the tau and kappa mesons and other anomalous heavy particles is summarized in the most clear and simple fashion imaginable, with a complete absence of nuclear physicists' jargon, yet rigorously and with all the detail that a specialist in the field would require. In the article "Reactions of $\pi$-Mesons with Nucleons" by E. M. Henley, M. A. Ruderman, and J. Steinberger, the current theoretical jargon is used rather freely and this reviewer must confess that he was soon lost. "Extranuclear Interactions of Electrons and Gamma Rays," by D. R. Corson and A. O. Hanson, contains the latest data on the scattering of electrons and positrons, on ionization loss of charged particles in matter, and on pair production and bremsstrahlung. Here, again, familiarity with the field is assumed and the reader is referred for background to the article by Bethe and Ashkin in Volume 1 of these "Annual Reviews." Two articles, "The Standardization of Neutron Measurements" by A. Wattenberg and "Photographic Emulsions" by Y. Goldschmidt-Clermont, deal exclusively with techniques of experimentation in the nuclear physics field and will be of no interest to non-specialists. There is a fine article of very general interest by L. D. Marinelli on "Radiation Dosimetry and Protection." The basic problems involved in measurement of gamma rays and neutrons are clearly explained and various problems that arise in obtaining protection of people from dangerous radiation sources are touched on.

In the biological field we find an article that will certainly be of interest to all scientists who work with radiation, "Practical Aspects of Radiation Injury," by L. H. Hempelmann and J. G. Hoffman. In language entirely comprehensible to non-medical scientists, detailed discussions are given of acute radiation injury in man, including clinical accounts of the Japanese exposed to rays from the Hiroshima and Nagasaki bombs, and some American victims of radiation accidents. Discussion of delayed effects of chronic radiation in man, including cancer, is also given. There is an interesting section on experimental therapy of acute radiation injury in animals. Another fine paper is entitled "Vertebrate Radiobiology: Embryology" by R. Rugh. Some remarkable recent experiments on irradiations *in utero* are clearly presented and discussed. Two other articles, "Vertebrate Radiobiology: Histopathology and Carcinogenesis" by J. Furth and A. C. Upton, and "Cellular Radiobiology" by A. H. Sparrow and F. Forro, Jr., contain little integrating background and are of value chiefly as catalogs of recent papers. It is indeed difficult to see what more the authors could have done in the limited space available in view of the vast amount of work currently being turned out in these fields. The number of literature references given in the two articles are, respectively, 204 and 279.

Summarizing, we see that at least six of the fifteen articles in this volume satisfy the very difficult criterion of holding the interest of non-specialists in their fields while still presenting their material in sufficient detail to be of value to the specialist. The authors who deserve particular congratulation are Leprince-Ringuet, Hughes, Willard, Marinelli, Rugh, and Hempelmann and Hoffman. Future contributors to this review could well attempt to model their articles on these six examples. All the articles in the book are, of course, required reading for specialists, and the volume as a whole is a must for any laboratory engaged in the study of nuclear processes or high energy radiation in any of its aspects.

The book is well printed and this reviewer failed to note any misprint. A complete author index and a useful subject index are included.

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