REVIEWS OF BOOKS

Annual Review of Nuclear Science. Vol. 7. (Annual Reviews Inc., Palo Alto, California, 1957.) Pp. v + 496. Price $7.50.

Vol. 7 contains considerably less chemical material than previous issues, the greater part of the space being devoted to topics in nuclear physics. The range covered is so wide that one wonders whether it would not be more appropriate to subdivide the material into two parts, one dealing with radioactivity and the physical, chemical and biological effects associated with it and another devoted essentially to nuclear physics. The current volume begins with an article on Mu-Meson Physics by J. Rainwater and this is followed by a short review by K. A. Kraus and F. Nelson on Radiochemical Separations by Ion Exchange. Although the methods used in radiochemistry are discussed, the treatment is quite general and no features uniquely associated with radioactivity are brought out. The next article on Equipment for High Level Radiochemical Processes by N. B. Garden and E. Nielsen is more in the nature of a general summary than a detailed review of recent progress and deals mainly with American practice. The authors imply that glove boxes provide an adequate contamination barrier in all circumstances, an opinion based, no doubt, on their experience at the University of California, but this view is by no means universally held. The next four articles are devoted to biological topics. Cellular Radiobiology by E. L. Powers includes a section on ultra-violet radiation; Biochemical Effects of Ionizing Radiation by Barbara E. Holmes covers a very wide field; the mass of empirical data here is bewildering but there has been clear progress, especially in protective studies where, for example, it now seems to be established that anoxia is a protective factor with which the actions of many protective additives is associated. It was probably a mistake to include a section on food sterilization as this subject deserves a separate report. The remaining biological articles on Vertebrate Radiobiology (Lethal Actions and Associated Effects) by V. P. Bond and J. S. Robertson, and Vertebrate Radbiology (The Pathology of Radiation Exposure) by C. C. Lushbaugh are detailed reviews of recent work.

The subsequent articles are all nuclear physical: The Collective Model of Nuclei by F. Villars, Nuclear and Nucleon Scattering of Electrons by R. Hofstadter and Collisions of $\lesssim 1$ BEV Particles (Excluding Electrons and Photons) with Nuclei are well-presented, authoritative reviews. The last includes a discussion of radiochemical results in relation to the relative importance of fission, spallation and fragmentation. Whereas spallation is regarded as being due to a thermal evaporation process involving the nucleus as a whole, fragmentation is due to the break-up of a local area of the nucleus which has become heated by pion absorption or other effect. The last two subjects dealt with are The Measurement of Nuclear Spins and Static Moments of Radioactive Isotopes by W. A. Nierenberg and Hyperons and Heavy Mesons (Systematics and Decay) by M. Gell-Mann and A. H. Rosenfeld. Progress in this latter field has been rapid and already attempts to systematize our knowledge of the properties of heavy particles with the aid, for example, of the concept of strangeness, are meeting with some success. The situation is thoroughly expounded by Gell-Mann and Rosenfeld; indeed, the presentation and scope of the nuclear physical and biological articles is impressive whilst the rather meagre chemical contributions to recent volumes tend to suffer in comparison.

Typographical and other errors occur rather more frequently than in previous volumes but otherwise the usual editorial standard has been maintained.

R. S.

Received 1st *August*, 1958

The Effects of Ionizing Radiation on Natural and Synthetic High Polymers. By FRANK A. BOVEY. (Interscience Publishers Inc., London and New York, 1958.) Pp. xiii + 287.

Rapid advances may be expected when branches of science, previously separate, grow together and reinforce each other with their different disciplines and outlooks. The book under review arises out of such an encounter, and this is revealed by the wide scope of the aspects discussed in its pages—the production of atomic radiation and its interaction with the structure of molecules; the influence of changes in electronic structure on chemical reactions; the relation between molecular size and arrangement and physical properties of polymers; radiation-induced changes in biological systems; and radiation protection. It is therefore no longer possible to classify the subject-matter of this book as either physics, chemistry or biology; all contribute their part.

In the past few years a considerable amount of interest has been devoted to the effects of atomic radiation on materials. This problem is of fundamental importance in the design of nuclear reactors for which components must have considerable radiation resistance. An aspect of increasing industrial importance is the ability of such radiations to promote permanent and useful changes in certain materials. Of fundamental scientific interest is the ability of these radiations to initiate chemical reactions under conditions (such as in the solid state) where the more conventional chemical techniques are difficult to apply. Finally, the study of radiation effects in biological molecules has revealed aspects of the utmost importance in biology and medicine.

In all these considerations, the study of radiation effects in long chain polymers occupies a key position. Plastics are becoming of increasing importance as structural materials; some of the changes produced are of considerable practical value in improving such properties as heat resistance and strength. On the fundamental side there are often remarkably simple theoretical relationships between physical properties and molecular arrangement, and the latter can be modified in a quantitatively reproducible manner by varying conditions of irradiation, such as the dose. The changes produced by radiation in biological molecules can be compared with those observed in the less complex irradiated polymer macromolecules, so that it becomes possible to separate out radiation-induced changes of a purely physical or chemical nature (such as the influence of temperature or concentration on reaction rate) from those which are specific to biological systems.

Although early observations of radiation effects in polymers date back over a number of years (the reviewer first observed the cross-linking of polyethylene in 1940) it is only in the last seven or eight years that systematic studies have been undertaken. At present there are still a number of fundamental gaps in our knowledge of the subject, and one of the major difficulties in writing any review s to link together the published results into a comprehensive pattern, knowing that many of the arguments presented are likely to be shown to be false in a very short time.

The author has met this challenge by writing a critical review, rather than aiming at an exhaustive monograph. Nevertheless in the course of his well-written presentation he has succeeded in referring to most published papers in the field. His review deals with the properties of ionizing radiations and their general effects in simple molecules, the mathematical theory of cross-linking and degradation, and the properties of various irradiated polymers, including naturally occurring macromolecules. He has not considered such aspects as the use of radiation in polymerization, grafting, and curing of polyesters, in which radiation serves to initiate a chain reaction. The book is very readable, and contains few errors, although many points are open to debate. The reviewer objects to the prevalent term " ionizing radiation " where many, if not most of the effects studied are due

to excited, and not to ionized molecules. Many of these effects can also be produced by exposure to ultra-violet light, which gives rise to excitation, but use of the corresponding term " exciting radiation " is liable to be misconstrued by the layman.

A. C.

Received 18*th August*, 1958

Principles of Physical Chemistry. By SAMUEL H. MARON and CARL F. PRUTTON. 3rd edn. (Macmillan, New York, 1958.) Pp. viii + 789. Price 59s. 6d.

Each of the twenty-three chapters into which this attractive book has been divided is followed by a short list of references to the literature and by a set of problems. The printing is excellent, the diagrams admirable and the exposition throughout is marked by great clarity.

No book on physical chemistry fails to deal with the celebrated equation of van der Waals, and this book is no exception. But it improves upon most accounts in two respects: (1) it gives the equation, as it ought to be given, for any mass of gas, and not simply for 1 mole; (2) it omits the illogical argument that the form and magnitude of the pressure term $-a/v^2$ arise because the attractive force per unit area is proportional to the product of the number of molecules on unit area of surface and to the number of molecules in unit volume of gas. Such an argument could be valid only if the force between a pair of molecules were independent of their distance apart.

The book has been written so clearly that the reviewer has had to look hard for passages that could, in his opinion, be improved upon. The first is on p. 26, where (1/3) should now be replaced by (1/2). Another is on p. 373 when Hendixson's treatment of distribution with dimerization is described. This treatment, though sound, has been superseded since 1940 by a simpler and more direct one.

The theoretical thread running through the book is that of chemical thermodynamics. The equally important and possibly more stimulating theories of chemical dynamics and chemical statistics are only lightly touched upon. Einstein's equation for the heat capacity of monatomic solids, for example, is not derived; nor is Bohr's expression for the total energy of the hydrogen atom, although their derivation requires less mathematics than is used in some of the thermodynamic sections, and is usually included in school textbooks. Granting that the derivation of many equations must necessarily be omitted from an introductory textbook, it may be wondered whether the omissions in this case are rather more one-sided than the title of the book would lead us to expect. Physical chemistry makes use of thermodynamics, but is greater than it in scope and importance. Students who have had no previous instruction in physics will miss the assistance which a judicious amount of mechanics would have given them. As a clear account of descriptive physical chemistry, handled on thermodynamic lines, this elementary textbook can be warmly recommended to first-year university students.

E. A. M.-H.

Received 20*th August*, 1958

Handbuch der Katalyse, Vol. V (Heterogene Katalyse II). Ed. G.-M. SCHWAB, (Springer-Verlag, Vienna, 1957.) Pp. vi + 779. Price £15 13s.

The first volume of Schwab's *Handbuch* appeared in 1941 and there followed, in quick succession, a further five volumes. Thus, in spite of the war, the original aim to provide in seven volumes a cross-section of the whole field of catalysis—

homogeneous, biological and heterogeneous catalysis—was very nearly achieved. It is, however, a poignant commentary on events in Europe that it has taken another 14 years for the missing volume V (the second in the series of three on heterogeneous catalysis) to make its appearance.

There are four chapters in the new volume: the first (140 pages) is by A. G. Nasini, G. Saini and (in part) P. Brovetto, and is a general one on adsorption; the second, of only 20 pages, is an account in English by F. H. Constable of views on 'active centres'; the third, by G.-M. Schwab, H. Noller and J. Block, runs to 250 pages and is entitled "Kinetics of heterogeneous catalysis"; the fourth (330 pages), which concerns mixed and supported catalysts, is written by G. Natta and R. Rigamonti. One may say at once that by providing the general theoretical background to the individual steps of adsorption and actual catalytic reaction, and by incorporating a wealth of well-ordered information on mixed catalysts, the volume admirably fills the gap left behind in the originally planned trilogy on heterogeneous catalysis.

After this lapse of time, however, it is perhaps more appropriate to enquire to what extent the volume merits a place *per se* as a new source book on heterogeneous catalysis. In this respect it is naturally disappointing that much of the compilation bears the stamp of a volume whose publication has been long delayed. The first chapter, for instance, cannot be said to approach the frontiers of research in chemisorption. The emphasis, in fact, is on physical adsorption and the statistical mechanics of adsorption, yet the time of compilation was such that the application of physical adsorption to studies of, for example, the porosity of catalysts, is not even mentioned in a footnote. The second chapter, the only one of the four which is not in German, has little to recommend it at the present time for about 100 of its 120 listed references refer to pre-war papers. Fortunately, however, the book rises above these difficulties in the third and fourth chapters, both of which can be strongly recommended. Let it be stressed, too, that these two chapters together represent more than three-quarters of the book. The masterly review of the kinetics of catalysis by Prof. Schwab and his co-workers comprises some 70 pages of general introduction followed by a comprehensive discussion of individual reactions, complete up to the end of 1954. Moreover, in refreshing contrast to many post-war reviews on catalysis, due attention has been paid to Russian contributions. Much the same may be said of the authoritative review on mixed catalysts which forms the last chapter. Promoted catalysts, alloy and mixed oxide catalysts, supported catalysts and multifunctional catalysts are all systematically discussed. The chapter is easy to read and the authors have successfully blended into it some clear indications of the too-often-despised *art* of catalysis.

The production conforms to the very high standards set by the editor and publishers in the previous volumes of the *Handbuch*, and mistakes in the text are remarkably few. There are, however, errors in the bibliography, especially in the spelling of names, and the reader attempting to identify authors may also find transliterations which require the use of seven letters (schtsch) to represent one Russian character rather tedious. Any criticisms, however, must be seen in relation to the size of the bibliography, which is immense. Moreover, the excellent presentation which characterizes all the chapters will make the search for information very easy, even for the chemist whose German is not fluent. One can only hope that this will be consolation to those English or American library committees who perceive, as they surely must, that the price is sufficient to buy *several* volumes of other post-war works on catalysis.

F. S. S.

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Progress in Stereochemistry, Vol II. Edited by W. KLYNE and P. B. D. DE LA MARE. (Butterworths Scientific Publications, London, 1958.) Pp. 323. Price £2 10s.

For the second volume of *Progress in Stereochemistry* Dr. Klyne has been joined by Dr. de la Mare as joint editor. This partnership has been as successful as Dr. Klyne's original vol. I in securing first-class articles on stereochemistry. In fact, every article in vol. II is sound and worthy of the space that it occupies.

The whole scope of stereochemistry is exemplified. The first article by Dr. J. C. Speakman is an excellent general survey of the methods of crystallography, specially X-ray crystallography, and of their contributions to the elucidation of stereochemistry. There is no doubt that X-ray crystallography is beginning to make an important impact on structural organic chemistry. If X-ray crystallographers stopped working on trivial structures, which have already been adequately defined by ordinary chemical methods, and concentrated on unknown structures they would serve Science even more effectively than they do now. Dr. Speakman gives several examples of what they can do if they try!

The second article by Dr. G. H. Williams gives a valuable survey of stereochemical aspects of free-radical reactions. Our knowledge of these processes has increased greatly since before the war and Dr. Williams gives an authoritative account of the facts and some indication of the flux of discussion and theory in this field.

The third article is by Dr. P. B. D. de la Mare himself and deals with stereochemistry of displacements, both nucleophilic and electrophilic, at unsaturated centres. This is a vast subject and so the treatment is necessarily in illustrative form. Theoretical organic chemistry easily generates man's passions and no doubt not everyone will agree with Dr. de la Mare's selection and treatment of the subject. The discussion is, however, excellent as well as stimulating.

The fourth article is by Dr. B. M. Wepster on the steric effects of mesomerism. This is a field to which Dr. Wepster himself has already made important contributions and he gives a very fine summary of the present state of knowledge.

The fifth article by Dr. M. M. Harris is equally authoritative for it deals with the study of optically labile compounds. This is a phenomenon which frequently deals with quite subtle forms of isomerism and its description made very interesting reading.

In the next article Dr. F. G. Mann writes on the stereochemistry of the group 5B elements. It would have been difficult to find anyone more familiar with this field than Dr. Mann, who has made many fundamental contributions thereto, and the Editors are fortunate in having persuaded him to contribute. It is clear that progress in this area continues at a rapid pace.

The seventh article by Prof. Marrack and Dr. Orlans is biochemical in nature and deals with steric factors in immunochemistry. If anyone should feel complacent about the grasp of stereochemistry currently attained by the human intellect, this chapter should quickly restore a more modest outlook. It is clear that the life process has a very much more deep and subtle knowledge of stereochemistry than the intellect has yet begun to attain. Stereochemists can find plenty of interesting facts upon which to meditate.

The last article is by Dr. R. J. Gillespie and Prof. R. S. Nyholm. It presents the stereochemistry of inorganic molecules and complex ions and shows that, in some respects, inorganic stereochemistry is more advanced and more interesting than organic stereochemistry. At least one is not restricted to the tetrahedron! The article attains the high standard that one would expect from the authors concerned.

D. H. R. B.

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