material, was isolated in *ca.* 70% yield. Further, the aldehyde VIII was converted smoothly to tigogenin acetate [m.p. 200–202°, $[\alpha]_D$ −74° ($CHCl_3$)] when it was treated with boron trifluoride etherate in benzene for sixteen hours at room temperature. In blank experiments, *no* tigogenin was produced from dihydrotigogenin monoacetate (VII) by treatment with acidic reagents.

It may be noted that the recent deuterium exchange experiments of Callow and Massy-Beresford[1] are entirely in accord with the isomerization mechanism here proposed.

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RECEIVED NOVEMBER 24, 1958

BOOK REVIEWS

The Effects of Ionizing Radiation on Natural and Synthetic High Polymers. By FRANK A. BOVEY, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1958. xiii + 287 pp. 16 × 23.5 cm. Price, $8.00.

Under the editorship of Professor H. Mark a new series of books on polymers has been started, a series entitled "Polymer Reviews" of which the first is this interesting book written by F. A. Bovey, on radiation effects in polymers. Professor Mark is to be congratulated for initiating this series; we look forward to additional volumes as time goes on.

The first two chapters of Dr. Bovey's book summarize the properties of ionizing radiations and the chemical effects produced by them in gases and condensed systems. The subject matter of these two chapters is well organized and clearly written, but it constitutes in no sense a complete or authoritative discussion of the subject. For example, while radiation sources are briefly described and illustrated by photographs, the reader will find here no helpful details, such as thickness of shielding required or detailed designs of radiation cells. The author is uncertain whether to recommend 20 or 15.5 for $G(Fe^{+++})$ in the Fricke dosimeter. However, these first two chapters do constitute a good introduction to the subject of radiation chemistry.

Next comes a chapter summarizing the history of ionizing effects in high polymers, crosslinking and scission, effect of oxygen, protection and promotion, and the general effects of ionizing radiations on the physical, chemical and electrical properties of high polymers. In the historical section references to the early American[1] and Soviet[2] work are missing. The discussion of crosslinking and scission emphasizes such effects, probably because of their importance in influencing properties of industrial interest, while at the same time the production and decay of unsaturation are hardly mentioned. The section on the general effects of oxidation is as good as could have been written considering the incomplete knowledge of the mechanism and kinetics of radiolytic oxidation existing at the time the book was written (and even today, for that matter). In discussing protective action and energy transfer effects, the author correctly describes the important work of Manion and Burton, but Fig. III-I(b) illustrates the independence of effects and no energy transfer in mixed benzene and toluene, rather than any protective action. The fourth chapter describes and simplifies in a well written manner, mathematical theories of gelation, crosslinking, scission, branching and endlinking and various combinations of these effects. This is probably the best chapter of the book and exemplifies the author's own interest in these aspects of the radiation chemistry of polymers.

(1) M. Dole, Report of Symposium IV. "Chemistry and Physics of Radiation Dosimetry," Army Chemical Center, Md., 1950, p. 120.

(2) V. L. Karpov, "Conference of the Academy of Sciences of the U.S.S.R. on the Peaceful Uses of Atomic Energy," July 1, 1955, English Translation U.S. Atomic Energy Commission, Washington, D.C., 1956.

The rest of the book contains chapters in which specific solid polymers are considered one after the other. With a few exceptions, everything that has been discovered through the year 1956 about the action of ionizing radiations on solid polymers is mentioned. Subjects completely omitted are (1) the use of ionizing radiations in promoting the polymerization of monomers, and (2) the production of graft polymers. Perhaps these subjects are reserved for later volumes in the series. The last chapter on natural macromolecules, such as cellulose, proteins, viruses, etc., contains an interesting account of radiation effects in this complex field. Again, it is only an introduction, but a good one, and not an authoritative treatment. For example, the author interprets the results of Fricke on egg albumin as due to "hidden" breaks in the polypeptide chain, for which there is no conclusive evidence.

Surprisingly, the subject of the oxidation of polymers during irradiation has been poorly handled. Thus, the important paper of Sears and Parkinson[3] in which post-irradiation oxidation effects were first described is not mentioned. If the author had read the first American work[1] on polyethylene, he would not have concluded that the results of Lawton, Balwit and Powell demonstrate that "carbonyl formation in polyethylene is mainly a postirradiation effect." The significant observations of Chapiro[4] are quite inadequately described. Admittedly we have much learned, but even in 1956 we knew more than the reader of Dr. Bovey's book would infer.

In his foreword Professor Mark expressed the hope that this volume will be stained by chemicals while left lying on working benches in laboratories rather than remaining clean and neat standing on library shelves. Because of his excellent organization and comprehensive coverage of this extremely active branch of polymer chemistry, it is quite evident that Dr. Bovey's book will fulfill Professor Mark's expectations. Those of us who are working in this field will be indebted to Dr. Bovey for many years for his helpful review.

(3) W. C. Sears and W. W. Parkinson, Jr., *J. Polymer Sci.*, **21**, 325 (1956).

(4) A. Chapiro, *J. chim. phys.*, **52**, 246 (1955).

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The Properties of Gases and Liquids. Their Estimation and Correlation. By ROBERT C. REID, Associate Professor of Chemical Engineering, Massachusetts Institute of Technology, and THOMAS K. SHERWOOD, Professor of Chemical Engineering, Massachusetts Institute of Technology. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N. Y. 1958. xii + 386 pp. 16 × 23.5 cm. Price, $10.00.

One of the most important problems facing design engineers is the accurate prediction and extrapolation of physical data. This book is a summary of methods available

for liquids and gases. It consists of nine chapters: an introductory chapter, and sections on Critical Properties. *PVT* Relationships, Vapor Pressures and Latent Heats, Heats and Free Energies of Formation, Viscosity, Thermal Conductivities, Diffusion Coefficients, and Vapor–Liquid Equilibria.

The authors have been thorough in searching the literature and diligent in comparing the methods with experiment The sole test of all the methods is the pragmatic one of ability to predict or correlate data. It appears to the writer that the authors have been remarkably successful in avoiding personal prejudices. Where relatively esoteric theories such as the Hirschfelder version of the Chapman–Enskog theory give reasonably quantitative results the authors have not hesitated to bring in the results of these theories in usable form, but with no theoretical background. (This is probably sound in a book addressed to the practicing engineer, as it is most difficult to develop a theory accurately and correctly in a few pages.) On the other hand, the authors have not hesitated to introduce purely empirical methods where they seem to apply.

The index seems reasonably complete. Rather than a Table of Contents, the authors have inserted a list of Recommended Methods for Estimating or Correlating Properties, with appropriate page references. This seems to be a useful idea.

The writer would like to quibble with one point in the introduction. The authors imply that the theory of liquids is at present in quite good shape compared to the modern theory of solids. There are few people who would agree to this. There are probably sufficient other reasons for omitting a discussion of solids.

The book can be recommended to practicing chemical engineers and industrial chemists, as well as to students in design courses.

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Proceedings of the Symposium on the Role of Solid State Phenomena in Electric Circuits. New York, N. Y. April 23, 24, 25, 1957. Volume VII. Sponsored by Polytechnic Institute of Brooklyn, Microwave Research Institute. Edited by JEROME FOX. With the assistance of MARTHA CROWELL. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1957. xvi + 339 pp. 15.5 × 23 cm. Price, $5.00.

The book contains twenty-five contributions and a short round table discussion. The symposium being international, offered twenty papers representing American laboratories, three English, one Canadian, one German and no others. The various papers are naturally of widely different scope and depth. Some seem limited by company policy, but on the whole they give an interesting expert birds-eye view of the beginning of a new avalanche of developments in solid state electrical engineering. Certainly not all areas that one might expect are discussed, no thermo electric effects, for example, and hardly any photo-magneto-electric devices. The main emphasis is on amplification, switching, and modulation.

A principal theme, expressly stated in the first paper, but underlying many others, is that the production of one new semi-conducting material with unusual properties "can do more to revolutionize the performance of an electric circuit than can all the classic ingenuity of circuit design." Inasmuch as the guide lines for creating materials with specified properties are still very scant, a veritable gold rush is on, in which the theoretical surveyors can barely keep up with the new claims staked from day to day. The book gives a living picture of this situation. By its very nature it is in the first place of interest to those concerned more or less directly with one of the branches which it covers, but also the reader with a general background in electrical circuitry or in solid state physics can read many of its papers with profit to keep up qualitatively with new developments. The manner of presentation of most of the papers is very non-mathematical.

In the second paper E. W. Herold endeavors to outline "future circuit aspects of solid state phenomena," based on superconductivity, molecular amplifiers, magnetic effects in semiconductors, and the general use of controlled inhomogeneity. As a matter of fact, all these principles are being used or explored at present so that their future use is certain. However, the clear manner in which these are presented systematically is commendable and instructive.

In a short paper P. P. Ewald shows how, historically, our knowledge of solids has grown, and how the present development is rooted mainly in two ideas: the perfect crystal, and the role of imperfections and their interactions with external agents. The tone of the paper cautions against overconfidence in present "patchwork theory" and predicts many as yet undiscovered "bugs."

R. C. Fletcher summarizes recent progress in the fields of semiconductors and of magnetism. It is a very concise account of the interrelations between many branch studies in these two fields.

The "versitron," presented by M. W. P. Strandberg, is a new variety of maser, based on spin reversal of a gadolinium salt or similar material, whose low noise the author-inventor calls fabulous.

J. O. Artman discusses the general principles of maser amplifiers with special emphasis to the microwave region. His mathematical analysis of gain, band width, noise, and power limitations gives a clear and concise description of the factors governing this new class of devices.

W. P. Mason describes how ferroelectric single crystals can be used for similar applications as those where ferromagnetics are used, in particular for information storage and amplifiers.

T. S. Moss from England surveys In Sb devices. They are essentially based on the high mobility, low effective mass and small energy gap of this material, and lead to three types of applications, based on magneto resistance, Hall effect and photo effects. An interesting variety of some twenty devices is sketched.

H. F. Mark presents a brief report on the conduction properties of some organic plastics.

G. Fischer and W. B. Pearson from Canada attempt to relate the occurrence of semi-conduction in solid compounds to the bond properties between the atoms, by a set of semi-empirical rules.

H. Kroemer discusses the theory of graded inhomogeneities in semi-conductors, which produce effects similar to, but in some instances more favorable than, those obtained by applying electric or magnetic fields.

Three papers on transistors follow. W. W. Gaertner discusses mathematically the possibilities which depletion layer transistors have in microwave amplification. E. L. Steele and B. R. Gossick discuss frequency limitations. G. C. Sziklai and L. R. Hill report on what seems a promising beginning of the construction of tetrode transistors as commutators.

Two papers on superconductivity are due to I. M. Templeton from England and to H. O. McMahon. Both misspell the name of the inventor of superconductivity and neither mentions the Bardeen Cooper theory. This field clearly stands in its infancy and awaits the discovery of new materials with higher transition points. Meanwhile reversing switches, and d.c. transformers as well as other special devices are being developed.

A. Papoulis and T. C. Chen thoroughly develop the theory of the time dependence of the magnetization M when a stepfunction ΔH is applied, on the basis of domain wall motion, and its application to fast core switching.

D. L. Fresh reports on the development of some new ferrites. E. Stern and P. S. Pershan follow with theory and experimental confirmation of second harmonic generation and mixing in certain microwave ferrites, due to the non-linearity of the equation of precession.

J. J. Dropkin sets the stage for subsequent papers on photoconductivity by reviewing the principles of its mechanism in phosphors and barriers. A number of possible applications are next discussed by R. E. Halsted, using a photon stage for coupling two electrical circuits, for example. The wealth of possibilities in this area is expanding exponentially. A. Bramley and T. E. Rosenthal discuss photoconductive switches, especially multiple switches, their merits and limitations. This type of application seems very promising. A. A. Gibson and T. W. Granville from England describe a fast modulator for microwave and infrared radiation, named "transparitor" because it becomes transparent when an r.f. field is applied in right geometrical relation to the microwaves. Its time constant is of the order of 10^{-12} sec. I. Broser